MONITORING REPORT
Version 4.0 and date 02/09/2010

Switching of fuel from coal to palm oil mill biomass waste residues at Industrial de Oleaginosas Americanas S.A. (INOLASA)
Reference number: 1314
Monitoring period number 4 (01/10/2009 - 31/08/2010)

SECTION A. General description of the project activity

A.1. Brief description of the 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 is combusting biomass in a mixture of approximately 85% PK shells and 15% EFB. The quantity of PK shells that the plant will need is approximately 20,000 tons a year. The combustion of biomass results in a low amount of ash production, corresponding to 3-4% of the feeding mass. These ashes are used as an aggregate for cement and concrete mixtures.

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

The emission reductions achieved during this monitoring period are: **32,842 tCO_2e**

A.2. Project Participants

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Industrial de Oleaginosas Americanas S.A. (INOLASA)
and
KfW

A.3. Location of the 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.4. Technical description of the project

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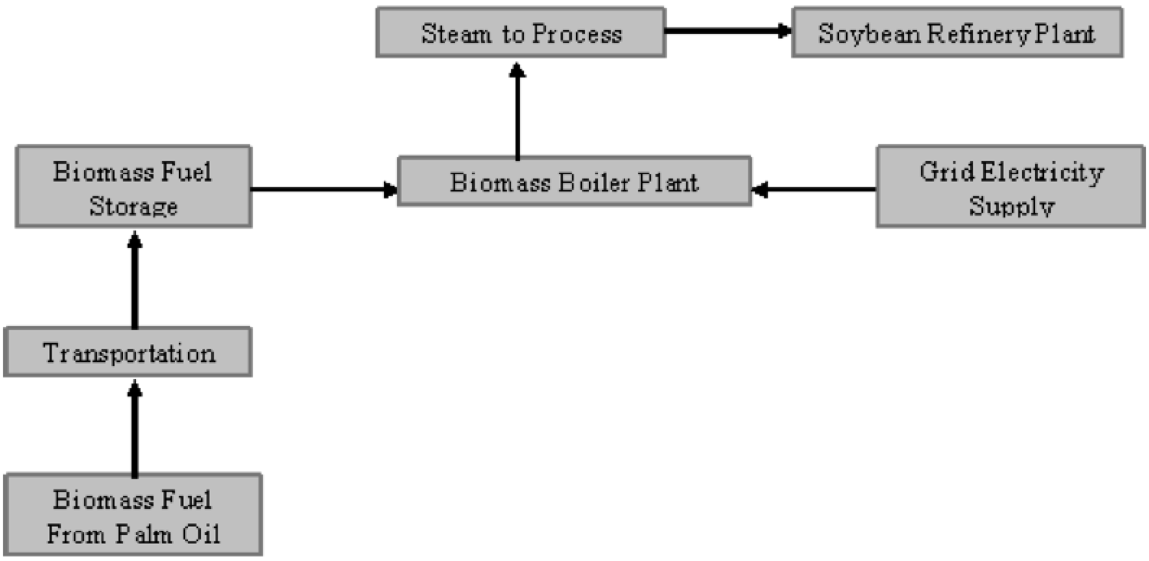
A bi-drum watertube boiler with membrane wall design wall and a rated capacity of 35,000 kg steam per hour is installed. The boiler has a designed pressure of 35.0 bars, but is currently used on 12.0 bars. The overall efficiency is given with 80%.

Biomass residues from the palm oil are used as fuel; these biomasses are empty fruit bunches and palm kernel shells.

The boiler is used for the generation of process steam for an onsite soybean refinery plant.



A.5. Title, reference and version of the baseline and monitoring methodology applied to the project activity:

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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 18 2007

A.6. Registration date of the project activity:

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30 November 2007

A.7. Crediting period of the project activity and related information (start date and choice of crediting period):

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30 November 2007 – 29 November 2014 (Renewable)

A.8. Name of responsible person(s)/entity(ies):

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SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

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

B.2. Revision of the monitoring plan

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The monitoring plan was not revised; therefore the original monitoring plan of the registered PDD is applicable.

B.3. Request for deviation applied to this monitoring period

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No deviations occurred during this monitoring period.

