# Project design document form for small-scale CDM project activities

**(Version 08.0)**

*Complete this form in accordance with the Attachment "Instructions for filling out the project design document form for small-scale CDM project activities" at the end of this form.*

| 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 10 |
| **Completion date of the PDD** | 20/06/2018 |
| **Project participant(s)** | 1. Industrial de Oleaginosas Americanas S.A. (INOLASA) |
| **Host Party** | Costa Rica |
| **Applied methodology(ies) and, where applicable, applied standardized baseline(s)** | Applied methodology: "*Thermal energy for the user with or without electricity*", AMS-I.C, version 20, 01 June, 2014 |
| **Sectoral scope(s) linked to the applied methodology(ies)** | Sectoral scope: 1: Energy industries (renewable - / non-renewable sources |
| **Estimated amount of annual average GHG emission reductions** | 50,710 |

## SECTION A. Description of project activity

### A.1. Purpose and general description of project activity

Note: This is the revised PDD corresponding to the **second** crediting period of this project.

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 (PKS), 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 **354,969 $tCO_2$** during the crediting period.

The proposed project activity is being 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.

Pre-project operation at INOLASA involved 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 therefore set to represent the baseline situation.

**Table 1**

| Pre-project 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. Since version 03 of this PDD, bagasse and wood chips are also contemplated. In said revision, availability of cane bagasse and wood chips was demonstrated by indicating a site-specific surplus for the sources providing former as well as a country-wide surplus existence of unused wood residues for the latter[1].

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.

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[1] As allowed in ACM0006 version 12.1.1 – see p.14. In the event additional sources of bagasse are contemplated, the project participant will provide evidence of the fate of this biomass in the absence of the project. If this was not possible, leakage emissions shall be deducted as per the latest version of the tool “*Leakage in biomass small-scale project activities*”.

<u>Environmental aspects:</u>

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
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 2 - Location map of INOLASA**

## A.3. Technologies and/or measures

Currently, steam is produced with three 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 replaced the existing 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 12.7 bar. INOLASA will install, operate and maintain this new boiler that is imported from Malaysia. The boiler will combust biomass in a mixture of approximately 37% palm kernel shells, 42% empty fruit branches, 14% bagasse and 7% wood chips, depending on availability, 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 2 – Key information**

| 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 3 – Technical Design Specification of Biomass Boiler**

| 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 | 12.7 bar (1270 kPa) 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: | 37% palm kernel shells, 42% empty fruit branches, 14% bagasse and 7% wood chips, depending on availability. |
| Dust Emissions | <=100 mg/ nm³ |

| | |
|---|---|
| Overall efficiency on Gross Calorific Value of | 80%[2] |

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[3]. 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.

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[2] During actual implementation, and considering that a different biomass mix (with a higher moisture rate) was ultimately used for this project, boiler efficiency has been less than this nominal value. In terms of additionality, this implies that the baseline alternative (i.e. coal fire boiler) would have been even more desirable than the project scenario.

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

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 available 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 m³, located next to the boiler.

**Figure 3 - Picture of the EFB storage**

**Figure 4 - Palm fruit**

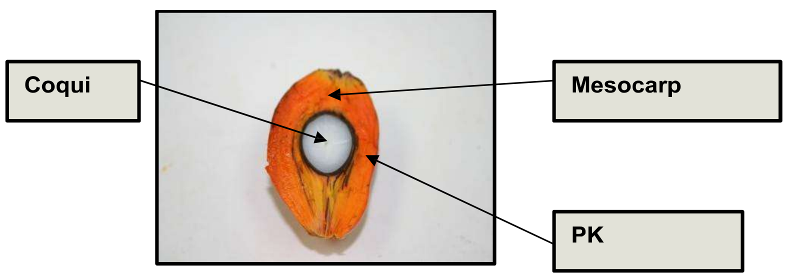
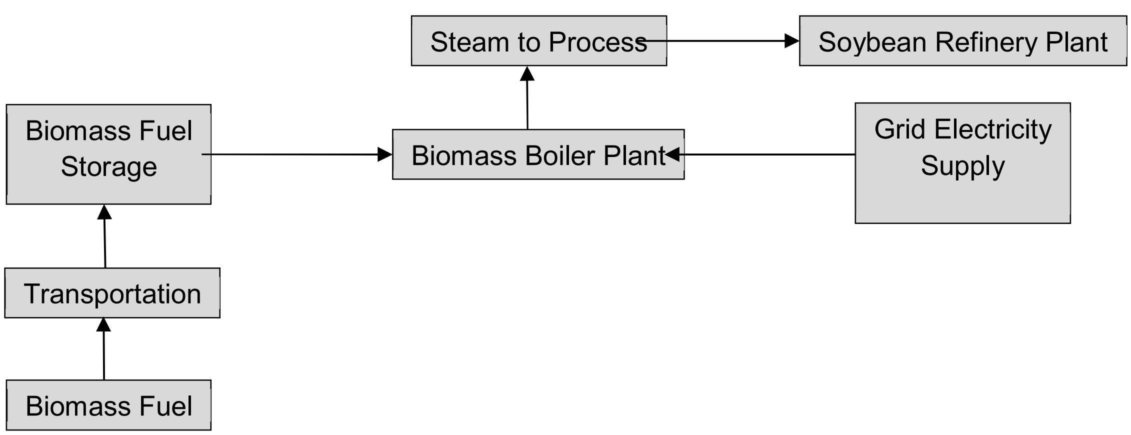



**Figure 5 - Diagram of the process (project activity)**



## A.4. Parties and project participants

| Party involved<br>(host) indicates host Party | Private and/or public entity(ies) project participants<br>(as applicable) | Indicate if the Party involved wishes to be considered as project participant (Yes/No) |
|---|---|---|
| Costa Rica (host) | Private entity:<br>Industrial de Oleaginosas Americanas S.A (INOLASA) | 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 and standardized baseline

## B.1. Reference of methodology and standardized baseline

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 20.0 (EB79, 01 June, 2014)

Tools used:

- "*Project and leakage emissions from transportation of freight*" (version 01.1.0)
- "*Tool for the demonstration and assessment of additionality*[4]" (version 2)
- "*Methodological tool – Determining the baseline efficiency of thermal or electric energy generation systems" (Version 02.0)*
- "*Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation*" (version 03)
- "*Tool to calculate the emission factor for an electricity system*" (version 06.0)

[4] Valid at the time of the original additionality analysis.

- "*Leakage in biomass small-scale project activities*" (version 04.0)

UNFCCC CDM website:
http://cdm.unfccc.int/methodologies/DB/W3TINZ7KKWCK7L8WTXFQQOFQQH4SBK

## B.2. Project activity eligibility

| Condition | Comments |
|---|---|
| 2. This methodology comprises renewable energy technologies that supply users with thermal energy that displaces fossil fuel use. These units include technologies such as solar thermal water heaters and dryers, solar cookers, energy derived from renewable biomass and other technologies that provide thermal energy that displaces fossil fuel. | The project comprises the installation and commissioning of a biomass boiler used to provide heat to INOLASA, a soybean products processing facility, thus displacing use of coal. |
| 3. Biomass-based cogeneration and trigeneration systems are included in this category. | Not applicable, as the project does not involve simultaneous generation of thermal energy and electricity in one process. |
| 4. Emission reductions from a biomass cogeneration or trigeneration system can accrue from one of the following activities:<br>(a) Electricity supply to a grid;<br>(b) Electricity and/or thermal energy (steam or heat) production for on-site consumption or for consumption by other facilities;<br>(c) Combination of (a) and (b). | Not applicable |
| 5. Project activities that seek to retrofit or modify an existing facility for renewable energy generation are included in this category. | The pre-project scenario considers a bunker-fuelled boiler, which is replaced by a renewable energy source. Baseline scenario is the use of coal instead of biomass (discussed below). |
| 6. In the case of new facilities (Greenfield projects) and project activities involving capacity additions the relevant requirements related to determination of baseline scenario provided in the "General guidelines for SSC CDM methodologies" for Type-II and Type-III Greenfield/capacity expansion project activities also apply. | This project was undertaken in an existing facility. |
| 7. The total installed/rated thermal energy generation capacity of the project equipment is equal to or less than 45 MW thermal | The biomass boiler rating is 35 ton of steam/hr at 35 bar. This corresponds to an energy capacity of about 27 $MW_{thermal}$. |
| 8. For co-fired systems, the total installed thermal energy generation capacity of the project equipment, when using both fossil and renewable fuel, shall not exceed 45 MW thermal. | No co-firing is involved in this project activity. |
| 9. The following capacity limits apply for biomass cogeneration and trigeneration units:<br>(a) If emission reductions of the project activity are on account of the thermal and electrical energy | Not applicable |

| | |
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| production, the total installed thermal and electrical energy generation capacity of the project equipment shall not exceed 45 MW thermal. For the purpose of calculating this capacity limit the conversion factor of 1:3 shall be used for converting electrical energy to thermal energy (i.e. for renewable energy project activities, the maximal limit of 15 MW(e) is equivalent to 45 MW thermal output of the equipment or the plant);<br>(b) If the emission reductions of the project activity are solely on account of thermal energy production (i.e. no emission reductions accrue from the electricity component), the total installed thermal energy production capacity of the project equipment of the cogeneration unit shall not exceed 45 MW thermal;<br>(c) If the emission reductions of the project activity are solely on account of electrical energy production (i.e. no emission reductions accrue from the thermal energy component), the total installed electrical energy generation capacity of the project equipment of the cogeneration unit shall not exceed 15 MW. | |
| 10. The capacity limits specified in paragraphs 7 to 9 apply to both new facilities and retrofit projects. In the case of project activities that involve the addition of renewable energy units at an existing renewable energy facility, the total capacity of the units added by the project should comply with capacity limits in specified in the paragraphs 7 to 9, and shall be physically distinct from the existing units. | There was no renewable capacity previous to the one installed by this project. |
| 11. If solid biomass fuel (e.g. briquette) is used, it shall be demonstrated that it has been produced using solely renewable biomass and all project or leakage emissions associated with its production shall be taken into account in the emissions reduction calculation. | Not applicable as no processed biomass fuels are used. The project uses palm kernel shells, empty fruit bunches, cane bagasse and wood chips. |
| 12. Where the project participant is not the producer of the processed solid biomass fuel, the project participant and the producer are bound by a contract that shall enable the project participant to monitor the source of the renewable biomass to account for any emissions associated with solid biomass fuel production. Such a contract shall also ensure | No processed biomass fuels are contemplated in the project design. |

| | |
|---|---|
| that there is no double-counting of emission reductions. | |
| 13. If electricity and/or thermal energy produced by the project activity is delivered to a third party i.e. another facility or facilities within the project boundary, a contract between the supplier and consumer(s) of the energy will have to be entered into that ensures there is no double-counting of emission reductions. | The energy produced within the project is to be used on-site within the project developer's premises. |
| 14. If the project activity recovers and utilizes biogas for producing electricity and/or thermal energy and applies this methodology on a standalone basis i.e. without using a Type III component of a SSC methodology, any incremental emissions occurring due to the implementation of the project activity (e.g. physical leakage of the anaerobic digester, emissions due to inefficiency of the flaring), shall be taken into account either as project or leakage emissions as per relevant procedures in the tool "Emissions from solid waste disposal sites" and/or "Project emissions from flaring". In the event that the biomass fuel (solid/liquid/gas) is sourced from an existing CDM project, then the emissions associated with the production of the fuel shall be accounted with that project. | No recovery of biogas is involved in this project. |
| 15. If project equipment contains refrigerants, then the refrigerant used in the project case shall have no ozone depleting potential (ODP). | Not applicable as the equipment does not contain refrigerants. |
| 16. Charcoal based biomass energy generation project activities are eligible to apply the methodology only if the charcoal is produced from renewable biomass sources provided:<br>(a) Charcoal is produced in kilns equipped with methane recovery and destruction facility; or<br>(b) If charcoal is produced in kilns not equipped with a methane recovery and destruction facility, methane emissions from the production of charcoal shall be considered. These emissions shall be calculated as per the procedures defined in the approved methodology "AMS-III.K: Avoidance of methane release from charcoal production by shifting from traditional open-ended methods to mechanized charcoaling process". Alternatively, conservative emission factor values from peer reviewed literature or from a registered CDM project activity can be used, provided that it can be | Not applicable as no charcoal is involved in this project. |

