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

CONTENTS

Annexes

Revision history of this document

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

SECTION A. General description of small-scale project activity

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

Eecopalsa Biogas Expansion – Honduras
Version number of the document: 2
Date: 30th of April 2010

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

Summary
The Eecopalsa Biogas Expansion project activity (hereafter referred to as "the project") involves the recovery of biogas and electricity generation at PALCASA Palm Oil Mill in Honduras. Extraction of palm oil is one of the most important economic activities in the region and the main business activity of EECOPALSA. The production capacity at the PALCASA Palm Oil Mill will increase in the coming years. Consequently, the volume of generated effluents will also grow and a new wastewater system has to be developed to treat the growing volume of effluents. According to the national environmental regulations, the wastewater has to be treated before discharging to be in compliance with national water standards. The most common low-cost treatment option is the use of a system including anaerobic open lagoons. The anaerobic conditions in these lagoons (also known as palm oil mill effluent (POME) ponds) allow for the existence of anaerobic bacteria, which convert the organic matter contained in the effluent into methane. This process is called methanogenesis and results in the release to the atmosphere of biogas with a methane concentration of around 60%.

The project participants have decided to utilise the biogas which is currently being released to the atmosphere. Therefore, a wastewater treatment system will be implemented which include covered lagoons and a biogas recovery system. The captured biogas will be utilised in a gas engine for the generation of electricity. The generated electricity will be delivered to the national grid (managed by Empresa Nacional de Energía Eléctrica (ENEE)[1]).

An estimated 3.17 GWh/year of electricity generated by the project will be delivered to the national grid. The total annual emission reductions from the methane recovery system and electricity generation are estimated as 17,135 tCO_2eq/year.

Contribution to sustainable development
Apart from reducing methane emissions and generating renewable electricity, the proposed project contributes to sustainable development in the following ways:

- The project will reduce Honduras' dependency on fossil fuels by using wastewater resources from the palm oil industry to generate electricity.
- The project will implement sustainable practices and systems to treat palm oil mill effluents.
- The project will reduce the problems with odours that the process of the anaerobic decay of the effluents generates.
- The project will create local and regional employment both during its construction phase and its operational phase. The project will also help to enhance the skill level of employees through on the job training provided by the technology supplier and Eecopalsa.

1 Empresa Nacional de Energía Eléctrica. http://www.enee.hn/ (last accessed 03.03.10)

A.3. Project participants:

Table 1. Project Participants

Name of Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Honduras (host)	Energía Ecológica de Palcasa, S.A. (EECOPALSA, private company)	No
France	OneCarbon International B.V., private company	No

In Honduras, small-scale palm oil producers are associated in companies and cooperatives. The company Energía Ecológica de Palcasa S.A (EECOPALSA) was established in order to develop the proposed project activity. 51% of the shares of EECOPALSA belong to Palmas Centroamericanas S.A. PALCASA, (a company 100% owned by 536 small-scale palm oil producers), and 49% belongs to some of the small-scale producers who are also members of PALCASA.

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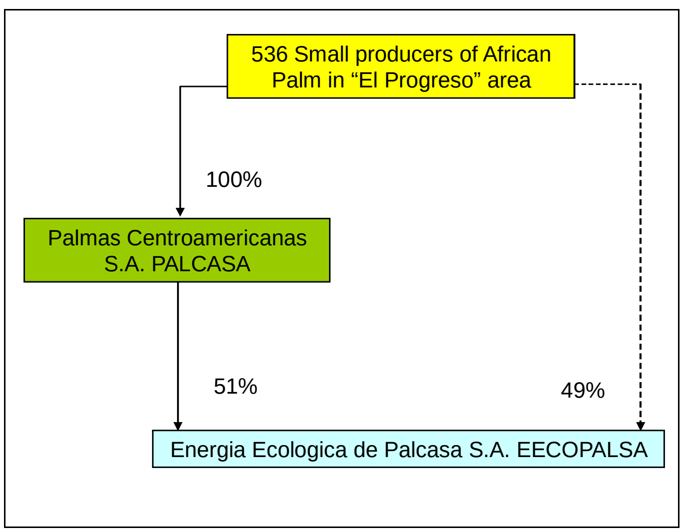

Figure 1. The ownership structure of EECOPALSA

Full contact information for the project participant is provided in Annex 1.

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

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

A.4.1.1. Host Party(ies):

Honduras

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

Yoro Department / Municipality of El Progreso

A.4.1.3. City/Town/Community etc:

El Progreso city

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

The project will be located in Yoro Department at La Aldea Los Castaños, nearby Guaymitas town and 16 kilometres away from El Progreso city. The coordinates for the Project are 15°29'51.00"N, 87°42'15.00" W. The Project is situated at 74 meters altitude above sea level.

Figure 2. Map of Honduras and location of the project area (Source: Google Earth)

Figure 3. Map of the vicinity of the project area (Source: Google Earth)

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

The Project involves the installation of a methane recovery system parallel to the wastewater treatment system as well as a grid connected electricity generation power plant. According to Appendix B to the simplified modalities and procedures for small-scale CDM project activities[2] the project can be classified as:

Type I: Renewable Energy Projects
Category I.D.: Grid connected renewable electricity generation
Sectoral scope: 1 - Energy industries (renewable - / non-renewable sources)

Type III: Other Project Activities
Category III.H.: Methane recovery in wastewater treatment
Sectoral scope: 13 - Waste handling and disposal

2 Decision 17/CP.7, paragraph 6 (c) (i). Available at: http://cdm.unfccc.int/Reference/COPMOP/08a01.pdf#page=43 (last accessed 03.03.10)

The proposed project activity consists of the construction of a new wastewater treatment system, which allows for the capture of biogas, and a unit for the combustion of biogas for the electricity generation. The project involves the construction of:

- One covered lagoon (volume: 11,000 m^3);
- Two facultative lagoons (volume: 8,400 m^3);
- A gas engine with a power generation capacity of 925 kW.

In the wastewater treatment system, the energetic biogas will be captured using environmentally safe and sustainable technologies. In addition the implanted system helps to avoid the major problems that affect traditional systems, such as the requirement to have an extensive area, groundwater contamination and lagoon clogging due to sludge accumulation.

The technology will be imported since no local supplier can provide the required system.

A general scheme of the system is presented in figure 4 below.

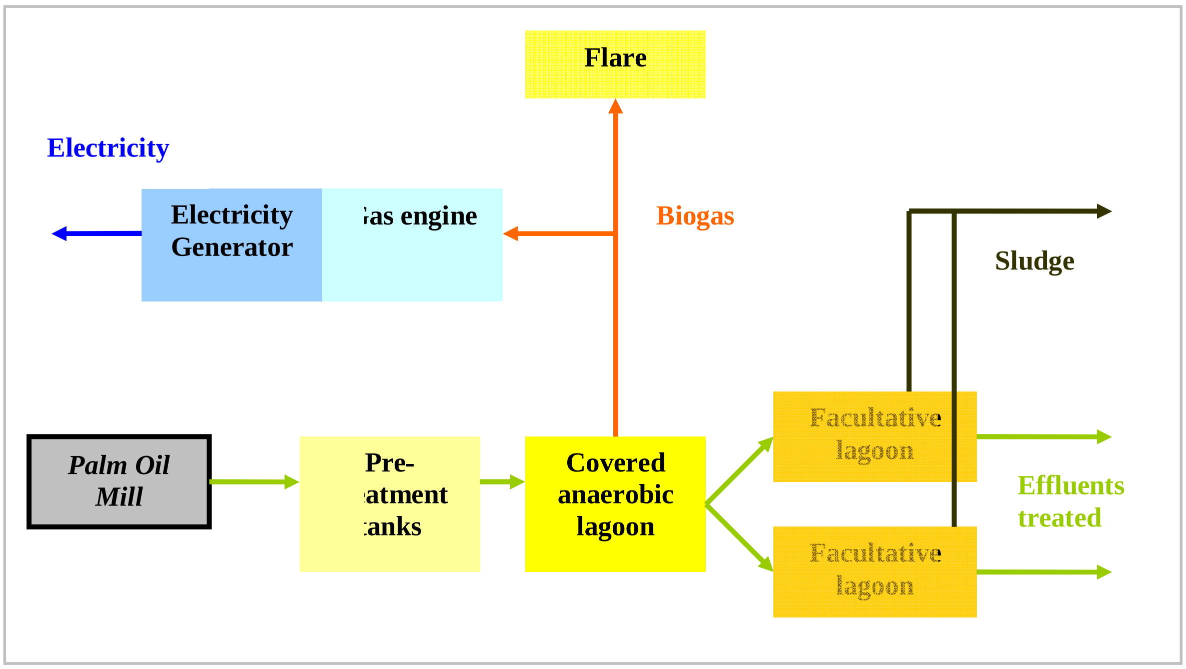

Figure 4. Scheme of the wastewater treatment and electricity generation system

The components of the whole system are explained in more detail below.

Methane recovery in the wastewater system

The wastewater treatment system consists of a chain of lagoons: starting from concrete tanks to recover the oil (florentines), followed by a covered lagoon (where the biogas is captured) and ending with the post treatment lagoons.

The biogas will be captured in the covered lagoon and transported via a pipeline to the gas engine.

The covered lagoon will be constructed in a way that facilitates maintenance. The cover for the lagoon will be made out of a plastic which is resistant to bad weather, biological degradation, UV radiation and provides a system to evacuate accumulated rainwater.

The cover anchoring will be made along the perimeter to guarantee that it is hermetically sealed. A piping system will be equipped with a by-pass to be used in case of difficulties or for maintenance.

Sludge treatment
The sludge will be used as fertiliser. There is only one pump so its horometer could be used to calculate the total volume of sludge purged. The sludge to become fertilizer will be dried to reach a moisture content of 50% and then packed to be taken away. During periods with very intensive production, a backup system will be in place to use part of the sludge for fertirrigation. Since both, Eecopalsa POME [3] and Eecopalsa Biogas Expansion (the project), send sludge to the pump on different dates, the sludge from both systems will not mix in the horometer.

Overall, this system will contribute minimise negative environmental impacts of the plant and as an additional benefit, the system will provide humidity and organic nutrients to the soil.

Grid connected renewable electricity generation
The biogas recovered from the covered lagoon will be blown into a 925 kW gas engine for the purpose of electricity generation. The following components of the system are also included:

- PVC pipes to transport the recovered biogas to the engine
- Blower to inject the biogas into the engine
- Water condensation system
- H_2S biological and chemical filters
- Flare
- Measuring devices
- Safety valves

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

Table 2. Estimated annual emission reductions

Years	**Annual estimation of emission reductions (tonnes of CO_2-eq)**
2010	12,776
2011	16,654
2012	17,647
2013	18,088
2014	18,309

[3] This is a short name for Project 0492 : Eecopalsa – biogas recovery and electricity generation from Palm Oil Mill Effluent ponds, Honduras.

2015	16,985
2016	16,728
2017	2,757
Total emission reductions (tonnes of CO_2-eq)	119,943
Total number of crediting years	7
Annual average over the crediting period of estimated reductions (tonnes of CO_2-eq)	17,135

The project results in an estimated annual average emission reduction of 17,135 tonnes of CO_2 eq.

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

The project does not receive public funding.

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

In accordance with Appendix C of the Simplified Modalities and Procedures for Small-Scale CDM project activities[4], a proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

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

In accordance with the conditions above, Project 0492: Eecopalsa – biogas recovery and electricity generation from Palm Oil Mill Effluent ponds and the proposed Eecopalsa Biogas Expansion project are not deemed to be debundled component of a large project activity. The first one was registered in September 2006, more than two years ago, and therefore condition number 3 does not apply.

SECTION B. Application of a baseline and monitoring methodology

[4] Appendix C of the Simplified Modalities and Procedures for Small-Scale CDM project activities .Available at: http://cdm.unfccc.int/Projects/pac/howto/SmallScalePA/sscdebund.pdf (last accessed 03.03.10)

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

Grid connected renewable electricity generation
Approved small-scale baseline methodology AMS-I.D "Grid connected renewable electricity generation" (version 15)[5].

Methane recovery in wastewater treatment
Approved small-scale baseline methodology AMS-III.H "Methane recovery in wastewater treatment" (version 14)[6].