B.4. Notification or request of approval of changes

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No changes to the project activity happened.

SECTION C. Description of the monitoring system

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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.

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 OneCarbon International B.V., which has been purchased by the company Orbeo.

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.

Data collection and procedures:
The staff of the biomass boiler collects data on a daily basis, and transfers these data to weekly and final monthly reports. Crosschecks of the final reports against the daily data are performed for quality assurance.
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.

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.

In cases where no data are available due to failures of the monitoring equipment, the person responsible for the monitoring decides promptly which actions are to be undertaken, in order to minimise the amount of not registered GHG emission reductions. In this case, the CDM-consultant OneCarbon is consulted.

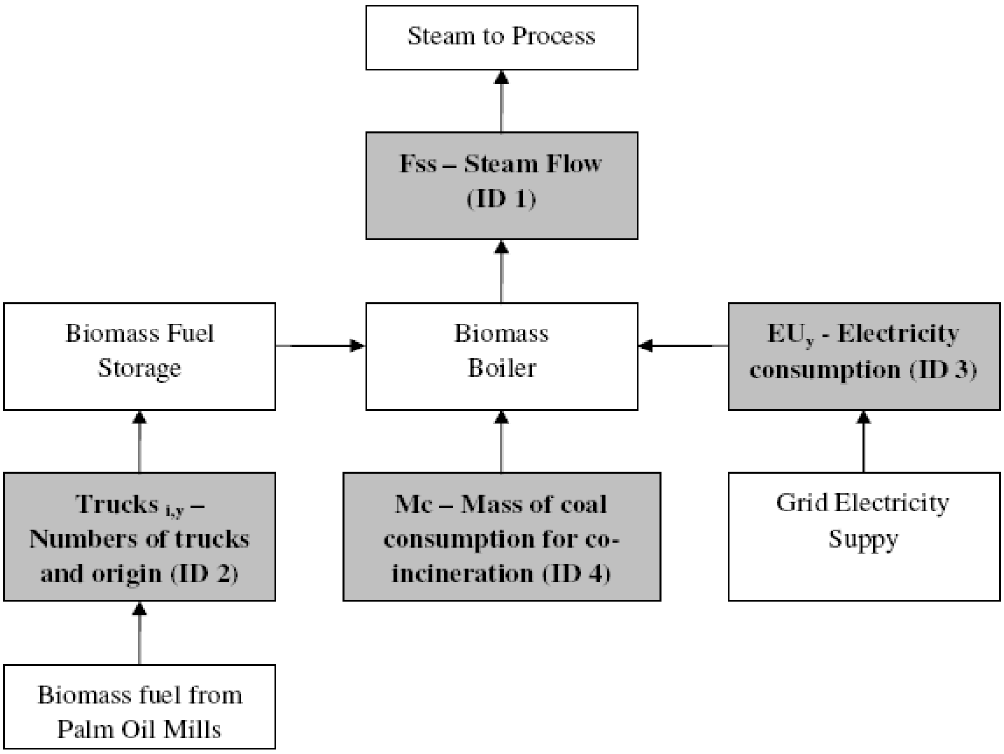

Figure 1: Sketch of monitoring points

SECTION D. Data and parameters

D.1. Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors

Data / Parameter:	**ID.5 / Km_i**
Data unit:	**km**
Description:	Distance from palm oil mill i to the biomass boiler
Source of data used:	This information is provided by the contracted transport company.
Value(s) :	Km – distance Coto 47 to Barranca 340 Km – distance Quepos to Barranca 133
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	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.

