Monitoring report form
(Version 03.1)

Monitoring report

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).
Reference number of the project activity	1314
Version number of the monitoring report	1
Completion date of the monitoring report	04/10/2013
Registration date of the project activity	30/11/2007
Monitoring period number and duration of this monitoring period	Monitoring Period Number: 7 Duration: 01/10/2012 – 30/09/2013 (first and last days included)
Project participant(s)	1. Industrial de Oleaginosas Americanas S.A. (INOLASA) 2. Vattenfall Energy Trading Netherlands N.V.
Host Party(ies)	Costa Rica
Sectoral scope(s) and applied methodology(ies)	Sectoral scope: 1: Energy industries (renewable - / non-renewable sources Applied methodology: "*Thermal energy for the user with or without electricity*", AMS-I.C, version 10, May 18th, 2007
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	44,454 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	51,560 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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The project activity comprises the installation of a biomass fuelled boiler to supply steam for internal production processes, displacing a coal-fired boiler. Coal is replaced by palm kernel shells (PK shells) and empty fruit bunches (EFB), saving coal consumption and consequently reducing carbon emissions.

Biomass fuel is 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. The biomass is transported from the palm oil plants using trucks with a capacity of 25-28 tons each, making approximately 2-3 trips per day.

The project activity replaced the current boilers with a new biomass boiler. This new boiler has a capacity to produce 35 tons of steam/hour with a design pressure of 35 bars. However, during the first years it will only produce 20 tons of steam/hour with a pressure of 12 bars.

The boiler was originally combusting biomass in a mixture of approximately 85% palm kernel (PK) shells and 15% empty fruit branches (EFB); however, during after this monitoring period new biomasses have been introduced and thus the resulting mix is approximately: 51% palm kernel shells, 28% empty fruit branches, 17% bagasse and 4% wood chips.

The boiler was installed and commissioned on April 15, 2007 and April 24, 2007 respectively.

The total emission reductions achieved during this monitoring period are: **51,560 tCO_2e**

A.2. Location of project activity

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Costa Rica
Province of Puntarenas, District of Barranca.
Coordinates: 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''. The altitude is sea level.

A.3. Parties and project participant(s)

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

A.4. Reference of applied methodology

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The small scale project activity is registered under the following methodology:

"Thermal energy for the user with or without electricity", AMS-I.C, version 10, May 18th, 2007

A.5. Crediting period of project activity

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Type: 7 years renewable crediting period

The crediting period of the project activity is from 30/11/2007 to 29/11/2014

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

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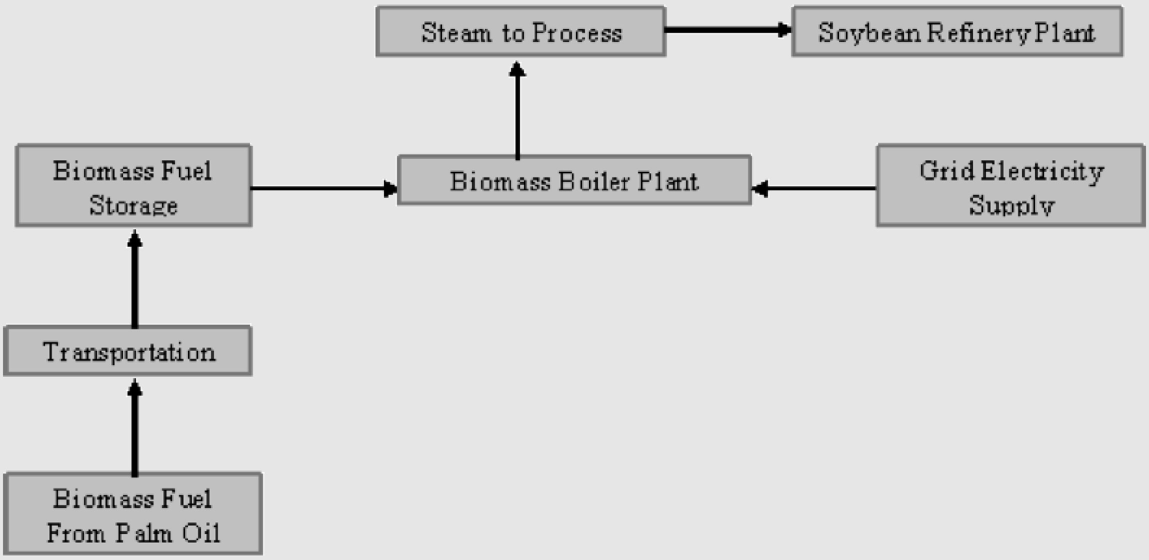
The project is fully implemented and operational as explained in the previous verification processes and the PDD.