Applied methodological tools

"Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories" (version 12)[7]

"Combined tool to identify the baseline scenario and demonstrate additionality" (version 02.2)[8]

"Tool to calculate the emission factor for an electricity system" (version 2)[9]

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

Grid connected renewable electricity generation
The methodology AMS-I.D "Grid connected renewable electricity generation" (version 15) is applicable to the proposed project activity because it fulfils the required criteria:

- The project consists of a grid connected electricity generation unit fuelled with biogas;
- The installed capacity of the proposed project activity is 0.925 MW, hence below the 15 MW limit for a small scale project activity.

Methane recovery in wastewater treatment
The methodology AMS-III.H "Methane recovery in wastewater treatment" (version 14) is applicable to the proposed project activity because it fulfils the required criteria:

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[5]EB 50. I.D. Grid connected renewable electricity generation (version 15) .Available at: http://cdm.unfccc.int/UserManagement/FileStorage/7QXAZ5036WN8BEYKUDFRPJGL21V4I9 (last accessed 03.03.10)

[6] EB 48, III.H. Methane recovery in wastewater treatment (version 14) Available at: http://cdm.unfccc.int/UserManagement/FileStorage/K3DAOL1H7RB9CN5GMXET4F0WSU26ZY (last accessed 03.03.10)

[7]EB 50, Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories. General Guidance. Available at: http://cdm.unfccc.int/Reference/Guidclarif/ssc/methSSC_guid06.pdf (last accessed 03.03.10)

[8]EB 28, "Combined tool to identify the baseline scenario and demonstrate additionality" Available at: http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-02-v2.2.pdf (last accessed on 03.03.2010)

[9]EB 50. Tool to calculate the emission factor of an electricity system (version 02). Available at: http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.pdf (last accessed 03.03.10)

- The project activity recovers methane from biogenic organic matter in wastewater by the (iv) "*introduction of methane recovery and combustion to an existing anaerobic reactor, lagoon, septic tank or an on site industrial plant*".
- The recovered methane is utilised for electrical energy generation;
- The emission reductions of the proposed project activity are 15,726 tonnes CO2eq/year, hence less than 60 ktCO_2eq annually.
- It is a new facility (Greenfield project) that complies with the requirements in the General Guidance for SSC methodologies version 12.1[10].

B.3. Description of the project boundary:

With reference to the methodology AMS-I.D "Grid connected renewable electricity generation" (version 15), the project boundary encompasses the physical, geographical site of the renewable generation source.

With reference to the methodology AMS-III.H "Methane recovery in wastewater treatment" (version 14), the project boundary is the physical, geographical site where the wastewater and sludge treatment takes place in baseline and project situation. It covers all facilities affected by the project activity including sites where the processing, transportation and application or disposal of waste products as well as biogas takes place.

The sludge will be dried in a system that is shared with another CDM project (CDM reference no. 0492). As a result, the boundaries of both projects overlap. Management procedures have been established for the drying process in order to clearly differentiate between the sludge generated by both projects[11].

The project boundary of Eecopalsa Biogas Expansion has been determined taking into account the applicable criteria. The project boundary is presented in figure 5 (below).

[10] EB 50, Indicative Simplified Baseline And Monitoring Methodologies For Selected Small-Scale CDM Project Activity Categories (Version 12.1) General Guidance. Availble at: http://cdm.unfccc.int/methodologies/SSCmethodologies/history/guid_ssc_meth/guid_ssc_v12_1.pdf (last accessed: 03.03.10)

[11] The Sludge Operations Manual and the technology provider's Monitoring Manual are available to the DOE.

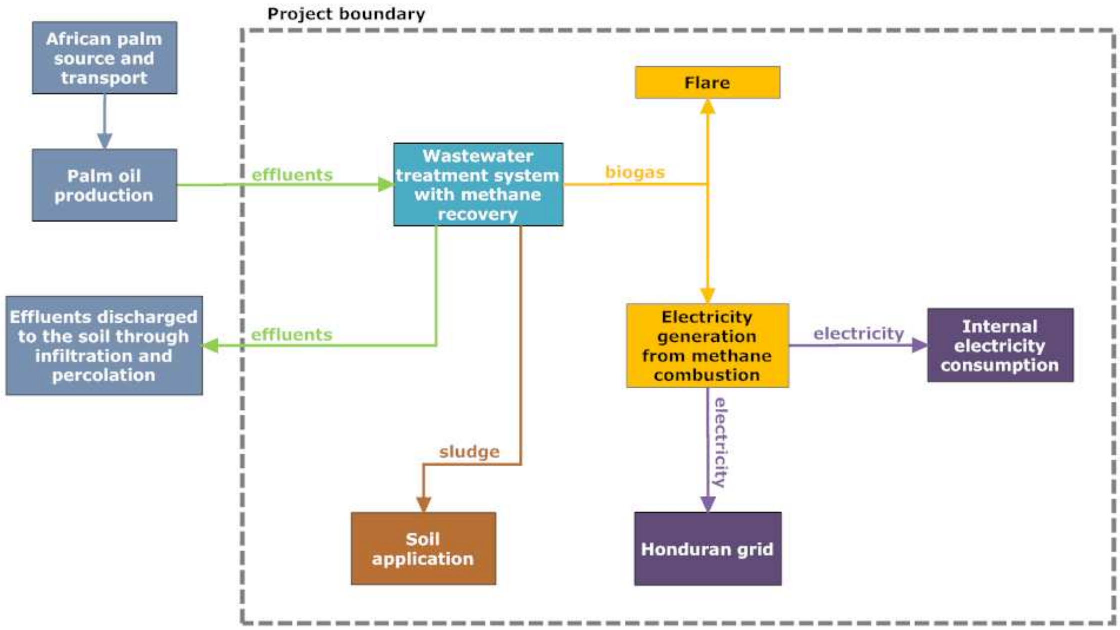

Figure 5. Graphical representation of the project boundary

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

Grid connected renewable electricity generation
In accordance with methodology AMS-I.D "Grid connected renewable electricity generation" (version 15), the baseline is the amount of kWh produced by the renewable generating unit multiplied by an emission coefficient of the grid.

Methane recovery in wastewater treatment
The production capacity at the EECOPALSA Palm Oil Mill will increase in the coming years. Consequently the volume of generated effluents will also grow and a new wastewater system has to be developed to treat these effluents. According to Honduran environmental regulations, industrial effluents have to be treated before they are discharged to the watercourses. The construction of open anaerobic lagoons is a low cost solution and is the common practice for palm oil mill effluent treatment (see section B.5). Therefore, the baseline scenario - which is the scenario implemented in absence of the CDM project activity - is an anaerobic open lagoon system.

The wastewater system can be classified as a Greenfield project. With reference to the "Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories"[12], "type III Greenfield projects (new facilities) can use a type III small-scale methodology provided that they can demonstrate that the most plausible baseline scenario for this project activity is the baseline provided in the respective type III small-scale methodology. The demonstration should include the assessment of the alternatives of the project activity. For the purpose of the demonstration, project participants may apply the steps 1 to 3 of the latest version of the "Combined tool to identify the baseline

[12] EB 50, Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories. General Guidance. Available at: http://cdm.unfccc.int/Reference/Guidclarif/ssc/methSSC_guid06.pdf (last accessed 03.03.10)

scenario and demonstrate additionality"[13] to identify the baseline scenario. If the identified baseline scenario is the same as the baseline of the methodology, and it can be demonstrated that the implementation of the project as 'the proposed project activity undertaken without being registered as CDM', is not the common practice in the region, project participants can apply the methodology."

Taking the aforementioned conditions into account, the scenario (iv) *The existing anaerobic wastewater treatment system without methane recovery and combustion* is the most likely baseline scenario and hence the methodology AMS-III.H "Methane recovery in wastewater treatment" (version 14) is applied to the proposed project activity.

The assessment of the alternatives to the project is performed in section B.5 by using the "Combined tool to identify the baseline scenario and demonstrate additionality" (version 02.2).

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

To demonstrate the additionality of the project and to identify the baseline scenario in the Greenfield situation, the "Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories" (version 12.1)[14] require the application of steps 1 to 3 of the "Combined tool to identify the baseline scenario and demonstrate additionality" (version 02.2). As well as that, a barrier analysis has been chosen to demonstrate additionality and therefore the "Guidelines for objective demonstration and assessment of barriers" version 01[15] have been followed.

Step 1. Identification of alternatives scenarios

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

Consistent with current laws and regulations, two realistic alternatives have been identified for the processing of the wastewater from EECOPALSA's palm oil mill. These alternatives are presented in the table 3 below.

Table 3. Alternatives for the expansion of EECOPALSA palm oil mill

Alternative A	Continuation of the common practice, i.e. construction of open lagoons system, in accordance with national law regulations, without methane recovery and electricity generation
Alternative B	Implementation of methane recovery with electricity generation and without CDM revenues

Sub-step 1b. Consistency with mandatory applicable laws and regulations

[13] EB 28, "Combined tool to identify the baseline scenario and demonstrate additionality" Available at: http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-02-v2.2.pdf (last accessed on 03.03.2010)

[14] EB 50, Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories. General Guidance. Available at: http://cdm.unfccc.int/Reference/Guidclarif/ssc/methSSC_guid06.pdf (last accessed 03.03.10)

[15] EB 50, "Guidelines for objective demonstration and assessment of barriers" version 01, Annex 13. Available at: http://cdm.unfccc.int/EB/050/eb50_repan13.pdf?bcsi_scan_3CC2F976B940F09F=UfpOPl+blLYHpDldKAr4IBIAAABdITQl:1 (last accessed 08.03.10)

The following legislation is applicable to the project activity.
1. Decree 70, 2007 Promotion of renewable energy.
2. Decree 118, 2003 National law for drinking water and basic sanitation.
3. Decree 104, 1993 Environmental Law of Honduras.
4. Decree 180, 2003 Law of territory and land use.
5. Decree 1085, 2002 Criteria to classify projects that request an environmental authorization.
6. Ministerial agreement 635, 2003 Environmental categories matrix in order to get environmental authorization.
7. Agreement 58 of Health Secretary of Honduras, 1996 Technical Standards for the discharge of residual water to receiving stations and the sanitary sewage system.

The two alternatives are consistent with the above mentioned legislation and will be used for the demonstration of additionality.

Step 2. Barrier analysis

Sub-step 2a. Identify barriers that would prevent the implementation of alternative scenarios

Implementation of the project without the CER revenues (alternative B defined under sub-step 1a) faces barriers that prevent the realisation of this alternative. An overview of the barriers is shown in table 4. Each barrier is described in more detail in the section below.

Table 4. Identified barriers for development of the project activity

Type of barrier	**Identified barrier**
Technological	Lack of Honduran technology suppliers
Prevailing practice	The project differs from the prevailing practice in Honduras and there are no legal incentives for methane capture.

Technological barriers

The particular technology used in the proposed project activity is marginally used in the relevant region.

As it has been already mentioned in a previous section, the company Energía Ecológica de Palcasa S.A (EECOPALSA) was created to develop the proposed project activity by a company owned by 536 small-scale palm oil producers - Palmas Centroamericanas S.A. (PALCASA) - and some small-scale producers who own 49% of the company. The company is not the subsidiary of a multinational group and has its productive focus in producing African Palm and Palm Oil. Thus, it does not have easy access to finance, technology or know-how of the operation. Indeed, the industries in the region are very sensitive to palm oil price variations and its evolution over the past year has put many producers of the region in difficult situations[16].

Currently, there are no local suppliers in Honduras that can provide the methane capture and biogas recovery systems. The project owner, therefore, has to use technology delivered by a non-Honduran technology supplier. This constitutes a risk for the continuous operation of the plant since potential replacements or major problems would have to be solved by a technology supplier located in Spain,

[16] Ramirez, Lilian (2009). En crisis productores de palma africana. La prensa. hn, El Progreso, 13.03.09. Available at: http://www.laprensa.hn/Pa%C3%ADs/Ediciones/2009/03/13/Noticias/En-crisis-productores-de-palma-africana (last accessed 02.03.10)

Guascor[17]. This lack of national technology producers together with the lack of skilled labour properly trained to operate and maintain the technology also involve risks. These and other risks lead to a situation where no lagoon has been covered without considering CDM support[18]. This means that the technology is a marginal practice outside CDM according to Guideline 3 of the "Guidelines for objective demonstration and assessment of barriers" version 01[19], Technological risks are still too high for companies like Eecoplasa to overcome without the potential income from the credits.