Data / Parameter:	**ID.6 / VF_{cons}**
Data unit:	**l/km**
Description:	Vehicle fuel consumption in litres per kilometre
Source of data used:	This information is provided by the contracted transport company
Value(s) :	0.6
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	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**
Data unit:	**MJ/kg**
Description:	Calorific value of the fuel
Source of data used:	Diesel reference value for Costa Rica
Value(s) :	45.91
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	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**
Data unit:	**kg/l**
Description:	Diesel density
Source of data used:	The fuel density of Diesel in Costa Rica
Value(s) :	0.85
Indicate what the data are	Project emission calculation

used for (Baseline/ Project/ Leakage emission calculations)	
Additional comment:	National specifications for Diesel fuel in Costa Rica

Data / Parameter:	**ID.9 / EFdiesel**
Data unit:	**tCO_2/MJ**
Description:	Emission factor Diesel
Source of data used:	IPCC
Value(s) :	20.2 tC/TJ x 44/12 = 74.1 tCO_2/TJ = 0.00007 tCO_2/MJ
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	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.11 / EFgrid**
Data unit:	**tCO_2/GWh**
Description:	Emission factor Costa Rican grid
Source of data used:	This factor has been calculated using ICE data and available info from other sources. See Annex 3 of the PDD
Value(s) :	62.86
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission 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 / η_{th}**
Data unit:	**%**
Description:	Energy efficiency of the boiler in the baseline scenario
Source of data used:	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) :	78
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	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 / η_p**
Data unit:	**%**
Description:	Energy efficiency of the boiler in the project scenario
Source of data used:	Is based upon the manufacturer´s information
Value(s) :	80
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	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 / $NCV_i = NCV_c$**
Data unit:	**TJ/kt**
Description:	Is the net calorific value of the fossil fuel type i
Source of data used:	Based on tests done to Colombian coal
Value(s) :	A default value of 10,887 BTU/lb will be considered based on tests done to Colombian coal (equivalent 25.73 TJ/kt)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	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 / $COEF_i$**
Data 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 used:	Reference from Colombian provider of coal
Value(s) :	2.38 tCO_2/t of coal
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	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 / Hss_i**
Data unit:	**kJ/kg**
Description:	Is the enthalpy of the saturated steam at 12 bar
Source of data used:	Set as default value provided from saturated steam table
Value(s) :	2782.73
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	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 / Fss_i**
Data 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:	101,861,000
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Type: Mass Flow Transmitter Make/Model: Rosemount 3095M Accuracy class: +/-1% Serial number: 0217271 Calibration frequency: According to *"General Guidelines to SSC CDM methodologies"*, version 14.1, para. 17.(c) at least every three years. However, the manufacturer assures 10 year stability of +/-0.25% Date of last calibration: 13.10.2009 Validity: At least until 12.10.2012
Measuring/ Reading/ Recording frequency:	Continuous measurement, daily reading and monthly recording
Calculation method (if applicable):	Flow of steam in tonnes/yr is converted to TJ by calculation.
QA/QC procedures applied:	Flow meter will be subject to a regular maintenance and testing regime to ensure accuracy (see table in Annex 4 to the PDD).

Data / Parameter:	**ID.2 / $trucks_{i,y}$**
Data unit:	**Number**
Description:	Number of trucks and origin
Measured /Calculated /Default:	Measured
Source of data:	Project owner, logbook
Value(s) of monitored parameter:	579 trucks arrived from Quepos 415 trucks arrived from Coto
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable
Measuring/ Reading/ Recording frequency:	Measured at each delivery and subsequently recorded
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	The recorded data will be crosschecked on a regular basis with the invoices from the transportation service provider

Data / Parameter:	**ID.3 / EU_y**
Data 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:	1.28
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Type: Electricity meter Make/Model: Schneider Electric CM3250 Accuracy class: IEC 687 0.5 class Serial number: 15000219 Calibration frequency: 15 years stability according to manufacturer. But according to *"General Guidelines to SSC CDM methodologies"*, version 14.1, para. 17.(c) at least every three years. Date of last calibration: 02.07.2009 Validity: At least until 01.07.2012
Measuring/ Reading/ Recording frequency:	Measured continuously, reading daily, recorded monthly

Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	The electricity meter will be recalibrated periodically by the supplying firm

Data / Parameter:	**ID.4 / Mc_y**
Data unit:	**kt/year**
Description:	Mass of coal consumption for co-incineration at the project plant, during year y
Measured /Calculated /Default:	Measured
Source of data:	Project owner
Value(s) of monitored parameter:	0 (zero)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable
Measuring/ Reading/ Recording frequency:	In case of coal purchase measured and recorded monthly
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	The recorded data will be crosschecked on a regular basis with the amounts of coal invoiced by the coal supplier