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| demonstrated that the parameters from these are comparable e.g. source of biomass, characteristics of biomass such as moisture, carbon content, type of kiln, operating conditions such as ambient temperature. | |
| 17. In cases where the project activity utilizes biomass, sourced from dedicated plantations, applicability conditions prescribed in the tool "Project emissions from cultivation of biomass" shall apply. | Not applicable |

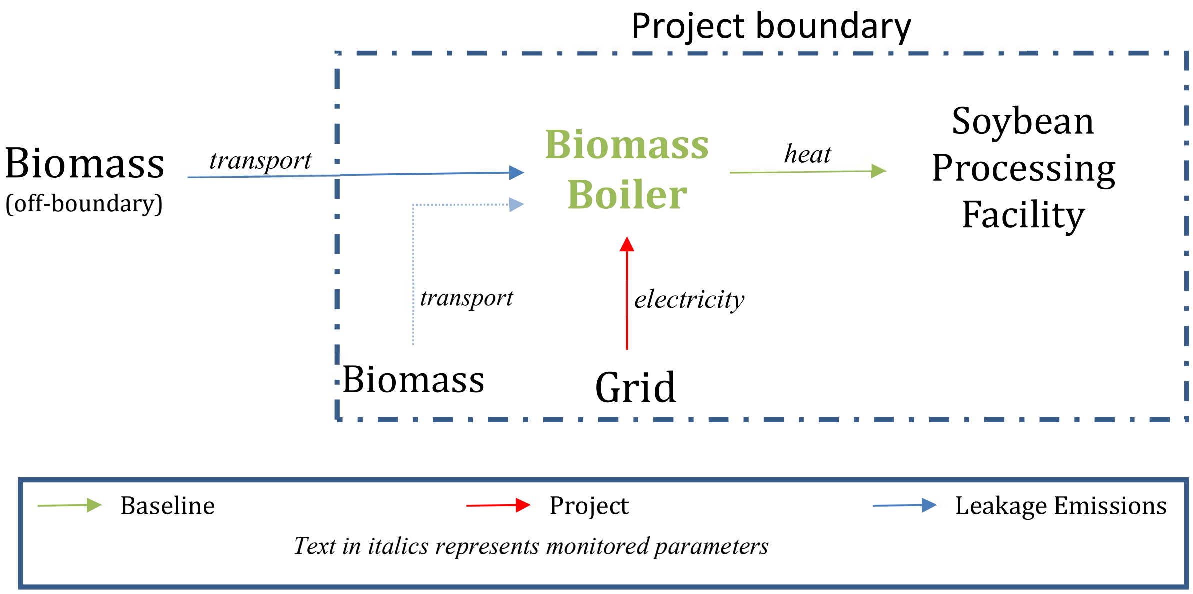
### B.3. Project boundary

In accordance with the methodology, the spatial extent of the project boundary encompasses:

| Component | Comments |
|---|---|
| (a) All plants generating power and/or thermal energy located at the project site, whether fired with biomass, fossil fuels or a combination of both | This includes the INOLASA facility where the biomass boiler is located. |
| (b) All power plants connected physically to the electricity system (grid) that the project plant is connected to | The project is connected to the Costa Rican National Interconnected System. |
| (c) Industrial, commercial or residential facility, or facilities, consuming energy generated by the system and the processes or equipment affected by the project activity | This corresponds to the INOLASA facility. |
| (d) The processing plant of biomass residues, for project activities using solid biomass fuel (e.g. briquette), unless all associated emissions are accounted for as leakage emissions or are part of an independently registered CDM project. | Not applicable as the project does not use processed biomass. |
| (e) The transportation itineraries, if the biomass is transported over distances greater than 200 kilometres, unless all associated emissions are accounted for as leakage emissions | Emissions from transportation itineraries for biomass sources further than 200 km are subject to monitoring and deducted as leakage as per the tool "*Project and leakage emissions from transportation of freight*". |
| (f) The site of the anaerobic digester in the case of project activity that recovers and utilizes biogas for producing electricity and/or thermal energy and applies this methodology on a standalone basis i.e. without using a Type III component of a SSC methodology. | Not applicable as the project does not recover biogas. |

The project boundary is schematized as per the figure below. Note that no GHG reductions are claimed from avoidance of $CH_4$ emissions from the avoided open-air disposal of the biomass wastes used by this project.

**Figure 6 - Project boundary**




## B.4. Establishment and description of baseline scenario

**Assessment of changes in national/sectoral policies at the time of renewal of crediting period**
As per paragraph 289 of the "Clean Development Mechanism Project Standard", version 09.0, the demonstration of the validity of the original baseline or its update does not require a reassessment of the baseline scenario, but rather an assessment of the emissions which would have resulted from that scenario. Moreover, paragraph 290 indicates that project participants shall assess and incorporate the impact of national and/or sectoral polices and circumstances.

In the specific case of Costa Rica, however, there were no changes regarding to the use of biomass/fossil fuels in the legislation applicable to this project respect to the time of its CDM registration. The relevant, applicable legal framework for this project includes the *"Reglamento sobre emisiones de contaminantes atmosféricos provenientes de Calderas y Hornos de Tipo Indirecto # 36551 – S – MINAET - MTSS"*(norms for the emissions from boilers)[5] and the *"Ley Orgánica del Ambiente"* (General environmental law)[6]. Although these norms have been updated since the registration of the project, the use of biomass is still not mandatory and the use of fossil fuels (such as bunker, which is the pre-project scenario, or coal, the baseline scenario) is not forbidden nor restricted. Thus, the national circumstances are the same as they were during the original submission of this project.

The original baseline assessment, based on version 10 of AMS-I.C and its corresponding tools, is provided below. Note however that this is the same baseline that would result from the use of version 20 of the methodology.

[5] *Reglamento sobre emisiones de contaminantes atmosféricos provenientes de Calderas y hornos de tipo indirecto #36551-S-MINAET-MTSS* (including reforms introduced in 24/09/2012) is available to the DOE.

[6] *Ley Orgánica del ambiente* (Law No. 7554, originally from 04/10/1995, last reformed in 25/06/2012) is available to the DOE.

**Table 4 - Baseline as originally presented for the first crediting period**

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|---|
| **<u>Baseline</u>**<br>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.<br><br>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 <u>that would have been used</u> 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.<br><br>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.<br><br>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.<br><br>Additional supporting information submitted to the validator includes:<br>• Financial analysis for each alternative scenario<br>• Quotation for a coal boiler<br>• Quotation and investment details for a biomass boiler<br>• Description of technological innovations of the biomass firing system in question |

## B.5. Demonstration of additionality

As per paragraph 287 of the "Clean Development Mechanism Project Standard", version 07.0, for the preparation of a revised PDD "Project participants shall update those sections of the project design document (CDMPDD) relating to the baseline, estimated emission reductions and the monitoring plan using an approved baseline and monitoring methodology"; therefore section B.5 on demonstration of additionality remains the same as that for the registered CDM-PDD corresponding to the first crediting period.

**Table 5 - Additionality demonstration as per original PDD**

| |
|---|
| 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 fulfil 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)". 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 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 | +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 | 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** | **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 economic sustainable development.

## B.6. Emission reductions

### B.6.1. Explanation of methodological choices

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \quad (1)$$

Where:

| | |
|---|---|
| $ER_y$ | Emission reductions in year *y* ($tCO_2e$) |
| $BE_y$ | Baseline emissions in year *y* ($tCO_2e$) |
| $PE_y$ | Project emissions in year *y* ($tCO_2$) |
| $LE_y$ | Leakage emissions in year *y* ($tCO_2$) |

Each of these items will be discussed below.

**<u>Baseline emissions</u>**

The emission reductions are realized by avoidance of emissions from the combustion of coal for the generation of steam for the internal production processes; this is the only source of GHG reductions claimed by the project (and thus $BE_y = BE_{thermal,CO2,y}$).

Paragraph 33 on AMS-I.C version 20 establishes that baseline emissions from heat production are to be estimated as:

(2) $$BE_{thermal,CO2,y} = (EG_{thermal,y}/\eta_{BL,thermal}) \cdot EF_{FF,CO2}$$

Where:

| | |
|---|---|
| $BE_{thermal,CO_2,y}$ | The baseline emissions from thermal energy displaced by the project activity during the year *y* ($tCO_2$) |
| $EG_{thermal,y}$ | The net quantity of thermal energy supplied by the project activity during the year *y* (TJ). *Calculated based on the difference in enthalpy and the amount of steam supplied (see below)* |
| $EF_{FF,CO_2}$ | The $CO_2$ emission factor of the fossil fuel that would have been used in the baseline plant obtained from reliable local or national data if available, alternatively, IPCC default emission factors can be used ($tCO_2/TJ$). *Although coal is the baseline fuel, the methodology requires use of the pre-project fuel's emission factor (in this case, bunker) if the latter is more conservative than the former (discussed below).* |
| $\eta_{BL,thermal}$ | The efficiency of the plant using fossil fuel that would have been used in the absence of the project activity. *Manufacturer value is used as discussed below.* |

According to page 27 of the methodology, the net amount of heat ($EG_{thermal,y}$) is determined using the difference in enthalpy, i.e. the difference in the enthalpy between the liquid entering and the steam leaving the boiler. As discussed during the validation of the project[7], the boiler has to operate at a constant, 12.7 bar pressure. Therefore, this parameter is given by:

(3) $$EG_{thermal,y} = F_{ss,y} \cdot (h_g - h_f)$$

Where:

| | |
|---|---|
| $F_{ss,y}$ | Steam flow from the biomass boiler in the period *y* (t/period) |
| $h_g$ | Enthalpy of the saturated steam leaving boiler (in TJ/t) |
| $h_f$ | Enthalpy of the liquid entering boiler (in TJ/t) |

As the baseline for this project was determined to be the use of a coal-fired boiler[8], the efficiency provided by the manufacturer of the coal boiler was considered for the parameter $\eta_{BL,thermal}$ during the first crediting period. This is consistent with option (d) in page six of the "*Tool to determine the baseline efficiency of thermal or electric generation systems*" (version 02) and therefore the approach will also be used for this second period[9].

Regarding the remaining parameter, $EF_{FF,CO2}$, the methodology (p.9) states that "*For project activities implemented in existing facilities where the additionality is demonstrated based on a baseline scenario that is not the continuation of the current practice (e.g. continued use of the fossil fuel that was used prior to the implementation of the project activity), the baseline emission*

[7] Validation Report, page 39.

[8] This was not the same as the pre-project scenario, consisting of a bunker-fired boiler.

[9] The coal boiler efficiency was originally derived from a coal boiler quotation, as demonstrated during the project's validation (see e.g. Validation Report, p. 14 and 17). No full-load functions / performance curves were available at the date and thus the use of this value is justified as per page 9 of the referred tool.

*factor is chosen as lower of the two: (a) the emission factor of the fossil fuel that would have been used in the identified baseline scenario; and (b) the emission factor of the fossil fuel that was used prior to the implementation of the project activity*". Thus, the emission factors for coal (baseline) and bunker (pre-project) are compared: the emission factor for coal implicit in the original PDD[10] is 92.50 $tCO_2/TJ$, whereas the default IPCC emission factor[11] for residual fuel oil is 77.40 $tCO_2/TJ$; thus the latter will be used.

**<u>Project emissions</u>**

According to the methodology, the following items must be considered:

**Table 6 - Project emissions considered**

| Element / requirement | Included? | Comments |
|---|---|---|
| $CO_2$ emissions from on-site combustion of fossil fuels ($PE_{FF,y}$) shall be calculated using the latest version of the "*Tool to calculate project or leakage $CO_2$ emissions from fossil fuel combustion*". | yes | A bulldozer is occasionally required to transport biomass within the project site[12]. Details on the calculation are provided below. |
| $CO_2$ emissions from electricity consumption ($PE_{EC,y}$) shall be calculated using the latest version of the "*Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation*". | yes | Electricity consumption of the biomass boiler is directly attributable to the project and therefore the respective emissions are accounted for. Details on the calculations are provided below. |
| Any other significant emissions associated with project activity within the project boundary. | no | No additional sources of emissions attributable to the project take place within the project boundary (see however the discussion on leakage below). |
| For geothermal project activities, project participants shall account for the following emission sources, where applicable: fugitive emissions of carbon dioxide and methane due to release of non-condensable gases from produced steam; and carbon dioxide emissions resulting from combustion of fossil fuels related to the operation of the geothermal power plant. | no | Not applicable. |

In line with the previous table, and in accordance with the notation from the respective tools, project emissions are given by:

(4) $$PE_y = PE_{FF,j,y} + PE_{EC,y}$$

Where:

---

[10] Resulting from the reported net calorific value of 25.73 TJ/kt and the emission factor of 2380 $tCO_2/kt$.

