PROJECT DESIGN DOCUMENT FORM
FOR SMALL-SCALE CDM PROJECT ACTIVITIES (F-CDM-SSC-PDD)
Version 04.1

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	Switching of fuel from coal to palm oil mill biomass waste residues at Industrial de Oleaginosas Americanas S.A. (INOLASA)
Version number of the PDD	Version 03
Completion date of the PDD	29/11/2013
Project participant(s)	1. Industrial de Oleaginosas Americanas S.A. (INOLASA) 2. Vattenfall Energy Trading Netherlands N.V.
Host Party(ies)	Costa Rica
Sectoral scope(s) and selected methodology(ies)	Sectoral scope: 1: Energy industries (renewable - / non-renewable sources Applied methodology: "*Thermal energy for the user with or without electricity*", AMS-I.C, version 10, May 18th, 2007
Estimated amount of annual average GHG emission reductions	38,212 tCO_2

SECTION A. Description of project activity
A.1. Purpose and general description of project activity

The proposed CDM project activity comprises the installation of a biomass fuelled boiler to supply steam for internal production processes, displacing a coal-fired boiler. Coal will be replaced by palm kernel shells (PK shells), empty fruit bunches (EFB) and other type of renewable biomass available in the area, saving coal consumption and consequently reducing carbon emissions. The project is estimated to reduce a total of **267,487 tCO_2** during the crediting period.

The proposed project activity will be developed at INOLASA (Industrial de Oleaginosas Americanas S.A). INOLASA is a company established in 1986 in Costa Rica, with the objective of supplying the country and the region of Central America with high quality soybean products. The company is located in the province of Puntarenas, the district of Barranca.

The current operation at INOLASA involves the use of bunker to generate heat. Due to the increase in bunker prices, the company evaluated the switch to alternative fuels, such as renewable biomass and coal. It was found that without CDM income coal is the most feasible option, while with CDM biomass is the most feasible option. Coal fuel was believed to represent the baseline situation. Not only economic reasons explain this decision, but also logistical and organisational risks can be found, as for example biomass supply from distant palm oil mills.

Table A.1

Current situation	**Baseline situation**	**Project activity**
Bunker-fuelled boilers	Coal-fuelled boilers	Biomass-fuelled boiler

Biomass fuel will be mainly purchased from three nearby palm oil mills, called Palo Seco, Naranjo and Coto. The first two mills are located in Quepos and the last one in Golfito, in the province of Puntarenas. Furthermore it will be also purchased from another palm oil mill called Rio Escondido, located in Nicaragua. The palm oil mills belong to “Grupo NUMAR”, a group of several companies active in the plantation, extraction, processing and production of vegetable oil. Thanks to efficiency measures being taken in the three NUMAR’s boilers, a greater availability of renewable resources will be generated. In addition, bagasse and wood chips will be used.

The present CDM project activity involves incineration of a wide range of renewable biomass fuels, including palm oil mill residues, bagasse and wood wastes that are nowadays abandoned or disposed with no management at all. Such is the case of PKS, which is seen nowadays as a residue not considered for the heat generation systems of the NUMAR’s mills. INOLASA is relying on CDM in order to make the proposed project viable.

Regarding the biomass from the palm oil plants, it will be transported using trucks with a capacity of 25-28 tons each, making approximately 3 trips per day. Daily trips will be also done to obtain the bagasse and several trips per week to obtain wood chips. During the maintenance period of the biomass boiler, bunker will be combusted for two weeks in the current boilers in order to supply the required energy

Environmental aspects:
The project contributes to sustainable development in Barranca, Punteras as it uses renewable resources in an innovative technology. PK shells, EFB as well as other type of renewable biomass bring advantages for mitigating global warming. Local benefits include:

- Environmental contamination. The project prevents the PK shells from being burned in the field, avoiding local air contaminants.

- Biomass that would otherwise be left for decay is being used for steam generation, preventing contamination of the soil.
- Local air pollution. Sulphuroxide (SOx) emissions will decrease, since biomass contains lower sulphur content than coal.

<u>Socio-economic aspects:</u>
The project also aims to improve quality of life for local habitants:

- A local school will directly benefit from the proposed project activity. The biomass revenues of Coto (Grupo Numar) will be directed to this school.
- Employment opportunities will increase, especially during the construction and installation of the system, but also over the longer term during maintenance and operation activities of the more advanced biomass-fired boiler and related systems.
- A sustainable competitive advantage for the palm oil industry is created by using waste of the production processes in a more efficient way.

Figure 1: Location of INOLASA and Numar´s Industries

A.2. Location of project activity
A.2.1. Host Party(ies)

Costa Rica

A.2.2. Region/State/Province etc.

Province of Puntarenas

A.2.3. City/Town/Community etc.

District of Barranca

A.2.4. Physical/ Geographical location

The project activity is located in Puntarenas, the largest province of Costa Rica. Puntarenas is an area of 11,276 km^2 and has a population of 350,000 habitants. The central part of Puntarenas has a population of 100,000 habitants and is situated 130 km from San José, the capital of Costa Rica. The project activity is situated in district eight, Barranca, in the central part of Puntarenas.

Precise coordinates for the project are 454.5-459 North; 217.5-217.9 East. Latitude of Barranca is N 09, 59', 23.5'', and longitude is W 084, 42', 36.9''. Its altitude is sea level. It has an approximate population of 38, 199 habitants.

Figure 6: Location map of INOLASA

A.3. Technologies and/or measures

Currently, steam is produced with two bunker-fuelled boilers. Each has a capacity to produce 20 tons of steam/hour with a pressure of 12 bar. Two coal-fired boilers would have been installed as part of the baseline. These boilers both have the capacity of 40 kBtu/h, 10.4 barg.

The proposed CDM project activity intends to replace the actual boilers by a new biomass boiler. This new boiler will have a capacity to produce 35 tons of steam/hour with a design pressure of 35 bars. However, during the first years it will only produce 20 tons of steam/hour with a pressure of 12 bars. INOLASA will install, operate and maintain this new boiler that is imported from

Malaysia. The boiler will combust biomass in a mixture of approximately 51% palm kernel shells, 28% empty fruit branches, 17% bagasse and 4% wood chips, depending on availability.

The combustion of biomass will result in a low amount of ash production, corresponding to 3 - 4% of the feeding mass. These ashes will be used as an aggregate for cement and concrete mixtures.

Key information and data to determine the baseline scenario and the project scenario:

Table A.3

Characteristics	**Baseline Scenario**	**Project Scenario**
Operating Boilers	Two coal fired boilers, 40 kBtu/h, 10.4 barg.	One biomass fired boiler, 35 T/h, 35 Barg.
Fuel Input	Coal (Bituminous)	Biomass (mainly PK shells and EFB; also bagasse and wood chips)

The next table shows the new boiler's design and technical specifications:

Table A.4

Technical Design Specification of Biomass Boiler	
Boiler Type	Fraser II Bi-Drum Watertube Boiler, Membrane wall design
Boiler Capacity	35,000 Kg/Hr
Boiler Model	FR 16/49
Boiler working pressure	12.0 bar resp. 31.0 bar
Design pressure	35.0 bar
Steam Temperature	192°C (Saturated) resp. 275°C (40° Superheated)
Feed water temperature	120°C +/- 5% (Economizer Water outlet temperature)
Air temperature at F.D Fan	220°C to 240°C (pre-heater air outlet temperature)
Actual steam evaporation	35,000 Kg/Hr.
Draught system	Balance Draught
Burning method	Reciprocating Step Grate; water cooled; hydraulically operated; grate material with high allow content.
Fuel to be used:	51% palm kernel shells, 28% empty fruit branches, 17% bagasse and 4% wood chips, depending on availability
Dust Emissions	<=100 mg/ nm^3
Overall efficiency on Gross Calorific Value of Fuel	80%

From its storage site, the biomass is transported by an elevator into a conveyor that is used to conduct the biomass unto the boiler's feed system.

The PK shells transportation equipment type is a 'Grate Cooled Hydraulic Operated Reciprocating Step'. A reciprocating grate is a continuous ash discharge grate used for firing the biomass fuel. The reciprocating grate consists of cast iron bars mounted on shafts. Alternate shafts are connected together and oscillated by hydraulic driven mechanism. There are fixed shafts at the sides of each oscillating shaft. The bars have slots to allow for combustion air at the bottom of the grate.

The fuel is fed into the boiler by gravity at the front end of the grate. Due to the reciprocating action of the grate, the fuel moves towards the ash discharge end. The speed of the grate is set in such a way that the fuel is fully incinerated when it reaches the discharge end. This results in a continuous ash discharge.

The boiler's specifications comply with all the emission regulations of the country[1]. There are bag filters in the boiler's chimney in order to keep dust emissions below 100 milligrams/nm^3. Compared to the baseline, no additional water consumption will take place during the project activity.

As a result of the palm oil milling process, some types of waste are generated. There are three types of biomass waste streams derived from the palm industry:

- Mesocarp fibres (MF)
- Palm kernel shells (PKS)
- Empty Fruit Bunches (EFB)

The palm oil mills involved are Palo Seco, Naranjo,Coto and Río Escondido. Two of these, Palo Seco and Naranjo, currently use MF and PKS as input for their boilers to generate heat. These mills will adjust their boilers so that the more humid EFB can be available and also be combusted. This will result in an abundance of PKS, which will be used at INOLASA's proposed CDM project activity. Coto has already adjusted its boiler; the abundance of PKS is currently left in the open air for decay. This is in line with Costa Rican laws concerning biomass waste treatment.

During the proposed project activity Coto's PKS will also be used at INOLASA production facility to generate heat. Coto is located in a free trade zone and therefore is not allowed to commercialize its biomass without previous permission by the competent authorities. In order to avoid bureaucratic delays Palma Tica decided to donate the PKS to a local school. The school in their turn will sell the PKS to INOLASA for a price of 1,00 US$ per ton and will be the recipient of these revenues. Although this construction seems to be very complicated, it is much easier than overcoming the bureaucratic hurdles for commercialization of the biomass. At the same time this construction allows INOLASA and Palma Tica to reinforce their social commitment in the region.

All three palm oil mills are currently using EFB as fertilizer. The EFB is left in open air to decay before it can function as fertilizer, resulting in the emission of methane to the atmosphere. In order to be conservative, methane emissions prevented by using the EFB for heat generation purposes instead, will not be taken along in CDM baseline emission calculations.

In order to cope with biomass availability issues preventing the project from achieving its foreseen capacity, as well as to keep fuel oil use (bunker) to a minimum, the project proponent has sought additional sources of biomass. Two new types of biomass residues were identified as being able to satisfy humidity requirements in order to be used in the plant´s boilers: cane bagasse (obtained from two nearby sugar cane mills) and wood chips from nearby sawmills. Sawmills provide, free of charge, wood waste accumulated from their Teak and Melina processing lines to the three suppliers that furnish the wood chips used by Inolasa.

INOLASA has a storage capacity of 15 days, corresponding to 1,500 tons of PK shells. It will be stored in a new warehouse with a capacity of 3,000 m^3, located next to the boiler.

[1] "Reglamento sobre emisiones de contaminantes atmosféricos provenientes de Caldera. # 30222 – S – MINAE" and "Reglamento de Calderas # 26789 – MTSS".