Prevailing practice

In Honduras, there is no regulation governing the capture of methane emissions in the palm oil industry and no other regulatory incentives to prevent methane emissions from oxidation lagoons[22]. The main norms that affect effluent management are the Technical Norms for the Discharge of Residual Water to Receiving Bodies and Sanitary Sewage ("Normas técnicas de las descargas de aguas residuales a cuerpos receptores y alcantarillado sanitario") from the Health Secretariat enacted the 13th of December 1997[23]. These norms establish the maximum level of Chemical Oxygen Demand (COD) that effluents can have to be legally discharged into water streams. Open lagoons are the most financially attractive way of meeting these norms for industries that produce residues with high COD levels (given the low investment and maintenance costs involved). Nonetheless, this solution leads to substantial amounts of methane emissions into the atmosphere. The table below shows how this is also the case in the palm oil industry, where outside CDM projects – whether registered or at validation **-** the current practice is dominated by the treatment of POME in open lagoons without methane recovery[24]. All palm oil mills analyzed outside CDM do not have biodigestors and treat their effluents in open lagoons. The cases in which mills do have methane recovery systems have been developed counting on the support of CDM. This table clearly illustrates the argument proposed above: that open lagoons are the prevailing practice in Honduras and that without CDM, methane from palm oil mill effluents would not be captured at all. Only the potential income from CDM has proven to be a good enough incentive to change the prevailing practice and overcome the increased uncertainty associated with a project that does not follow the common effluent management system in Honduras and has technology risks.

Table 5. Palm Oil Mills' Residues Treatment Systems in Honduras[25]

[17]The purchase order of the technology was made available to the DOE.

[18] Information on the status of palm oil effluent treatment systems in Honduras has been made available to the DOE.

[19] EB 50, "Guidelines for objective demonstration and assessment of barriers" version 01, Annex 13. Available at: http://cdm.unfccc.int/EB/050/eb50_repan13.pdf?bcsi_scan_3CC2F976B940F09F=UfpOPl+blLYHpDldKAr4IBIAAABdITQl:1 (last accessed 08.03.10)

[22] Agüero Starkman, Sixto. Diagnóstico del aprovechamiento biomásico para la generación de energía en Honduras.Tegucigalpa: Secretaría de Recursos Naturales y Ambiente – Dirección General de Energía, December 31, 2004. page: 15

http://www.cimeqh.org/sitio/descargas/problemaenergetico/diagnostico_biomasa.pdf. (last accessed: 12-05-2009)

[23] Secretaría de Salud. Normas Tecnicas Descargas Aguas Residuales, 1997. http://www.ersaps.gob.hn/NR/rdonlyres/9D578951-ECC7-4FFD-B4C6-F58A232750C9/817/NormasTecnicasDescargasAguasResiduales.pdf. . (last accessed: 12-05-2009)

[24] Agüero Starkman, Sixto. *Diagnóstico del aprovechamiento biomásico para la generación de energía en Honduras*.Tegucigalpa: Secretaría de Recursos Naturales y Ambiente – Dirección General de Energía, December 31, 2004. page: 14 http://www.cimeqh.org/sitio/descargas/problemaenergetico/diagnostico_biomasa.pdf. (last accessed: 12-05-2009)

[25] This information has been obtained by contacting professionals of the Palm Oil Mill industry in Honduras. A copy of this chart has been validated by the National Federation of African Palm Producers of Honduras and made available to the DOE.

ID	Ref.	Title	Host country	Province / State/Region	Status	Type
CDM0774	492	Eecopalsa – biogas recovery and electricity generation from Palm Oil Mill Effluent ponds	Honduras	Yoro	Registered	Methane avoidance
CDM2428	1483	Energeticos Jaremar – Biogas recovery from Palm Oil Mill Effluent (POME) ponds, and heat & electricity generation	Honduras	Atlántida	Registered	Methane avoidance
CDM3097		Lean Biogas recovery from Palm Oil Mill Effluent (POME) ponds and biogas / biomass utilisation at Exportadora del Atlántico, Lean	Honduras	Atlántida	At Validation / Financial Process	Methane avoidance
CDM3098		Aguan biogas recovery from Palm Oil Mill Effluent (POME) ponds and biogas / biomass utilisation - Exportadora del Atlántico, Aguan	Honduras	Colón	At Validation	Methane avoidance
CDM5816		ERH – Biogas recovery, heat and electricity generation from effluents ponds (Hondupalma)	Honduras	Yoro	At Validation	Methane avoidance
CDM5828		- Methane recovery &	Honduras	Colón	At Validation	Methane avoidance

		power generation from oil mill plant effluents (Aceydesa)				
		Coapalma	Honduras		No CDM	Open lagoon
		Cooperativa Salamá	Honduras		No CDM	Open lagoon
		Compañía Agrícola Industrial Ceibeña S. A.	Honduras		No CDM	Open lagoon
		Agropalma	Honduras		No CDM	Open lagoon

From the barrier analysis above, it can be concluded that the project would not have occurred without support from CDM. The project activity currently faces significant technological barriers that would have prevented its implementation. In addition, the project activity goes beyond the applicable legislation and the common practices in Honduras and therefore in the absence of CDM the current situation would prevail. Thus, the proposed project activity can be deemed "additional to the baseline scenario".

Sub-step 2b. Eliminate alternative scenarios which are prevented by the identified barriers
The barriers described in sub-step 2a are valid for the alternative B, implementation of methane recovery with electricity generation and without CDM revenues. The business as usual scenario, alternative A, is not hindered by the identified barriers.

Step 3. Investment analysis

This step is not applied.

From the additionality analysis above, it can be concluded that the project would not have occurred without support from CDM. The CDM project activity goes beyond the applicable legislation and the common practices in Honduras. In addition, the project activity currently faces significant barriers that prevent its implementation. Therefore, the proposed project activity can be deemed "additional to the baseline scenario".

Step 4. Common practice analysis

As explained in *Sub-step 2a*, the Technical Norms for the Discharge of Residual Water to Receiving Bodies and Sanitary Sewage ("Normas técnicas de las descargas de aguas residuales a cuerpos receptores y alcantarillado sanitario") from the Health Secretariat enacted the 13th of December 1997[26] establish the maximum level of Chemical Oxygen Demand (COD) that effluents can have to be legally discharged into water streams. Since open lagoons are the most financially attractive way of meeting these norms for

[26] Secretaría de Salud. Normas Tecnicas Descargas Aguas Residuales, 1997. http://www.ersaps.gob.hn/NR/rdonlyres/9D578951-ECC7-4FFD-B4C6-F58A232750C9/817/NormasTecnicasDescargasAguasResiduales.pdf. . (last accessed: 12-05-2009)

industries that produce residues with high COD levels (because they have low investment and maintenance costs), the current practice is dominated by the treatment of POME in open lagoons without methane recovery[27]. As demonstrated above, only potential CDM revenues demonstrably act as an incentive to overcome the technological risks associated with the project.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

The project activity is applicable to the baseline and monitoring methodology of AMS-I.D “Grid connected renewable electricity generation” (version 15) and AMS-III.H “Methane recovery in wastewater treatment” (version 14) under Appendix B of the simplified modalities and procedures.

Emission reductions

In what follows, we will present the ex-ante emission reduction calculations and the ex-post calculations will be detailed in section B7.

Total emission reductions of the project will be calculated as a sum of emission reductions from methane recovery in wastewater treatment and emission reduction obtained through combustion of recovered methane for electricity generation.

$$ER_y = ER_{y,power} + ER_{y,methane} \qquad \textbf{(1)}$$

Where:

ER_y = Total emission reductions of the project in year *y* (tCO_2/year)
$ER_{y,power}$ = Emission reductions from electricity generation in year *y* (tCO_2/year)
$ER_{y,methane}$ = Emission reductions from methane recovery in wastewater treatment in year *y* (tCO_2/year)

Grid connected renewable electricity generation

For the purpose of calculating the emission reductions from electricity generation, the following equation is applied:

$$ER_{y,power} = BE_{y,power} - PE_{y,power} - Leakage_{y,power} \qquad \textbf{(2)}$$

Where:

$ER_{y,power}$ = Emission reductions from electricity generation in year *y* (tCO_2/year)
$BE_{y,power}$ = Baseline emissions from electricity generation in year *y* (tCO_2/year)
$PE_{y,power}$ = Project emissions from electricity generation in year *y* (tCO_2/year)
$Leakage_{y,power}$ = Leakage emissions from electricity generation in year *y* (tCO_2/year)

[27] Agüero Starkman, Sixto. *Diagnóstico del aprovechamiento biomásico para la generación de energía en Honduras*.Tegucigalpa: Secretaría de Recursos Naturales y Ambiente – Dirección General de Energía, December 31, 2004. page: 14 http://www.cimeqh.org/sitio/descargas/problemaenergetico/diagnostico_biomasa.pdf. (last accessed: 12-05-2009)

Methane recovery in wastewater treatment
For the purpose of calculating the emission reductions from methane recovery in wastewater treatment, the following equation is applied:

$$ER_{y,methane} = BE_{y,methane} - \left(PE_{y,methane} + Leakage_{y,methane}\right) \quad \textbf{(3)}$$

Where:

$ER_{y,methane}$	=	Emission reductions from methane recovery in wastewater treatment in year *y* (tCO_2/year)
$BE_{y,methane}$	=	Emissions from the wastewater treatment in baseline scenario in year *y* (tCO_2/year)
$PE_{y,methane}$	=	Project emissions from methane recovery in wastewater treatment in year *y* (tCO_2/year)
$Leakage_{y,methane}$	=	Leakage emissions in year *y* (tCO_2/year)

<u>Baseline emissions</u>

Grid connected renewable electricity generation
In accordance with methodology AMS-I.D. "Grid connected renewable electricity generation" (version 15), the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the "Tool to calculate the emission factor for an electricity system" (version 01.1). The following equation is used to calculate baseline emissions from electricity generation:

$$BE_{y,power} = EG_y \cdot EF_{grid,CM,y} \quad \textbf{(4)}$$

Where:

$BE_{y,power}$	=	Baseline emissions from electricity generation in year *y* (tCO_2/year)
EG_y	=	Net electricity generated by the project in year *y* (GWh/year)
$EF_{grid,CM,y}$	=	Combined margin emission factor (tCO_2eq/GWh)

"Tool to calculate the emission factor for an electricity system" provides the following six steps to calculate combined margin emission factor:

Step 1. Identify the relevant electric power system.
Step 2. Select an operating margin (OM) method.
Step 3. Calculate the operating margin emission factor according to the selected method.
Step 4. Identify the cohort of power units to be included in the build margin (BM).
Step 5. Calculate the build margin emission factor.
Step 6. Calculate the combined margin (CM) emissions factor.

<u>Step 1. Identify of the relevant electric power system</u>

According to the "Tool to calculate the emission factor for an electricity system" (version 01.1), a project's electricity system has to be defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity and that can be dispatched

without significant transmission constraints. Correspondingly, in this project activity the project electricity system include the project site and all power plants attached to the Honduran national grid[28].

Step 2. Choose whether to include off-grid power plants in the project electricity system
This step was ignored, as no off-grid power plants are in the project electricity system

Step 3. Select an operating margin (OM) method
According to the "Tool to calculate the emission factor for an electricity system" (version 01.1), to calculate the operating margin ($EF_{grid,OM,y}$), project developers have the option to select from four potential methods:

a) Simple OM, or
b) Simple adjusted OM, or
c) Dispatch Data Analysis OM, or
d) Average OM.

Option a) is applied for the calculation of the operating margin, since the low-cost/must-run resources constitute less than 50% of total Honduran grid generation[29]. With reference to the "Tool to calculate the emission factor for an electricity system" (version 01.1), the OM emission factor is calculated using an ex-ante option, i.e. based on the most recent 3-year generation-weighted average data available at the moment of submission. Data from the years 2006, 2007 and 2008 have been used for the calculations.

Step 4. Calculate the operating margin emission factor according to the selected method
The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost / must run power plants / units. It is calculated based on data on fuel consumption and net electricity generation of each power plant/unit with the following equation:

$$EF_{grid,OMsimple,y} = \frac{\sum_{i,m} FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{\sum_{m} EG_{m,y}} \qquad \textbf{(5)}$$

Where:

$EF_{grid,OMsimple,y}$	=	Simple operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
$FC_{i,m,y}$	=	Amount of fossil fuel type *i* consumed by power plant/unit *m* in year *y* (mass or volume unit)
$NCV_{i,y}$	=	Net calorific value (energy content) of fossil fuel type I in year *y* (GJ / mass or volume unit)
$EF_{CO2,i}$	=	CO_2 emission factor of fossil fuel type I in year y (tCO_2/GJ)
$EG_{m,y}$	=	Net electricity generated and delivered to the grid by the power plant/unit *m* in year *y* (MWh)
M	=	All power plants/units serving the grid in the year *y* except low-cost/must-run power plants/units

[28] The data to calculate the CM have been provided by the Honduran Electricity Company (ENEE) by e-mail, these documents have been made available to the DOE.
[29] In 2008, 37,9% of the total grid generation exists from sources that are not low-cost/must-run. This information is based on public information from ENEE. More information can be found under Annex 3.