[11] IPCC 2006, Vol. 2, Chapter 1, Table 1.4.

[12] Additionally, bunker may be consumed during biomass-boiler down-times. However, this corresponds to the pre-project scenario and therefore no baseline / project emissions are accounted during such periods.

| | |
|---|---|
| $PE_y$ | Project emissions from the project activity during the year *y* ($tCO_2$/period) |
| $PE_{FF,j,y}$ | Project emissions from fossil fuel consumption during year *y* ($tCO_2$/period); no fuel consumption takes place in the project scenario[13] (this parameter is the same as $PE_{FC,j,y}$ on the "*Tool to calculate project or leakage CO2 emissions from fossil fuel combustion*"). |
| $PE_{EC,y}$ | Project emissions from electricity consumption in period *y* ($tCO_2$/period) |

Emissions from electricity consumption, calculated as per the "*Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation*" (p. 5) are given by:

$$PE_{EC,y} = \sum_j EC_{PJ,j,y}.EF_{EL,j,y} \cdot (1 + TDL_{j,y}) \quad (5)$$

Where:

| | |
|---|---|
| $PE_{EC,y}$ | Project emissions from electricity consumption in year *y* ($tCO_2$/yr); |
| $EC_{PJ,j,y}$ | Quantity of electricity consumed by the project electricity consumption source *j* in period *y* (MWh/yr)[14]; |
| $EF_{EL,j,y}$ | Emission factor for electricity generation for source *j* in year *y* ($tCO_2$/MWh)[15] |
| $TDL_{j,y}$ | Average technical transmission and distribution losses for providing electricity to source *j* in year *y* |

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

Leakage accounts for emissions outside the project's boundary but occurring as a result of the implementation of the CDM activity. The methodology establishes the following considerations for leakage emissions:

**Table 7 - Leakage emissions considered**

| Element / requirement | Included? | Comments |
|---|---|---|
| If the energy generating equipment currently being utilised is transferred from outside the boundary to the project activity, leakage is to be considered. | no | The biomass-boiler and all ancillary equipment used in this project was new and therefore no transference from a different sector took place. |
| In cases where the collection/processing/transportation of biomass residues is outside the project boundary and due to the implementation of the project activity biomass residues are transported over a distance of 200 kilometres, $CO_2$ emissions from the | yes | Transportation of biomass from all sources will be monitored; emissions derived from distances further than 200 km will be deducted as leakage. Details on the calculations are provided below. |

[13] Only minor fuel consumption takes place occasionally to run an on-site bulldozer; however, as demonstrated in past verifications, such emission source represents less than 1% of the project's emission reductions and thus is neglected in this monitoring plan.

[14] The only process in this case is the operation of the biomass boiler.

[15] Calculated according to the "Tool to calculate the emission factor for an electricity system"; details provided in the Annex.

| | | |
|---|---|---|
| collection/processing/transportation of biomass residues to the project site shall be taken into account as leakage using the latest version of the tool "Project and leakage emissions from transportation of freight". | | |

Emissions from transportation of biomass from sources further than 200 km are calculated in accordance to Option B (default values) of the tool "*Project and leakage emissions from transportation of freight*" (version 01.1.0):

(6)

$LE_y = LE_{TR,y} = \sum_f D_{f,y} \cdot FR_{f,y} \cdot EF_{CO2,f} \cdot 10^{-6}$ , when $D_{f,y} > 200$ km;

or:

$LE_y = 0$, when $D_{f,y} \leq 200$ km

Where:

| | |
|---|---|
| $LE_{TR,y}$ | Leakage emissions from transportation of freight monitoring period *y* ($tCO_2$); |
| $D_{f,y}$ | Round trip distance between the origin and destination of freight transportation activity *f* in monitoring period *y* (km); |
| $FR_{f,y}$ | Total mass of freight transported in freight transportation activity *f* in monitoring period *y* (t) |
| $EF_{CO2,f}$ | Default $CO_2$ emission factor for freight transportation activity *f* (gCO2/t km); *default values provided by the tool* |
| *f* | Each of the freight transportation activities conducted in the project activity and involving distances larger than 200 km in monitoring period *y* |

Details on the monitored/default values assigned to each parameter are provided in the sections below.

### B.6.2. Data and parameters fixed ex ante

| Data / Parameter | $\eta_{BL,thermal}$ |
|---|---|
| Unit | % |
| Description | Efficiency of the baseline (coal based) boiler. |
| Source of data | Quotation from boiler manufacturer. |
| Value(s) applied | 78% |
| Choice of data or Measurement methods and procedures | This is consistent with option (d) in page six of the "*Methodological tool – Determining the baseline efficiency of thermal or electric energy generation systems*" (version 02.0). |
| Purpose of data | Calculation of $BE_{thermal,y}$ |
| Additional comment | |

| Data / Parameter | $EF_{FF,CO2}$ |
|---|---|

| | |
|---|---|
| Unit | tCO2/TJ |
| Description | CO2 emission factor of the fossil fuel that would have been used in the baseline plant. |
| Source of data | 2006 IPCC Guidelines for National GHG Inventories. Vol 2 (Energy), table 1.4 |
| Value(s) applied | 77.4 tCO2/TJ (corresponding to pre-project scenario fuel, which is residual fuel oil – see comments below). |
| Choice of data or Measurement methods and procedures | As allowed by the methodology. |
| Purpose of data | Calculation of $BE_{thermal,y}$ |
| Additional comment | Although coal is the baseline fuel, the methodology requires use of the pre-project fuel's emission factor (in this case, bunker) if the latter is more conservative than the former. |

| | |
|---|---|
| Data / Parameter | $EF_{EL,j,y}$ |
| Unit | $tCO_2/MWh$ |
| Description | Emission factor for electricity generation for source *j* in year *y* ($tCO_2/MWh$) |
| Source of data | Calculated according to the "*Tool to calculate the emission factor for an electricity system*" (version 06) using official information from the Costa Rican grid. |
| Value(s) applied | 0.2288 $tCO_2/MWh$ |
| Choice of data or Measurement methods and procedures | Details provided in Appendix 4. |
| Purpose of data | Calculation of $PE_{EC,y}$ |
| Additional comment | - |

| | |
|---|---|
| Data / Parameter | $EF_{CO2,f}$ |
| Unit | $gCO_2$/t km |
| Description | Default CO2 emission factor for freight transportation activity *f* |
| Source of data | Project and leakage emissions from transportation of freight |
| Value(s) applied | Light vehicles: 245 $gCO_2$/t km<br>Heavy vehicles: 129 $gCO_2$/t km |
| Choice of data or Measurement methods and procedures | Default values as provided by the tool. |
| Purpose of data | Calculation of $LE_{TR,y}$ |
| Additional comment | Light vehicles are vehicles with a Gross Vehicle Mass (GVM[16]) equal or less to 26 tonnes; otherwise the vehicle is considered "Heavy". |

| | |
|---|---|
| Data / Parameter | $TDL_{j,y}$ |
| Unit | - |
| Description | Average technical transmission and distribution losses for providing electricity to source *j* in year *y* |

[16] Maximum on-road mass of the fully-loaded vehicle, consisting of its tare mass (i.e. vehicle mass) and the mass of the load (i.e. the freight).

| | |
|---|---|
| Source of data | CEPAL, Estadísticas del subsector Eléctrico 2012[17] (Central American Statistics for the electric sector compiled by UN's ECLAC) |
| Value(s) applied | 11.6% |
| Choice of data or Measurement methods and procedures | Default value as provided by the tool for project consumption sources |
| Purpose of data | Calculation of $PE_{EC,y}$ |
| Additional comment | - |

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

The ex-ante estimation uses the same set of equations that will be used for emission reductions calculations during actual monitoring and verification. Assumptions were made for parameters that will be determined through monitoring.

Equation (2) is used to estimate ex-ante emission reductions. For the latter, the only monitored parameter is $EG_{thermal,y}$ , which is estimated using a revised assumption regarding internal energy demand (462,707 GJ/yr for 2014[18]), increased 5.90% every year (same increase rate as per the original PDD). Baseline coal boiler efficiency ($\eta_{BL,thermal}$) and its corresponding emission factor ($EF_{FF,CO2}$) are determined ex-ante according to details given in section B.6.2; therefore the same values are used for the emission reduction estimate.

Equation (4) indicates two sources of project emissions, of which only $PE_{EC,y}$ is relevant for this project. The parameters involved in the calculation of the latter include:

**Table 8 – Assumptions for the ex-ante estimate of project emissions**

| Parameter | Assumption |
|---|---|
| $EC_{PJ,j,y}$ | 2,826 MWh/yr, corresponding to the biomass boiler consumption. As per the original PDD (Appendix 4); this is obtained considering 6,000 hours of usage per year, for a rated consumption of 471 kW. |
| $EF_{EL,j,y}$ | Ex-ante grid emission factor as per B.6.2 (see details in Appendix 4) |
| $TDL_{j,y}$ | As per B.6.2 |

The last equation required is the one corresponding to leakage emissions, i.e. equation number (6). Each of its components are discussed in the table below.

**Table 9 – Assumptions for the ex-ante estimate of leakage emissions**

| Parameter | Assumption |
|---|---|
| $D_{f,y}$ | As per B.6.2 (note that the project brings biomass from pre-fixed sites only). |
| $FR_{f,y}$ | As stated on the project description, the boiler is expected to combust, depending on availability, roughly |

[17] http://repositorio.cepal.org/bitstream/handle/11362/26293/1/M20130047_es.pdf (Spanish version available only)

[18] The base value for 2014 results from considering a requirement of 190,453 tonnes of steam and the enthalpy values reported in section B.6.2. Said requirement is based on the plants' historical demand in the period 2008-2013.

| | |
|---|---|
| | 37% palm kernel shells, 42% empty fruit branches, 14% bagasse and 7% wood chips. The respective energy contents are used to determine how many GJs and tonnes will be covered and required from each type of biomass. Finally, the percentage of biomass from each of the (fixed) locations is based on the experience from the project's latest verification[19]. Detailed calculations are available on the spreadsheet submitted with the revised PDD. |
| $EF_{CO2,f}$ | As per B.6.2 |

The following is the ex-ante assumption of energy and biomass demand for the project, based on the assumptions from the previous tables in this section (Table 8 and Table 9):

**Table 10 – Ex-ante estimate of energy and biomass demand**

| Year | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|
| Energy Demand (GJ) | 462,707 | 490,007 | 518,918 | 549,534 | 581,956 | 616,292 | 652,653 |
| Biomass Demand (t) | | | | | | | |
| PKS (t) | 21,299 | 22,556 | 23,887 | 25,296 | 26,788 | 28,369 | 30,043 |
| Palo Seco (Quepos) | 2,130 | 2,256 | 2,389 | 2,530 | 2,679 | 2,837 | 3,004 |
| Naranjo (Quepos) | 2,343 | 2,481 | 2,628 | 2,783 | 2,947 | 3,121 | 3,305 |
| Coto (Puntarenas) | 14,270 | 15,112 | 16,004 | 16,948 | 17,948 | 19,007 | 20,129 |
| Río Escondido (Nicaragua) | 2,556 | 2,707 | 2,866 | 3,036 | 3,215 | 3,404 | 3,605 |
| EFB (t) | 24,178 | 25,604 | 27,115 | 28,714 | 30,409 | 32,203 | 34,103 |
| Palo Seco (Quepos) | 12,089 | 12,802 | 13,557 | 14,357 | 15,204 | 16,101 | 17,051 |
| Naranjo (Quepos) | 12,089 | 12,802 | 13,557 | 14,357 | 15,204 | 16,101 | 17,051 |
| Wood Chips (t) | 4,030 | 4,267 | 4,519 | 4,786 | 5,068 | 5,367 | 5,684 |
| Otto Rucavado (Orotina) | 806 | 853 | 904 | 957 | 1,014 | 1,073 | 1,137 |
| Ademar Rodríguez (Orotina) | 806 | 853 | 904 | 957 | 1,014 | 1,073 | 1,137 |
| Fernando B. Hernández (Guanacaste) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BCRI S.A / IPCN S.A (Las Juntas) | 2,418 | 2,560 | 2,711 | 2,871 | 3,041 | 3,220 | 3,410 |
| Bagasse (t) | 8,059 | 8,535 | 9,038 | 9,571 | 10,136 | 10,734 | 11,368 |
| Azucarera El Palmar (Puntarenas) | 4,836 | 5,121 | 5,423 | 5,743 | 6,082 | 6,441 | 6,821 |
| Ing. Cutris (Alajuela) | 3,224 | 3,414 | 3,615 | 3,829 | 4,054 | 4,294 | 4,547 |

[19] Note, however, that actual amounts transported from each site are outside of INOLASA's control and therefore subject to uncertainty and biomass availability. Freight cargo from each site will consequently be duly monitored as depicted on section B.7.