Figure 3: Picture of the EFB storage

Figure 4: Palm fruit

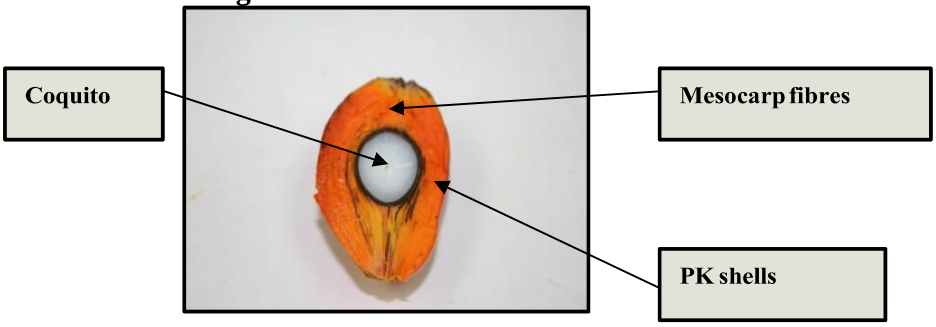
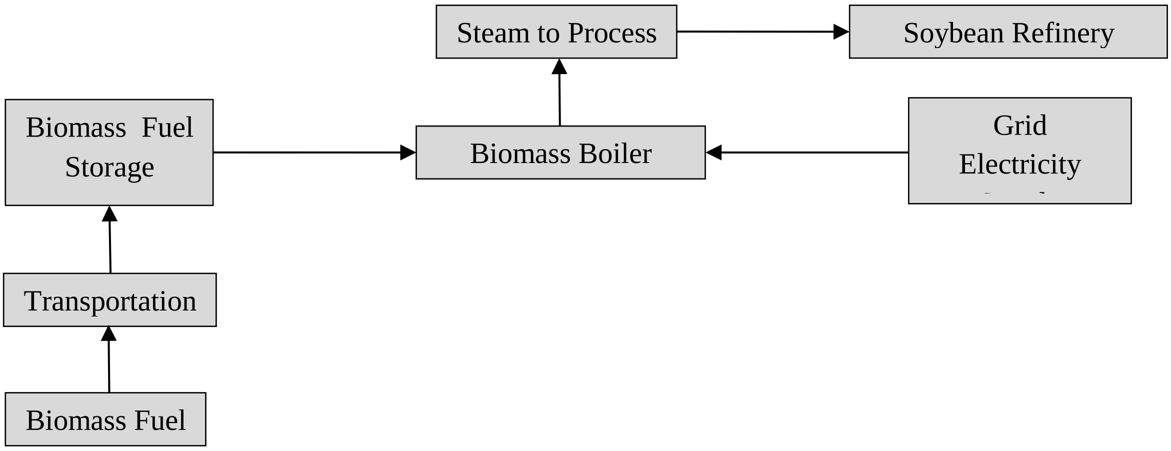


Figure 5: Diagram of the process (project activity)



A.4. Parties and project participants

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Costa Rica (host)	Private entity: Industrial de Oleaginosas Americanas S.A (INOLASA)	No
Netherlands	Private entity: Vattenfall Energy Trading Netherlands N.V.	No

A.5. Public funding of project activity

This project obtains no public support, including ODA funding.

A.6. Debundling for project activity

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

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

On the basis of the above, the project cannot be considered a debundled component of a large project as this project activity represents the first and only biomass fuelled boiler for INOLASA.

SECTION B. Application of selected approved baseline and monitoring methodology

B.1. Reference of methodology

Type I – Renewable Energy Projects

Title of baseline methodology: "*Thermal energy for the user with or without electricity*", Type I.C in Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM project activities.
Version 10_ Scope 1_ May 2007.

B.2. Project activity eligibility

This category comprises renewable energy technologies that supply individual households or users with thermal energy that displaces fossil fuels.

The simplified methodology type I.C covers co-fired systems where the energy output is not exceeding 45 $MW_{thermal}$. This project is an example of this category because it includes a technology (biomass boiler) that provides thermal energy that displaces the use of fossil fuel. The boiler rating is 35 ton of steam/hr at 35 bar. This corresponds to an energy capacity of about 27 $MW_{thermal}$ and is lower than the prescribed threshold. Therefore the simplified baseline and monitoring methodology of type I.C can be applied.

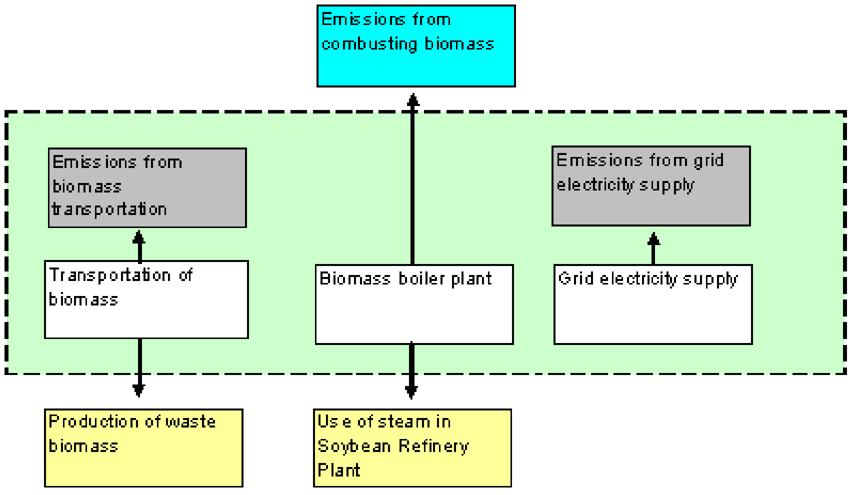
B.3. Project boundary

Referring to the Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM project activities, project boundary is the physical, geographical site of the renewable energy generation. A brief description of all sources of baseline and project emissions is given in below.

Project activity
The GHG emissions related to steam production by combusting biomass are zero, as the fuel source can be considered 'carbon neutral'. Emissions from biomass transportation and grid electricity supply for operating the biomass boiler are calculated as part of this scenario. Emissions for ash transportation are to be neglected, since these are below >1% of the total emissions.

The following diagram represents the project boundary. The parts coloured turquoise are part of the boundary as these relate to GHG emissions due to the project activity.

Figure 7: Project boundary



B.4. Establishment and description of baseline scenario

National policies and circumstances
Currently no legislation is in place in Costa Rica governing the use of PK shells and EFB as a fuel in the Costa Rican oil industry. Also, there are no direct programs or regulations limiting the future use of fossil fuels.

Baseline
The GHG emissions related to the generation of heat by means of coal combustion are part of the project boundary. These emissions are solely related to the combustion of coal; any emissions related to transport and indirect processes are not included in order to be conservative. Emissions related to electricity consumption of the coal boiler are included.

Note that the current operation at INOLASA involves the use of bunker to generate heat. As is indicated in baseline methodology: "*Thermal energy for the user with or without electricity"*, Type I.C in Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM project activities, "*…the simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity…"*. As indicated in section A.2, the current operation is the use of bunker, but coal would have been used in absence of the project activity. As shown in section B.3. by use of the "Tool for the demonstration and assessment of additionality (version 2)", a) NPV comparison between bunker-fuelled boilers and coal-fired boilers and b) barrier analysis of a biomass-fuelled boiler versus a coal-fuelled boiler indicates that coal combustion should be considered as the baseline situation.

Just as it is established in AMS.I-C ver. 10, the simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity times an emission coefficient for the fossil fuel displaced.

Going on with bunker is highly cost intensive due to increasing world market prices. This fuel alternative is economically very unattractive, as the financial indicators state in the PDD. For this reason, it has been decided to switch the fuel source for steam generation. Two alternatives have been raised, considering coal and biomass fuel. Both scenarios have been studied internally and quotations for both systems have been gathered, being the coal boiler always the less risky and financially more attractive option until the last minute inclusion of CDM revenues shifted the balance in favour of biomass. The main indicators are also showed in the PDD. All the supporting information for this analysis has been given during the validation phase.

Additional supporting information submitted to the validator includes:

- Financial analysis for each alternative scenario
- Quotation for a coal boiler
- Quotation and investment details for a biomass boiler
- Description of technological innovations of the biomass firing system in question

B.5. Demonstration of additionality

Current operation at INOLASA involves the use of bunker to generate heat. During recent years, the use of bunker for heat generation purposes was becoming more and more cost intensive due to increasing world market prices. Therefore, the company assessed alternative fuels. The use of coal proved to be more cost-efficient than bunker.. Consequently, the company decided to proceed with the switch from bunker to coal.

During the investigation phase of the coal boiler type, INOLASA discovered that efficiency improvements at the nearby Palm Oil Mill plantation of Coto had led to a surplus of biomass, in the form of palm kernel shells. INOLASA assessed the possible use of palm kernel shells instead of coal.

INOLASA decided not to proceed with this option as it was not considered viable due to several reasons:

- First of all, it was seen as a very complicated alternative, having to deal with risks concerning security of biomass supply,
- A new and yet unknown and unproven technology in the sector, and other logistical and organisational risks.
- Uncertainty regarding timely supply of quantities that fulfill the needs, due to dependency on different sources
- Risk of interrupting the production process at Inolasa. This in contrary to the supply of Columbian coal in the baseline scenario, an option that would not have involved supply risks at all.
- Risk that technological capacity building is insufficient for employers at Inolasa to execute the more complicated processes when operating the new biomass boiler

Besides all the reasons stated above, the use of biomass presented a financially less attractive option. However, the financial advantages of developing it as a CDM project are expected to outweigh the identified risks and this option was chosen. Summarizing, in the baseline situation coal would have been selected as fuel, while CDM allows for switching to biomass.

Determination of additionality

In line with attachment A to appendix B of the simplified M&P for small-scale CDM project activities, the project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

(a) Investment barrier: a financially more viable alternative to the project activity would have led to higher emissions;

(b) Technological barrier: a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions,

(c) Barrier due to prevailing practice: prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions;

(d) Other barriers: without the projects activity, for another specific reason identified by the project participant, such as institutional barriers or limited information, managerial resources, organizational capacity, financial resources, or capacity to absorb new technologies, emissions would have been higher.

In below it is explained that the proposed project activity would not have been implemented without CDM due to technological barriers, a barrier due to prevailing practice and other barriers. The financial analysis indicates a small advantage of implementing the coal-fuelled boiler compared

to implementing the biomass-fuelled boiler without taking into account CDM revenues. The difference is too small for INOLASA to have decided solely based on this financial analysis. In other words, the other barriers are decisive.

(a) **Investment barrier**

In order to show that the project activity is additional to the baseline situation, first of all an investment comparison is made in accordance with the "Tool for the demonstration and assessment of additionality (version 2)"[2]. The financial indicators NPV and the IRR are used to compare the alternatives to the project activity.

There are three realistic and credible alternatives that are available to the project participants in terms of the generation of heat for auxiliary use:

1) Continue with the current operation of using bunker as fuel for heat generation
2) Implement coal-fired boilers for heat generation
3) Develop the project activity without CDM revenue

The three alternatives are in compliance with applicable laws and regulations in Costa Rica. These laws are:

- "Reglamento sobre emisiones de contaminantes atmosféricos provenientes de Caldera. # 30222 – S – MINAE" (norms for the emissions from boilers)
- "Ley Organica del Ambiente" (General environmental law)

The three alternatives are compared on the basis of the Net Present Value (NPV) and the Internal Rate of Return (IRR). The NPV is used since the continuation of the current operation (alternative #1) does not require any additional investment. The IRR is used only to compare alternative #2 and #3 (as these do require investment). Although the project activity covers a seven year crediting period (only seven years of carbon revenues), the NPV and IRR analysis are based on a period of 10 years. This period is typical for INOLASA's investment decisions making process.

Table B.1: Comparative financial indicators heat generation

Option	Description	Investment	IRR (10 years)	NPV (10 years) in US $
1	Continue with the current operation of using bunker	$0	n/a	-$ 40,344,000
2	Implement coal-fired boilers for heat generation	$3,346,000	62%	$ 7,317,000
3	Develop the project activity without CDM revenue	$3,031,000	61%	$ 6,632,000

Option 1, continuing with INOLASA's current facility will not require any additional investments. This option leads to a low NPV compared to the alternatives. Therefore, this option has been rejected by INOLASA. Implementing coal-fired boilers requires the highest investment, compared to the alternatives. This option has a small advantage compared to implementing the biomass-fuelled boiler

[2] as proposed in the Executive Board's 16th meeting.

without taking into account CDM revenues. This difference is too small to base decisions on solely though.

As part of the 'Tool for the demonstration and assessment of additionality (version 2)' a sensitivity analysis is performed as well.