The boiler was installed and commissioned on April 15, 2007 and April 24, 2007 respectively. The CDM project activity was registered and started the first crediting period on 30 November 2007. From this date onward, the project was completely implemented and operational, as shown during the 1st, 2nd, 3rd, 4th, 5th and 6th Periodic Verifications.

The boiler installed is a bi-drum water-tube boiler with membrane design wall and a rated capacity of 35,000 kg steam per hour. It has a designed pressure of 35.0 bars, but is currently used on 12.0 bars. The overall efficiency is given with 80%. Table 1 shows more technical specifications of the biomass boiler.

Biomass residues from the palm oil are used as fuel; these biomasses are empty fruit bunches and palm kernel shells. Additionally, the boilers may also use other types of biomass as fuel, namely, sugar cane bagasse and wood chips. The boiler is used for the generation of process steam for an onsite soybean refinery plant. Figure 1 provides a process scheme.

Figure 1 - Process Scheme[1]



[1] Other types of biomass used are bagasse and wood chips (discussed below).

Table 1 - Technical specifications of 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	12.0 bar resp. 31.0 bar
Design pressure	35.0 bar
Steam Temperature	192°C (Saturated) resp. 275°C (40° Superheated)
Feed water temperature	120°C +/- 5% (Economizer Water outlet temperature)
Air temperature at F.D Fan	220°C to 240°C (pre-heater air outlet temperature)
Actual steam evaporation	35,000 Kg/Hr.
Draught system	Balance Draught
Burning method	Reciprocating Step Grate; water cooled; hydraulically operated; grate material with high allow content.
Fuel to be used:	Approx: 51% PK shells, 28% EFB, 17% bagasse and 4% wood chips.
Dust Emissions	<=100 mg/ nm³
Overall efficiency on Gross Calorific Value of Fuel	80%

During this monitoring period the following special events were recorded:

Table 2 – Event log

Date	Event description
31/10/2012 - 03/11/2012	Boiler stopped for cleaning from the 31-10-12 up the 03-11-2012
15/11/2012 -16/11/2012	Boiler stopped for maintenance and cleaning from the 15th up the 16-11-2012
06/12/2012 -09/12/2012	Boiler stopped for maintenance from the 06th up the 09-12-2012
24/12/2012 - 26/12/2012	Boiler stopped from the 24 th up the 26-12-2012
01/01/13	The boiler stopped on first of January.
12/02/2013 - 15/02/2013	Boiler stopped for cleaning from the 12-02-13 up the 15-02-2013
23/03/2013 - 31-03/2013	Shut down for Easter Week from the 23-03-13 up the 31-03-2013
17/04/2013 - 18/04/2013	Boiler stopped for cleaning from the 17-04-13 up the 18-04-2013
27/05/2013 - 28/05/2013	Boiler stopped for cleaning from the 27-05-13 up the 28-05-2013
04/07/2013 - 06/07/2013	Boiler stopped for cleaning from the 04-07-13 up the 06-07-2013
30/08/2013 - 31/08/2013	Shutdown of the plant

The cleaning of the biomass boiler is programmed for each one and a half months, and is based on an agreement between the Costa Rican Ministry of Health and INOLASA. This maintenance, involving cleaning equipment and the boiler, normally takes around a week.

There were no incidences or situations during the Monitoring Period which may impact the applicability of the methodology.

One additional source of emissions was detected during the 6th monitoring period, which comes from the use of 42 trucks (overall) bringing biomass (PK Shells) from Cukra palm oil mill in Río Escondido (Nicaragua), a site located 840 km from the project site. These trucks were used as they would have returned empty from Río Escondido after delivering fertilizer from “Grupo Fertica” (Fertilizer Company) located also in Puntarenas, 10 Km from INOLASA (the project site). Notice that as the use of these trucks would have

occurred anyway, this actually *reduces* project emissions by lowering the amount of trucks coming from Quepos and Coto (the locations from which the project obtains its biomass). Nevertheless, emissions from these trucks are assessed using the same criteria used for parameter $PE_{trans,y}$ for conservativeness.