**Table 11 - Ex-ante estimate of baseline, project and leakage emissions**

| Year | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|
| **Baseline emissions (tCO2)** | 45,915 | 48,624 | 51,493 | 54,531 | 57,748 | 61,155 | 64,763 |
| **Project emissions (tCO2)** | 722 | 722 | 722 | 722 | 722 | 722 | 722 |
| From electricity consumption (tCO2) | 722 | 722 | 722 | 722 | 722 | 722 | 722 |
| **Leakage (tCO2)** | 2,893 | 3,063 | 3,244 | 3,436 | 3,638 | 3,853 | 4,080 |
| From transportation of PKS (tCO2) | 1,959 | 2,075 | 2,197 | 2,327 | 2,464 | 2,610 | 2,763 |
| Palo Seco (Quepos) | 73 | 77 | 82 | 87 | 92 | 97 | 103 |
| Naranjo (Quepos) | 80 | 85 | 90 | 95 | 101 | 107 | 113 |
| Coto (Puntarenas) | 1,252 | 1,326 | 1,404 | 1,487 | 1,574 | 1,667 | 1,766 |
| Río Escondido (Nicaragua) | 554 | 587 | 621 | 658 | 697 | 738 | 781 |
| From transportation of EFB (tCO2) | 830 | 879 | 930 | 985 | 1,043 | 1,105 | 1,170 |
| Palo Seco (Quepos) | 415 | 439 | 465 | 493 | 522 | 553 | 585 |
| Naranjo (Quepos) | 415 | 439 | 465 | 493 | 522 | 553 | 585 |
| From transportation of Wood Chips (tCO2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Otto Rucavado (Orotina) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ademar Rodríguez (Orotina) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fernando B. Hernández (Guanacaste) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BCRI S.A / IPCN S.A (Las Juntas) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| From transportation of Bagasse (tCO2) | 104 | 110 | 117 | 123 | 131 | 138 | 147 |
| Azucarera El Palmar (Puntarenas) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ing. Cutris (Alajuela) | 104 | 110 | 117 | 123 | 131 | 138 | 147 |
| **Emission Reductions (tCO2)** | **42,300** | **44,839** | **47,527** | **50,373** | **53,388** | **56,581** | **59,961** |

### 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) |
|---|---|---|---|---|
| 2014 | 45,915 | 722 | 2,893 | 42,300 |
| 2015 | 48,624 | 722 | 3,063 | 44,839 |
| 2016 | 51,493 | 722 | 3,244 | 47,527 |
| 2017 | 54,531 | 722 | 3,436 | 50,373 |
| 2018 | 57,748 | 722 | 3,638 | 53,388 |
| 2019 | 61,155 | 722 | 3,853 | 56,581 |
| 2020 | 64,763 | 722 | 4,080 | 59,961 |
| Total | 384,228 | 5,051 | 24,208 | 354,969 |
| Total number of crediting years | 7 | | | |
| Annual average over the crediting period | 54,890 | 722 | 3,458 | 50,710 |

## B.7. Monitoring plan

### B.7.1. Data and parameters to be monitored

| Data / Parameter | $EG_{thermal,y}$ |
|---|---|
| Unit | TJ/period |
| Description | Net quantity of thermal energy supplied by the project activity during the period *y* |
| Source of data | Calculated using equation (3) and data from the mass flow transmitter that determines steam flow ($F_{ss,y}$) and relevant temperatures / pressures of water feed and saturated steam. |
| Value(s) applied | For the purpose of estimating emission reductions ex-ante, a value was assumed directly for $EG_{thermal,y}$ = 462,707 GJ for the base year (2014) with an annual increase of 5.90%, based on the plant's energy requirements. |
| Measurement methods and procedures | Energy is calculated based on steam flow / temperature / pressure data from continuous recording using multivariable mass flow transmitter connected to the SCADA system.<br><br>Temperature and pressure of the feed water as well as the pressure of the saturated steam will be monitored either manually or by means of the SCADA system using calibrated equipment. These are used to determine the enthalpy of feed water entering and saturated steam leaving the boiler (respectively, $h_f$ and $h_g$ in equation 3), by means of wet / saturated steam tables. All values will be reported using SI units. |
| Monitoring frequency | Continuously measured, daily read and monthly recorded / reported.<br><br>Temperature and pressure are continuously monitored, integrated hourly and monthly recorded. |
| QA/QC procedures | Meters have an accuracy rating of at least +/- 5% and are calibrated periodically as per manufacturer specifications. Data and boiler operation can be checked by steam boiler inspector authorized by Labour Ministry. The meters automatically present values in mass units (i.e. the equipment internally accounts for temperature and pressure of the gas). |
| Purpose of data | Calculation of $BE_y$ |
| Additional comment | In general lines, and as discussed in the original validation report[20] the general steam consumption to fulfil soy production requirements at the facility is 525 kg of saturated steam at 10 bars of pressure per each ton of soy produced. The boiler has to operate always at the same pressure because the steam consuming equipment operates at a design pressure. Since the boiler is located at a distance from the plant, the operating pressure needs to be slightly higher at around 12.7 bar in order to always guarantee the supply steam at 10 bar at the plant site. Despite the expected lack of variation in pressure and temperature, both of these will be monitored and used to determine the appropriate enthalpy values. |

[20] Validation report, page 39.

| Data / Parameter | $EC_{PJ,j,y}$ |
|---|---|
| Unit | MWh per period |
| Description | Quantity of electricity consumed by the project electricity consumption source *j* in period *y* |
| Source of data | On-site meter. |
| Value(s) applied | 2,826 MWh/yr (assumption based on the equipment rating and expected operational hours). |
| Measurement methods and procedures | On site Metering equipment |
| Monitoring frequency | Continuously measured, daily read and monthly recorded. |
| QA/QC procedures | The meter is recalibrated as per manufacturer requirements. Meter accuracy is +/- 0.5. |
| Purpose of data | Calculation of $PE_{EC,\ y}$ |
| Additional comment | The only process in this case is the operation of the biomass boiler. |

| Data / Parameter | $FR_{f,y}$ |
|---|---|
| Unit | t |
| Description | Total mass of freight transported in freight transportation activity *f* in monitoring period *y* |
| Source of data | Transport log book. |
| Value(s) applied | See Table 10 on section B.6.3. |
| Measurement methods and procedures | - |
| Monitoring frequency | Continuous. |
| QA/QC procedures | Data can be double checked using invoices from transportation service provider. |
| Purpose of data | Estimation of $LE_y$ |
| Additional comment | As all the biomass is transported to the project site, measuring of this parameter implies measurement of all quantities of biomass consumed by the project. |

| Data / Parameter | $D_{f,y}$ |
|---|---|
| Unit | km |
| Description | Round trip distance between the origin and destination of freight transportation activity *f* in monitoring period *y* (*f* in this case being only transportation of biomass to boiler). |
| Source of data | This information is provided by the contracted transport company. |
| Value(s) applied | Distance Coto 47 to Barranca: 680 km<br>Distance Quepos to Barranca: 266 km<br>Distance Rio Escondido to Barranca: 1680 km<br>Distance Puntarenas to Barranca:22 km<br>Distance Alajuela to Barranca:250 km<br>Distance Orotina to Barranca: 44 km<br>Distance Guanacaste to Barranca: 320 km<br>Distance Las Juntas (Abangares) to Barranca: 120 km |
| Measurement methods and procedures | Distance was determined by the readings of the mileage counter of a representative truck. |
| Monitoring frequency | Continuous. |
| QA/QC procedures | Data can be double checked using invoices from transportation service provider and/or by measuring the distance on a 1:50,000 map. |
| Purpose of data | Estimation of $LE_y$ |
| Additional comment | All sources are monitored; however, leakage emissions will be deducted only from distances larger than 200 km. |

| Data / Parameter | $B_{Biomass,y}$ |
|---|---|
| Unit | Mass or volume for each biomass type. |
| Description | Net quantity of biomass consumed in year $y$ |
| Source of data | Plant records |
| Value(s) applied | Mass or volume-based measurements adjusted by moisture content will be used. The quantity of biomass will be determined for each batch and type of biomass. |
| Measurement methods and procedures | Continuously (upon arrival of each batch). |
| Monitoring frequency | An energy balance (based on documents from purchased quantities) will be prepared to cross-check the measurements and stock changes. |
| QA/QC procedures | Kindly note that this parameter is required for equation (14) in the methodology; however, said equation is not used for the purpose of our baseline emission reductions calculation, which are instead based on actual energy measurements (equation (3)). The parameter is nonetheless monitored to evaluate the overall consistency of the energy measurements. |
| Purpose of data | |
| Additional comment | |

| Data / Parameter | - |
|---|---|
| Unit | % |
| Description | Moisture content of the biomass (wet basis) |
| Source of data | Plant records |
| Value(s) applied | On-site measurements are not required as emission reductions are not calculated based on biomass energy input. Thus, moisture content can either be determined on site or using values provided by the supplier.<br>(In case of dry biomass, monitoring of this parameter is not necessary) |
| Measurement methods and procedures | For each batch of biomass a specific value will be used. This can either be an ex-ante estimate, a value provided by the supplier or a value determined based on on-site measurements<br>The weighted average will be calculated for each monitoring period and used in the calculations |
| Monitoring frequency | - |
| QA/QC procedures | Kindly note that the requirement stated on the methodology (monitoring frequency row for this parameter), which states that “*The moisture content of biomass of homogeneous quality shall be monitored for each batch of biomass*”, applies only to the cases “where emission reductions are calculated based on biomass energy input” (AMS-I.C. ver. 20 p. 29, row “Measurement procedures (if any)” on the biomass moisture content box). |
| Purpose of data | |
| Additional comment | |

### B.7.2. Sampling plan

N.A.

### B.7.3. Other elements of monitoring plan

INOLASA will be in charge of monitoring the performance of the project activity related to carbon emission.

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.

### B.8. Date of completion of application of methodology and standardized baseline and contact information of responsible persons/ entities

This baseline and monitoring methodology application study was completed on 30/04/2014 by Geo Ingeniería Ingenieros Consultores S.A., San José - Costa Rica.

- Phone: + (506) 2290 4656 / Fax: + (506) 2290 5297
- E-mail: scastro@geoingenieria.co.cr

The entity above is not considered a project participant.

## 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 second crediting period starts on 30/11/2014.

#### 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 12**

| 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 |
| 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 |
| 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 |
| 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 13**

| 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 |
| 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 |

| | |
|---|---|
| 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 14**

| | **1. What is your level of participatio n in communal decision** | **2. What kind of participation do you exercise regarding environmental** | **3. What position do you have with regard to the development of the** | **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 | 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 | 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 | No negative effects are expected |
| **Asociación Desarrollo Integral Barranca Puntarenas** | High, we watch over the welfare of the whole | 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 | Damage in the roadways close to the plant. |

| | | | | | |
|---|---|---|---|---|---|
| **Jersen Fallas Alex Brenes** | represent. | entrepreneurs about benefits and damages on an environmental | 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 | 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** | 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 and responsible persons/ entities

| | |
|---|---|
| Project participant and/or responsible person/ entity | ☒ Project participant<br>☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity |
| Organization name | Industrial de Oleaginosas Americanas S.A. (INOLASA) |
| Street/P.O. Box | Barranca |
| Building | |
| City | Puntarenas |
| State/Region | Puntarenas |
| Postcode | |
| Country | Costa Rica |
| Telephone | (506) 2519-7216 |
| Fax | (506) 2220-1208 |
| E-mail | smt@inolasa.com |
| Website | www.inolasa.com |
| Contact person | Fabio Guerrero |
| Title | General Manager |
| Salutation | Mr. |
| Last name | Guerrero |
| Middle name | Jose |
| First name | Fabio |
| Department | |
| Mobile | (506) 8816-5913 |
| Direct fax | (506) 2220-1208 |
| Direct tel. | (506) 2519-7216 |
| Personal e-mail | fgc@inolasa.com |

# Appendix 2. Affirmation regarding public funding

There is no public funding in this project.