Table B.2: Sensitivity analysis

Option	**Description**	Sensitivity in O&M	IRR (10 years)
2	Implement coal-fired boilers for heat generation	+5%	62%
3	Develop the project activity without CDM revenue	-5%	61%
Option	**Description**	Sensitivity in fuel cost	IRR (10 years)
4	Implement coal-fired boilers for heat generation	+5% (in cost of coal)	61%
5	Develop the project activity without CDM revenue	-5% (in cost of biomass)	61%

A 5 % increase of operation and maintenance costs of the coal boiler would lead to an IRR of 62%.
A 5 % decrease of operation and maintenance costs of the biomass boiler would lead to an IRR of 61%.

Thus, in case the O&M costs for both alternatives would turn out to be 5% different than expected, in any case the coal-fired boiler would yield a higher IRR.

Barriers b, c and d

b) Technological barrier

- Employers at INOLASA currently operate the bunker fuelled boiler. Implementing the baseline technology (coal boiler) would not have resulted in major changes concerning complexity in boiler operation. Procedures involved to feed the boiler with coal are not very different from those relating to the bunker boiler. Feeding biomass into the biomass boiler involves more complicated technology, using for example an advanced biomass transportation type of equipment. More on this can be found in section A.4, technical description of the project activity.
- The palm oil mill 'Coto' has already adjusted its boiler in order to combust the more humid empty fruit bunches. 'Palo Seco' and 'Naranjo' still have to adjust their boilers in order to realise the required amount of palm kernel shells that will be used at INOLASA. The uncertainty concerning timely and adequate implementation of the new technology at these two palm oil mills poses a risk to INOLASA's production process.

c) Barrier due to prevailing practice

- This project is to be considered first of its kind. No other industries use biomass waste streams from another industrial sector. INOLASA is the first plant in Costa Rica using waste streams from several other facilities for own heat generation purposes.
- Contrary to the food processing industry INOLASA makes up part of, using biomass to generate heat is widely spread in the palm oil business in Costa Rica. Common practice in

Costa Rican food processors is steam generation by the use of bunker boilers. Although there are some existing examples present in the food processing industry using biomass for heat generation, this is not a common option in the sector.

d) Other barriers

- Logistical barrier: INOLASA is dependent of three remote palm oil mills supplying the biomass. Trucks are transporting the biomass each day, at a minimum distance of 133 kilometres between INOLASA and the three palm oil mills. This results in uncertainty regarding timely supply of biomass.
- Barrier regarding security of supply: By implementing the proposed project activity, INOLASA becomes dependent of biomass residue production at the three palm oil mills. If by some unforeseen reason the quantity of biomass residues does not satisfy the requirements at INOLASA, its production process might be disrupted. This is in contrary to the supply of coal in the baseline scenario, a relatively secure option that would hardly have involved supply risks at all.

Impact of CDM registration

CDM revenue contributes to the project to a great extent. Without it, the project will not be implemented. If carbon credits are secured, assuming an average CER price of $US 12 per tCO_2 up to 2012, and a post- 2012 price of $US 5, the following investment evaluation is realised.

Table B.3: Financial analysis of project

Description	Investment (incl CDM dev costs)	NPV (10 years)	IRR (10 years)
Develop project activity as CDM project	$3,081,000	$7,649,000	68%

With CDM revenues, an IRR of 68% is expected. This is 6% higher than the baseline IRR. Therefore, the CDM revenues mean that INOLASA will choose the biomass-fuelled boiler over the coal-fired boiler.

Concluding

In absence of the project activity the most likely scenario would be that INOLASA would continue to implement coal-fired boilers. This baseline scenario would not contribute to the sustainable development as the new project will do, in that it uses renewable resources in an innovative technology that contributes to environmental, social, cultural and economical sustainable development.

B.6. Emission reductions
B.6.1. Explanation of methodological choices

The emission reductions are realized by avoidance of emissions from the combustion of coal for the generation of steam for the internal production processes.

The energy output of the new biomass boiler has an energy output of 27 $MW_{thermal}$. Since this is below the threshold of 45MW thermal specified in methodology type I.C "*Thermal energy for the user with or without electricity*", the project is eligible for the use of this monitoring methodology.

Monitoring methodology I.C prescribes that monitoring shall consist of metering the energy produced by a sample of systems where the simplified baseline is based on the energy produced multiplied by an emission coefficient. In the project activity the amount of energy produced is measured with a steam flow meter.

The project activity emissions consist of the emissions from transportation of the biomass and emissions from the electricity consumed by the project. The emissions from transportation of the biomass are determined by multiplying the amount of trucks from each palm oil mill with an emission coefficient.
The emissions from electricity usage are determined by multiplying the amount of electricity consumed by the emission factor for the Costa Rican grid, obtained from registered CDM projects.

Formula relevant for project activity emissions:

$$PE_{trans,y} = \sum trucks_{i,y} \cdot TransCOEF_i$$

$$TransCOEF_i = km_i \cdot VF_{cons} \cdot CV_{diesel} \cdot D_{diesel} \cdot EF_{diesel}$$

$$PE_{boiler,y} = EU_y \cdot EF_{grid}$$

Formula relevant for the baseline:

$$BE_{heat,y} = \frac{Q_y}{\eta_{th} NCV_i} COEF_i$$

$$Q_y = h_{ssi} F_{ssi} / 10^{-9}$$

$$BE_{boiler,y} = EU_y EF_{grid}$$

No specific formulae are provided in the appendix. Paragraph 6 of this appendix states that "*For renewable energy technologies that displace technologies using fossil fuels, the simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity times an emission coefficient for the fossil fuel displaced*".

In the baseline of the proposed project activity is the use of coal-fired boilers to meet the steam demand of INOLASA's plant.

The emissions related to biomass steam production are zero, as the fuel source is a renewable source of waste biomass.

Emissions arising from the construction of the project have been excluded from the project boundary. It is assumed that similar activities and related emissions – for example, installation of new boilers as older boilers are retired – would also occur in the baseline situation. It is also extremely difficult to accurately estimate the emissions arising from construction, especially transportation of materials.

Emissions related to bunker use during the maintenance period has been excluded as well. The same maintenance period would have been required in the baseline situation as well.

Emissions from biomass transportation and emissions from electricity consumption by the biomass boiler are further described in the section below.

Emissions from transportation of biomass
The project results in transport emissions from transportation of the biomass from the palm oil mills to INOLASA, for this transport diesel fuelled trucks are used. The origin of each truck supplying biomass to INOLASA is recorded. For each truck load of biomass the GHG emissions are obtained by multiplying with an origin bound emission coefficient.

The emission coefficients for each Palm Oil Mill is determined by use of parameters set forth in Approved Methodology AM0025 / Version 03, paragraph “Emissions from transportation”. IPCC default values for fuel consumption and emission factors may be used. The CO2 emissions from a biomass load are calculated from the quantity and the specific CO2-emission factor of the fuel used by the trucks.

$$PE_{trans,y} = \sum trucks_{i,y} \cdot TransCOEF_i$$

Where:

$PE_{trans,y}$ = project emissions resulting from transportation of the biomass in year ‘y’
$trucks_{i,y}$ = number of trucks supplying the biomass originating from palm oil mill i in year ‘y’
$TransCOEF_i$ = Coefficient for the CO_2 emissions from 1 truck load of biomass originating from palm oil mill i

$$TransCOEF_i = km_i \cdot VF_{cons} \cdot CV_{diesel} \cdot D_{diesel} \cdot EF_{diesel}$$

Where:

Km_i = distance from palm oil mill i to the biomass boiler (km)
VF_{cons} = vehicle fuel consumption in litres per kilometre (l/km) CVdiesel = Calorific calue of the fuel (MJ/kg)
Ddiesel = diesel density (kg/l)
EFdiesel = emission factor diesel (tCO_2/MJ)

For the transportation of biomass trucks with a load capacity of 28 ton are used. To be conservative $TransCOEF_i$ is determined based on a full truck load. The trucks use 0.6 litre of diesel per kilometer[3], the calorific value of the fuel is 45.91 MJ/kg[4], the fuel density of diesel in Costa Rica is 0.85 kg/l[5] and the emission factor of the fuel is 20.2 tC/TJ[6].

Emissions from grid electricity consumption
The project emissions resulting from electricity consumption by the boiler are determined by:

$$PE_{boiler,y} = EU_y \cdot EF_{grid}$$

Where:

[3] Source: Truck supplier
[4] Source: Refinadora Costarricense de Petróleo, RECOPE
[5] Source: Refinadora Costarricense de Petróleo, RECOPE
[6] Source: 2006 IPCC Guidelines for National GHG inventories Table 1.3 p1.21

$PE_{boiler,,y}$ = Project emissions resulting from electricity usage in year 'y' EU_y = Electricity Usage in year 'y'
EFgrid = Emission factor of the Costa Rican grid.

The calculation of the grid's emission factor is presented in Annex 3. The resultant value for the grid emission factor is equal to 62.86 ton CO_2eq/GWh. This low value represents the Costa Rican grid, mainly composed by hydro power generation. There are no proved fossil fuel storages in the country; still some new capacity has been added to the grid based on imported fossil fuels.

The biomass fuelled boiler of 471 KW of installed capacity is expected to operate 5796 hrs per year, including a two weeks maintenance period. This results in a total electricity consumption of 2.72 GWh per year.

Specifications and breakdown of electricity consumption can be found in annex 3.

Finally the following statement can be defined to estimate project emissions:
Average annual Project activity emissions (t CO_2/year during 7 year period) = Emissions from biomass transportation + Emissions from the consumption of grid electricity

Baseline:

Emissions due to coal combustion

The amount of fossil fuel that would have been consumed in the absence of the project is calculated using guidance from ACM006, paragraph "Emission reductions…due to the displacement of heat"

The baseline for the GHG emissions from fossil fuel combustion in the boilers is determined by dividing the amount of generated heat during the project activity by the net calorific value of the fuel and the efficiency of the boiler. This is multiplied with a CO_2 emission factor for the displaced fossil fuel.

According to:

$$BE_{heat,y} = \frac{Q_y}{\eta_{th} NCV_i} COEF_i$$

where:

$BE_{heat,y}$ = baseline emissions for fossil fuels during the year y in tons of CO_2eq.
Q_y = the quantity of heat generated in the project plant using renewable resources only, that displaces heat generation in the fossil fuel fired boiler during the year y in TJ. This is the same variable mentioned in AMS.I-C ver. 10 as HG_y.
η_{th} = the energy efficiency of the boiler. The energy efficiency of the boiler that would be used in absence of the project activity is based upon the manufacturer's information. NCV_i is the net calorific value of the fossil fuel type i per TJ/kt.
$COEF_i$ = CO_2 emission factor of the fossil fuel type i fired in the boiler in the absence of the project activity in tCO_2/kt

The total quantity of heat generated in the project plant (Qt_y), is to be based on the following equation:

$$Q_y = h_{ssi} F_{ssi} 10^{-9}$$

where

Q_y = total quantity of heat generated in the project plant using renewable and fossil fuel resources, during year y, in TJ.
hss_i = enthalpy of the saturated steam at 12 bar (2782.73 Kj/kg set as a default value).
Fss_i = steam flow monitored, during year y (kg/year)

In order to quantify ex-ante emission reductions, the total quantity of heat generated in the project plant (Q_y) has been determined by forecasting the heat demand of the production process. This quantity is expected to increase by 5.9 % per year, based on the trend in energy consumption over the last three and a half years. Please find Annex 5 with the data. The maintenance period of the coal boiler in the baseline scenario has been taken into account.

IPCC default values are used to determine the CO_2 emission factor of the fossil fuel in the boiler in absence of the project activity.

Emissions caused by grid electricity consumption (coal boiler)
The project emissions resulting from electricity consumption by the boiler are determined by:

$$BE_{boiler,y} = EU_y \cdot EF_{grid}$$

Where:

$BE_{boiler,,y}$ = Baseline emissions resulting from electricity usage in year 'y'
EU_y = Electricity Usage in year 'y'
EFgrid = Emission factor of the Costa Rican grid.