Fuerthermore, during this monitoring period and because of a low availability of palm kernel shells (PK shells) and empty fruit bunches (EFB) in the Palm oil mills, INOLASA also purchased biomass from two sugar mills called Ingenio El Palmar and Ingenio Cutris S.A., the first one located in Puntarenas and the last one in San Carlos, in Alajuela Province. Furthermore, they purchased wastes from woods (wood chips), from Orotina and Santa Cruz Guanacaste. The later purchases happened in order not to stop the boiler and not use bunker instead.

B.2. Post registration changes

B.2.1. Temporary deviations from registered monitoring plan or applied methodology

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There are no temporary deviations from the registered monitoring plan or applied methodology during this monitoring period.

B.2.2. Corrections

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There were no corrections from the registered monitoring plan or applied methodology during this monitoring period.

B.2.3. Permanent changes from registered monitoring plan or applied methodology

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Changes from previous periods

The monitoring plan has been revised and has been approved on 31/05/11; these modifications reflected the changes introduced in the monitoring plan in order to reflect the discontinued use of coal as a co-fired fuel. In the present, separate dedicated boilers are used (i.e. separate boilers for biomass and bunker).

Changes in the present period

In order to cope with biomass availability issues, as well as to_keep fuel oil use (bunker) to a minimum, the project proponent has sought additional sources of biomass. Two new types of biomass residues were identified as being able to satisfy humidity requirements in order to be used in the plant´s boilers: cane bagasse (obtained from two nearby sugar cane mills) and wood chips from nearby sawmills. Details of the new biomasses are provided in the table below:

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

The monitoring plan has been consequently revised to reflect the new trajectories followed by trucks bringing the new biomass into the project site. In particular, the potential values for the parameter "distance to the biomass boiler" (Km_i) has been updated.

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

Comparative costs per TJ using different types of biomass[2]

Parameter	PKH	EFB	Wood Chips	Bagasse
Energy content (TJ/t - dry basis)	22.7	n.a	20.80	18.89
Humidity (%)	17%	n.a	25%	52%
Energy per t (TJ/t - wet basis)	18.841	17.9	15.6	9.065808
Price per t ($/t - wet)	15.83	50.00	64.40	34.00
Price per TJ ($/TJ)	0.84	2.79	4.13	3.75

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

B.2.4. Changes to project design of registered project activity

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No changes to project design have been made.

B.2.5. Changes to start date of crediting period

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No changes to the start date of the crediting period have been approved during this monitoring period or submitted with this monitoring report.

B.2.6. Types of changes specific to afforestation or reforestation project activity

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n.a

SECTION C. Description of monitoring system

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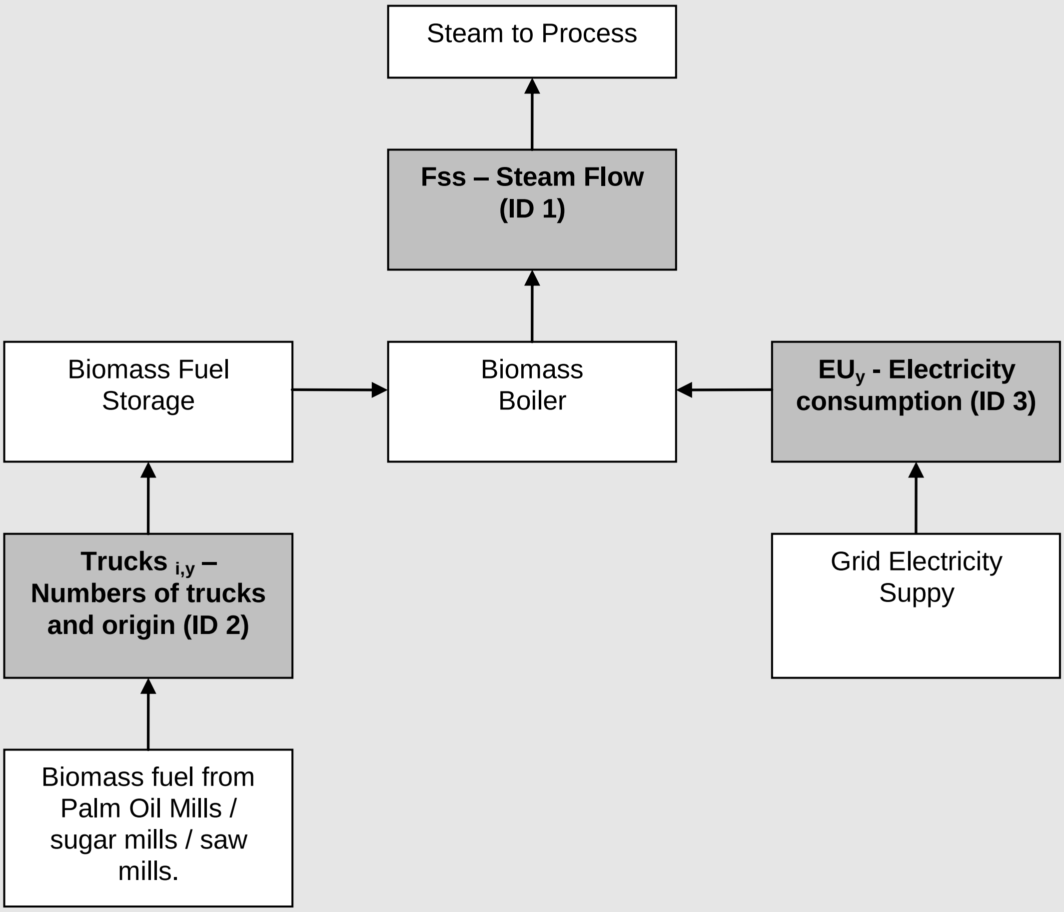
The main metering points relevant for this project can be schematically interpreted from Figure 2 below.