# Appendix 3. Applicability of methodology and standardized baseline

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 15**

| | | |
|---|---|---|
| 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 16 - 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 17 - 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 18 - 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.

**Figure 7 - 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.

**V Grid emission factor calculation**

The combined margin emission factor consists of a weighted average between two emission factors: the "Operating Margin" (which focuses on existing fossil fuelled plants affected by the project) and the "Build Margin" (which aims to capture the project's effect on the incorporation of new plants to the grid).

A complete set of updated data that allows performing all relevant calculations is not publicly available. Moreover, the consulting team has approached the relevant authorities in order to request updated data with no response. In light of this, the project uses the latest data available, which is information for the 2008-2010 period.

The relevant Tool to calculate the emission factor for an electricity system (version 06.0) applies six steps for the calculation of $EF_{grid,CM,y}$:

**Step 1. Identify the relevant electricity systems**

For determining the electricity emission factors, a project electricity system is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity and that can be dispatched without significant transmission constraints. As described earlier in this document, in Costa Rica the relevant electric power system for the project is the National Electric System[21] (NES), the only grid in the country.

**Step 2. Choose whether to include off-grid power plants in the project electricity system (optional)**

Project participants are allowed to choose between the following two options to calculate operating margin and build margin emission factors:

- Option I: Only grid power plants are included in the calculation.

- Option II: Both grid power plants and off-grid power plants are included in the calculation.

As the NES represents most of the national generation in Costa Rica, and considering the fact that the project obtains its electricity from the national grid, only grid connected plants will be included in the calculations (i.e. Option I is chosen).

[21] The original name in Spanish is: "*Sistema Interconectado Nacional*"

**Step 3. Select a method to determine the operating margin (OM)**

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:

(a) Simple OM; or

(b) Simple adjusted OM; or

(c) Dispatch data analysis OM; or

(d) Average OM.

In Costa Rica, low cost/must-run resources are comprised solely by renewable energies. The latter constitute more than 50% of the total grid generation, as seen in **Error! Reference source not found.** below; this holds for each year in the period and is therefore valid for the average of these values according to approach 1 presented by the tool (p.12).

**Table 19 - Low cost/Must-run generation in the 2006-2010 period**

| Type | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|
| Renewables | 94% | 92% | 93% | 95% | 93% |
| Fossil fuels | 6% | 8% | 7% | 5% | 7% |
| **Total** | 100% | 100% | 100% | 100% | 100% |

*Source:* Author's elaboration based on ARESEP statistics (see baseline spreadsheet attached)

Likewise, visual inspection of the load duration curves (see figures below) allows to confirm that the average amount of load (MW) supplied by low-cost/must-run resources in a grid in the most recent three-year period is less than the average of the lowest annual system loads corresponding to the same years (i.e. in every year, the curve filled in blue is always greater than the line showing the lowest annual system load).

**Figure 8 – Load duration curve for the Costa Rican grid (2008).**

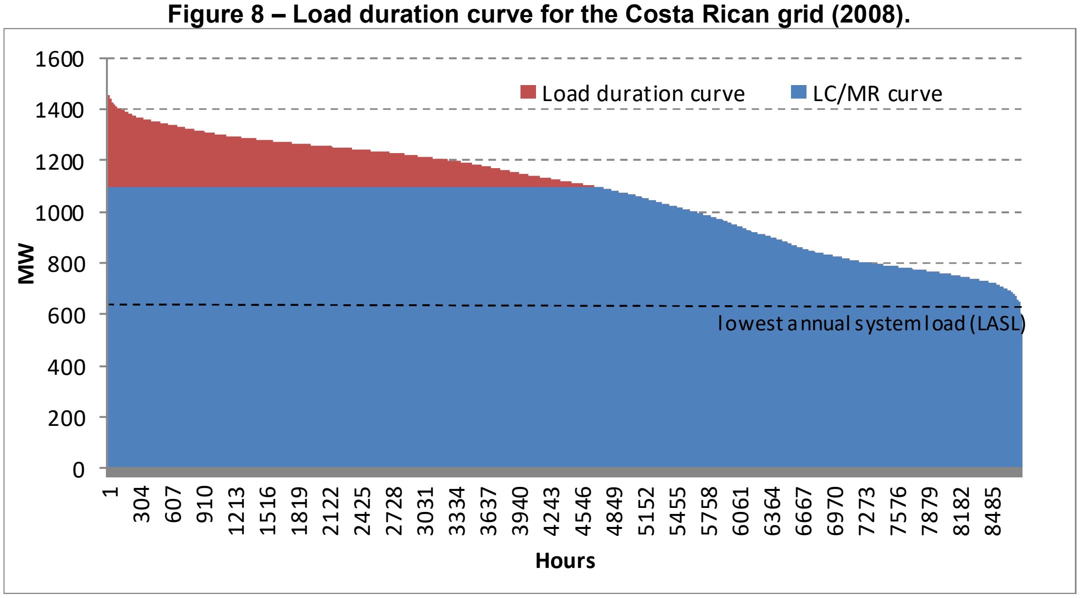


**Figure 9 – Load duration curve for the Costa Rican grid (2009).**

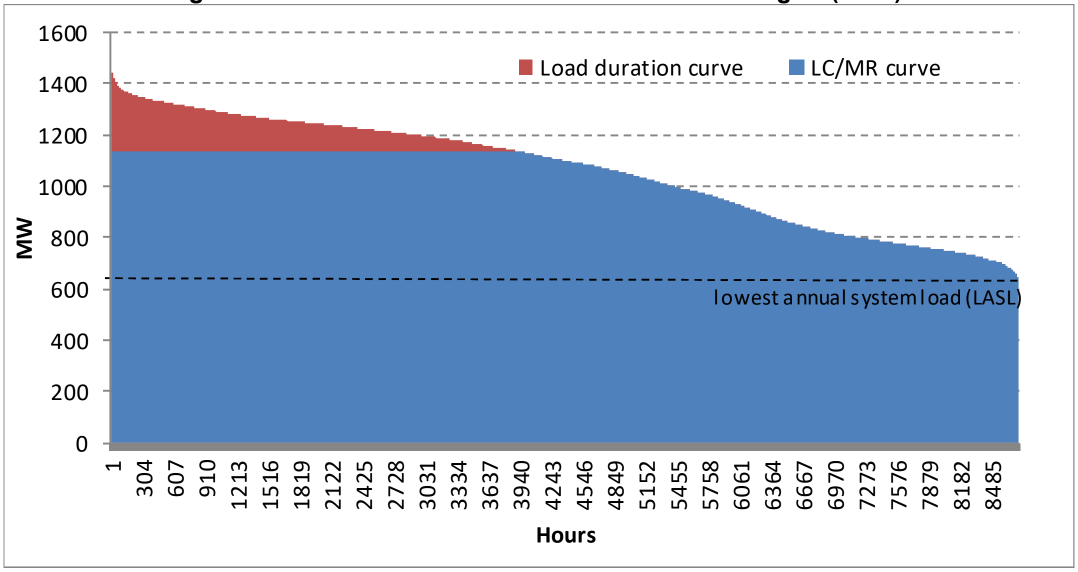
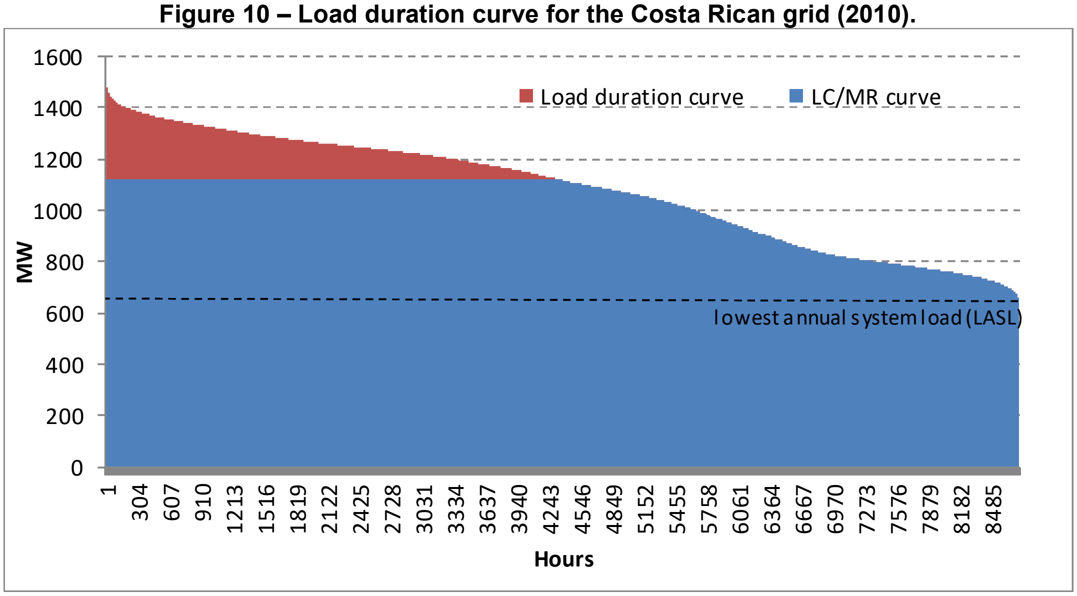
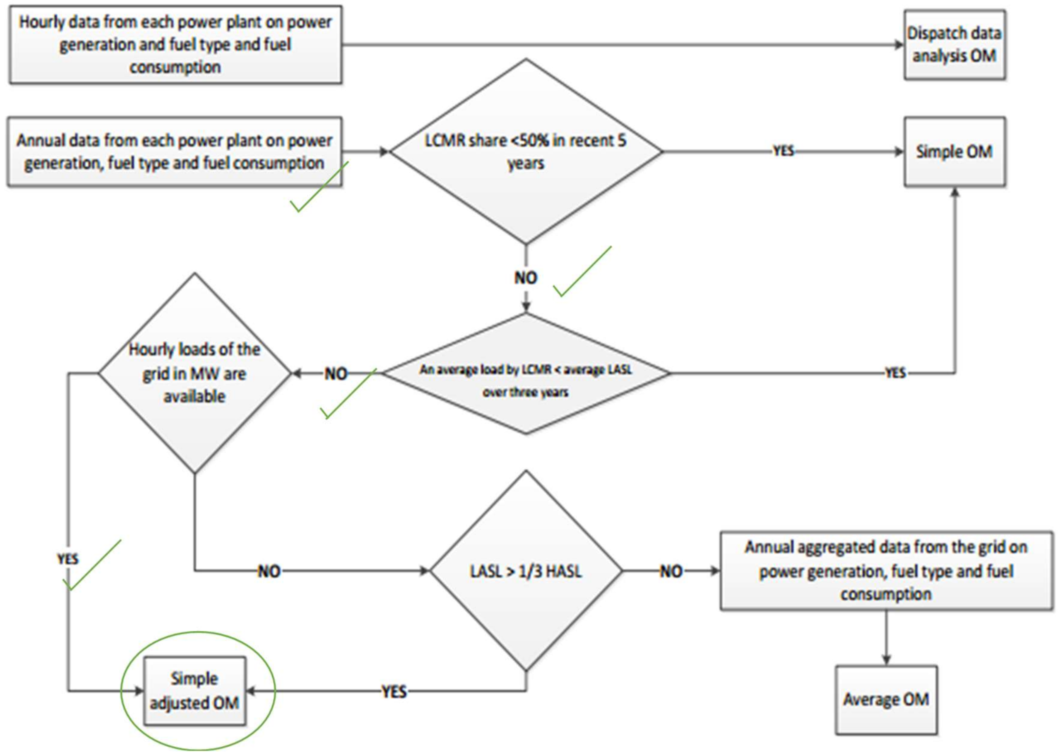



**Figure 10 – Load duration curve for the Costa Rican grid (2010).**




Thus, option (b) (Simple adjusted OM) will be used in the context of this project activity. The methodological choices in this section are summarized in the following figure:

**Figure 11 – Summary of methodological choices for the selection of OM method.**




Finally, the data vintage chosen for the estimation of the simple OM is the *ex-ante* option (paragraph 42 (a) in the tool), i.e. the emission factor is determined once at validation stage, which implies that no monitoring and recalculation of the factor during the crediting period will be required; three years of most recent data available will be used in the calculations.