The coal boiler has an installed capacity of 185 KW and is expected to operate 5796 hrs per year, including a two weeks maintenance period. This results in a total electricity consumption of 1.07 GWh per year. As it is stated above, an emission factor of 62.86 tCO_2/GWh is used for the Costa Rican grid.

Specifications and breakdown of electricity consumption can be found in Annex 3.

Leakage:
According to Appendix B, I.C., paragraph 17, leakage is to be considered if the energy generating equipment is transferred from another activity or if the existing equipment is transferred to another activity. Since this is not the case, the proposed project activity does not quantify leakage effects.

B.6.2. Data and parameters fixed ex ante

Data / Parameter	**Km_i**
Unit	km
Description	distance from palm oil mill i to the biomass boiler
Source of data	This information is provided by the contracted transport company.
Value(s) applied	Km - distance Coto 47 to Barranca: 340 Km - distance Quepos: 133 Km – distance Rio Escondido to Barranca: 840 Km – distance Puntarenas to Barranca: 22 Km – distance Alajuela to Barranca: 250 Km – distance Orotina to Barranca: 44 Km – distance Guanacaste to Barranca:320
Choice of data or Measurement methods and procedures	Distance was determined by the readings of the mileage counter of a representative truck. It was crosschecked by measuring the distance on a 1:50,000 map.
Purpose of data	Used to calculate project emissions
Additional comment	

Data / Parameter	**VF_{cons}**
Unit	l/km
Description	vehicle fuel consumption in liters per kilometer
Source of data	This information is provided by the contracted transport company.
Value(s) applied	0.6
Choice of data or Measurement methods and procedures	It relies on specific truck data based on the contracted transport company’s fleet of trucks.
Purpose of data	Used to calculate project emissions
Additional comment	

Data / Parameter	**CVdiesel**
Unit	MJ/kg
Description	Calorific value of the fuel
Source of data	Diesel reference value for Costa Rica.
Value(s) applied	45.91
Choice of data or Measurement methods and procedures	This reference is considered as a fixed value, and based on the fuel provider’s specifications (Refinadora Costarricense de Petróleo, S.A.).
Purpose of data	Used to calculate project emissions
Additional comment	

Data / Parameter	**Ddiesel**
Unit	kg/l
Description	diesel density
Source of data	the fuel density of diesel in Costa Rica
Value(s) applied	0.85
Choice of data or Measurement methods and procedures	National specifications for diesel fuel in Costa Rica
Purpose of data	Used to convert volume to mass units
Additional comment	

Data / Parameter	**EFdiesel**
Unit	tCO_2/MJ
Description	emission factor diesel
Source of data	IPCC
Value(s) applied	20.2 tC/TJ x 44/12 = 74.1 tCO_2/TJ = 0.00007 tCO2/MJ
Choice of data or Measurement methods and procedures	This reference comes from the latest IPCC guidelines, and has been considered as representative for the current emission reduction calculation.
Purpose of data	Used to calculate project emissions
Additional comment	

Data / Parameter	**EUy**
Unit	GWh.
Description	electricity consumption of baseline boiler
Source of data	Quotations from boiler technology provider
Value(s) applied	1.07
Choice of data or Measurement methods and procedures	baseline boiler: including a two weeks maintenance period.
Purpose of data	Used to calculate BEboiler
Additional comment	

Data / Parameter	**EUy**
Unit	GWh.
Description	electricity consumption of project boiler
Source of data	Quotations from boiler technology provider
Value(s) applied	2.72
Choice of data or Measurement methods and procedures	Including a two weeks maintenance period
Purpose of data	Used to calculate project emissions
Additional comment	

Data / Parameter	**EFgrid**
Unit	tCO2/GWh
Description	Emission factor of the Costa Rican grid.
Source of data	This factor has been calculated using ICE data and available info from other sources. See Annex 3
Value(s) applied	62.86
Choice of data or Measurement methods and procedures	This baseline emission factor was calculated ex-ante in a transparent and conservative manner as the average of the “approximate operating margin” and the “build margin”.
Purpose of data	Used to calculate baseline / project emissions as required
Additional comment	

Data / Parameter	η_{th}
Unit	%
Description	energy efficiency of the boiler in the baseline scenario
Source of data	The energy efficiency of the boiler that would be used in absence of the project activity is based upon the manufacturer’s information.
Value(s) applied	78%
Choice of data or Measurement methods and procedures	The efficiency is considered as a fixed value, and based on the manufacturer’s information for coal.
Purpose of data	Used to calculate $BE_{heat,y}$
Additional comment	

Data / Parameter	η_p
Unit	%
Description	energy efficiency of the boiler in the project scenario
Source of data	is based upon the manufacturer's information.
Value(s) applied	80%
Choice of data or Measurement methods and procedures	The efficiency is considered as a fixed value, and based on the manufacturer's information for biomass fuels.
Purpose of data	-
Additional comment	

Data / Parameter	**NCVi = NCVc**
Unit	TJ/kt.
Description	is the net calorific value of the fossil fuel type i
Source of data	based on tests done to Colombian coal
Value(s) applied	A default value of 10,887 BTU/lb will be considered based on tests done to Colombian coal (equivalent to 25.73 TJ/kt).
Choice of data or Measurement methods and procedures	The net calorific value of the fossil fuel is determined by means of analytical results at the 'Laboratory of Puerto Bolivar, La Guajira, in accordance with the applicable ASTM standards. The resulting 'Screen Analysis Certificate' was developed by the 'Inspectorate Colombia Ltda.'.
Purpose of data	Used to calculate baseline / project emissions as required
Additional comment	

Data / Parameter	**COEFi**
Unit	tCO2/kt
Description	is the CO_2 emission factor of the fossil fuel type i fired in the boiler in the absence of the project activity in.
Source of data	Reference from Colombian provider of coal
Value(s) applied	2.38 tCO2/t of coal
Choice of data or Measurement methods and procedures	Carbon percentage of the Colombian coal that would have been used is stated as 64.9%
Purpose of data	Used to calculate baseline and project emissions as required
Additional comment	

Data / Parameter	hssi
Unit	Kj/kg
Description	is the enthalpy of the saturated steam at 12 bar
Source of data	Set as a default value provided from saturated steam tables.
Value(s) applied	2782.73 Kj/kg
Choice of data or Measurement methods and procedures	This is considered as a fixed value and will be used for emission reduction calculations.
Purpose of data	Used to calculate BE_{Heat}
Additional comment	

B.6.3. Ex-ante calculation of emission reductions

Formula relevant for project activity emissions:

$$PE_{trans,y} = \sum trucks_{i,y} \cdot TransCOEF_i$$

$$TransCOEF_i = km_i \cdot VF_{cons} \cdot CV_{diesel} \cdot D_{diesel} \cdot EF_{diesel}$$

$$PE_{boiler,y} = EU_y \cdot EF_{grid}$$

Formula relevant for the baseline:

$$BE_{heat,y} = \frac{Q_y}{\eta_{th} NCV_i} COEF_i$$

$$Q_y = h_{ssi} F_{ssi} / 10^{-9}$$

$$BE_{boiler,y} = EU_y EF_{grid}$$

No specific formulae are provided in the appendix. Paragraph 6 of this appendix states that "*For renewable energy technologies that displace technologies using fossil fuels, the simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity times an emission coefficient for the fossil fuel displaced*".

In the baseline of the proposed project activity is the use of coal-fired boilers to meet the steam demand of INOLASA's plant.

The emissions related to biomass steam production are zero, as the fuel source is a renewable source of waste biomass.

Emissions arising from the construction of the project have been excluded from the project boundary. It is assumed that similar activities and related emissions – for example, installation of new boilers as older boilers are retired – would also occur in the baseline situation. It is also extremely difficult to accurately estimate the emissions arising from construction, especially transportation of materials.

Emissions related to bunker use during the maintenance period has been excluded as well. The same maintenance period would have been required in the baseline situation as well.

Emissions from biomass transportation and emissions from electricity consumption by the biomass boiler are further described in the section below.

Emissions from transportation of biomass

The project results in transport emissions from transportation of the biomass from the palm oil mills to INOLASA , for this transport diesel fuelled trucks are used. The origin of each truck supplying biomass to INOLASA is recorded. For each truck load of biomass the GHG emissions are obtained by multiplying with an origin bound emission coefficient.

The emission coefficients for each Palm Oil Mill is determined by use of parameters set forth in Approved Methodology AM0025 / Version 03, paragraph "Emissions from transportation". IPCC default values for fuel consumption and emission factors may be used. The CO2 emissions from a biomass load are calculated from the quantity and the specific CO2-emission factor of the fuel used by the trucks.

$$PE_{trans,y} = \sum trucks_{i,y} \cdot TransCOEF_i$$

Where:

$PE_{trans,y}$ = project emissions resulting from transportation of the biomass in year 'y'
$trucks_{i,y}$ = number of trucks supplying the biomass originating from palm oil mill i in year 'y'
TransCOEFi = Coefficient for the CO_2 emissions from 1 truck load of biomass originating from palm oil mill i

$$TransCOEF_i = km_i \cdot VF_{cons} \cdot CV_{diesel} \cdot D_{diesel} \cdot EF_{diesel}$$

Where:

Km_i = distance from palm oil mill i to the biomass boiler (km)
VF_{cons} = vehicle fuel consumption in litres per kilometre (l/km) CVdiesel = Calorific calue of the fuel (MJ/kg)
Ddiesel = diesel density (kg/l)
EFdiesel = emission factor diesel (tCO_2/MJ)

For the transportation of biomass trucks with a load capacity of 28 ton are used. To be conservative TransCOEFi is determined based on a full truck load. The trucks use 0.6 litre of diesel per kilometer[7], the calorific value of the fuel is 45.91 MJ/kg[8], the fuel density of diesel in Costa Rica is 0.85 kg/l[9] and the emission factor of the fuel is 20.2 tC/TJ[10].

Emissions from grid electricity consumption

The project emissions resulting from electricity consumption by the boiler are determined by:

$$PE_{boiler,y} = EU_y \cdot EF_{grid}$$

[7] Source: Truck supplier
[8] Source: Refinadora Costarricense de Petróleo, RECOPE
[9] Source: Refinadora Costarricense de Petróleo, RECOPE
[10] Source: 2006 IPCC Guidelines for National GHG inventories Table 1.3 p1.21

Where:

$PE_{boiler,,y}$ = Project emissions resulting from electricity usage in year 'y' EU_y = Electricity Usage in year 'y'
EFgrid = Emission factor of the Costa Rican grid.

The calculation of the grid's emission factor is presented in Annex 3. The resultant value for the grid emission factor is equal to 62.86 ton CO_2eq/GWh. This low value represents the Costa Rican grid, mainly composed by hydro power generation. There are no proved fossil fuel storages in the country; still some new capacity has been added to the grid based on imported fossil fuels.

The biomass fuelled boiler of 471 KW of installed capacity is expected to operate 5796 hrs per year, including a two weeks maintenance period. This results in a total electricity consumption of 2.72 GWh per year.

Specifications and breakdown of electricity consumption can be found in annex 3.

Finally the following statement can be defined to estimate project emissions:
Average annual Project activity emissions (t CO_2/year during 7 year period) = Emissions from biomass transportation + Emissions from the consumption of grid electricity

Baseline:

Emissions due to coal combustion

The amount of fossil fuel that would have been consumed in the absence of the project is calculated using guidance from ACM006, paragraph "Emission reductions…due to the displacement of heat"

The baseline for the GHG emissions from fossil fuel combustion in the boilers is determined by dividing the amount of generated heat during the project activity by the net calorific value of the fuel and the efficiency of the boiler. This is multiplied with a CO_2 emission factor for the displaced fossil fuel.