[2] PKH and EFB are the original types used as per registered PDD (all the data used in the estimation was derived from page 30 of the PDD); wood chips and bagasse have been included in this revision according to data provided by the suppliers. Detailed calculations are available to the DOE.

Figure 2 – Metering scheme



Further information on the relevant parameters that are monitored is readily available in Section D below.

Roles and responsibilities:
The Project owner is Industrial de Oleaginosas Americanas S.A. (INOLASA). INOLASA is therefore responsible for the operation and the monitoring of the project activities. INOLASA has appointed one person to be responsible for monitoring, Mr. Domingo Vásquez Vásquez. The operational staff, the Superintendent of Production and the Superintendent of Maintenance, report to him.

Data collection and procedures:
The Superintendent of Production collects data on a daily basis, and transfers these data to weekly and final monthly reports, which are submitted to the responsible for monitoring. The Superintendent of Maintenance saves the steam flow data digitally, which he regularly crosschecks with the manual data. In addition, crosschecks of the final reports against the daily data are performed for quality assurance.

Emission reduction calculation: The CDM spreadsheet is prepared from the original data. It comprises monthly summary sheets that contain the daily data for easy control and comparison of these against other sources. The data sheets are compiled by the person responsible for monitoring, and signed by the plant manager.

Trainings:
During the crediting period internal trainings are performed. If trainings are performed during this monitoring period, receipts of these internal trainings will be available on-site.

Involvement of Third Parties:

Support and consultancy regarding the CDM obligations is provided by the company Geo Ingeniería Ingenieros Consultores S.A. During operation, the technical team of INOLASA is supported, if necessary, by the technology provider PETRA.

Documentation from the authorised boiler inspector during his yearly on-site visit will be available during the on-site visit.

A third party check of the electricity meter has been performed and the documentation will be available to the DOE.

Troubleshooting procedures:
In case of unforeseen problems or failures of the data recording system, the operating staff will switch to manual readings of all meters. This procedure is well defined and trained by the staff, since manual readings as back-up for the computerised data readings have been a part of the normal operation since the starting period of this project. Furthermore, a logbook will be maintained, recording all deviations from normal operation, including observations and all other information necessary to document. In this way, jumps or periods where operating conditions are out of range can be identified and explained.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

Data / Parameter:	ID.5 / Km_i
Unit:	**km**
Description:	Distance from palm oil mill i to the biomass boiler
Source of data:	This information is provided by the contracted transport company.
Value(s) applied):	Km – distance Coto 47 to Barranca: 340 Km – distance Quepos to Barranca: 133 Km – distance Rio Escondido to Barranca: 840 Km – distance Puntarenas to Barranca:22 Km – distance Alajuela to Barranca:250 Km – distance Orotina to Barranca: 44 Km – distance Guanacaste to Barranca:320
Purpose of data:	Project emission calculation
Additional comment:	Distance was determined by the readings of the mileage counter of a representative truck. It was cross checked by measuring the distance on a 1:50,000 map. Distances values expressed above are one way only; thus, they are multiplied by two in order to obtain the round-trip distance. Palo Seco and Naranjo palm mills are both located at Quepos; only Coto palm mill is located in Coto 47.