I = All fossil fuel types combusted in power plant/unit *m* in the year *y*
Y = Three most recent years for which data is available at the time of submission of the project (2005, 2006 and 2007)

There is no available information on the fuel consumption for some plants fuelled with bunker (Green Valley and Elcatex), one diesel plant (Ampac) and two coal plants (Celsur and Envasa) connected to the grid, their emission factors have been estimated using option B2 for calculating simple OM, according to the “Tool to calculate the emission factor for an electricity system” (version 01.1). Option B2 can be applied if only data on electricity generation and the fuel type for each power unit is available. To calculate the emission factor of those three power plants the following equation is used:

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \cdot 3.6}{\eta_{m,y}} \quad \textbf{(6)}$$

Where:
$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$EF_{CO2,m,i,y}$ = Average CO_2 emission factor of fuel type *i* used in power unit *m* in year *y* (tCO_2/GJ)
$\eta_{m,y}$ = Average net energy conversion efficiency of power unit *m* in year *y* (%)
Y = Three most recent years for which data is available at the time of submission of the project (2005, 2006 and 2007)

The average net energy conversion efficiency values have been obtained from Annex I of the “Tool to calculate the emission factor for an electricity system” (version 01.1). To ensure conservativeness, the highest net energy conversion efficiency, has been chosen for those three power plants mentioned.

The calculated operating margin emission factor is **622.5 tCO_2/GWh**.

Step 5. Identifying the group of the power units to be included in the build margin

According to the “Tool to calculate the emission factor for an electricity system” (version 01.1), the sample group of power units *m* used to calculate the build margin consists of the set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently[30].

In terms of vintage of data option 1 has been chosen, i.e. for the first crediting period the build margin emission factor is calculated ex-ante based on the most recent information available on units already built for sample group *m* at the time of CDM-PDD submission to the DOE for validation. The most recent data belong to 2008. For further crediting periods the build margin emission factor will be calculated according to the respective provisions for option 1.

The list of the power plants is given in Annex 3 which is the baseline information of this PDD.

Step 6. Calculation of the build margin emission factor

[30] If 20% falls on part capacity of a unit, that unit is fully included in the calculation.

The built margin emissions factor is the generation-weighted average emissions factor (tCO_2/MWh) of all power units *m* during the most recent year *y* for which power generation data is available, calculated as follows:

$$EF_{grid,BMsimple,y} = \frac{\sum EG_{m,y} \cdot EF_{EL,m,y}}{\sum_{m} EG_{m,y}} \quad \textbf{(7)}$$

Where:

$EF_{grid,BM,y}$ = Build margin CO_2 emissions factor in year *y* (tCO_2/GWh)
$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (GWh)
$EF_{EL,m,y}$ = CO_2 emission factor of the power unit *m* in year *y* (tCO_2/GWh)
M = Power units included in the build margin
Y = most recent historical year for which power generation data is available

The CO_2 emission factor of each power unit *m* ($EF_{EL,m,y}$) is determined according to the guidance of the "Tool to calculate the emission factor for an electricity system" (version 01.1) in step 3 for simple OM, using for *y* the most recent historical year for which power generation data is available, and using for *m* the power units included in the build margin.

Step 7. Calculation of the combined margin emission factor

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \cdot w_{OM} + EF_{grid,BM,y} \cdot w_{BM} \quad \textbf{(8)}$$

Where:

$EF_{grid,CM,y}$ = Combined Margin emission factor in year *y* (tCO_2/MWh)
$EF_{grid,OM,y}$ = Operating margin emission factor in year *y* (tCO_2/MWh)
$EF_{grid,BM,y}$ = Build margin emission factor in year *y* (tCO_2/MWh)
w_{OM} = Weighting of operating margin emission factor (-)
w_{BM} = Weighting of build margin emission factor (-)
$EF_{grid,CM,y}$ = Combined Margin emission factor in year *y* (tCO_2/MWh)
$EF_{grid,OM,y}$ = Operating margin emission factor in year *y* (tCO_2/MWh)
$EF_{grid,BM,y}$ = Build margin emission factor in year *y* (tCO_2/MWh)
w_{OM} = Weighting of operating margin emission factor (-)
w_{BM} = Weighting of build margin emission factor (-)
$EF_{grid,CM,y}$ = Combined Margin emission factor in year *y* (tCO_2/MWh)
$EF_{grid,OM,y}$ = Operating margin emission factor in year *y* (tCO_2/MWh)
$EF_{grid,BM,y}$ = Build margin emission factor in year *y* (tCO_2/MWh)
w_{OM} = Weighting of operating margin emission factor (-)
w_{BM} = Weighting of build margin emission factor (-)

According to the "Tool to calculate the emission factor for an electricity system" (version 01.1), the following default values are used for weights for the operating margin and build margin emission factors: w_{OM} = 0.5 and w_{BM} = 0.5.

The calculated combined emission factor is **581.6 tCO_2/GWh**.

Methane recovery in wastewater treatment

According to the methodology AMS-III.H "Methane recovery in wastewater treatment" (version 14), the baseline emissions for scenario (iv) *the existing anaerobic wastewater treatment system without methane recovery and combustion* are calculated as follows:

$$BE_{y,methane} = BE_{ww,treatment,y} \quad \textbf{(9)}$$

Where:

$BE_{y,methane}$ = Baseline emissions in year *y* (tCO_2e)

$BE_{ww,treatment,y}$ = Baseline emissions of the wastewater treatment systems affected by the project activity in year y (tCO_2e)

The methane emission potential of the anaerobic wastewater treatment plant in the baseline situation is calculated through equation (10) below:

$$BE_{ww,treatment,y} = \sum_i Q_{ww,i,y} * COD_{removed,i,y} * MCF_{ww,treatment,BL,i} * B_{o,ww} * UF_{BL} * GWP_{CH4} \quad \textbf{(10)}$$

Where:

$Q_{ww,i,y}$ = Volume of wastewater treated in baseline wastewater treatment system *i* in the year *y* (m^3)

$COD_{removed,i,y}$ = Chemical oxygen demand removed by baseline treatment system i in year *y* (tonnes/m^3), measured as the difference between inflow COD and the outflow COD in system *i*

$B_{o,ww}$ = Methane producing capacity of the wastewater (IPCC lower value of 0.21 kg CH_4/kg COD)

$MCF_{ww,treatment,BL,i}$ = Methane correction factor for baseline wastewater treatment systems *i* in (MCF value as per table 6)

i = Index for baseline wastewater treatment system

UF_{BL} = Model correction factor to account for model uncertainties (0.94)

GWP_{CH4} = Global Warming Potential for methane (value of 21)

Table 6. IPCC default values for Methane Correction Factor (MCF)[31]

Type of wastewater treatment and discharge pathway or system	MCF value
Discharge of wastewater to sea, river or lake	0.1
Aerobic treatment, well managed	0.0
Aerobic treatment, poorly managed or overloaded	0.3
Anaerobic digester for sludge without methane recovery	0.8
Anaerobic reactor without methane recovery	0.8
Anerobic shallow lagoon (depth less than 2 metres)	0.2

[31] Table taken from the methodology AMS-III.H version 14 (page 6/7).

Anerobic deep lagoon (depth more than 2 metres)	0.8
Septic system	0.5

For the methane correction factor of the anaerobic wastewater treatment system in the baseline scenario ($MCF_{ww,treatment,BL,i}$) the lower value with regard to the anaerobic deep lagoon is applied, since its depth is more than 2 meters. Therefore, $MCF_{ww,treatment,BL,i}$ = 0.8.

With reference to the methodology AMS-III.H "Methane recovery in wastewater treatment" (version 14), the methane emissions from decay of the final sludge generated by the treatment system could be neglected if the sludge is combusted under controlled conditions, disposed in a landfill with methane recovery, or used for soil application. The sludge generated by the project will be used for soil application, therefore $MEP_{y,s,treatment}$ = 0 tonnes.

Project emissions

The renewable electricity generation does not result in project emissions, since the combustion of recovered methane for electricity generation is considered as CO_2-neutral. The project emissions solely involve emissions from methane recovery in wastewater system.

Methane recovery in wastewater treatment

In accordance with the methodology AMS-III.H "Methane recovery in wastewater treatment" (version 14), the project activity emissions are calculated as follows:

$$PE_{y,methane} = \begin{Bmatrix} PE_{power,y} + PE_{ww,treatment,y} + PE_{ww,discharge,y} + PE_{s,final,y} + \\ PE_{fugitive,y} + PE_{biomass,y} + PE_{flaring,y} \end{Bmatrix} \quad \textbf{(11)}$$

Where:

$PE_{y,methane}$	=	Project emissions from methane recovery in wastewater treatment in year *y* (tCO_2e)
$PE_{power,y}$	=	Emissions from electricity or fuel consumption in year *y* (tCO_2e).
$PE_{ww,treatment,y}$	=	Methane emissions from wastewater treatment systems affected by the project activity, and not equipped with biogas recovery, in year *y* (tCO_2e).
$PE_{ww,discharge,y}$	=	Methane emissions on account of inefficiency of the project activity wastewater treatment systems and presence of degradable organic carbon in treated wastewater in year *y* (tCO_2e).
$PE_{s,final,y}$	=	Methane emissions from anaerobic decay of the final sludge produced in year *y* (tCO_2e).
$PE_{fugitive,y}$	=	Methane fugitive emissions on account of inefficiencies in capture systems in year *y* (tCO_2e)
$PE_{flaring,y}$	=	Methane emissions due to incomplete flaring in year *y* (tCO_2e)
$PE_{biomass,y}$	=	Emissions due to physical leakage from dedicated piped network in year *y* (tCO_2e)

From these identified potential emission sources the following sources are not applicable or considered zero.

Table 7. Potential emission sources that are not applicable or considered zero

Parameter	Not applicable/considered zero
$PE_{y,power}$	The project emissions from electricity ($PE_{y,power}$) of the wastewater treatment system are not available at this stage and only estimations can be made. However, from Eecopalsa biogas recovery from Palm Oil Mill Effluent (POME) ponds project experience, which tends to be the same technology as for this project activity, this parameter contributes fairly less than other project emissions. Therefore, parameter $PE_{y,power}$ can be neglected for ex-ante calculations. Nevertheless, project emissions from own electricity consumptions will be measured and hence considered for ex-post calculations once real data is available.
$PE_{ww,discharge,y}$	As the residual waters will percolate and infiltrate into the ground there are no project emissions due to the discharge pathway expected. These emissions only occur in case the water is discharged into a sea, rievr or lake, what is not the case for the project situation.
$PE_{y,s,final}$	The project emissions from anaerobic decay of the final sludge ($PE_{y,s,final}$) are neglected since the sludge will be used for soil application.
$PE_{ww,treatment,y}$	Project emissions from wastewater treatment systems affected by the project activity, and not equipped with biogas recovery ($PE_{ww,treatment,y}$) are not considered. The Eecopalsa Biogas Expansion project does not involve measures mentioned above, hence $PE_{ww,treatment,y}$ = 0 tCO_2e.
$PE_{biomass,y}$	Project emissions related to the storage of biomass under anaerobic conditions ($PE_{biomass,y}$) are not considered in the project activity as no biomass will be stored under anaerobic conditions.

The project emissions from methane release in capture systems are determined as follows:

$$PE_{fugitive,y} = PE_{fugitive,ww,y} + PE_{fugitive,s,y} \qquad \textbf{(12)}$$

Where:

$PE_{fugitive,y}$ = Project emissions from methane release in capture systems in year y (tCO_2e)

$PE_{fugitive,ww,y}$ = Fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment systems in the year y (tCO_2e).

$PE_{fugitive,s,y}$ = Fugitive emissions through capture inefficiencies in the anaerobic sludge treatment systems in the year y (tCO_2e).

Since the anaerobic sludge treatment is not considered in the project design, the project emissions from that source are not taken into account. Therefore, $PE_{fugitive,s,y}$ = 0 tCO_2e.

The fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment ($PE_{fugitive,ww,y}$) are calculated based on equation (14) below:

$$PE_{fugitive,ww,y} = (1 - CFE_{ww}) * MEP_{ww,treatment,y} * GWP_{CH4} \qquad \textbf{(13)}$$

Where:

CFE_{ww} = Capture efficiency of the biogas recovery equipment in the wastewater treatment. Default value of 0.9 is used.

$MEP_{y,ww,treatment}$ = Methane emission potential of wastewater treatment system equipped with biogas recovery in year *y* (tonnes)

The methane emission potential of the wastewater treatment system is calculated as follows:

$$MEP_{ww,treatment,y} = Q_{ww,y} * B_{o,ww} * UF_{PJ} * \sum_{k} COD_{removed,PJ,k,y} * MCF_{ww,treatment,PJ,k} \quad \textbf{(14)}$$

Where:

$COD_{removed,PJ,k,y}$ = Chemical oxygen demand removed by the treatment system *j* of the project activity equipped with methane recovery in the year *y* (tonnes/m^3)

$MCF_{ww,treatment,PJ,k,y}$ = Methane correction factor for the project wastewater treatment system *k* equipped with biogas recovery equipment (MCF values from Table 6)

Chemical oxygen demand removed by the treatment system *k* ($COD_{removed,PJ,k,y}$) is the difference of inflow COD and the outflow COD of the system.

For the methane correction factor of the for the wastewater treatment system *k* in the project scenario equipped with methane recovery ($MCF_{ww,treatment,PJ,k,y}$) the value with regard to anaerobic deep lagoon (depth more than 2 meters) is applied. Therefore, $MCF_{ww,treatment,PJ,k,y}$ = 0.8.

The project emissions due to incomplete flaring in year y are determined as per the “Tool to determine project emissions from flaring gases containing methane” (tCO2e):

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} \times (1 - \eta_{flare,h}) \times \frac{GWP_{CH4}}{1000} \quad \textbf{(15)}$$

Where:

Variable	SI Unit	Description
$PE_{flare,y}$	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

For the enclosed flare the default value of 50% flare efficiency is used. For the ex-ante calculation the mass flow rate of methane per hour is simplified to the amount of methane that is estimated to be flared per year. This amount is based on the assumption that 10% of the captured methane is flared. The amount of captured methane is the total amount of methane generated discounted by the amount of methane released due to capture inefficiencies.

<u>Leakage</u>

According to AMS-I.D paragraph 14 and AMS-III.H paragraph 28, leakage from renewable electricity generation and methane recovery in wastewater treatment is not taken into consideration since the used technology is not transferred from and to another activity.

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

Data / Parameter:	**ID.1 / TFF_y**
Data unit:	Tonnes/year
Description:	The expected amount of fresh fruit to be processed in year *y*
Source of data used:	Feasibility study of EECOPALSA
Value applied:	See Table 11
Justification of the choice of data or description of measurement methods and procedures actually applied :	The feasibility study for the project gives the expected production of the palm oil mill for the coming years.
Any comment:	

Data / Parameter:	**ID.2 / WU**
Data unit:	m^3/tonnes fresh fruit
Description:	The average water usage per processed ton of fresh fruit
Source of data used:	Feasibility study of EECOPALSA
Value applied:	1.035
Justification of the choice of data or description of measurement methods and procedures actually applied :	The feasibility study for the project gives the average water usage per processed ton of fresh fruit.
Any comment:	

Data / Parameter:	**ID.3 / COD_{inflow}**
Data unit:	Tonnes/m^3
Description:	Chemical Oxygen Demand per m^3 of water entering the lagoon
Source of data used:	Results of laboratory analysis
Value applied:	$65.630 * 10^{-3}$
Justification of the choice of data or description of measurement methods and procedures actually applied :	The laboratory analysis was performed in compliance with the Technical Quality Standard for Discharge of Wastewater into Receivers. The results have been used for the purpose of proper sizing of the lagoons for anaerobic treatment.
Any comment:	This parameter is used to calculate $COD_{y,removed,j}$. See section B.6.3 for calculations.

Data / Parameter:	**ID.4 / $B_{o,ww}$**
Data unit:	kg CH_4/kg COD

Description:	Methane producing capacity of the wastewater
Source of data used:	Methodology AMS-III.H version 14
Value applied:	0.25
Justification of the choice of data or description of measurement methods and procedures actually applied :	The default value is used according to the methodology AMS-III.H version 14.
Any comment:	

Data / Parameter:	**ID.5 / $MCF_{ww,treatment,PJ}$**
Data unit:	-
Description:	Methane correction factor for the wastewater treatment system equipped with biogas recovery equipment
Source of data used:	Table III.H.1. IPPC default values for Methane Correction Factor (MCF)
Value applied:	0.8
Justification of the choice of data or description of measurement methods and procedures actually applied :	In accordance with methodology AMS-III.H version 14, the MCF value for an anaerobic reactor is applied.
Any comment:	See Table 6

Data / Parameter:	**ID.6 / $MCF_{ww,treatment,BL,i}$**
Data unit:	-
Description:	Methane correction factor for the anaerobic wastewater treatment system *i* in the baseline scenario
Source of data used:	Table III.H.1. IPPC default values for Methane Correction Factor (MCF)
Value applied:	0.8
Justification of the choice of data or description of measurement methods and procedures actually applied :	In accordance with methodology AMS-III.H version 14, the MCF value for an anaerobic deep lagoon (depth more than 2 meters) is applied.
Any comment:	See Table 6

Data / Parameter:	**ID.7 / GWP_CH_4**
Data unit:	-
Description:	Global Warming Potential for methane
Source of data used:	Methodology AMS-III.H version 14
Value applied:	21
Justification of the choice of data or description of measurement methods	The default value is used according to the methodology AMS-III.H version 14.

and procedures actually applied :	
Any comment:	

Data / Parameter:	**ID.8 / CFE_{ww}**
Data unit:	-
Description:	Capture and utilization/combustion/flare efficiency of the methane recovery and combustion/utilization equipment in the wastewater treatment
Source of data used:	Methodology AMS-III.H version 14
Value applied:	0.9
Justification of the choice of data or description of measurement methods and procedures actually applied :	The default value is used according to the methodology AMS-III.H version 14.
Any comment:	

Data / Parameter:	**ID.9 / η_{flare}**
Data unit:	%
Description:	Efficiency of the flaring process
Source of data used:	Methodology AMS-III.H version 14
Value applied:	50
Justification of the choice of data or description of measurement methods and procedures actually applied :	The default value for open flares is used according to the methodology AMS-III.H version 14.
Any comment:	

Data / Parameter:	**ID.10 / NCV_{CH4}**
Data unit:	TJ/Gg
Description:	Net calorific value of biogas/methane
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2, Chapter 1, Table 1.2
Value applied:	50.4
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC is the preferable source of default values if other reliable sources are not available.
Any comment:	

Data / Parameter:	**ID.11 / D_{CH4}**
Data unit:	kg CH_4 /m^3 CH_4
Description:	Density of methane

Source of data used:	Methodology ACM0001 version 11, footnote 5, page 10
Value applied:	0.7168
Justification of the choice of data or description of measurement methods and procedures actually applied :	The default value for the density of methane is derived from the standard conditions used for correction of the volume. This is determined from the standard conditions of temperature and pressure (0 degree Celsius and 1,013 bar).
Any comment:	

Data / Parameter:	**ID.12 / $FC_{i,m,y}$**
Data unit:	l/year
Description:	Amount of fossil fuel *i* consumed in the project electricity system by generation sources *m* in years 2005-2007
Source of data used:	ENEE (National Company for Electric Energy)
Value applied:	See Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	ENEE is the official source for the related data, hence providing the most up-to-date and representative information.
Any comment:	

Data / Parameter:	**ID.13 / NCV_{Diesel}**
Data unit:	TJ/Gg.
Description:	The net calorific value for Diesel
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, volume 2 chapter 1 (table 1.2)
Value applied:	41.4 TJ/Gg
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC is the preferable source of default values if other reliable sources are not available.
Any comment:	

Data / Parameter:	**ID.14 / NCV_{Bunker}**
Data unit:	TJ/Gg.
Description:	The net calorific value for bunker
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, volume 2 chapter 1 (table 1.2)
Value applied:	39.8 TJ/Gg
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC is the preferable source of default values if other reliable sources are not available.
Any comment:	

Data / Parameter:	**ID.15 / $EF_{CO2,Diesel}$**
Data unit:	tCO_2e/TJ.
Description:	Emission factor for Diesel
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, volume 2, chapter 1 table 1.4
Value applied:	72.6 tCO_2e/TJ
Justification of the choice of data or description of measurement methods and procedures actually applied :	The IPCC Guidelines are the most reliable source for these values.
Any comment:	

Data / Parameter:	**ID.16 / $EF_{CO2,Bunker}$**
Data unit:	tCO_2e/TJ.
Description:	Emission factor for bunker
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, volume 2, chapter 1 table 1.4
Value applied:	75.5 tCO_2e/TJ
Justification of the choice of data or description of measurement methods and procedures actually applied :	The IPCC Guidelines are the most reliable source for these values.
Any comment:	

Data / Parameter:	**ID.17 / $EG_{m,y}$**
Data unit:	GWh
Description:	The electricity in GWh delivered to the grid by source *j* with fuel *i*, in year *y*
Source of data used:	Official information provided by ENEE (National Company for Electric Energy)

Value applied:	See Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	The information provided by the ENEE's database is considered to be representative of the electricity generation of the grid.
Any comment:	

Data / Parameter:	**ID.18 / $\eta_{m,y}$**
Data unit:	%
Description:	Average net energy conversion efficiency of power unit *m* in year *y*
Source of data used:	Annex I of the "Tool to calculate the emission factor for an electricity system"
Value applied:	46%
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value from the "Tool to calculate the emission factor for an electricity system".
Any comment:	

Data / Parameter:	**ID.19 / D_{Diesel}**
Data unit:	kg/m^3
Description:	Density of Diesel
Source of data used:	IEA 2006 Oil Information 2007/ pg.21 (http://wds.iea.org/WDS/tableviewer/document.aspx?FileId=1059)
Value applied:	844 kg/m^3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Used for the conversion of the fuel volume unit to mass unit.
Any comment:	

Data / Parameter:	**ID.20 / D_{Bunker}**
Data unit:	kg/m^3
Description:	Density of bunker
Source of data used:	IEA 2006 Oil Information 2007/ pg.21 (http://wds.iea.org/WDS/tableviewer/document.aspx?FileId=1059)
Value applied:	944 kg/m^3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Used for the conversion of the fuel volume unit to mass unit.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

The total emission reductions of the project activity are calculated on the basis of the equations and parameters presented and explained in section B.6.1 of this document. Detailed calculations of the combined margin emission factor are presented in Annex 3 of this document. Full calculations are available in Excel files attached to the document.

The first 7 year crediting period starts on March 2010. Therefore, the emission reductions calculations for year 2010 and 2017 consider the 10 months and 2 months the project will be operational in those respective years.

Baseline emissions

Grid connected renewable electricity generation

1. Calculation of the baseline emissions from electricity generation

Input data:

1. Calculation of the baseline emissions from electricity generation

Input data

Table 8. Net electricity generation of the project

Year	2010	2011	2012	2013	2014	2015	2016	2017
EG_y [GWh/year]	2.70	3.53	3.74	3.83	3.88	3.60	3.54	0.58

$EF_{grid,CM,y} = 581.6\ tCO_2eq/GWh$ [32]

Calculations

Equation (4): $BE_{y,power} = EG_y \cdot EF_{grid,CM,y}$

Results

Table 9. Baseline emissions from electricity generation

Year	2010	2011	2012	2013	2014	2015	2016	2017
$BE_{y,power}$ [tCO_2eq/year]	1,573	2,050	2,172	2,227	2,254	2,091	2,059	339

Methane recovery in wastewater treatment

2. Calculation of volume of wastewater

Input data

Table 10. The expected amount of fresh fruit to be processed

Year	2010	2011	2012	2013	2014	2015
TFF_y [t/year]	139,000	151,000	160,000	164,000	166,000	154,000

$WU = 1.035\, m^3/t$

Calculations

Equation (16): $Q_{y,ww} = TFF_y \cdot WU$

Results

Table 11. Volume of wastewater

Year	2010	2011	2012	2013	2014	2015	2016	2017
$Q_{y,ww}$ [m^3]	71,932	78,142	82,800	84,870	85,905	79,695	78,487.7	77,625

3. Calculation of the removed Chemical Oxygen Demand

Input data

[32] Calculations of the combined margin emission factor are presented in Annex 3 of this document.