According to:

$$BE_{heat,y} = \frac{Q_y}{\eta_{th} NCV_i} COEF_i$$

where:

$BE_{heat,y}$ = baseline emissions for fossil fuels during the year y in tons of CO_2eq.
Q_y = the quantity of heat generated in the project plant using renewable resources only, that displaces heat generation in the fossil fuel fired boiler during the year y in TJ. This is the same variable mentioned in AMS.I-C ver. 10 as HG_y.
η_{th} = the energy efficiency of the boiler. The energy efficiency of the boiler that would be used in absence of the project activity is based upon the manufacturer's information. NCV_i is the net calorific value of the fossil fuel type i per TJ/kt.
$COEF_i$ = CO_2 emission factor of the fossil fuel type i fired in the boiler in the absence of the project activity in tCO_2/kt

The total quantity of heat generated in the project plant (Qt_y), is to be based on the following equation:

$$Q_y = h_{ssi}F_{ssi}10^{-9}$$

where

Q_y = total quantity of heat generated in the project plant using renewable and fossil fuel resources, during year y, in TJ.

hss_i = enthalpy of the saturated steam at 12 bar (2782.73 Kj/kg set as a default value).

Fss_i = steam flow monitored, during year y (kg/year)

In order to quantify ex-ante emission reductions, the total quantity of heat generated in the project plant (Q_y) has been determined by forecasting the heat demand of the production process. This quantity is expected to increase by 5.9 % per year, based on the trend in energy consumption over the last three and a half years. Please find Annex 5 with the data. The maintenance period of the coal boiler in the baseline scenario has been taken into account.
IPCC default values are used to determine the CO_2 emission factor of the fossil fuel in the boiler in absence of the project activity.

Emissions caused by grid electricity consumption (coal boiler)
The project emissions resulting from electricity consumption by the boiler are determined by:

$$BE_{boiler,y} = EU_y \cdot EF_{grid}$$

Where:

$BE_{boiler,,y}$ = Baseline emissions resulting from electricity usage in year 'y'

EU_y = Electricity Usage in year 'y'

EFgrid = Emission factor of the Costa Rican grid.

The coal boiler has an intalled capacity of 185 KW and is expected to operate 5796 hrs per year, including a two weeks maintance period. This results in a total electricity consumption of 1.07 GWh per year. As it is stated above, an emission factor of 62.86 tCO_2/GWh is used for the Costa Rican grid.

Specifications and breakdown of electricity consumption can be found in Annex 3.

Leakage:
According to Appendix B, I.C., paragraph 17, leakage is to be considered if the energy generating equipment is transferred from another activity or if the existing equipment is transferred to another activity. Since this is not the case, the proposed project activity does not quantify leakage effects.

Table B.5. : Baseline Emissions

			2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Efficiency bunker boiler	75%											
Energy content bunker C	38.39	MJ/liter										
Price bunker C	0.35	US$/liter										
Maintenance for coal or biomass boiler	2	weeks/year										
Bunker C consumption replaced		k liters	9,956	10,544	11,166	11,824	12,522	13,261	14,043	14,871	15,749	16,678
Energy demand INOLASA (wo maintenance)		GJ	275,629	291,890	309,110	327,346	346,658	367,109	388,766	411,702	435,990	461,711
Bunker C cost		k US$	3,485	3,690	3,908	4,139	4,383	4,641	4,915	5,205	5,512	5,837
Coal demand baseline												
Efficiency coal boiler	78%											
Energy content coal	25.73	MJ/kg										
Price coal (including transport)	48.07	US$/t										
Coal demand		t	13,734	14,544	15,402	16,311	17,273	18,292	19,371	20,514	21,724	23,006
Coal cost		k US$	660	699	740	784	830	879	931	986	1,044	1,106
Biomass demand project												
Efficiency biomass boiler	80%											
Energy content Palm Kernel Hulls (dry base)	22.7	MJ/kg										
Energy content Empty Fruit Bunches	17.9	MJ/kg										
Humidity PKH	17%	H2O										
Price PKH and EFB from Palma Tica Quepos	50	US$/t										
Price PKH from Palma Tica Coto	1	US$/t										
Palm kernel hull demand (wet base)		t	18,287	19,365	20,508	21,718	22,999	24,356	25,793	27,314	28,926	30,632
PKH supply from Coto		t	12,751	13,864	15,043	16,365	17,646	19,003	19,875	21,325	22,528	23,140
PKH supply from Palma Tica		t	5,536	5,501	5,465	5,353	5,353	5,353	5,353	5,353	5,353	5,353
EFB supply from Palma Tica		t	0	0	0	0	0	0	595	670	1,100	2,252
Biomass cost		k US$	290	289	288	284	285	287	317	322	345	403
Baseline emissions												
Baseline emissions coal combustion												
Emission factor coal	2.38	tCO2/t coal										
Coal demand		t	13,734	14,544	15,402	16,311	17,273	18,292	19,371	20,514	21,724	23,006
Emissions from coal combustion		tCO2	32,711	34,641	36,685	38,849	41,141	43,568	46,138	48,860	51,743	54,795
Baseline emissions electricity use coal boiler												
Emission factor Costa Rican grid	62.86	tCO2/GWh										
Operating hours per year*		hrs	5,769.23	5,769.23	5,769.23	5,769.23	5,769.23	5,769.23	5,769.23	5,769.23	5,769.23	5,769.23
Electricity consumption		GWh	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07
Emissions from electricity use coal boiler		tCO2	67.09	67.09	67.09	67.09	67.09	67.09	67.09	67.09	67.09	67.09
Total baseline emissions		tCO2	32,778	34,708	36,752	38,916	41,208	43,635	46,205	48,927	51,810	54,862
Total baseline emissions (10 year period)		tCO2										

* Excluding maintenance period of two weeks

Table B.6. : Project Emissions

			2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Electricity consumption biomass boiler												
Emission Factor Costa Rican grid	tCO2/GWh	62.86										
Operating hours per year*	hrs		5,769.23	5,769.23	5,769.23	5,769.23	5,769.23	5,769.23	5,769.23	5,769.23	5,769.23	5,769.23
Electricity consumption	GWh		2.72	2.72	2.72	2.72	2.72	2.72	2.72	2.72	2.72	2.72
Total emissions from electricy consumption	tCO2/year		171	171	171	171	171	171	171	171	171	171
* Excluding maintenance period of two weeks												
Transportation of Palm Oil Mill biomass												
Truck capacity	tonnes/year	28										
Km - distance Coto 47 to Barranca (two ways)	km/year	680										
Km - distance Quepos (two ways)	km/year	266										
VF - vehicle fuel consumption	l/km	0.60										
CV - calorific value of fuel	MJ/kg	45.91										
D - fuel density	kg/l	0.85										
EF - emission factor of fuel	tCO2/MJ	0.00007										
Load - Coto 47 to Barranca	tonnes/year		12,751	13,864	15,043	16,365	17,646	19,003	19,875	21,325	22,528	23,140
Load - Quepos to Barranca	tonnes/year		5,536	5,501	5,465	5,353	5,353	5,353	5,948	6,023	6,453	7,605
Total distance per year	km		362,254	388,960	417,249	448,285	479,401	512,353	539,172	575,107	608,404	634,214
Total emissions from transportation biomass	tCO2/year		630	676	725	779	833	890	937	999	1,057	1,102
Transportation of residual ash from the biomass boiler to CEMEX plant in Colorado de Abangares												
Truck capacity	tonnes/year	20										
Km - distance to Colorado de Abangares (two ways)	km/year	120										
VF - vehicle fuel consumption	l/km	0.60										
CV - calorific value of fuel	MJ/kg	45.91										
D - fuel density	kg/l	0.85										
EF - emission factor of fuel	tCO2/MJ	0.00007										
Load - Barranca to Colorado de Abangares	tonnes/year		684	684	684	684	684	684	684	684	684	684
Total distance	km/year		4104	4104	4104	4104	4104	4104	4104	4104	4104	4104
Total emissions from transportation ash	tCO2/year		7	7	7	7	7	7	7	7	7	7
Total project activity emissions	tCO2/year		807	854	903	957	1,011	1,068	1,115	1,177	1,235	1,280
Total project activity emissions (10 years)												
Total emissions from electricity consumption (10 years)	tCO2	8,629										
Total transport emissions (10 years)	tCO2	8,700										
Total project activity emissions (10 years)	tCO2	17,329										

B.6.4. Summary of ex-ante estimates of emission reductions

Year	Baseline emissions (tCO_2 e)	Project emissions (tCO_2 e)	Leakage (tCO_2 e)	Emission reductions (tCO_2 e)
2007	32,778	807	0	31,971
2008	34,708	854	0	33,854
2009	36,752	903	0	35,849
2010	38,916	957	0	37,959
2011	41,208	1,011	0	40,197
2012	43,635	1,068	0	42,567
2013	46,205	1,115	0	45,090
Total	274,202	6,715	0	267,484
Total number of crediting years	7			
Annual average over the crediting period	39,172	959	0	38,212

B.7. Monitoring plan
B.7.1. Data and parameters to be monitored

Data / Parameter	Fssi
Unit	kg/yr
Description	is the steam flow monitored, during year y
Source of data	Project owner
Value(s) applied	
Measurement methods and procedures	m(1) and c(2)(1) Steam output flow meter (2) Flow of steam in tonnes/yr is converted to TJ by calculation Recorded monthly and summed for each year.
Monitoring frequency	Monthly recorded
QA/QC procedures	Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy. (see table in Appendix 5).
Purpose of data	Baseline emissions
Additional comment	

Data / Parameter	$trucks_{i,y}$
Unit	Number
Description	No. of trucks + origin
Source of data	Project owner
Value(s) applied	
Measurement methods and procedures	The origin of each truck arriving with biomass is recorded
Monitoring frequency	each time a truck with biomass arrives
QA/QC procedures	The recorded data will be crosschecked on a regular basis with the invoices from the transportation service provider.
Purpose of data	Project emissions
Additional comment	

Data / Parameter	EU_y
Unit	GWh/year
Description	Electricity consumption biomass boiler in the project scenario
Source of data	Project Owner
Value(s) applied	
Measurement methods and procedures	Measured and recorded monthly
Monitoring frequency	Measured and recorded monthly
QA/QC procedures	The kWh meter will be calibrated periodically by the supplying firm
Purpose of data	Project emissions
Additional comment	

Note: In Appendix 5 a detailed overview is presented on accuracy level, calibration procedure, quality assurance and quality control of the monitoring process.

B.7.2. Sampling plan

n.a.

B.7.3. Other elements of monitoring plan

Title of monitoring methodology: "*Thermal energy for the user with or without electricity*", Type I.C in Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM project activities, Version 10_Scope 1_May 2007.

The energy output of the new biomass boiler has an energy output of 27 $MW_{thermal}$. Since this is below the threshold of 45MW thermal specified in methodology type I.C "*Thermal energy for the user with or without electricity*", the project is eligible for the use of this monitoring methodology.

Monitoring methodology I.C prescribes that monitoring shall consist of metering the energy produced by a sample of systems where the simplified baseline is based on the energy produced multiplied by an emission coefficient. In the project activity the amount of energy produced is measured with a steam flow meter.

The project activity emissions consist of the emissions from transportation of the biomass and emissions from the electricity consumed by the project. The emissions from transportation of the biomass are determined by multiplying the amount of trucks from each palm oil mill with an emission coefficient.
The emissions from electricity usage are determined by multiplying the amount of electricity consumed by the emission factor for the Costa Rican grid, obtained from registered CDM projects.
INOLASA is responsible for the operation of the biomass boiler and administration of the data, also for the costs of the operation and maintenance of the boiler's control system.

The commissioning of the boiler is done by the technology provider PETRA. INOLASA will be responsible for the installed technology. INOLASAs personnel will be trained by PETRA that afterwards will support INOLASA's technical team. A training plan is carried out by PETRA during the first weeks of operation.

INOLASA will be in charge of monitoring the performance of the project activity related to carbon emission. Since no leakeage is expected from the project activity, the emission reductions will be monitored by installing the adequate and calibrated meters according to the standards of Costa Rica.
The procedures for data collection and monitoring management will include:

- Management structure for monitoring
    - Monitoring team
    - Changes in monitoring team
- Introduction to baseline calculations
- Project Management calculations:
    - Data collection for monitoring
    - Data record and storage
    - Emission reduction calculation
- Procedures
    - Monitoring
    - Calibration
- Reporting
    - Monitoring reporting
    - Regular manual update

Internal Auditing: Procedures for internal auditing will be implemented in order to assure that the monitoring methodology is being performed in the correct manner, describing the non-conformities and proposing correctives measures when needed. The person in charge of following these auditing procedures will be determined with the monitoring team.
Since the monitoring equipment is the same as the Operation equipment, the maintenance will be performed in the same way. Specific training for the Monitoring Team will be provided prior to the boiler's operation.