***Step 4. Calculate the operating margin emission factor according to the selected method.***
The simple adjusted operating margin emission factor ($EF_{grid,OM-adj,y}$) is calculated based on the net electricity generation of each power unit and an emission factor for each power unit, as follows:

$$EF_{grid,OM-adj,y} = (1-\lambda_y)\cdot\frac{\sum_m EG_{m,y}\cdot EF_{EL,m,y}}{\sum_m EG_{m,y}} + \lambda_y\cdot\frac{\sum_k EG_{k,y}\cdot EF_{El,k,y}}{\sum_k EG_{k,y}} \quad (7)$$

where:

$EF_{grid,OM-adj,y}$ = Simple adjusted operating margin $CO_2$ emission factor in year y ($tCO_2/MWh$)
$\lambda_y$ = Factor expressing the percentage of time when low-cost/must-run power units are on the margin in year *y*
$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year *y* (MWh)
$EG_{k,y}$ = Net quantity of electricity generated and delivered to the grid by power unit k in year *y* (MWh)
$EF_{EL,m,y}$ = $CO_2$ emission factor of power unit m in year y ($tCO_2/MWh$)
$EF_{EL,k,y}$ = $CO_2$ emission factor of power unit k in year y ($tCO_2/MWh$); = 0 as in Costa Rica only renewable energies are considered as low cost/must-run units.
*m* = All grid power units serving the grid in year *y* except low-cost/must-run power units
*k* = All low-cost/must run grid power units serving the grid in year *y*

$y$ = The relevant year as per the data vintage chosen in Step 3

As fuel consumption and electricity generation is available, option A.1 of the "Tool to calculate the emission factor for an electricity system" (version 06.0 – see paragraph 50 (a)) is used:

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{EG_{m,y}} \tag{8}$$

Where:

$EF_{EL,m,y}$ = $CO_2$ emission factor of power unit m in year y ($tCO_2/MWh$)
$FC_{i,m,y}$ = Amount of fossil fuel type i consumed by power unit m in year $y$ (Mass or volume unit)
$NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type $i$ in year $y$ (GJ/mass or volume unit)
$EF_{CO2,i,y}$ = $CO_2$ emission factor of fossil fuel type $i$ in year $y$ ($tCO_2/GJ$)
$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit $m$ in year $y$ (MWh)
$m$ = All power units serving the grid in year $y$ except low-cost/must-run power units
$i$ = All fossil fuel types combusted in power unit m in year $y$
$y$ = The relevant year as per the data vintage chosen in Step 3

$EF_{EL,k,y}$ is calculated in an analogous way replacing the $m$ for the $k$ units.

Whenever fuel consumption data is unavailable[22], option A.2 in the "Tool to calculate the emission factor for an electricity system" (version 06.0 – paragraph 50 (b)) is followed and thus the emission factor of each plant is determined according to:

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \cdot 3.6}{\eta_{m,y}} \tag{9}$$

Where:
$EF_{EL,m,y}$ = $CO_2$ emission factor of power unit $m$ in year $y$ ($tCO_2/MWh$)
$EF_{CO2,m,i,y}$ = Average $CO_2$ emission factor of fuel type $i$ used in power unit $m$ in year $y$ ($tCO_2/GJ$)
$\eta_{m,y}$ = Average net energy conversion efficiency of power unit $m$ in year $y$ (ratio)
$m$ = All power units serving the grid in year $y$ except low-cost/must-run power units
$y$ = The relevant year as per the data vintage chosen in Step 3

Lastly, the $\lambda_y$ factor is calculated as per the step-wise procedure presented in Appendix 3 of the tool. A summary of this procedure is as follows[23]:

$$\lambda_y = \frac{\text{number of hours low-cost/must-run sources are on margin in year } y}{\text{8760 hours per year}} \tag{10}$$

Step (i) Plot a load duration curve. Collect chronological load data (typically in MW) for each hour of the year $y$, and sort the load data from the highest to the lowest MW level. Plot MW against 8760 hours in the year, in descending order.

[22] In our data set, only consumption unavailable is the one corresponding to Guápiles/Orotina units in 2008.

[23] Detailed calculations of load duration curves needed to obtain the Lambda factors are available on the EF spreadsheet. The curves are nevertheless presented under Step 3 *supra*.

Step (ii) Collect electricity generation data from each power plant/unit. Calculate the total annual generation (in MWh) from low-cost/must-run power plants/units (i.e. $\Sigma_k EG_{k,y}$).

Step (iii) Find out the intersection on the load duration curve in order to determine a period LCMR sources are on the margin. To find the intersection, fill the area under the load duration curve by the total generation (in MWh) from LCMR power plants/units. To fill the area, plot a horizontal line across the load duration curve such that the area under horizontal line and the curve right from the intersection point (MW times hours) equals the total generation (in MWh) from low-cost/must-run power plants/units (i.e. $\Sigma_k EG_{k,y}$).

Step (iv) Determine the "Number of hours for which low-cost/must-run sources are on the margin in year y". First, locate the intersection of the horizontal line plotted in Step (iii) and the load duration curve plotted in Step (i). The number of hours (out of the total of 8760 hours) to the right of the intersection is the number of hours for which low-cost/must-run sources are on the margin. If the lines do not intersect, then one may conclude that low-cost/must-run sources do not appear on the margin and $\lambda_y$ is equal to zero.

***Step 5. Calculate the build margin (BM) emission factor***

In terms of vintage of data, project participants can choose between one of the following two options:

> **Option 1:** For the first crediting period, calculate the build margin emission factor *ex ante* based on the most recent information available on units already built for sample group *m* at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.
>
> **Option 2:** For the first crediting period, the build margin emission factor shall be updated annually, *ex post*, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available.

Option 1 (*ex ante* build margin) is chosen for this project activity.

The sample group of power units *m* used to calculate the build margin should be determined as per the following procedure, consistent with the data vintage selected above[24]:

(a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently ($SET_{5\text{-}units}$) and determine their annual electricity generation ($AEG_{SET\text{-}5\text{-}units}$, in MWh); according to the latest information available in Costa Rica, the last 5 power units to enter the grid were Garabito, El Encanto, Coneléctrica, Coopeguanacaste and Barranca. Their overall generation was $AEG_{SET\text{-}5\text{-}units}$ = 494,074 MWh.

(b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities ($AEG_{total}$, in MWh; in Costa Rica in 2010: $AEG_{total}$ = 9,080,323 MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of $AEG_{total}$ (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\%}$) and determine their annual electricity generation

[24] The calculations presented in this sub-section can be reproduced from the baseline spread sheet attached to the PDD (see the BM sheet).

($AEG_{SET\geq20\%}$, in MWh); in our data, the set goes from Garabito (commissioned in 2010) to the Angostura (commissioned in 2000), with $AEG_{SET\geq20\%}$ = 2,413,739 MWh.

(c) From $SET_{5\text{-}units}$ and $SET_{\geq20\%}$ select the set of power units that comprises the larger annual electricity generation ($SET_{sample}$); thus, according to INE data, $SET_{sample} = SET_{\geq20\%}$.

Identify the date when the power units in $SET_{sample}$ started to supply electricity to the grid (shown on Table 20). If none of the power units in $SET_{sample}$ started to supply electricity to the grid more than 10 years ago, then use $SET_{sample}$ to calculate the build margin. In our case, the eldest unit in the set (Angostura) was commissioned in 2000, which is more than 10 years ago and thus sub-step (d) must be followed.

**Table 20 - Determination of the set of plants included in the BM w/o CDM projects**

| Plant / unit | Starting date | Fuel | Generation 2010 [MWh] | Cumm. respect overall 2010 generation[25] |
|---|---|---|---|---|
| Garabito | 2010 | Fossil fuel | 24,717 | 0.27% |
| El Encanto (CNFL) | 2009 | Hydro | 52,000 | 0.84% |
| Coneléctrica | 2009 | Hydro | 188,698 | 2.92% |
| Coopeguanacaste (CH Canalete) | 2008 | Hydro | 64,722 | 3.64% |
| Barranca | 2008 | Fossil fuel | 163,937 | 5.44% |
| San Antonio | 2008 | Fossil fuel | 97,804 | 6.52% |
| Cariblanco | 2007 | Hydro | 288,959 | 9.70% |
| El General | 2006 | Hydro | 192,697 | 11.82% |
| Guápiles / Orotina | 2006 | Fossil Fuel | 83,449 | 12.74% |
| Ingenios (Taboga) | 2004 | Bagasse | 35,970 | 13.14% |
| Miravalles V | 2003 | Geothermal | 115,992 | 14.42% |
| Moín CNFL | 2003 | Fossil fuel | 43,796 | 14.90% |
| Peñas Blancas | 2002 | Hydro | 158,862 | 16.65% |
| Angostura | 2000 | Hydro | 902,137 | 26.58% |
| **Total** | | | **2,413,739.22** | 26.58% |

*Source:* Author's elaboration based on ARESEP and DSE statistics (see baseline spread sheet attached)

(d) Exclude from $SET_{sample}$ the power units which started to supply electricity to the grid more than 10 years ago. Include in that set the power units registered as CDM project activities, starting with power units that started to supply electricity to the grid most recently, until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system to the extent possible. CDM units are displayed in Table 21. Determine for the resulting set ($SET_{sample\text{-}CDM}$) the annual electricity generation ($AEG_{SET\text{-}sample\text{-}CDM}$, in MWh). This is shown on Table 22.

**Table 21 - Generation from CDM power projects in Costa Rica**

| Project | Ref. # | Starting date | MWh in 2010 |
|---|---|---|---|
| Guanacaste | 4147 | 2009 | 150,977 |
| La Joya | 0541 | 2006 | 244,201 |
| Río Azul | 0037 | 2004 | 70 |
| Cote | 0251 | 2003 | 13,000 |

[25] Total grid generation in 2010 (excluding CDM projects) was 9,080,323 MWh.

| | | | |
|---|---|---|---|
| Tejona | 0824 | 2001 | 415 |

*Source:* Author's elaboration based on ARESEP and DSE statistics (see baseline spread sheet attached)

**Table 22 - Determination of the set of plants included in the BM including CDM projects**

| Company | Starting date | Fuel | Generation 2010 [MWh] | Cumm. respect overall 2010 generation |
|---|---|---|---|---|
| Garabito | 2010 | Thermal | 24,717 | 0.27% |
| El Encanto -CNFL | 2009 | Hydro | 52,000 | 0.84% |
| Coneléctrica | 2009 | Hydro | 188,698 | 2.92% |
| Guanacaste **(CDM)** | 2009 | Wind | 150,977 | 4.59% |
| Coopeguanacaste (CH Canalete) | 2008 | Hydro | 64,722 | 5.30% |
| Barranca | 2008 | Fossil fuel | 163,937 | 7.10% |
| San Antonio | 2008 | Fossil fuel | 97,804 | 8.18% |
| Cariblanco | 2007 | Hydro | 288,959 | 11.36% |
| El General | 2006 | Hydro | 192,697 | 13.49% |
| Guápiles / Orotina | 2006 | Fossil Fuel | 83,449 | 14.40% |
| La Joya **(CDM)** | 2006 | Hydro | 244,201 | 17.09% |
| Ingenios (Taboga) | 2004 | Bagasse | 35,970 | 17.49% |
| Río Azul **(CDM)** | 2004 | Biogas | 70 | 17.49% |
| Miravalles V | 2003 | Geothermal | 115,992 | 18.77% |
| Moín CNFL | 2003 | Fossil fuel | 43,796 | 19.25% |
| Cote **(CDM)** | 2003 | Hydro | 13,000 | 19.39% |
| Peñas Blancas | 2002 | Hydro | 158,862 | 21.14% |
| **Total** | | | **1,919,851.23** | 21.14% |

*Source:* Author's elaboration based on ARESEP and DSE statistics (see baseline spread sheet attached)

If the annual electricity generation of that set comprises at least 20% of the annual electricity generation of the project electricity system (i.e. $AEG_{SET\text{-}sample\text{-}CDM} \geq 0.2 \times AEG_{total}$), then use the sample group $SET_{sample\text{-}CDM}$ to calculate the build margin and ignore steps (e) and (f). As this is our case, $SET_{sample\text{-}CDM}$ will be the group of plants used for the build margin.