$COD_{y,\inf low,i} = 0.06563\, tonnes/m^3$
$COD_{y,outflow,i} = COD_{y,ww,treated} = 0.004475512\, tonnes/m^3$ [33]
Calculations
Equations (17): $COD_{y,removed,i} = COD_{y,\inf low,i} - COD_{y,outflow,i}$ $COD_{y,removed,i} = COD_{y,\inf low,i} - COD_{y,ww,treated}$
Results
$COD_{y,outflow,i} = COD_{y,ww,treated} = 0.004475512\, tonnes/m^3$

4. Calculation of baseline emissions from wastewater treatment

Input data
$Q_{y,ww}$ = Table 11. Volume of wastewater
$COD_{y,removed,i} = 0.061156397\, tonnes/m^3$
$B_{o,ww} = 0.25\, kg\, CH_4 / kgCOD$
$MCF_{ww,treatment,BL,i} = 0.8$
$UF_{BL} = 0.89$
$GWP\_CH_4 = 21$
Calculations
Equation (10): $BE_{ww,treatment,y} = Q_{ww,i,y} * COD_{removed,i,y} * MCF_{ww,treatment,BL,i} * B_{o,ww} * UF_{BL} * GWP_{CH4}$
Results

Table 13. Baseline emissions from wastewater treatment

Year	2010	2011	2012	2013	2014	2015	2016	2017
$BE_{y,methane}$ [tCO_2eq/year]	13,703	17,864	18,928	19,402	19,638	18,218	17,942	2,958

[33] This value is calculated as a 6% of $COD_{y,inflow,j}$ value. This is an assumption based on the technology provider of the project, which is based on a measurement campaign done on the adjacent biogas facility. As the new facility (project activity) and the existing facility (existing CDM project 492) will operate under identical conditions in terms of technology applied, input flow and climate conditions, these measurements are a precise estimate for the project's operation, and are considered historical data.

Project emissions

Methane recovery in wastewater treatment

5. Calculation of methane emission potential of wastewater treatment plant

Input data

$Q_{y,ww}$ = Table 11. Volume of wastewater

$B_{o,ww} = 0.25\, kg\, CH_4 / kgCOD$

$COD_{y,removed,j} = COD_{y,removed,i} = 0.061156397\ tonnes / m^3$

$UF_{PJ} = 1.12$

$MCF_{ww,treatment,PJ} = 0.8$

Calculations

Equation (14): $MEP_{ww,treatment,y} = Q_{ww,y} \cdot B_{o,ww} \cdot UF_{PJ} \cdot COD_{removed,PJ,y} \cdot MCF_{ww,treatment,PJ}$

Results

Table 15. Methane emission potential of wastewater treatment plant

Year	2010	2011	2012	2013	2014	2015	2016	2017
$MEP_{y,ww,treatment}$ [tCH_4/year]	821	1,070	1,134	1,163	1,177	1,092	1,075	177

6. Calculation of fugitive project emissions through capture inefficiencies in the anaerobic wastewater treatment system:

Input data

$CFE_{ww} = 0.9$

$MEP_{ww,treatment,y}$ = Table 15. Methane emission potential of wastewater treatment plant

$GWP_{CH_4} = 21$

Calculations

Equation (13): $PE_{fugitive,y} = PE_{fugitive,ww,y} = (1 - CFE_{ww}) \cdot MEP_{ww,treatment,y} \cdot GWP_{CH_4}$

Results

Table 16. Project emissions from methane release in capture and utilization / combustion / flare systems

Year	2010	2011	2012	2013	2014	2015	2016	2017
$PE_{y,fugitive}$ [tCO_2eq/year]	1,724	2,248	2,382	2,442	2,471	2,293	2,258	372

7. Calculation of project emissions due to incomplete flaring:

Input data

$Q_{y,ww}$ = Table 11. Volume of wastewater
$COD_{y,removed,i} = 0.061156397\ tonnes/m^3$
$B_{o,ww} = 0.25\ kg\ CH_4 / kgCOD$
$MCF_{ww,treatment,BL,i} = 0.8$
$UF_{PJ} = 1.12$
$CFE_{ww} = 0.9$
$MEP_{ww,treatment,y}$ = Table 15. Methane emission potential of wastewater treatment plant
$CH_{4,flared} = 10\%$
$Flare_{efficiency} = 50\%$
Calculations
Equation (15): $PE_{flaring,y} = \left\{ \begin{matrix} [Q_{ww,y} \cdot COD_{removed,i,y} \cdot B_{o,ww} \cdot MCF_{ww,treatment,PJ,i} \cdot UF_{PJ}] \\ -[(1-CFE) \cdot MEP_{ww,treatment,PJ,i}] \end{matrix} \right\} \cdot CH_{4,flared} \cdot (1-Flare_{efficiency}) \cdot GWP_{CH4}$
Results

Table 17. Project emissions from incomplete flaring

Year	2010	2011	2012	2013	2014	2015	2016	2017
$PE_{flared,y}$ [tCO_2eq/year]	776	1,012	1,072	1,099	1,112	1,032	1,016	167

8. Calculation of project emissions from methane recovery in wastewater treatment

Input data
$PE_{flaring,y}$ = Table 17. Project emissions from methane release from incomplete flaring
$PE_{y,fugitive}$ = Table 16. Project emissions from methane release in capture and utilization / combustion / flare systems
Calculations

Equation (12): $PE_{methane,y} = PE_{fugitive,y} + PE_{flaring,y}$

Results

Table 17. Project emissions from methane recovery in wastewater treatment

Year	2010	2011	2012	2013	2014	2015	2016	2017
$PE_{y,methane}$ [tCO_2eq/year]	2,500	3,260	3,454	3,540	3,583	3,324	3,274	540

Emission reductions

9. Calculation of emission reduction from electricity generation

Input data

$BE_{y,power}$ = Table 9. Baseline emissions from electricity generation

$PE_{y,power}$ = 0

$Leakage_{y,power}$ = 0

Calculations

Equation (2): $ER_{y,power} = BE_{y,power} - PE_{y,power} - Leakage_{y,power}$

Results

Table 18. Emission reduction from electricity generation

Year	2010	2011	2012	2013	2014	2015	2016	2017
$ER_{y,power}$ [tCO_2eq/year]	1,573	2,050	2,172	2,227	2,254	2,091	2,059	339

10. Calculation of emission reduction from methane recovery in wastewater treatment

Input data

$BE_{y,methane}$ = Table 13. Baseline emissions from wastewater treatment

$PE_{y,methane}$ = Table 17. Project emissions from methane recovery in wastewater treatment

$Leakage_{y,methane}$ = 0

Calculations

Equation (3): $ER_{y,methane} = BE_{y,methane} - \left(PE_{y,methane} + Leakage_{y,methane}\right)$

Results

Table 19. Emission reduction from methane recovery in wastewater treatment

Year	2010	2011	2012	2013	2014	2015	2016	2017
$ER_{y,methane}$ [tCO_2eq/year]	11,203	14,604	15,474	15,861	16,055	14,894	14,668	2,418

11. Calculation of total emission reduction of the project activity

Input data

$ER_{y,power}$ = Table 18. Emission reduction from electricity generation

$ER_{y,methane}$ = Table 19. Emission reduction from methane recovery in wastewater treatment

Calculations

Equation (1): $ER_y = ER_{y,power} + ER_{y,methane}$

Results

Table 20. Total emission reduction of the project activity

Year	2010	2011	2012	2013	2014	2015	2016	2017
ER_y [tCO_2eq/year]	12,776	16,654	17,647	18,088	18,309	16,985	16,728	2,757

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

Values for year 2010 and 2017 are adapted according to duration of the crediting period.

Table 21. Ex-ante estimation of emission reductions 2010/2017

Year	**Estimation of project activity emissions (tCO2-eq)**	**Estimation on baseline emission (tCO2-eq)**	**Estimation of leakage (tCO2-eq)**	**Estimation of overall emission reduction (tCO2-eq))**
2010	2,500	15,276	0	12,776
2011	3,260	19,914	0	16,654
2012	3,454	21,101	0	17,647
2013	3,540	21,628	0	18,088
2014	3,583	21,892	0	18,309
2015	3,324	20,309	0	16,985
2016	3,274	20,002	0	16,728
2017	540	3,297	0	2,757
Total emission reductions (tonnes of CO_2-eq)	23,476	143,419	0	119,943

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

B.7.1 Data and parameters monitored:

Data / Parameter:	**ID.19 / $BG_{y,captured}$**
Data unit:	Nm^3/year
Description:	Amount of biogas captured in year “y”

Source of data to be used:	Measured continuously by flow meter
Value of data	N/A
Description of measurement methods and procedures to be applied:	Data measured by a continuous flow meter. All data will be archived electronically. The procedures applied will strictly follow the supplier's manual.
QA/QC procedures to be applied:	*QA:* The device will be recalibrated according to the instructions (schedules, procedures) for QA of the technology provider. *QC:* There will be strict compliance to maintenance schedule recommended by the technology provider.
Any comment:	

Data / Parameter:	**ID.20 / $BG_{y,fuelled}$**
Data unit:	Nm^3/year
Description:	Amount of biogas consumed in gas engine in year "y"
Source of data to be used:	Measured continuously by flow meter
Value of data	N/A
Description of measurement methods and procedures to be applied:	Data measured by a continuous flow meter. All data will be archived electronically. The procedures applied will strictly follow the supplier's manual.
QA/QC procedures to be applied:	*QA:* The device will be recalibrated according to the instructions (schedules, procedures) for QA of the technology provider. *QC:* There will be strict compliance to maintenance schedule recommended by the technology provider.
Any comment:	Pressure and temperature measurements will be executed in case of usage of the volume flow meter.

Data / Parameter:	**ID.21/ $BG_{y,flared}$**
Data unit:	Nm^3/year
Description:	Amount of biogas consumed in the flare in year "y"
Source of data to be used:	Measured continuously by flow meter
Value of data	N/A
Description of measurement methods and procedures to be applied:	Data measured by a continuous flow meter. All data will be archived electronically. The procedures applied will strictly follow the supplier's manual.
QA/QC procedures to be applied:	*QA:* The device will be recalibrated according to the instructions (schedules, procedures) for QA of the technology provider. *QC:* There will be strict compliance to maintenance schedule recommended by the technology provider.
Any comment:	Type of device: open flare Pressure and temperature measurements will be executed in case of usage of the volume flow meter.

Data / Parameter:	**ID.22 / w_{CH4}**
Data unit:	%
Description:	Fraction of methane in biogas in year "y"
Source of data to be used:	Monitoring system
Value of data	N/A
Description of measurement methods and procedures to be applied:	The methane fraction will be performed continuously or at least with a frequency to satisfy statistical 95% confidence level. The results of measurements will be stored manually in electronic database. The procedures applied will strictly follow the supplier's manual.
QA/QC procedures to be applied:	*QA:* The device will be recalibrated according to the instructions (schedules, procedures) for QA of the technology provider. *QC:* There will be strict compliance to maintenance schedule recommended by the technology provider.
Any comment:	-

Data / Parameter:	**ID.23 / T_{flare}**
Data unit:	^oC
Description:	Temperature in the exhaust gas of the flare
Source of data to be used:	Continuously measurement by thermocouple
Value of data	Above the temperature showing that the flare is operational
Description of measurement methods and procedures to be applied:	The temperature is measured continuously to demonstrate that the flare is operational. A high level of accuracy of the measurements will be achieved due to the use of high-precision equipment.
QA/QC procedures to be applied:	Replaced or calibrated in accordance to the supplier's manual.
Any comment:	-

Data / Parameter:	**ID.24 / $EU_{y,sludge}$**
Data unit:	-
Description:	End-use of the final sludge in year "y"
Source of data to be used:	Monitoring system
Value of data	N/A
Description of measurement methods and procedures to be applied:	The sludge will be treated in the system that is shared with adjacent CDM project - Eecopalsa biogas recovery from Palm Oil Mill Effluent (POME) ponds (CDM reference no. 0492). To avoid mixing of sludge and to monitor amount of sludge, the project owner has prepared special management procedures including operation schedules[35] of the existing system, which allow separate treatment of sludge that is generated by two projects.
QA/QC procedures to be applied:	N/A

35 Management procedures regarding sludge treatment are available to the DOE.

Any comment:	-

Data / Parameter:	**ID.25 / EG_y**
Data unit:	GWh/year
Description:	Net electricity generation of the project activity in year “y” delivered to the grid
Source of data to be used:	Measured by an electricity meter
Value of data	Table 9 (ex-ante estimations)
Description of measurement methods and procedures to be applied:	The net electricity production will be measured continuously. A high level of accuracy of the measurements will be achieved due to the use of high-precision equipment calibrated and tested according to recognized standards. Hourly measurement and monthly will take place.
QA/QC procedures to be applied:	*QA:* The device will be recalibrated according to the instructions (schedules, procedures) for QA of the technology provider. *QC:* There will be strict compliance to maintenance schedule recommended by the technology provider.
Any comment:	Measurement results shall be cross-checked with records for sold electricity.