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

24/04/2007

C.1.2. Expected operational lifetime of project activity

25 years

C.2. Crediting period of project activity
C.2.1. Type of crediting period

Renewable

C.2.2. Start date of crediting period

The later date of 01/09/2007 or date of registration

C.2.3. Length of crediting period

7 years

SECTION D. Environmental impacts
D.1. Analysis of environmental impacts

The National Technical Environmental Secretariat (SETENA), the branch of the Ministry of the Environment and Energy (MINAE) is responsible for reviewing environmental impact assessments for development projects in Costa Rica.

The project must comply with the environmental regulations of the country and obtain the necessary approvals of SETENA.

INOLASA took into account all of SETENA's Environmental Evaluation Procedures, which included two steps:

1. Initial Evaluation, which consisted of performing the Previous Environmental Evaluation (D1 or FEAP) for determining the environmental classification of the project activity.
2. Final Evaluation: Depending on SETENA's resolution on the D1, the company should carry out one of the following requirements:
    a. DJCA: Sworn Statement on Environmental Commitments (provided to the validator as document D1-120-2006-SETENA),
    b. PPGA: Forecast of Environmental Management Plan,
    c. EsIA: Environmental Impact Study.

INOLASA presented to SETENA the D1 and obtained its approval on July 15, 2006 at 9:05 a.m. with resolution No. 1127-2006 (provided to the validator as document Res-1127-2006-SETENA). After determining the project's feasibility, SETENA agreed that the project didn't require preparing an Environmental Impact Study (EsIA) because there were no significant environmental impacts. Instead, INOLASA had to make a Sworn Statement on Environmental Commitments. The SETENA approval of the Environmental Evaluation Procedures means that the project complies with all of the requisites of the government's environmental law. The environmental approval letter and the DJCA are attached in Annex 6.

In addition, the company obtained the following permits to start with the Project:

1. The Occupational (Labour) Health Counsel supplied them the permission for installing the boiler, on April 21-2006 with the resolution No.072-2006.
2. The Costa Rican Health Ministry supplied the "location permission" for the construction of the boiler project on March 20, 2006.

As the project plant will be located in the designated industrial area inside INOLASA's plant, there will not be any significant impact on neighboring communities or industries. In addition, the company will provide constant maintenance to the boiler's functioning system with the objective of controlling the vibrations and noise levels. Finally, is important to mention that the boiler fulfils the emission regulations in the country.

After determining the project's feasibility, SETENA agreed that the project didn't require preparing an Environmental Impact Study (EsIA) because there was no evidence of significant environmental impacts.

SECTION E. Local stakeholder consultation
E.1. Solicitation of comments from local stakeholders

The stakeholder consultation took place on Wednesday 13 of September 2006, 4 p.m. in meeting room #1 of the Instituto Nacional de Aprendizaje (INA) in Puntarenas, district Barranca.

The following procedure to prepare for the event was followed:

A preliminary search and selection for invitees was carried out considering the principal political representatives (regional and local government), ecclesiastic representatives, organized groups and institutions in the Barranca district and Puntarenas. Special regard was made to their proximity to INOLASAs installations.

After the selection, organizations and persons that had been identified were approached directly by the staff in charge, to announce informally the stakeholder consultation and to circulate the relevant information in the local and regional community. The importance of an active participation in the event was highlighted.

The final invitation was made through different channels, as: email, fax, signed letters with a written receipt and publication in the two most popular newspapers in the region. Respective copies are presented in a separate document.

21 participants attended the stakeholder presentation representing a total of 13 organizations and institutions. A list with the signatures of the participants is presented in a separate document as well.

Form of presentation of the project at the meeting:

A power point presentation was given, explaining the project details regarding technology, construction and operation. After the presentation an open question round was held. A video of the whole stakeholder consultation is available and can be submitted on request. A compilation of the question and answers given in this part of the consultation can be found in section E.2.
Afterwards a questionnaire with 5 specific but open questions was distributed, giving room for personal remarks. A compilation of the given comments is included in section E.2., copies of the filled in questionnaires are also presented in a separate document.

E.2. Summary of comments received

Summary of the questions received during the open round and the respective answers:

Table E.1

Question	Answer
How does this closed CO2 cycle work?	CO2 is converted by plants, e.g. rice, sugar cane or palm trees, because they need it.
Is there any change in the emission of gases through the new boiler?	Yes, a reduction of Sulfur.
We only have sugar cane and no palm trees! Where does the CO2 produced by INOLASA fall?	CO2 is converted by plants, e.g. rice, sugar cane or palm trees, because they need it. *Comment from Police:* They won't have to buy fossil fuel anymore; the plant will be auto sufficient. It will generate more employment.
We understood that Palma Tica was going to move and to fuse with INOLASA, and now we just hear that there is huge amounts of palm kernel hulls (PKH) in Golfito.	That was a misunderstanding; the invitation did not state anything like this. It only made reference to the carbon credits, which lower the production costs, reduce the drain of foreign currency from the country, generate employment and more companies will copy the project in order to lower their costs.
Currently, there are three bunker boilers, which will be replaced by only one biomass boiler. What will happen with the employees? What are the risks of explosion in an emergency situation?	The biomass boiler directly and indirectly requires more employees. The technology is more sophisticated and the biomass storage does not involve any risks. Therefore, it is safer than the bunker boilers.
What kind of noises would be caused by this new boiler?	It is one boiler instead of three, so it will be less noisy.
Regarding the PKH: How is it going to be stored, because of the pests like rodents and flies?	PKHs will be stored closed and under a roof, since some 100 tons per day will be consumed but biomass for two weeks will be stored. In this time no bad odors are generated nor can rodents breed. In addition the PKH have to be dry.
There is a time bomb (FERTICA, an industry in the vicinity) in Barranca! What are the dangers of the new boiler?	This boiler is safer than the former ones and of course one boiler involves less risk of an accident than three. The boiler was designed in London and has a certification that we can show to you.
We know that you're working well. I'd like to know if there will be changes in the design against fires?	Yes, we have plans, approved by the INS, and there is an extension to cover the new approach zones and more.
What would happen if the PKH caught fire?	That is very improbable because the PKH will only be stored for a short time.

Additional comments:

Table E.2.

Person	Comment
Fire brigade	All requirements are fulfilled very well. I'm looking forward to see the new approach. I'd like to thank Roy the firefighter who works at INOLASA.
CCSS	I congratulate INOLASA on the change from hydrocarbons and the utilization of additional filters that eliminate the emission of particles, because the worst disease in Barranca is respiratory infection.

Vice Mayor	The community is interested. Thanks to INOLASA and the source of employment it provides. There is negative investment in Puntarenas, that's why people leave. Therefore, I'm not worried about INOLASA developing projects because they pass through many institutional filters. They are reputable, clean the atmosphere and do not violate the law. All permits required from the local government and the community will be granted, concratulations.
Victor Castro	I'm proud that you will present the project for CDM to the UN and that it is considered by them. The boiler is very important to the community. Hopefully, there was 20 INOLASAs around. Puntarenas does not have any support, you're a blessing.

Summary of the comments in the questionnaires:

Table E.3

	1. What is your level of participation in communal decision making?	**2. What kind of participation do you exercise regarding environmental problems in the area?**	**3. What position do you have with regard to the development of the project?**	**4. What do you expect from the project?**	**5. What are the possible impacts of the projects to the neighbors?**
MUNICIPALIDAD Lic. Reinaldo Vargas Campos, Lic. Marni Chang Sibaja	High, because it's the local government.	High level of participation	It's an excellent project for the development of the region.	That other companies will be appealed to develop their operations in Puntarenas.	The viability of the project has to be assessed by SETENA.
Bomberos de El Roble Alexander Araya Micó.	High, especially in emergencies.	Limited, only in case of an emergency	It should fulfil the required rules of security.	Employment and welfare is expected.	Noise and bad odours
Comité Cantonal de Deportes Y Riojalandia # 1 Pablo Vega M.	High, since we're an entity for recreation, formation and sports in the community	observant	Positive, with regard to the benefit for the community	More employment and improvement for the employees	Not enough knowledge to judge
Policía de proximidad de Barranca Freiby Salas Villalobos	High, always supporting the community	Participates and cooperates in manifestations and complaints if necessary	neutral	Should be coordinated with the security company	Possible contamination
Área de Salud de Barranca Licda. Doris Chávez Salas	Low	Educate and create consciousness in the community regarding the environment.	We admire and give our props to the initiative of substituting hydrocarbons.	Decrease local, national and worldwide contamination	More employment, less contamination
Asociación Desarrollo de Guadalupe Bº Los Ángeles Barranca	High, we're heard in all projects.	Through us the whole community is represented.	It is very good.	We hope to be considered in the distribution of the employment.	No negative effects are expected

Asociación Desarrollo Integral Barranca Puntarenas	High, we watch over the welfare of the whole community we	Following the new law of SETENA we have to consult	The presented objectives shall be fulfilled and the received	The quality of the environment will not be altered. To be	Damage in the roadways close to the plant.
Jersen Fallas Alex Brenes	represent.	entrepreneurs about benefits and damages on an environmental level.	comments shall be considered.	considered in the distribution of the employment.	
Asociación Pro mejoras Doña Cecilia Víctor Castro Cruz	Medium	Observant	None	No contamination in the community will occur.	A positive effect like more employment is expected.
Asociación Desarrollo Del Roble Andrés Narauz	Low	Low	Be careful with the management of boilers.	Positive, with regard to the development of the project	No consequences are expected.
Junta de Salud de Barranca Sra. Rosibel Pizarro Mora	Medium	Educate and raise consciousness in the community with regard to the environment.	None	Decrease local, national and worldwide contamination	Better security for the employees and the community
Industrias Cerdas S.A. Arnoldo Cerdas	Low	None	We support the project.	Decrease of contamination	The emission of particle decreases
Unidad Pacifico Central (INA) Luis Marcial Arguedas Trejos	Low	Our policy is to respect the environment and the right for a healthy ambience.	Supportive, conditioned to the realisation according to what was presented.	Lower labour risk and less contamination from hydrocarbons	More traffic, possible contamination
Zona Franca Barranca Silvia Moraga Berrocal Luis Arguedas	Low	Cooperation	Very positive	Competitiveness, less global warming	Work, clean ambience

E.3. Report on consideration of comments received

The concerns regarding damages to the main roadways refer to a situation that is not caused by the operation of one sole company. There are many companies running business in the zone, like Zona Franca de Barranca, Arrocera, Industrias Sardimar and Subasta Ganadera. All of them make use of the main road that passes by INOLASA.
In this specific case there will be no significant increase of truck traffic because the biomass transporters will replace the bunker tankers. The increase in traffic will be from 2 to 3 additional truck trips per day. Actually, an improvement of the traffic situation is expected on the short term due to the upcoming complete opening of the coastal road and the finalization of the San Jose-Puerto Caldera road which will alleviate traffic.

Regarding the concern for the possible increase of noise it was made clear and accepted, that the new boiler will not cause more noise than the existing bunker boilers.

Furthermore, bad odours and the breeding will be prevented thanks to the following measures:

- The biomass is going to be used as fuel and consequently has to remain dry. Therefore, it is going to be transported and stored in a dry environment, roofed over under optimal conditions for its incineration. At the same time this dry ambient and the short storage time prevent the biomass from decay and the generation of bad odours.
- INOLASA is a processor of alimentary products of first-class quality. Consequently, it is obliged by the Ministry of Health of Costa Rica to apply the most rigorous hygiene measures. Additionally, a big part of INOLASAs production is exported and it therefore has to fulfil the phytosanitary requirements for exportation and the standards of the importing countries.