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

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}} \qquad (11)$$

Where:
$EF_{grid,BM,y}$ = Build margin $CO_2$ emission factor in year *y* ($tCO_2/MWh$)
$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$EF_{EL,m,y}$ = $CO_2$ emission factor of power unit *m* in year *y* ($tCO_2/MWh$) (as per eq. (8))
*m* = Power units included in the build margin
*y* = Most recent historical year for which power generation data is available

***Step 6. Calculate the combined margin (CM) emissions factor***

Once the operating and build margin emission rates are obtained, the *combined margin* (CM) was based in the option (a) "Weighted average CM" and is calculated according to the following expression:

$$EF_{grid,CM,y} = EF_{grid,OM-adj,y} \cdot w_{OM} + EF_{grid,BM,y} \cdot w_{BM} \quad (12)$$

Where:
$EF_{grid,BM,y}$ = Build margin $CO_2$ emission factor in year *y* ($tCO_2/MWh$)
$EF_{grid,OM,y}$ = Operating margin $CO_2$ emission factor in year *y* ($tCO_2/MWh$)
$w_{OM}$ = Weighting of operating margin emissions factor (%)
$w_{BM}$ = Weighting of build margin emissions factor (%)

$w_{OM}$ and $w_{BM}$ are the weights given respectively to the operating margin emission factor and the build margin emission factor (i.e. $w_{OM}$ + $w_{BM}$ = 1). For this project, $w_{OM}$ = 0.25 and $w_{BM}$ = 0.75 are the default values for the first crediting period and are thus used in the context of this project activity.

The following tables summarize the results:

**Table 23 - Operating margin emission factor calculation**

| Therma l Power Plants | Power Generation ($EG_{m,y}$) | | | Fuel type ($i$) | Fuel consumed ($FC_{i,m,y}$) | | | Emissions | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MWh | | | | Thousand liters | | | tCO2 ($FC_{i,m,y}$ * $NCV_{i,y}$ * $EF_{CO2,i,y}$) | | | tCO2/MWh ($EF_{EL,m,y}$ as per equation (8)) | | |
| | 2008 | 2009 | 2010 | | 2008 | 2009 | 2010 | 2008 | 2009 | 2010 | 2008 | 2009 | 2010 |
| Colima | 12,399 | 9,108 | 8,335 | bunker | 3,528 | 2,656 | 2,396 | 10,482 | 7,890 | 7,119 | 0.85 | 0.87 | 0.85 |
| San Antonio | 23,350 | 5,877 | 7,348 | diesel | 9,333 | 2,465 | 3,088 | 24,707 | 6,526 | 8,174 | 1.06 | 1.11 | 1.11 |
| Moín CNFL | 135,592 | 84,536 | 43,796 | diesel | 46,151 | 28,653 | 15,240 | 122,168 | 75,849 | 40,342 | 0.90 | 0.90 | 0.92 |
| Barranca | 17,518 | 5,323 | 6,883 | diesel | 7,475 | 2,252 | 2,927 | 19,788 | 5,960 | 7,747 | 1.13 | 1.12 | 1.13 |
| Moín Pistón | 8,305 | 8,510 | 14,343 | bunker | 2,214 | 2,072 | 3,525 | 6,579 | 6,157 | 10,474 | 0.79 | 0.72 | 0.73 |
| Moín Gas | 187,937 | 85,046 | 190,563 | diesel | 64,412 | 29,428 | 66,785 | 170,508 | 77,901 | 176,790 | 0.91 | 0.92 | 0.93 |
| Guápiles / Orotina | 88,188 | 67,475 | 83,449 | bunker | n.a. | 15,118 | 18,932 | 52,108 | 44,920 | 56,252 | 0.59 | 0.67 | 0.67 |
| Barranca Alq. | 59,876 | 81,869 | 163,937 | diesel | 16,856 | 23,399 | 47,390 | 44,621 | 61,940 | 125,447 | 0.75 | 0.76 | 0.77 |
| San Antonio Alq. | 143,395 | 103,466 | 97,804 | diesel | 44,150 | 31,200 | 29,943 | 116,871 | 82,590 | 79,264 | 0.82 | 0.80 | 0.81 |
| Garabito | 0 | 0 | 24,717 | bunker | - | 0 | 6,396 | 0 | 0 | 19,005 | | | 0.77 |
| **Total Thermal** | **676,560** | **451,209** | **641,175** | | | | | **567,831** | **369,733** | **530,615** | **0.8393** | **0.8194** | **0.8276** |

*Source:* Author's elaboration based on ARESEP statistics (see baseline spread sheet attached)

**Table 24 – Generation weighted average, adjusted OM emission factor**

| Year ($y$) | Unadjusted (tCO2/MWh) $\frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}}$ | $\lambda_y$ | Adjusted (tCO2/MWh) $EF_{grid,OM-adj,y}$ as per eq. (7) | Generation (MWh) $\sum_m EG_{m,y}$ |
|---|---|---|---|---|
| 2008 | 0.8393 | 0.4649 | 0.4491 | 676,560 |
| 2009 | 0.8194 | 0.5471 | 0.3711 | 451,209 |
| 2010 | 0.8276 | 0.5050 | 0.4096 | 641,175 |
| Generation weighted average: $EF_{grid,OM-adj,2008-2010}$ | | | **0.4149** | |

*Source:* Author's elaboration based on ARESEP statistics (see baseline spread sheet attached)

**Table 25 - Build margin emission factor calculation**

| Company ($m$ units included in the BM) | Generation 2010 [MWh] ($EG_{m,2010}$) | Cumm. respect overall 2010 generation(*) | Fossil Fuel type ($i$) | Fossil fuel consumption ($10^3$ lts) ($FC_{i,m,y}$) | Emissions ($tCO_2$) ($FC_{i,m,y}$ * $NCV_{i,y}$ * $EF_{CO2,i,y}$) | $tCO_2/MWh$ ($EF_{EL,m,y}$ as per eq. (8)) |
|---|---|---|---|---|---|---|
| Garabito | 24,717 | 0.27% | Bunker | 6,396 | 19,005 | 0.77 |
| El Encanto (CNFL) | 52,000 | 0.84% | None | | | - |
| Coneléctrica | 188,698 | 2.92% | None | | | - |
| Guanacaste | 150,977 | 4.59% | None | | | - |
| Coopeguanacaste (CH Canalete) | 64,722 | 5.30% | None | | | |
| Barranca Alq. | 163,937 | 7.10% | Diesel | 47,390 | 125,447 | 0.77 |
| San Antonio Alq. | 97,804 | 8.18% | Diesel | 29,943 | 79,264 | 0.81 |
| Cariblanco | 288,959 | 11.36% | None | | | - |
| El General | 192,697 | 13.49% | None | | | - |
| Guápiles / Orotina | 83,449 | 14.40% | Bunker | 18,932 | 56,252 | 0.67 |
| La Joya | 244,201 | 17.09% | None | | | |
| Ingenios (Taboga) | 35,970 | 17.49% | None | | | - |
| Río Azul | 70 | 17.49% | None | | | |
| Miravalles V | 115,992 | 18.77% | None | | | - |
| Moín CNFL | 43,796 | 19.25% | Diesel | 15,240 | 40,342 | 0.93 |
| Cote | 13,000 | 19.39% | None | | | |
| Peñas Blancas | 158,862 | 21.14% | None | | | - |
| **Total** | **1,919,851.23** | 21.14% | $EF_{grid,BM,2010}$ (eq. (11)) | | **320,311** | **0.1668** |

*Source:* Author's elaboration based on ARESEP and DSE statistics (see baseline spread sheet attached)

**Table 26 - Combined margin emission factor**

| | |
|---|---|
| *EFgrid,OM-adj,2008-2010* | 0.4149 |
| *ωOM* | 0.25 |
| *EFgrid,BM,2010* | 0.1668 |
| *ωBM* | 0.75 |
| ***EFgrid,CM*** | **0.2288** |

*Source:* Author's calculation

# Appendix 5. Further background information on monitoring plan

All details provided on section B.7.

# Appendix 6. Summary of post registration changes

| Version PDD | Date | Nature of revision |
|---|---|---|
| 09 | 17/10/2017 | Re-submission where changes in expected generation and expected biomass mix are highlighted for approval of changes. |
| 08 | 17/10/2017 | Reversed values from expected generation and expected biomass mix to those on version 03 of the PDD. |
| 07 | 06/04/2017 | Re-submission after UNFCCC incomplete. References to latest version of the tools have been included. |
| 06 | 11/04/2016 | Re-submission after UNFCCC incomplete + new use of latest PDD template (version 8). |
| 05 | 07/07/2015 | Changes after renewal of crediting period and re-validation of the project. |
| 04 | 17/06/2014 | First draft for the renewal of the crediting period (for revision during the validation only) |
| 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.<br>- Included other origins of biomass from the same project group as the project owner that were already being used since the 5th verification.<br>- 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.<br>- 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).<br>- 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 ex-ante provision of the plant's energy demand**[26]

*General description of the changes*

The ex-ante estimation of emission reductions is based on the plant's energy demand. The original estimate for this parameter was prepared for the first crediting period, i.e. prior to 31/01/2007 (date of the original PDD submitted for registration, i.e. version 02) and considering historical information of the last 3.5 years available at the time (PDD v03, p.18). A revised estimate was prepared for the renewal of the crediting period, as originally submitted for validation (PDD version 04, dated 17/06/2014), more than seven years after the original calculation.

Table 27 and Table 28 provide an overall comparison of the original (PDD v03) and the revised (PDD v09) estimates. According to the plant operators' estimate at the time of submission of the PDD for the renewal, 190,453 t of steam would be required for 2014 (equivalent to 462,707 GJ at the assumed enthalpy values)[27]. This value is in line with the evolution of the demand in the period 2008-2013 (i.e. last 6 years of available information at the time of requesting for renewal). As per the respective monitoring reports, energy demand in 2008 was 70,981 t of steam, whereas the demand in 2013 was 161,565 t, thus resulting in an interannual growth rate of 17.9%. Applying this rate to the 2013 value results in 190,453 t for 2014. For subsequent years, an annual increase of 5.90% was assumed (as in the original PDD). This is justified as in recent years (i.e. after approval of changes in PDD version 2, allowing the use of additional sources of biomass) the availability of biomass has been more stable and therefore the heat production from this source subject to less variation. This is also visible in the data by comparing the interannual rates (last column in the tables above) for the 2008-2013 period (Table 27) with the ones in the 2014-2016 period (last row on Table 27 and Table 28).

**Table 27 – Monitored data versus PDD estimates (already validated values)**

| **(I)** Year | **(II)** t of steam from biomass (monitored) [28] | Total (GJ)[29] | | | Difference (%)[30] | | |
|---|---|---|---|---|---|---|---|
| | | **(III)** Monitored | **(IV)** 1st CP PDD (v03) | **(V)** 2nd CP PDD (v09) | (IV) and (III) | (V) and (IV) | (II) respect to previous year |
| 2008 | 70,981 | 172,449 | 291,890 | | -40.9% | | |
| 2009 | 90,533 | 219,952 | 309,110 | | -28.8% | | 27.5% |
| 2010 | 98,146 | 238,446 | 327,346 | | -27.2% | | 8.4% |
| 2011 | 140,905 | 342,330 | 346,658 | | -1.2% | | 43.6% |
| 2012 | 131,788 | 320,180 | 367,109 | | -12.8% | | -6.5% |

[26] This section reflects the changes from version 08 to version 09 of the PDD.

[27] This value is in line with the evolution of the demand in the period 2008-2013 (i.e. last 6 years of available information at the time of requesting for renewal). As per the respective monitoring reports, energy demand in 2008 was 70,981 t of steam, whereas the demand in 2013 was 161,565 t, thus resulting in an interannual growth rate of 17.9%. Applying this rate to the 2013 value results in 190,453 t for 2014. For subsequent years, an annual increase of 5.90% was assumed (as in the original PDD). This is justified as in recent years (i.e. after approval of changes in the PDD, allowing the use of additional sources of biomass) the availability of biomass has been more stable and therefore the heat production from this source subject to less variation. This is also visible in the data (compare e.g. the interannual rates (last column in the tables above) for the 2008-2013 period with the ones in the 2014-2016 period).

[28] Data available in the respective monitoring reports except for November and December 2014 (obtained from plant's files), as these correspond to the second crediting period (not yet submitted for verification).

[29] Considering same enthalpy values as in the ex-ante calculation of the 2nd CP PDD. See footnote below.