Data / Parameter:	ID.6 / VFcons
Unit:	l/km
Description:	Vehicle fuel consumption in litres per kilometre
Source of data:	This information is provided by the contracted transport company.
Value(s) applied):	0.6
Purpose of data:	Project emission calculation
Additional comment:	It relies on specific truck data based on the contracted transport company´s fleet of trucks

Data / Parameter:	**ID.7 / CVdiesel**
Unit:	MJ/kg
Description:	Calorific value of the fuel
Source of data:	Diesel reference value for Costa Rica
Value(s) applied):	45.91
Purpose of data:	Project emission calculation
Additional comment:	This reference is considered as a fixed value, and based on the fuel provider´s specifications (Refinadora Costarricense de Petróleo, S.A.)

Data / Parameter:	**ID.8 / Ddiesel**
Unit:	kg/l
Description:	Diesel density
Source of data:	The fuel density of Diesel in Costa Rica
Value(s) applied):	0.85
Purpose of data:	Project emission calculation
Additional comment:	National specifications for Diesel fuel in Costa Rica

Data / Parameter:	**ID.9 / EFdiesel**
Unit:	tCO_2/MJ
Description:	Emission factor Diesel
Source of data:	IPCC
Value(s) applied):	20.2 tC/TJ x 44/12 = 74.1 tCO_2/TJ = 0.0000741 tCO_2/MJ
Purpose of data:	Project emission calculation
Additional comment:	The reference comes from the latest IPCC guidelines, and has been considered as representative for the current emission reduction calculation

Data / Parameter:	**ID.10 / EUy**
Unit:	GWh
Description:	Electricity consumption of baseline boiler annually.
Source of data:	Quotations from boiler technology provider
Value(s) applied):	1.07
Purpose of data:	Baseline emission from electricity consumption
Additional comment:	Baseline boiler: including a two week maintenance period.

Data / Parameter:	**ID.11 / EFgrid**
Unit:	tCO_2/GWh
Description:	Emission factor Costa Rican grid

Source of data:	This factor has been calculated using ICE data and available info from other sources. See Annex 3 of the PDD
Value(s) applied):	62.86
Purpose of data:	Project emissions calculation
Additional comment:	This baseline emission factor was calculated ex-ante in a transparent and conservative manner as the average of the "approximate operating margin" and the "build margin"

Data / Parameter:	**ID 12 / ηth**
Unit:	%
Description:	Energy efficiency of the boiler in the baseline scenario
Source of data:	The energy efficiency of the boiler that would be used in absence of the project activity is based upon the manufacturer's information
Value(s) applied):	78
Purpose of data:	Baseline emission calculation
Additional comment:	The efficiency is considered as a fixed value and based on the manufacturer´s information for coal

Data / Parameter:	**ID.13 / ηp**
Unit:	%
Description:	Energy efficiency of the boiler in the project scenario
Source of data:	Is based upon the manufacturer´s information
Value(s) applied):	80
Purpose of data:	Baseline emission calculation
Additional comment:	The efficiency is considered as a fixed value, and based on the manufacturer's information for biomass fuels

Data / Parameter:	**ID.14 / NCVi = NCVc**
Unit:	TJ/kt
Description:	Is the net calorific value of the fossil fuel type i
Source of data:	Based on tests done to Colombian coal
Value(s) applied):	A default value of 10,887 BTU/lb will be considered based on tests done to Colombian coal (equivalent 25.73 TJ/kt)
Purpose of data:	Baseline emission calculation
Additional comment:	The net calorific value of the fossil fuel is determined by means of analytical results at the 'Laboratory of Puerto Bolivar, La Guajira', in accordance with the applicable ASTM standards. The resulting 'Screen Analysis Certificate' was developed by the 'Inspectorate Colombia Ltda.'

Data / Parameter:	**ID.15 / COEFi**
Unit:	tCO_2/kt
Description:	Is the CO_2 emission factor of the fossil fuel type i fired in the boiler in the absence of the project activity
Source of data:	Reference from Colombian provider of coal

Value(s) applied):	2.38 tCO2/t
Purpose of data:	Baseline emission calculation
Additional comment:	Carbon percentage of the Colombian coal that would have been used is stated as 64.9%

Data / Parameter:	**ID.16 / Hssi**
Unit:	kJ/kg
Description:	Is the enthalpy of the saturated steam at 12 bar
Source of data:	Set as default value provided from saturated steam table
Value(s) applied):	2782.73
Purpose of data:	Baseline emission calculation
Additional comment:	This is considered as a fixed value and will be used for emission reduction calculations