For the above reasons the installation and operation of the new biomass boiler will be in compliance with local and international security standards and with the highest sanitary standards. An extremely hygienic management and vigilance of the biomass is in the best interest of the company, since it is required for its successful operations and sales.

SECTION F. Approval and authorization

LoA from Costa Rica issued on 03/08/2007;
LoA from the Netherlands issued on 11/12/2012.

- - - - -

Appendix 1: Contact information of project participants

Organization	INOLASA Industrial de Oleaginosas Americanas S.A.
Street/P.O. Box	Barranca
Building	
City	Puntarenas
State/Region	
Postcode	
Country	Costa Rica
Telephone	
Fax	
E-mail	cgonzalez@numar.net
Website	
Contact person	Carlos González May
Title	
Salutation	
Last name	González May
Middle name	
First name	Carlos
Department	Vicepresidente Desarrollo de Negocios
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

Organization	Vattenfall Energy Trading Netherlands N.V.
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State/Region	
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Country	The Netherlands
Telephone	+31 8809 850 67
Fax	+31 8809 855 99
E-mail	cdmteam@vattenfall.com
Website	http://corporate.vattenfall.com/
Contact person	Francisco Grajales
Title	Regional Manager
Salutation	Sr.
Last name	Grajales Cravioto
Middle name	
First name	Francisco
Department	Global Emissions
Mobile	+31 655872128
Direct fax	
Direct tel.	+31 880985455
Personal e-mail	francisco.grajales@vattenfall.com

Appendix 2: Affirmation regarding public funding

There is no public funding in this project.

Appendix 3: Applicability of selected methodology

All details provided in section B.

Appendix 4: Further background information on ex ante calculation of emission reductions

I Electric Energy Consumption Boilers

OPERATING HOURS PER YEAR		6000	HRS		
PRICE PER KWH	$	0,085			
CONSUMPTION COAL BOILER		185	KW	$	94.452
CONSUMPTION BIOMASS BOILER		471	KW	$	240.023

II Coal cost specification (including transport)

Costa Rica's coal supply depends mainly on imports, as it does with other fossil fuels. Because of this, the main source of coal consumption has come from other countries such as Colombia. One of the last available records of coal consumption has been used as an official reference for the unitary coal cost, in order to develop the economic analysis for the coal baseline scenario. This is detailed in the following table:

Table 1

Price coal (including transport)	48.07	US$/t

This reference has been provided by a cost specification from INCSA (Industria nacional de Cementos de Costa Rica S.A.), the biggest coal consuming facility in Costa Rica during the past decade, and can be considered reliable.

III Price of biomass including transport

Although renewable biomass will be provided from different sources, it has been considered to receive a continuous and confident supply of biomass from mainly three palm oil mills from NUMAR group. One of these palm oil mills, Coto, has already implemented technology measures and an efficient management use of its residues. This investment was undertaken before the start of the CDM project and will consequently not be reflected in a price for the biomass from Coto. But in order to contribute to the development of the community purchase of PKH from the Coto mill is made through a donation- procurement scheme with a nearby rural school. The price of one dollar per ton is meant as a voluntary donation to the school in order to involve the local community in the project and to make a social contribution. Wood chips and bagasse were not considered in the additionality analysis as these are more expensive types of biomass (on an energy per $ basis), which is conservative.

On the other hand the reconditioning measures at Palo Seco and Naranjo to the existing boilers have been undertaken in order to release biomass resources and supply biomass especially for the project following the example of Coto. The following table details the cost associated with boiler's reconditioning and modification:

Table 2: Boiler's reconditioning and modification costs

Boiler´s site	Investment related US$
Palo Seco	288,044
Naranjo	204,278

Consequently these investments have been transferred to the economic value of the newly available palm oil residues. Due to this reason, a renewable fuels market has developed in the area. The following table details the prices of the renewable resources related to the NUMAR's palm oil mills:

Table 3: Boiler's reconditioning and modification costs

Source of fuels	Price US$/t
Price PKH and EFB from Palma Tica Quepos (Palo Seco & Naranjo)	50
Price PKH from Palma Tica Coto	1

IV Fuel transportation

There is going to be only one type of trucks used for this project. These are the common trucks used for palm oil residues transportation in the area, and they are always filled up its full capacity with load. Calculations in the PDD assume the highest load and the highest fuel consumption, in order to preserve conservativeness. Their characteristics are synthesized in the following table:

Table 4: Main characteristics of double axis trucks

Variable	value	Unit
Length	13,72	m
Load capacity	25 - 28	TM
Fuel consumption	0,4 - 0,6	Diesel lt/ km
Number of vehicles used	4	
Average distance traveled by one vehicle	200	Km.
Calorific value of Diesel	46,000	MJ/kg

Rented trucks are used to import the palm oil plant, rice husk or any type of biomass to the site. The following pictures characterize further these types of trucks.

Fig. 8 & 9 : Trucks for biomass transportation purposes.

The transport management involved in fuel transportation considers records of each trip done by the truck, storing variables such as date of the trip, supply number and total load weight. Although these data is registered and recorded, these variables are not part of the CDM project's monitoring plan.

V Grid emission factor calculation

The ex-ante estimate of the baseline emissions are calculated based on the projected net energy provided to the grid (in GWh /year), and an emission factor for the displaced grid electricity (in tCO_2 /GWh). The general criteria for the grid emission factor calculation rely on AMS I.D. This methodology requires that the baseline emission factor be calculated in a transparent and conservative manner, based on either

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the approved methodology ACM0002. Any of the four procedures to calculate the operating margin can be chosen, but the restrictions to use the Simple OM and the Average OM calculations must be considered, or

(b) The weighted average emissions (in kg CO2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

The project proponent has opted for approach (a). The baseline emission factor has been calculated according to the procedures of ACM0002 and relying on information from the ICE (Instituto Costaricence de Electricidad).

Dispatch data analysis has not been chosen to estimate the Operating Margin, because there is not enough available information to represent the grid merit order for each hour in this grid system. On the other hand the Simple OM method cannot be selected because low-cost/must run resources[5] constitute more than 50% of the total grid generation.

Instead of this, the average OM has been chosen as a representative criteria to estimate the OM grid emission factor.

(a) *Average OM*. The average Operating Margin (OM) emission factor ($EF_{OM,average,y}$) is calculated as the average emission rate of all power plants, using equation (1) above, but including low-operating cost and must-run power plants:

$$EF_{OM,y} = \frac{\sum_{i,j} F_{i,j,y} COEF_i}{\sum_{i,j} GEN_{i,j,y}} \qquad \textbf{\textit{(Eq.1)}}$$

Where:

$EF_{OM,y}$: Emission factor representative for the operating margin, in year y (tCO_2e/MWh).
$F_{i,j,y}$: is the consumption of fuel *i* (in TJ) by fuel sources *j* in year *y*
J: all generating sources serving the system.
$COEF_i$: is the CO_2 emission coefficient of fuel i in tCO_2e/TJ.
$GEN_{i,j,y}$: is the electricity in MWh delivered to the grid by the j source, with fuel i, and in year y.

Imports from other Regions will not be counted as part of the baseline emissions for this part of the analysis. Registered CDM projects that are connected to the same grid have not been accounted as part of the grid's emission factor.

The calculation of the weighted average was done using the most recent numbers for Costa Rica's interconnected system. We have used information from the years 2004-2005 & 2006, obtained from ICE (Instituto Costarricense de Electricidad).

Fuel consumption data is not easily available. Because of this, the product $\Sigma F_{i,j,y} \cdot COEF_{i,j}$ for each one of the plants was obtained from the following formulae:

$$\sum F_{i,j,y} COEF_{i,j,y} = \frac{GEN_{i,j,y}}{\eta_{j,y}} EF_{CO2,i} \cdot Oxid \cdot CF$$

Where variables and parameters used are:

- $GEN_{i,j,y}$: is the electricity generation for plant j, with fuel i, in year y, obtained from the ICE, in MWh.
- i: number of plants using fuel of type i.
- $\eta_{j,y}$: is the average efficiency factor for plants operating with fuel i, in year y, in %
- CF: is the conversion factor from MWh to TJ (0.0036)
- $EF_{CO2,i}$;: is the emission factor for fuel i, obtained from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, in tCO_2/TJ.
- $OXID_i$: is the oxidation factor for fuel i, obtained from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, equal to 98 %.

STEP 2. Build Margin emission factor ($EF_{BM,y}$)

This is calculated as the generation-weighted average emission factor (tCO2/MWh) of a sample of power plants m, as follows:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} COEF_{i,m}}{\sum_m GEN_{m,y}} \qquad \textbf{\textit{(Eq. 3)}}$$

where $F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described for the average OM method above for plants m.

The sample group *m* has been chosen according to Option 1 from ACM0002, for calculation of the build margin: Power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently. This option compromises larger annual generation than the 5 most recent plants built. Registered CDM projects that are connected to the same grid have not been accounted as part of the grid's emission factor.

STEP 3. Grid baseline emission factor *EF_y* calculation

The combined margin has been estimated as the average between the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin emission factor ($EF_{BM,y}$):

$$EF_{CM} = EF_{OM} \cdot 50\% + EF_{BM} \cdot 50\% \qquad \textbf{\textit{(Eq. 4)}}$$

Where:
EF_{CM}: Resultant combined margin for the grid, based on ex-ante estimations (ton CO_2/MWh).
EF_{OM}: Average operating margin of the grid (tonCO_2/MWh)
EF_{BM}: Emission factor for the Build margin at the grid (tonCO_2/MWh)

Following ex-ante estimations, we have the following resultant operating, build and combined margin values:

Table B.4: Result of the combined margin emission factor.

Emission factor	**Value (ton CO_2/MWh**
Average Operating Margin (2004)	0.008
Average Operating Margin (2005)	0.03
Average Operating Margin (2006)	0.05
Average Operating margin	**0.03**
Build Margin	**0.1**
Combined Margin	**0.06**

This baseline emission factor is the basis for calculating the emission factors through all the years in the crediting period.

The following tables summarize the operating margin emission calculations obtained from each electricity generation sources based on fossil fuels:

Operating Margin (tCO2/MWh) 2004				**0.008**		
Name of Power plant	**Colima**	**San Antonio Gas**	**Barranca**	**Moin Piston**	**Moin Gas**	**MOIC**
Fuel	Bunker	Diesel	diesel	bunker	Diesel	bunker
Electricity generated (MWh)	6,676	3,814	11,246	2,368	28,715	13,024
Emissions (tonCO2eq/year)	6,455	3,656	10,781	2,290	27,528	12,594

Operating Margin (tCO2/MWh) 2005				**0.03**		
Name of Power plant	**Colima**	**San Antonio Gas**	**Barranca**	**Moin Piston**	**Moin Gas**	**MOIC**
Fuel	**Bunker**	**Diesel**	**diesel**	**bunker**	**Diesel**	**bunker**
Electricity generated (MWh)	15,634	36,197	23,044	15,908	73,639	97,124
Emissions (tonCO2eq/year)	15,117	34,700	22,091	15,382	70,595	93,914

Operating Margin (tCO2/MWh) 2006				0.05		
Name of Power plant	Colima	San Antonio Gas	Barranca	Moin Piston	Moin Gas	MOIC
Fuel	Bunker	Diesel	diesel	bunker	Diesel	bunker
Electricity generated (MWh)	12,128	52,327	35,125	15,327	187,506	131,506
Emissions (tonCO2eq/year)	11,727	50,164	33,673	14,820	179,753	127,160

Build Margin Calculation (based on info from 2006 and assumptions):