Data / Parameter:	**ID.26 / EC_y**
Data unit:	GWh/year
Description:	Electricity consumption of the project activity in year “y”
Source of data to be used:	Measured by an electricity meter
Value of data	6.3% of total electricity generated by the project (ex-ante assumptions)
Description of measurement methods and procedures to be applied:	The electricity consumption of the project will be measured continuously. A high level of accuracy of the measurements will be achieved due to the use of high-precision equipment.
QA/QC procedures to be applied:	*QA:* The device will be recalibrated according to the instructions (schedules, procedures) for QA of the technology provider. *QC:* There will be strict compliance to maintenance schedule recommended by the technology provider.
Any comment:	

Data / Parameter:	**ID.27 / COD_{inflow}**
Data unit:	Tonnes/m^3
Description:	Chemical Oxygen Demand of waste water entering the lagoon
Source of data to be used:	Results of laboratory analysis
Value of data	
Description of measurement methods and procedures to be applied:	The laboratory analysis is to be performed in compliance with the Technical Quality Standard for Discharge of Wastewater into Receivers, with the standard methodologies and quality procedures for this industry.
QA/QC procedures to be applied:	*QA:* Certified laboratory.
Any comment:	

Data / Parameter:	**ID.27 / $COD_{outflow}$**
Data unit:	Tonnes/m^3
Description:	Chemical Oxygen Demand per m^3 of water leaving the lagoon
Source of data to be used:	Results of laboratory analysis
Value of data	
Description of measurement methods and procedures to be applied:	The laboratory analysis is to be performed in compliance with the Technical Quality Standard for Discharge of Wastewater into Receivers, with the standard methodologies and quality procedures for this industry.
QA/QC procedures to be applied:	*QA:* Certified laboratory.
Any comment:	

Data / Parameter:	**ID.28 / Effluent flow**
Data unit:	Tonnes
Description:	Effluent processed by the project during year ”y”
Source of data to be used:	Flow meter at the entrance of the covered lagoon.
Value of data	
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	*QA:* The device will be recalibrated according to the instructions (schedules, procedures) for QA of the technology provider. *QC:* There will be strict compliance to maintenance schedule recommended by the technology provider.
Any comment:	

Ex-post emission reductions

According to the methodology AMS-III.H “Methane recovery in wastewater treatment” (version 14), paragraph 31, the calculation of emission reductions shall be based on the lowest value of the following:

(i) The amount of biogas recovered and fuelled or flared (MD_y) during the crediting period, that is monitored *ex post*;

(ii) Ex post calculated baseline, project and leakage emissions based on actual monitored data for the project activity.

Regarding electricity generated by the project activity, the methodology AMS-I.D “Grid connected renewable electric generation” (version 15) states that monitoring shall consist of metering the electricity generated by the renewable technology.

The following equations will be applied for the purpose of the total emission reductions calculations:

$$ER_y = ER_{y,power} + ER_{y,MD} \quad \textbf{(18)}$$

Where:

ER_y = Total emission reductions of the project in year *y* (tCO_2/year)
$ER_{y,MD}$ = Emission reductions from methane recovery in wastewater treatment in year *y* (tCO_2/year)
$ER_{y,power}$ = Emission reductions from electricity generation in year *y* (tCO_2/year)

1) Ex-post emission reductions from electricity generation

$$ER_{y,power} = EG_y \cdot EF_{grid,CM} \quad \textbf{(19)}$$

Where:
$ER_{y,power}$ = Emission reductions from electricity generation in year *y* (tCO_2/year)
EG_y = Net electricity generation of the project activity in year “y” (GWh/year)
$EF_{grid,CM}$ = Honduras grid emission factor determined ex-ante (tCO_2/GWh)

2) Ex-post emission reductions from methane recovery

$$ER_{y,MD} = MD_y \cdot GWP\_CH_4 \quad \textbf{(20)}$$

Where:
$ER_{y,MD}$ = Emission reductions from methane recovery in wastewater treatment in year *y* (tCO_2eq/year)
MD_y = Amount of methane destroyed by the project activity (tCH_4/year)
GWP_CH_4 = Global Warming Potential for methane (value 21 is used)

$$MD_y = MD_{y,electricity} + MD_{y,flared} \quad \textbf{(21)}$$

Where:
MD_y = Amount of methane destroyed by the project activity (tCH_4/year)
$MD_{y,electricty}$ = Amount of methane used to electricity generation by the project activity (tCH_4/year)
$MD_{y,flared}$ = Amount of methane flared by the project activity (tCH_4/year)

$$MD_{y,electricity} = BG_{y,fuelled} \cdot w_{CH4} \cdot D_{CH4} \quad \textbf{(22)}$$

Where:
$MD_{y,electricty}$ = Amount of methane used to electricity generation by the project activity (tCH_4/year)
$BG_{y,fuelled}$ = Amount of biogas consumed in gas engine in year “y” (Nm^3 biogas/year)
w_{CH4} = Fraction of methane in biogas in year “y”
D_{CH4} = Density of methane (tCH_4 /m^3 CH_4)

$$MD_{y,flared} = BG_{y,flared} \cdot w_{CH4} \cdot D_{CH4} \cdot \eta_{flare} \quad \textbf{(23)}$$

Where:
$MD_{y,flared}$ = Amount of methane flared by the project activity (tCH_4/year)
$BG_{y,flared}$ = Amount of biogas flared in year “y” (Nm^3 biogas/year)
w_{CH4} = Fraction of methane in biogas in year “y”
D_{CH4} = Density of methane (tCH_4 /m^3 CH_4)
η_{flare} = Efficiency of the flaring process

B.7.2 Description of the monitoring plan:

The monitoring plan of Eecopalsa Biogas Expansion is consistent with methodology AMS-III.H "Methane recovery in wastewater treatment" (version 14) and methodology AMS-I.D "Grid connected renewable electric generation" (version 15). A scheme of the monitoring plan is presented below[36].

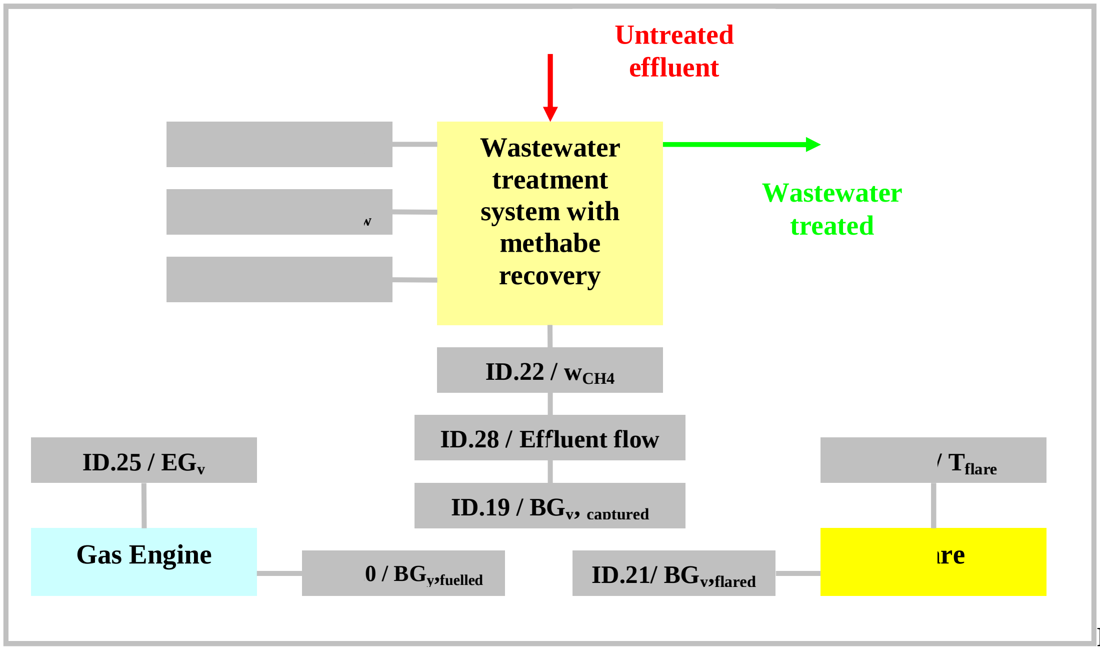

Figure 6. Monitoring plan of Eecopalsa Biogas Expansion

EECOPALSA will apply good practice procedures for monitoring and several operators will be employed for the engines and the lagoons. All of them will undergo the necessary training[37].

The data monitored will be recorded in a data management system called SCADA (Supervisory Control and Data Acquisition System). Parallel to that, the measurements will be recorded manually several times a day to avoid the loss of data in case of technical problems or maintenance needs of SCADA.

Monitoring Management

- The plant manager from the technical supplier will be responsible for the implementation of the monitoring plan during the first year of operation.
- The technical supplier's Operations and CDM Supervisor will be responsible for keeping the recorded data for at least two years after the end of the crediting period.

[36] The Sludge Operations Manual and the technology provider's Monitoring Plan are available to the DOE. Operator's training certificates are available to the DOE.
[37] A certification of employment creation and the contractual conditions for new workers is available to the DOE.

- The technical supplier will be responsible for the calibration of the measuring equipment. As well as that, they train the operators of the project for the correct operation and monitoring of the plant.
- Eecopalsa will be responsible for the preparation of the annual monitoring report and will check that CER calculations are carried out according to the monitoring methodology. The company will submit the annual monitoring report for verification to the Designated Operational Entity (DOE) and make sure that the operators in charge of the monitoring have undergone the relevant training.
- The project owner will be responsible for the verifications possibly hiring external consultants.

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

The final draft of this baseline section has been completed on 05/10/09.

The baseline has been prepared by OneCarbon International BV in consultation with EECOPALSA.

Company name:	OneCarbon International B.V.
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SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

30/05/2008

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

25 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:

01/03/2010

C.2.1.2. Length of the first crediting period:

7 year

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

N/A

C.2.2.2. Length:

N/A

SECTION D. Environmental impacts

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

According to Article 78 of the Honduran General Environmental Law, and the decree 1085 promulgated in 2002, there are 4 different project categories that have different requirements in terms of environmental authorization before starting operations[38]. Waste water lagoons are classified under category II and accordingly they require an environmental license. In order to obtain the environmental license, the project proponent must present a Qualitative Environmental Diagnosis prepared by a service provider registered by the SERNA (Secretaría de Recursos Naturales y Ambiente).

The Qualitative Environmental Diagnosis has been prepared by Agroconsa and submitted to the SERNA, and is available for the DOE.

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

SECTION E. Stakeholders' comments

Environmental impacts are not considered significant by the project participants or the host party, as presented in the Qualitative Environmental Diagnoses.

38 http://www.serna.gob.hn/servicios/licencias_amb/tabla_cat/Paginas/default.aspx (Website accessed on 09/09/2008)

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

The local stakeholder consultation was organized on the 6th of April, 2008. The meeting took place at the facilities of Eecopalsa, located in the rural area of the municipality El Progreso, Yoro Department, Honduras. The stakeholders present at the consultation first made a visit to the project site. After that, the project was presented to them via a non-technical summary of the project (handout) and a Power Point presentation. The Power Point presentation included, among others, the objectives and implications of the project, a description of the technical development of the project, its environmental aspects, social and economic aspects, and the contributions of the project to the local community.

The stakeholders were invited via personal invitations and via two adverts in local newspapers: “La Prensa” (on 18th of March 2008) and “Tiempo” (on 3rd of April 2008).