D.2. Data and parameters monitored

Data / Parameter:	**ID.1 / Fssi**
Unit:	kg/yr
Description:	Is the steam flow monitored, during year y
Measured/ Calculated / Default:	Measured
Source of data:	Project owner, flow meter
Value(s) of monitored parameter:	160,639,000 kg (for the entire period)
Monitoring equipment:	Type: Mass Flow Transmitter
Measuring/ Reading/ Recording frequency:	Make/Model: Rosemount 3095M
Calculation method (if applicable):	Accuracy class: +/-1%
QA/QC procedures:	Serial number: 0217271
Purpose of data:	
Additional comment:	Calibration frequency:

Data / Parameter:	**ID.2 / trucksi,y**
Unit:	Number
Description:	Number of trucks and origin

Measured/ Calculated / Default:	Measured
Source of data:	Project owner, logbook
Value(s) of monitored parameter:	818 trucks arrived from Quepos
Monitoring equipment:	552 trucks arrived from Coto
Measuring/ Reading/ Recording frequency:	82 trucks arrived from Rio Escondido
Calculation method (if applicable):	138 trucks arrived from Ingenio El Palmar
QA/QC procedures:	130 trucks arrived from Ingenio Cutris
Purpose of data:	47 trucks arrived from Orotina
Additional comment:	29 trucks arrived from Guanacaste

Data / Parameter:	**ID.3 / EUy**
Unit:	GWh/year
Description:	Electricity consumption biomass boiler in the project scenario
Measured/ Calculated / Default:	Measured
Source of data:	Project owner,
Value(s) of monitored parameter:	2.41030 GWh (for the entire period)
Monitoring equipment:	Type:
Measuring/ Reading/ Recording frequency:	Make/Model:
Calculation method (if applicable):	Accuracy class:
QA/QC procedures:	Serial number:
Purpose of data:	
Additional comment:	Calibration frequency:

D.3. Implementation of sampling plan

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n.a

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

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Please note that the references used for the parameters, namely 'IDs', are defined in chapter D above and are applicable for all following chapters.

The baseline emissions can be calculated with the following equation:

$$BE_y = BE_{heat,y} + BE_{boiler,y}$$

Where :

$BE_{heat,y}$	Emissions due to coal combustion. In absence of the project the heat would be generated by a coal boiler.
$BE_{boiler,y}$	Emissions caused by grid electricity consumption (coal boiler).

The emissions due to coal combustion are determined by dividing the amount of generated heat during the project activity by the net calorific value of coal and the efficiency of the coal boiler. This is multiplied with a CO_2 emission factor for the displaced fossil fuel (coal):

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

Where:

$BE_{heat,y}$	the baseline emissions for fossil fuels during the year y in tons of CO_2eq.
Q_y	is the quantity of heat generated in the project plant using renewable resources only, that displaces heat generation in the fossil fuel fired boiler during the year y in TJ. This is the same variable mentioned in AMS.I-C ver. 10 as HG_y (original notation in approved monitoring plan used for clarity).
η_{th}	is the energy efficiency of the boiler that would be used in absence of the project activity. (**ID.12, fixed**)
NCV_i	is the net calorific value of the fossil fuel type i per TJ/kt. In the baseline scenario, the plant only uses coal as fuel. (**ID.14, fixed**)
$COEF_i$	is the CO_2 emission factor of the fossil fuel type i fired in the boiler in the absence of the project activity in tCO_2/kt – in the project activity only coal. (**ID.15, fixed**)

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

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

Where

Q_y	is the total quantity of heat generated in the project plant using renewable resources, during year y, in TJ.
h_{ss}	is the enthalpy of the saturated steam at 12 bar (2782.73 MJ/t set as a default value) (**ID.16, fixed**).
F_{ss}	is the steam flow monitored, during year y (t/year) (**ID.1, to be monitored**)

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

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

Where:
$BE_{boiler,,y}$ Baseline emissions resulting from electricity usage in year 'y'
EU_y Electricity Usage in year 'y' (**ID.10, fixed**)
EF_{grid} Emission factor of the Costa Rican grid. (**ID.11, fixed**)