20% of grid generation 2006	**MWh**	**3,472,524**

Plant	Year	generation 2006 (MWh)	F.E. (tonCO2eq/MWh)	tonCO	registered CDM? (yes/no)
toro II	1996	516,708	0	0	no
miravalles II	1998	909,629	0	0	no
angostura	2000	1,797,954	0	0	no
miravalles III	2000	449,033	0	0	no
La Esperanza	2000	26,789	0	0	no
Garita 5 (augment of power capacity)	2002	398,156	0	0	no
Tejona	2002	81,302	0	0	yes
Peñas Blancas	2002	353,779	0	0	no
Moin Gas - CNFL.2	2003	187,506	0.97	181309	no
CHOCOSUELA (augment of power capacity)	2003	68,481	0.00	0	no
CNFL	2003	754,566	0.00	0	no
INGENIO TABOGA S.A.10	2003	36,135	0.00	0	no
miravalles V	2004	224,334	0	0	no
Río Azul	2004	27,550	0	0	yes
CACHI	2004	1,354,378	0	0	no
Cote	2004	13,169	0	0	yes

Pujol	2005	200,589	0.96	1922	no
general	2005	257,666	0	0	no
La joya	2005	364,939	0.00	0	yes
Total		**3,857,944**	**0.10**	**373,60**	

Considered as part of the build margin

Complete and detailed information of private generation (which is a minor share of the total grid) is not commonly found on a disaggregated level per plant, on the ICE records. The following assumptions have been done to complete this information (and to estimate the build margin):

- Registered CDM projects have not been considered for the build margin emission factor calculation
- Garita 5 and Chocosuela will not be considerered as part of the build margin because both of them are related to a small augment of capacity to existing power plants.
- Cote Generation: Reference obtained from the registered Cote PDD.
- Chocosuela generation: reference taken from Cote PDD
- La Esperanza hydro power project: reference taken from the COTE PDD
- Río Azul: estimated upon reference of installed capacity informed in Landfill Gas CDM project Río Azul and assuming 85% of plant load factor
- Ingenio Taboga generation: Estimated from official information on installed capacity (16.5 MW) and assuming 25 % of plant load factor

Default values have been provided from the following sources:

- Carbon emission factors for fuels: Default values from the 2006 IPCC Guidelines for National for GHG Inventories,
- Efficiency of power plants fuelled by bunker and diesel (source: World Bank based on ICE's net Efficiency conversion calculations)

	Efficiency	**Emission factor tonCO2/TJ IPCC 2006**
Bunker	28.24%	77.4
Diesel	27.27%	74.1

Appendix 5: Further background information on monitoring plan

Table 5 - Calibration and Quality Assurance monitoring equipment

	Equipment or method (e.g. signed lists) used for measuring (manufacturer	Continuous or sample	Will data be checked by a third entity?	Accuracy level	Calibration procedure	Quality assurance	Quality control
Heat generation							
Steam generated (tonnes/hour)	*Steam flow indicator and recorder a DP transmitter c/w square root extractor 0-100 kPa, 200 mm steam flow orifice plate, SIEMENS SITRANS pressure transmitter*	Continous	STEAM BOILER INSPECTOR AUTHORIZED BY MINISTERIO DEL TRABAJO	*±5% error*	As indicated by manufacture r	Provided by Supplier PETRA BOILERS SDN.BHD.	*calibration and Maintenance by Inolasa Oficials*
Electricity consume plant + auxiliary systems + biomass management	*ICE (Instituto Costarricense de Electricidad) KWH meter site 132181200208 - #0003171, Pegasys data adquisition software*	Continous	I.C.E.	N.A.	As indicated by manufacture r	Provided by Power Supplier	*calibration and Maintenance by suppliers*

Appendix 6: Summary of post registration changes

Version PDD	Date	Nature of revision
03	29/11/2013	- Revision to reflect use of cane bagasse and wood chips as additional types of supported biomass obtained from companies not within the same group as the project owner's. - Included other origins of biomass from the same project group as the project owner that were already being used since the 5th verification. - The parameter trucksi,y was deleted from section B.6.2 Data and parameters fixed ex-ante, as it is a parameter that is part of section B.7.1 Data and parameters to be monitored. Hence the erroneous inclusion in Section B.6.2 was removed. - A new PP was included, to match the latest MoC submitted to UNFCCC on 14/06/2013 and valid since 01/07/2013 (publicly available). - Adaptation to latest PDD template (ver. 4.1). Minor editorial revisions to adjust content to the template´s requirements were introduced.
Revised Monitoring Plan	31/05/2011	Changes in MP to reflect that the project would no longer co-fire fossil fuels.
02	31/01/2007	Registered PDD

Changes in the biomass profile used by the Inolasa Project[11]

In order to cope with biomass availability issues preventing the project from achieving its foreseen capacity, as well as to keep fuel oil use (bunker) to a minimum, the project proponent has sought additional sources of biomass.

In its original form, the Inolasa Project relied solely on palm kernel shells and empty fruit bunches purchased to identified sources within the project´s surroundings. The boiler was originally combusting biomass in a mixture of approximately 85% palm kernel shells and 15% empty fruit branches; however, during the seventh monitoring period new biomasses were introduced and thus the resulting mix is approximately: 51% palm kernel shells, 28% empty fruit branches, 17% bagasse and 4% wood chips.

Hence, two new types of biomass residues were identified as being able to satisfy humidity requirements in order to be used in the plant´s boilers: cane bagasse (obtained from two nearby sugar cane mills) and wood chips from nearby sawmills. Sawmills provide, free of charge, wood waste accumulated from their Teak and Melina processing lines to the three suppliers that furnish the wood chips used by Inolasa, The first usage of this new biomass was registered in January 2013, where cane bagasse shipments from Azucarera El Palmar took place. It is therefore clear that change was not known prior to the registration of the project.

In terms of the project´s ability to produce verifiable emission reductions, the change is not expected to have an impact. The boiler and the rest of the equipment in place have not been upgraded and therefore at this point the project does not have capacity for additional production.

[11] Version 03 of the PDD also includes the following minor revisions (not discussed herein as they do not pose any concerns regarding the eligibility of the project):
- Included other origins of biomass from the same project groups as the project owner (already being used since the 5th verification)
- The (monitored) parameter trucki,y was mistakenly included both as a parameter fixed ex-ante and monitored ex-post. Erroneous inclusion in section B.6.2 was removed.
- Adaptation of the PDD to latest template.

Impact on the eligibility of the project

Considering any potential impacts of the changes in terms of five elements concerning the project eligibility:

(i) Additionality

The changes do not pose any risks in terms of the project´s additionality, as the new types of biomass considered are more expensive than the original mix. The additionality analysis in the PDD compares two mutually exclusive projects, i.e. one that generates steam from coal and one that generates the same stream of energy from biomass. Thus, the use of a more expensive *biomass* only makes the baseline alternative (steam production from coal) even more attractive from an economic point of view. The following table presents a brief and conservative comparison between the costs of the original mix of biomass and the ones corresponding to the new types of biomass:

Comparative costs per TJ using different types of biomass[12]

Parameter	**Original biomasses**		**New biomasses**	
	PKH	**EFB**	**Wood Chips**	**Bagasse**
Energy content (TJ/t - dry basis)	22.7	n.a	20.80	18.89
Humidity (%)	17%	n.a	25%	52%
Energy content (TJ/t - wet basis)	18.84	17.9	15.6	9.07
Price per t ($/t - wet)	15.83[13]	50.00	64.40	34.00
Price per TJ ($/TJ)	**0.84**	**2.79**	**4.13**	**3.75**

Thus, it is clear that this change involves a higher price per TJ as compared to the value foreseen in the PDD. Therefore, the gap between the baseline alternative (the project undertaken using coal as fuel) and the project scenario will further widen as a result of the new mix.

(ii) Scale

The scale of the project does not change as a result of the new biomass. As discussed earlier on these notes, all the equipment installed and expected output from the latter remains the same in comparison to the information provided in the PDD.

(iii) Applicability and application of approved baseline methodology under which the project has been registered (or the later version of the methodology)

All justifications for the applicability of the methodology (AMS I.C version 10) provided in section B.2 of the original PDD are not affected by these changes. In terms of the actual application of the methodology, it is required to assess potential leakage effects for the new biomass as per the methodology.

[12] *Comments and sources:* Data used in the estimation of the price per TJ for the original biomass (PKH and EFB) was derived from page 30 of the PDD. Calorific values, moisture contents and prices of new biomasses provided by supplier and available to the DOE. Calculations are available on the file “Biomass Profile and price comparison.xlsx”

[13] Two prices are reported in the PDD (p.30) for PKH: 1 $/t (of which 12,751 tons are available) and 50 $/t (of which only 5,536 tons are bought). This results in a weighted average price of 15.83 $/t.

The "General guidance on leakage in biomass project activities" (version 03) states that projects that use biomass residues or wastes (as is the case of the Inolasa Project), the PDD must assess potential leakage effect from competing uses of the biomass. For example, a biomass power project that displaces biomass wastes from another power plant which, in order to provide a similar amount of energy requires the use of fossil fuels, should account for this cross-effect.

In the specific case of Inolasa, however, the sources providing the biomass are clearly identified and the fate of the biomass in the absence of the project is also known, as summarized in Table 1 below[14]. In every case, it is clear that the biomass wastes would have been dumped and left to decay. Therefore, no leakage needs to be accounted for[15].

Table 1 - Source of new biomass used by the project

Biomass type	Source	Distance (km, roundtrip)	Fate of biomass in the absence of the project
Cane bagasse	Azucarera el Palmar (Ciruelas de Miramar, Puntarenas)	22	Left to decay
Cane bagasse	Ingenio Cutris SA (Boca de Arenal de Cutris, Alajuela)	250	Left to decay
Wood chips	Otto R. Rodríguez	44	Left to decay
Wood chips	Ademar A. Rodríguez	44	Left to decay
Wood chips	Fernando B. Hernández	320	Left to decay

(iv) Compliance of the monitoring plan with applied monitoring methodology

The only change in the monitoring plan is to introduce the distances of the (fixed) points where the new biomass will be sourced. Project emissions arising from transport of the new biomass will be accounted for in the exact same way as the emissions from the original biomass was. Likewise, a provision was introduced to the monitoring plan for cases when leakage needs to be accounted for. Thus, the monitoring plan is in line with the applied monitoring methodology.

[14] Note that the General guidance on leakage in biomass project activities does not contemplate the case of a project that obtains its biomass from specific source. However, this is clearly depicted in the large scale methodology (equivalent to AMS I.C) ACM0006 "Consolidated methodology for electricity and heat generation from biomass" (version 12.1.1). Page 14 states that in order to rule out competing uses of biomass, project participants can "*demonstrate for the sites from where biomass residues are sourced that the biomass residues have not been collected or utilized (e.g. as fuel, fertilizer or feedstock) but have been dumped and left to decay, land-filled or burnt without energy generation (...) prior to their use under the CDM project activity. This approach is only applicable to biomass residues categories for which project participants can clearly identify the site from where the biomass residues are sourced*"

[15] During validation of the changes, availability of surplus biomass was demonstrated by indicating a site-specific surplus for the sources providing cane bagasse and a country-wide surplus existence of unused wood residues ("Processing, use and market of wood in Costa Rica", in *Revista Forestal Mesoamerica* (Vol. 8, 2011). This publication states (p.6) that "*manipulation and disposal of (wood industry) residues represents a serious problem in for the majority of the industries assessed*" and (p.7) that "*A generalized problem with the use and management of wood industry residues exist, which translates into low wood yields and do not constitute a meaningful economic resource. It is necessary to create a policy that generates the demand for biomass-based energy, by creating incentives for replacement of bunker/diesel boilers into chips/pellets or vegetal coal ones*" (translated from Spanish in the original report).

(v) Level of accuracy of the monitoring compared with the requirements contained in the registered monitoring plan

No changes in the accuracy levels of monitoring instruments are contemplated in the changes to this project. Thus, the accuracy and completeness in the monitoring process is not reduced as a result of the revision.

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History of the document

Version	Date	Nature of revision
04.1	11 April 2012	Editorial revision to change history box by adding EB meeting and annex numbers in the Date column.
04.0	EB 66 13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for small-scale CDM project activities” (EB 66, Annex 9).
03	EB 28, Annex 34 15 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.
02	EB 20, Annex 14 08 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>.
01	EB 07, Annex 05 21 January 2003	Initial adoption.
Decision Class: Regulatory **Document Type:** Form **Business Function:** Registration		