The list of stakeholders invited is presented below[39]:

- Residents from the local communities of the region
- Local schools
- NGOs:
  - WWF
  - “Fundación MDL de Honduras”
  - “Asociación Hondureña de Desarollo Ecológico” (AHDESA)
- The National Association of Palms Oil producers (FENAPALMAH)
- Representatives of the national and local Government (Secretaria de Recursos Naturales y Ambiente (SERNA), Leadership for Evaluation and Environmental Control (DECA), Unidad Municipal Ambiental, Mayor of El Progreso,
- Representatives of the neighbouring communities
- Other stakeholders

107 persons were present at the stakeholder consultation. The discussion was held in Spanish, the local language. Both, the informational material provided and the Power Point presentation, were also in Spanish. All relevant materials and information about the project were shared with the participants in a transparent manner. During the meeting the participants had the opportunity to present themselves, obtain an in-depth understanding of the project, raise questions and provide their comments on the project.

Each step of the procedure was documented via photos and video. Mr. Francisco Regalado from the NGO “PROMADERA” participated as an independent external supervisor. He confirmed the transparency and correct procedure of the stakeholder consultation in a written statement. All original documents are archived at the Eecopalsa facilities in Honduras.

On 18th of April 2008 the stakeholders were informed by newspaper advert (in local newspaper “El Tiempo”) about the results of the meeting and they were invited to review all documents related to the stakeholder consultation.

E.2. Summary of the comments received:

The comments received during the local stakeholder consultation are summarised in the table below.

39 A list with all the attendants to this meeting is available to the DOE.

Table. 22: Summary of comments received

Comment No.	Participant	Comment
1.	Juan Carlos Lopez, Secretaria de Recursos Naturales y Ambiente (SERNA)	The stakeholder expressed his satisfaction with the positive project's positive environmental impact regarding the mitigation of bad odours, flies and grime.
2.	Evelio Soler, Comunidad Vecina de Guaymitas	The stakeholder asked what exactly would be done with the wastewater treated in the lagoons.
3.	Margarita Escobar, Representative of the neighbouring community of La Colorada	The stakeholder expressed her concern regarding the smoke that the biomass boilers at the Eecopalsa site emit..Furthermore she asked about the presence of flies deriving from the decomposition of the organic biomass used in the boilers.
4.	Unidentified member of a neighbouring community	The stakeholder declared that they did not understand the concept of carbon credits and they requested to know what the amount of revenues are that Eecopalsa would obtain via the carbon credits.
5	Unidentified member of a neighbouring community	The stakeholder commented on the visibility of the project – several stakeholders mentioned that the project is highly visible, mainly from the road going to Tela port.
6	Unidentified member of a neighbouring community	Certain stakeholder cautioned that the project owner need to assure that the Guaymitas River would not be contaminated.
7	Unidentified member of a neighbouring community	The project owner should assure that there are no annoyances of the neighbouring communities during the construction phase or disturbances of the ecological reserve.

The full list of comments received during the stakeholder consultation process is available to the DOE.

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

The project participants addressed the received comments received from the stakeholders. In the table below their answers can be found to the received comments.

Table. 23: Answers on received comments

Com No.	Answer
2.	After the wastewater treatment system, the residual waters infiltrate in the ground contributing to a quicker water absorption by the soil. The system also helps to minimise the negative environmental impacts of the plant, provide humidity and organic nutrients to the soil.
3.	The project participants emphasied that the biomass boiler and the resulting flies are not part of the CDM project activity.
4.	The project participants explained in detail the concept of carbon credits. The amount and the purposes of the carbon income was explained to the stakeholders.
5.	The project participants explained that the CDM project activity is not highly visible from the street. Certain parts of the Eecopalsa facilities are indeed visible from the street; however, these buildings already existed and are not part of the CDM project activity.
6.	The Guaymitas River is not located nearby the project site and therefore the chances of contamination are extremely low. The only possibility of a contamination may occur in case of a serious and unlikely accident or malfunction of the wastewater treatment system.
7.	Due to its size, the project activity will not affect the ecological reserve or places of recreation.

Since the received comments were answered to satisfaction, no action has been undertaken to adapt or change the project design, or apply additional measures.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The project does not obtain public funding.

Annex 3

BASELINE INFORMATION

Table 1. Fuel consumption, energy generation and CO_2 emissions for the calculation of the Simple OM emission factor

plant	technology	comissioning date	yearly generation			yearly fuel consumption (k Liters)				yearly secondary fuel consumption (k Liters)				Calculation	EFom [tCO2/ GWh]
			2006	2007	2008		2006	2007	2008		2006	2007	2008		
TOTAL															**622,5**
electricity import	-	-					-	-	-		-	-	-		
Aguan	Biomass	01/01/02	0	0	0	None	0	0	0	None	0	0	0	B1	
Ampac	Diesel Engine	01/01/93	0	0	0	Diesel	0	0.757082	0	None	0	0	0	B1	
Aysa	Biomass	01/01/98	0	1	0	None	0	0	0	None	0	0	0	B1	
Azunosa	Biomass	01/12/04	10	12	13	None	0	0	0	None	0	0	0	B1	
Babilonia	Hydro	01/05/04	31	30	33	None	0	0	0	None	0	0	0	B1	
Cahsa	Biomass	01/01/05	27	43	39	None	0	0	0	None	0	0	0	B1	
Cañaveral	Hydro	01/01/64	186	165	152	None	0	0	0	None	0	0	0	B1	
Cececapa	Hydro	01/01/05	19	15	16	None	0	0	0	None	0	0	0	B1	
CelsurCOAL***	Coal	01/01/08	0	0	0	Coal	0	0	0	None	0	0	0	B1	
Celsur	Biomass	01/01/07	0	2	78	None	0	0	0	None	0	0	0	B1	
Cemcol**	Diesel Engine	01/01/04	0	0	0	Diesel	0	0	0	None	0	0	0	B1	
Chu	Biomass	01/01/07	0	4	8	None	0	0	0	None	0	0	0	B1	

mbagua															
Cortecito	Hydro	01/01/07	0	2	22	None	0	0	0	None	0	0	0	B1	
Cuyamapa	Hydro	01/01/07	0	50	53	None	0	0	0	None	0	0	0	B1	
Cuyamel	Hydro	01/01/07	0	18	39	None	0	0	0	None	0	0	0	B1	
Eda	Biomass		0	0	0	None	0	0	0	None	0	0	0	B1	
Eecopalsa	Biogas	01/01/06	0	2	3	None	0	0	0	None	0	0	0	B1	
El Cajón	Hydro	01/01/85	1041	1244	1308	None	0	0	0	None	0	0	0	B1	
El Coyolar	Hydro	01/01/00	0	0	0	None	0	0	0	None	0	0	0	B1	
El Níspero	Hydro	01/01/82	93	57	35	None	0	0	0	None	0	0	0	B1	
Elcatex	Diesel Engine	01/06/04	13	6	0	Bunker	0	0	0	None	0	0	0	B2	
Elcosa	Diesel Engine	01/01/94	248	319	199	Bunker	58364.26	71941.95	44744.31	Diesel	8.562601	7.237707	2.903411	B1	
Emce II	Diesel Engine	01/01/99	146	170	211	Bunker	32311.98	38558.45	47540.88	Diesel	1520.543	1292.283	1295.042	B1	
Enersa	Diesel Engine	01/03/04	1379	1376	1507	Bunker	307354.1	309893.6	336961.1	Diesel	692.5676	981.4475	1435.576	B1	
Envasa COAL (maquilas)	Coal	01/01/08	0	0	7	Coal	0	0	0	None	0	0	0	B2	
Green Valley	Diesel Engine	01/01/07	0	31	25	Bunker	0	0	0	None	0	0	0	B2	
La Ceiba *	Diesel Engine	01/01/74	63	51	34	Bunker	16212.58	12992.63	8345.8	Diesel	728.881	774.6088	682.0404	B1	
La Esperanza	Hydro	01/01/03	24	35	45	None	0	0	0	None	0	0	0	B1	
La Gloria	Hydro	01/01/07	0	3	21	None	0	0	0	None	0	0	0	B1	
La Grecia	Biomass	01/01/02	36	30	21	None	0	0	0	None	0	0	0	B1	

La Nieve	Hydro	01/01/02	2	1	1	None	0	0	0	None	0	0	0	B1	
La Puerta	Gas turbine	01/01/70	1	0	2	Diesel	500.7267	67.17213	1082.427	None	0	0	0	B1	
La Puerta - MEX	Gas turbine	01/01/94	0	0	1	Diesel	166.2212	165.3809	312.2927	None	0	0	0	B1	
Laeisz NACO**	Diesel Engine	01/09/04	31	7	0	Diesel	8764.671	1851.975	0	None	0	0	0	B1	
Laeisz**	Diesel Engine	01/01/00	0	0	0	Diesel	0	0	0	None	0	0	0	B1	
Lean ****	Biomass	01/01/02	0	0	0	None	0	0	0	None	0	0	0	B1	
Lufussa I	Gas turbine	01/01/95	8	2	13	Diesel	2527.618	694.3316	4036.706	None	0	0	0	B1	
Lufussa II	Diesel Engine	01/01/99	155	219	271	Bunker	35502.99	49915.24	63147.09	Diesel	73.91395	103.9096	3.607497	B1	
Lufussa III	Diesel Engine	01/08/04	1805	1824	1784	Bunker	374478.4	378443.8	367232.3	Diesel	13113.12	58.4619	78.60408	B1	
Nacaome	Hydro	01/01/02	32	43	42	None	0	0	0	None	0	0	0	B1	
Nacional de Ing.**	Diesel Engine	01/01/94	0	4	12	Diesel	0	0	0	None	0	0	0	B2	
Rio Blanco	Hydro	01/01/04	38	34	35	None	0	0	0	None	0	0	0	B1	
Río Lindo	Hydro	01/01/71	588	522	476	None	0	0	0	None	0	0	0	B1	
San Carlos	Hydro	01/01/07	0	0	16	None	0	0	0	None	0	0	0	B1	
Santa Fe	Diesel Engine	01/01/94	0	0	0	Diesel	7.457261	4.807473	85.79636	None	0	0	0	B1	
Santa María del Real	Hydro	01/01/86	4	3	5	None	0	0	0	None	0	0	0	B1	
Tres Valles	Biomass	01/12/04	27	21	22	None	0	0	0	None	0	0	0	B1	

Yojoa	Hydro	01/01/05	1	2	2	None	0	0	0	None	0	0	0	B1	
Zacapa	Hydro	01/01/06	3	2	3	None	0	0	0	None	0	0	0	B1	

Table 2. The set of power plants in the Honduran electricity system

	Taken from.. to	01/01/2008	01/08/2004	which is total of	19	power plants
	EFbm					540.4
	Total power generation					6.553
	% Selection of total power generation					30.1%
	Plant	**technology**	**comissioning date**	**CDM?**	**E [tCO2]**	**EG [GWh]**
	Sum selection				1,065,039	1971
1	Envasa COAL (maquilas)	Coal	01/01/2008	FALSE	5,686	7
2	CelsurCOAL***	Coal	01/01/2008	FALSE	0	0
3	San Carlos	Hydro	01/01/2007	FALSE	0	16
4	La Gloria	Hydro	01/01/2007	TRUE	0	21
5	Green Valley	Diesel Engine	01/01/2007	FALSE	17,453	25
6	Cuyamel	Hydro	01/01/2007	TRUE	0	39
7	Cuyamapa	Hydro	01/01/2007	TRUE	0	53
8	Cortecito	Hydro	01/01/2007	TRUE	0	22
9	Chumbagua	Biomass	01/01/2007	FALSE	0	8
10	Celsur	Biomass	01/01/2007	FALSE	0	78
11	Zacapa	Hydro	01/01/2006	TRUE	0	3
12	Eecopalsa	Biogas	01/01/2006	TRUE	0	3
13	Yojoa	Hydro	01/01/2005	TRUE	0	2
14	Cececapa	Hydro	01/01/2005	TRUE	0	16
15	Cahsa	Biomass	01/01/2005	FALSE	0	39
16	Tres Valles	Biomass	01/12/2004	TRUE	0	22
17	Azunosa	Biomass	01/12/2004	FALSE	0	13
18	Laeisz NACO**	Diesel Engine	01/09/2004	FALSE	0	0
19	Lufussa III	Diesel Engine	01/08/2004	FALSE	1,041,900	1,784

Honduras does not have significant exports or imports of energy and therefore the calculations are valid.

Table 3. Combined Margin

	EF	Weight
OM	**622.8**	**0.5**
BM	**540.4**	**0.5**
CM	**581.6**	

Annex 4

MONITORING INFORMATION

No additional information.