Month	ID1 Fss [t]	BEheat [tCO2e]	BEboiler [tCO2e]	BE_{total} [tCO_2e]
Oct-12	15,905.00	5248.65	5.71	5,254.36
Nov-12	12,864.00	4245.12	4.98	4,250.09
Dec-12	13,275.00	4380.75	4.98	4,385.72
Jan-13	11,688.00	3857.04	5.71	3,862.75
Feb-13	9,332.00	3079.56	4.42	3,083.98
Mar-13	10,527.00	3473.91	4.05	3,477.96
Apr-13	13,278.00	4381.74	5.16	4,386.90
May-13	14,652.00	4835.16	5.34	4,840.50
Jun-13	15,914.00	5251.62	5.53	5,257.14
Jul-13	13,985.00	4615.05	5.16	4,620.21
Aug-13	15,630.00	5157.90	5.34	5,163.24
Sep-13	13,589.70	4484.60	5.53	4,490.13
Total	**160,639.70**	**53,011.06**	**61.92**	**53,072.98**

E.2. Calculation of project emissions or actual net GHG removals by sinks

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The project emissions can be calculated with the following equation:

$PE_y = PE_{trans,y} + PE_{boiler,y}$

Where :
$PE_{trans,y}$ Project emissions resulting from transportation of the biomass in year 'y'
$PE_{boiler,,y}$ Project emissions resulting from electricity usage in year 'y'

The CO_2 emissions from a biomass load are calculated from the quantity and the specific CO_2-emission factor of the fuel used by the trucks.

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

Where:
$PE_{trans,y}$ Project emissions resulting from transportation of the biomass in year 'y'
$trucks_{i,y}$ Number of trucks supplying the biomass originating from palm oil mill i in year 'y' (**ID.2, to be monitored**)
$TransCOEF_i$ Coefficient for the CO_2 emissions from 1 truck load of biomass originating from palm oil mill i

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

Where:
Km_i Distance from palm oil mill i to the biomass boiler (km) (**ID.5, fixed;** double of the values reported in D.1 are considered in order to account for a round-trip.)
VF_{cons} Vehicle fuel consumption in litres per kilometre (l/km) (**ID.6, fixed**)

CV_{diesel} Calorific value of the fuel (MJ/kg) (**ID.7, fixed**)
D_{diesel} Diesel density (kg/l) (**ID.8, fixed**)
EF_{diesel} Emission factor diesel (tCO_2/MJ) (**ID.9, fixed**)

For the transportation of biomass trucks with a load capacity of 28 tonnes are used. To be conservative, $TransCOEF_i$ is determined based on a full truck load. The trucks use 0.6 litre of diesel per kilometre, the calorific value of the fuel is 45.91 MJ/kg, the fuel density of diesel in Costa Rica is 0.85 kg/l and the emission factor of the fuel is 74.1 tCO_2/TJ.

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

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

Where:
$PE_{boiler,,y}$ Project emissions resulting from electricity usage in year 'y'
EU_y Electricity Usage in year 'y' (**ID.3, to be monitored**)
EF_{grid} Emission factor of the Costa Rican grid. (**ID.11, fixed**)

	ID2 number of trucks							PE_{trans}	ID3 EU_y	PE_{boiler}	PE_{total}
Month	**Quepos**	**Coto**	**Rio Esc.**	**Ing. El Palmar**	**Ing. Cutris S.A.**	**Orot.**	**Guanac.**	**[tCO_2e]**	**[MWh]**	**[tCO_2e]**	**[tCO_2e]**
Oct-12	59	51	6	0	0	0	0	105	227	14	119.18
Nov-12	46	34	11	0	0	0	0	93	188	12	105.20
Dec-12	50	24	11	0	0	0	0	83	193	12	95.60
Jan-13	65	28	8	70	0	0	11	95	212	13	108.43
Feb-13	80	31	2	47	0	0	4	83	166	10	93.79
Mar-13	82	47	4	13	0	0	3	107	145	9	115.76
Apr-13	69	42	4	4	7	1	4	99	185	12	110.20
May-13	68	58	5	4	17	7	4	125	209	13	137.83
Jun-13	69	63	5	0	12	5	4	129	228	14	142.86
Jul-13	73	66	3	0	28	15	0	134	225	14	147.71
Aug-13	84	62	12	0	38	6	0	164	244	15	179.19
Sep-13	73	46	11	0	28	12	0	133	188	12	144.87
Total	**818**	**552**	**82**	**138**	**130**	**46**	**30**	**1,349.11**	**2,410.30**	**151.51**	**1,500.62**

Other emissions occurring within CDM project activity

A bulldozer for on-site transportation of biomass was used. The vessel consumed 27,688 litres of diesel.