[30] Note that PDD v03 only considered the enthalpy of the saturated steam leaving the boiler without considering that of the liquid entering the boiler. It can be shown that under this assumption, the overall difference for the entire period reduces from 13.39% to 0.67%.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2013 | 161,565 | 392,523 | 388,766 | | 1.0% | | 22.6% |
| 2014 | 176,817 | 429,579 | 411,702 | 462,707 | 4.3% | 12.4% | 9.4% |
| **Total** | **870,735** | **2,115,459** | **2,442,581** | | **-13.39%** | | |

**Table 28 – Monitored data versus PDD estimates (not yet verified values)**

| **(I)** Year | **(II)** t of steam from biomass (monitored) | Total (GJ)[31] | | | Difference (%) | | |
|---|---|---|---|---|---|---|---|
| | | **(III)** Monitored | **(IV)** 1st CP PDD (v03) | **(V)** 2nd CP PDD (v09) | (V) and (III) | (V) and (IV) | (II) respect to previous year |
| 2015 | 181,916 | 441,967 | 435,990 | 490,007 | -9.8% | 12.4% | 2.9% |
| 2016 | 185,457 | 450,570 | 461,711 | 518,918 | -13.2% | 12.4% | 1.9% |

Comparing the original estimate for 2014 with the updated provision shows an increment of 12.4% (Table 27). Such variation between an estimate made in 2007 and one made in 2014 is considered reasonable given the high level of uncertainty in the markets for INOLASA's products and the long period of time comprised between one forecast and the other. It is important to note that the estimate for energy demand is ultimately linked to the plant's *sales* (uncertain) rather than the installed capacity (fixed), as it would be the case e.g. for a conventional / renewable power plant serving the grid. The installed capacity of the project has been implemented as per the original PDD.

INOLASA supplies the country and the region of Central America with high quality soybean products. In particular, the plant processes soybean to produce human grade quality oils, obtaining as a by-product animal grade quality soy-flour and other animal products. Other vegetable oils processed on-site include sunflower, olive, and palm oil. Therefore, competition and substitute products affect the demand for INOLASA's sales, whereas climatic conditions affect the crops used as inputs in the production process. The historical evolution of the soy bean processed by the plant as well as the time series with the production of the main oils have been made available to the DOE to demonstrate the uncertainty of the plant's core business. This uncertainty naturally translates into the plant's total energy demand (also submitted to the DOE as evidence). Moreover, the availability of biomass adds further complications for the forecasting of the amount of energy that will be procured from this source, an issue that has already triggered a notification of changes in the PDD during the first crediting period. Due to the numerous parameters affecting the plant's output, it is extremely unlikely to achieve a fixed / immutable estimate instead of periodically revised ones.

Table 27 also shows that the revised ex-ante estimate provides a reasonable estimate of the plant's actual performance, especially when the experience from the 1st crediting period is considered.

*Impact on the eligibility of the project*

*(i) Additionality*

The changes do not compromise the project's additionality. The increased energy demand equally affects both the project and the baseline scenario, without making one or the other more economically attractive.

[31] Considering same enthalpy values as in the ex-ante calculation of the 2nd CP PDD.

Likewise note that the estimate relevant for the additionality analysis was the forecast available at the time of the investment decision, i.e. the original estimate as presented in PDD version 02 and 03.

*(ii) Scale*

The scale of the project is not affected by this change. All the equipment installed is in line with the provisions of the original 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 20) provided in section B.2 of the original PDD are not affected by these changes.

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

The actual monitoring plan is not affected by this change. Emission reductions are not dependent on the ex-ante estimate but rather on the monitored value for $EG_{thermal,y}$.

*(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 because of this revision.

**Changes in the biomass profile used by the Inolasa Project (II)**[32]

*General description of the changes*

In its original form, the Inolasa Project relied solely on palm kernel shells and empty fruit bunches that were 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 changed to approximately: 51% palm kernel shells, 28% empty fruit branches, 17% bagasse and 4% wood chips. During the renewal of the crediting period, the expected mix was further changed to 37% palm kernel shells, 42% empty fruit branches, 14% bagasse and 7% wood chips.

Although no new types of biomass have been introduced as part of this revision, and considering that this mix is only reported as an indicative figure, the possibility of an impact in the project cost structure is discussed in this section for conservativeness. The equations provided herein can also be used to assess the impact of future changes in the mix.

*Impact on the eligibility of the project*

*(i) Additionality*

[32] This section reflects the changes from version 08 to version 09 of the PDD.

Biomass usage has an impact on the fuel costs corresponding to the project scenario in the original additionality analysis (see for example the tab "Cash flow project wo CDM" in the original financial model submitted with the registered PDD ver. 2). The total fuel (biomass) cost is given by the sum of the amount paid for the biomass itself and the amount paid for transporting it to the project site. A specific biomass mix considering a specific origin was considered in the original additionality analysis; however, availability of biomass is uncertain and thus the biomass mix is subject to change.

This section provides a simple algebraic method for assessing the impact of different biomass mixes on total biomass procurement costs. The analysis compares total procurement costs for any biomass mix in comparison to the one specific mix considered in the original additionality analysis submitted with the original, registered PDD (version 02).

Total biomass procurement costs are given by:

(7) $$PC_t = BC_t + TC_t = Q_t \cdot p_{B,t} + D_t \cdot p_{T,t}$$

Where:

| | |
|---|---|
| $PC_t$ | Total biomass procurement cost for biomass mix $t$ ($) |
| $BC_t$ | Biomass cost of the mix $t$ ($) |
| $TC_t$ | Transport cost of the mix $t$ ($) |
| $Q$ | Quantity of biomass used by the project; to make valid comparisons this parameter is expressed in TJ. |
| $p_{B,t}$ | Price of biomass from the mix $t$ ($/TJ) |
| $Dt$ | Average distance travelled by trucks bringing the biomass mix $t$ (km) |
| $p_{T,t}$ | Average price per kilometre travelled with a full load ($/km) |

In general, each possible biomass mix will have its own price per TJ ($p_{B,t}$) and involve a different distance ($D_t$), whereas the quantity demanded ($Q$) and the price per kilometre ($p_T$) will be constant in order to provide valid comparisons of total procurement costs for different mixes.
The total procurement cost of any two given mixes can be compared by the quotient:

(8) $$\frac{PC_1}{PC_0} = \frac{Q \cdot p_{B,1} + D_1 p_T}{Q \cdot p_{B,0} + D_0 p_T}$$

The proportion of costs corresponding to biomass purchases ($\alpha_{B,0}$) and transport ($\alpha_{T,0}$) of the mix corresponding to $t=0$ (with $\alpha_{B,0}$ + $\alpha_{T,0}$ = 1) are given by:

(9) $$\alpha_{B,0} = \frac{BC_0}{PC_0} = \frac{Q \cdot p_{B,0}}{Q \cdot p_{B,0} + D_0 p_T}, \therefore \frac{\alpha_{B,0}}{p_{B,0}} = \frac{Q}{Q \cdot p_{B,0} + D_0 p_T}$$

(10) $$\alpha_{T,0} = \frac{TC_0}{PC_0} = \frac{D_0 p_T}{Q \cdot p_{B,0} + D_0 p_T}, \therefore \frac{\alpha_{T,0}}{D_0} = \frac{p_T}{Q \cdot p_{B,0} + D_0 p_T}$$

Thus, it is possible to re-write equation (8) as:

(11) $$\frac{PC_1}{PC_0} = \alpha_{B,0} \cdot \frac{p_{B,1}}{p_{B,0}} + \alpha_{T,0} \cdot \frac{D_1}{D_0}$$

This equation allows to compare the relative cost of any given generation mix compared to the one submitted with the original additionality analysis. If the quotient is equal or larger than 1, then the new procurement costs are equal or higher than the original cost estimate and therefore the new mix is equally or even more additional than the original one[33].

The values of $\alpha_{B,0}$ , $\alpha_{T,0}$ , $p_{B,0}$ and $D_0$ can be derived from the original additionality analysis submitted at time of registration. From the latter[34] we have that $\alpha_{B,0}$ = 0.37 and $\alpha_{T,0}$ = 0.63, $p_{B,0}$ = 0.8968 \$/GJ and $D_0$ = 589 km.

The following table summarizes the results for the original mix, the mix used in version 03 of the PDD, and the mix used in version 09:

| PDD Version | 02 | 03 | 09 |
|---|---|---|---|
| $P_{B,1}$ (\$/GJ) | 0.8968 ($p_{B,0}$ = $p_{B,1}$) | 2.0123 | 2.2967 |
| $D_1$ (km) | 589 ($D_0$ = $D_1$) | 461 | 398 |
| $PC_1/PC_0$ | 1.0000 | 1.3209 | 1.3697 |
| Remarks | Original analysis | First request for approval of changes | Second approval of changes with renewal of crediting period. |

The results show that costs of the procurement of biomass have increased 32% in the first revision and almost 37% in the renewal of the crediting period compared to the original estimate. Thus, additionality is by no means compromised with this change.

*(ii) Scale*

The scale of the project does not change as a result of the new biomass mix. 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 20) provided in section B.2 of the PDD are not affected by these changes.

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

Eventual leakage emissions from transport of biomass are already being considered in the present version of the monitoring plan. Thus, no further aspects of the PDD need to be revised due to this change.

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

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33 If on the other hand the quotient is less than 1, the method is not conclusive and additionality must be demonstrated in another way.

34 Detailed calculations available on the separate spreadsheet provided to the DOE (sheet "Inolasa generation mix_additionality check.xlsx").

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 this revision.

**Changes in the biomass profile used by the Inolasa Project (I)** [35] [36]

*General description of the changes*

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.

*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

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[35] 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 $truck_{i,y}$ 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.

[36] This section reflects the changes from version 02 to version 03 of the PDD.

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**[37]

| Parameter | Original biomasses | | New biomasses | |
|---|---|---|---|---|
| | **PKH** | **EFB** | **Wood Chips** | **Bagasse** |
| Energy content (GJ/t - dry basis) | 22.7 | n.a | 20.80 | 18.89 |
| Humidity (%) | 17% | n.a | 25% | 52% |
| Energy content (GJ/t - wet basis) | 18.84 | 17.9 | 15.6 | 9.07 |
| Price per t ($/t - wet) | 15.83[38] | 50.00 | 64.40 | 34.00 |
| Price per GJ ($/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.

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 29

[37] *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"

[38] 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.

below[39]. 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[40].

**Table 29 - 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.

*(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.

[39] 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*”

[40] 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).

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### Document information

| Version | Date | Description |
|---|---|---|
| 08.0 | 22 July 2016 | EB 90, Annex 2<br>Revision to include provisions related to automatically additional project activities. |
| 08.0 | 4 July 2016 | Published within annex 13 to the annotated agenda of EB90 |
| 07.0 | 15 April 2016 | Revision to ensure consistency with the "Standard: Applicability of sectoral scopes" (CDM-EB88-A04-STAN) (version 01.0). |
| 06.0 | 9 March 2015 | Revisions to:<br>• Include provisions related to statement on erroneous inclusion of a CPA;<br>• Include provisions related to delayed submission of a monitoring plan;<br>• Provisions related to local stakeholder consultation;<br>• Provisions related to the Host Party;<br>• Editorial improvement. |
| 05.0 | 25 June 2014 | Revisions to:<br>• Include the Attachment: Instructions for filling out the project design document form for small-scale CDM project activities (these instructions supersede the "Guidelines for completing the project design document form for small-scale CDM project activities" (Version 01.1));<br>• Include provisions related to standardized baselines;<br>• Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and **Error! Reference source not found.**;<br>• Change the reference number from *F-CDM-SSC-PDD* to *CDM-SSC-PDD-FORM*;<br>• Editorial improvement. |
| 04.1 | 11 April 2012 | Editorial revision to change history box by adding EB meeting and annex numbers in the Date column. |
| 04.0 | 13 March 2012 | EB 66, Annex 9<br>Revision required to ensure consistency with the "Guidelines for completing the project design document form for small-scale CDM project activities" |
| 03.0 | 15 December 2006 | EB 28, Annex 34<br>• 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. |

| *Version* | *Date* | *Description* |
|---|---|---|
| 02.0 | 08 July 2005 | EB 20, Annex 14<br>• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document.<br>• As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>. |
| 01.0 | 21 January 2003 | EB 07, Annex 05<br>Initial adoption. |

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