Table 3 - Other project emissions

Fuel consumed by on-site bulldozer	27,688	lts
calorific value of diesel (CV_{diesel})	45.91	MJ/kg
Density of diesel (D_{diesel})	0.85	kg/l
Emission factor diesel (EF_{diesel})	0.0000741	tCO_2 / MJ
Additional Project Emissions	80.06	tCO2
as % of ERs claimed	0.16	%

The overall amount of emissions arising from this source is 80.06 tCO2, around 0.16% of the emission reductions claimed for this period (51,560 tCO_2 – see E.5 below). In accordance with the CDM Validation and Verification Standard, only emissions which are expected to contribute more than 1% of the emission reductions should be addressed.

E.3. Calculation of leakage

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According to the registered PDD no sources of leakage are identified. Therefore leakage is considered zero.

E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

The total emission reductions can be easily calculated with the results of the above described equations. The emission reduction is equal to the baseline emissions minus project emissions and leakage emissions. Leakage emissions in this project are considered to be zero. The general equation is as follows:

$ER_y = BE_y - (PE_y + L_y)$

ER_y = Emission $reduction_{year}$
BE_y = Baseline $emissions_{year}$
PE_y = Project $emissions_{year}$
L_y = $Leakage_{year} = 0$

The table below summarizes the results presented above, however baseline emissions are conservatively presented after rounding down and project emissions after rounding up[3].

Item	Baseline emissions or baseline net GHG removals by sinks (t CO_2e)	Project emissions or actual net GHG removals by sinks (t CO_2e)	Leakage (t CO_2e)	Emission reductions or net anthropogenic GHG removals by sinks (t CO_2e)
Total	53,067	1,506	0	51,561

E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO_2e)	44,454[4]	51,561

The achieved emission reductions are 16% higher than the proportional ex-ante estimate.

[3] As shown in ER calculation excel file, sheet "SUMMARY"
[4] Obtained as (92/365) x 42,567 for 2012 + (273/365 x 45,090 for 2013 = 44,454

E.6. Remarks on difference from estimated value in registered PDD

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This is the project´s 7th monitoring period, and the first request in which the ex-ante estimate is surpassed. Expected and achieved emission reductions are shown on the table below:

Period		tCO_2		
		expected[5]	achieved[6]	difference
30/11/2007	31/12/2007	2,803	1,531	-45%
01/01/2008	30/11/2008	31,071	19,695	-37%
01/12/2008	30/09/2009	29,688	24,561	-17%
01/10/2009	31/08/2010	34,307	32,848	-4%
01/09/2010	30/09/2011	42,753	39,498	-8%
01/10/2011	30/09/2012	42,086	40,498	-4%
01/10/2012	30/09/2013	44,454	51,560	16%
Total (up to 30/09/2013)		**227,163**	**210,191**	**-7%**

Despite the 16% increase in this period, the overall issuance has been below expectations. This correlates closely to the project´s performance in terms of biomass-generated steam, as the latter is one of the main driving forces behind the claim for CERs. Performance in terms of biomass-generated steam is presented below:

Biomass-based steam production

Year	Predicted as per PDD (p. 30)	Actual		Comparison
	GJ	tons of steam	GJ[7]	
2009	309,110	84,223	234,369	-24.2%
2010	327,346	98,390	273,793	-16.4%
2011	346,658	140,454	390,846	12.7%
2012	367,109	131,778	366,703	-0.1%
2013[8]	388,766	118,595	330,018	n.a
2012-2013	383,307	160,639	447,015	16.6%

Therefore, the data shows that the increase in bagasse-based steam allows the project to “catch up” with the original long-term forecast envisioned in the registered PDD. Note that, however, this long term estimate has not yet been achieved, i.e. that the proportional part of the project´s total output for the 7-year period has not been reached. In turn, this implies that no key elements relative to the project´s additionality have been compromised by the increase in this period.

[5] Expected emission reductions are based on PDD estimates, which were in turn adjusted by the number of days in each year.
[6] *Source*: final version of the respective Monitoring Reports.
[7] @ default 2782.73 MJ/T enthalpy of the saturated steam (12 bars)
[8] Actual data for 2013 includes information up to 30/09/2013 and is therefore incomplete and the comparison with the year-round estimate presented in the PDD is not appropriate. This is why a 2012-2013 prorate estimate is used for comparison purposes. Detailed calculations are available in the spreadsheet.

E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards
Emission reductions or GHG removals by sinks (t CO_2e)	**210,191**	**-**

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Document information

Version	*Date*	*Description*
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.

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