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

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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.
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 project only coal as a fossil fuel is used. (**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**)

In order to open the possibility of co-incinerating renewable biomass and a minor fraction of coal, Q_y should always be calculated using the following formulae (in this monitoring period no co-incineration took place):

$$Q_y = (Qt_y - Mc_y \cdot NCV_c \cdot \eta_p)$$

Where:

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.
Qt_y	is the total quantity of heat generated in the project plant using renewable and fossil fuel resources, during year y, in TJ.
Mc_y	is the total mass of coal consumption for co-incineration at the project plant, during year y, in kt. (**ID.4, to be monitored**)
NCV_c	is the net calorific value for coal (TJ/kT). A default value of 11,404 BTU/lb will be considered based on tests done to Colombian coal (equivalent to 26.5 TJ/kt). (**ID.14, fixed**)
η_p	is the energy efficiency of the boiler in the project scenario. This variable is based upon the manufacturer's information. (**ID.13, fixed**)

The purpose of co-incineration for certain periods is to assure the supply of steam needed for the soybean process.

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

$$Qt_y = h_{ss} \cdot F_{ss} / 10^6$$

Where

Qt_y is the total quantity of heat generated in the project plant using renewable and fossil fuel 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**)

	ID.1 / F_{ss}	**ID.4 / M_c**	**BE_{heat}**	**BE_{boiler}**	**BE_{total}**
Month	**[t]**	**[t]**	**[tCO_2e]**	**[tCO_2e]**	**[tCO_2e]**
Oct-09	11,385.80	0.00	3,757.31	5.71	3,763.02
Nov-09	10,304.10	0.00	3,400.35	5.53	3,405.88
Dec-09	1,785.60	0.00	589.25	5.71	594.96
Jan-10	10,364.70	0.00	3,420.35	5.71	3,426.06
Feb-10	3,431.18	0.00	1,132.29	5.16	1,137.45
Mar-10	11,041.42	0.00	3,643.67	5.71	3,649.38
Apr-10	8,329.50	0.00	2,748.73	5.53	2,754.26
May-10	10,364.40	0.00	3,420.25	5.71	3,425.96
Jun-10	9,039.80	0.00	2,983.13	5.53	2,988.66
Jul-10	11,785.70	0.00	3,889.28	5.71	3,894.99
Aug-10	14,028.80	0.00	4,629.50	5.71	4,635.21
Total	101,861.00	0.00	33,614.11	61.73	**33,675.84**

E.2. Project emissions calculation

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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**)
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**)

	ID.2 / number of trucks		**PE_{trans}**	**ID.3 / EU_y**	**PE_{boiler}**	**PE_{total}**
Month	**Quepos**	**Coto**	**[tCO_2e]**	**[MWh]**	**[tCO_2e]**	**[tCO_2e]**
Oct-09	38	20	41.13	147.12	9.25	50.38
Nov-09	54	10	36.72	125.48	7.89	44.61
Dec-09	37	21	41.85	37.15	2.34	44.19
Jan-10	57	25	55.80	118.86	7.47	63.27
Feb-10	54	16	43.80	51.91	3.26	47.06
Mar-10	72	43	83.96	129.18	8.12	92.08
Apr-10	77	63	109.86	121.14	7.61	117.48
May-10	45	55	85.66	129.35	8.13	93.79
Jun-10	41	50	77.91	115.45	7.26	85.17
Jul-10	45	57	84.01	146.38	9.20	93.22
Aug-10	59	55	92.12	160.22	10.07	102.19
Total	579	415	752.82	1,282.25	80.60	**833.43**

E.3. Leakage calculation

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

E.4. Emission reductions calculation / table

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The total emission reductions can be easily calculated with the results of the below 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

	BEtotal	**PEtotal**	**ERtotal**
Month	**[tCO_2e]**	**[tCO_2e]**	**[tCO_2e]**
Oct-09	3,763.02	50.38	3,712.64
Nov-09	3,405.88	44.61	3,361.27
Dic-09	594.96	44.19	550.77
Jan-10	3,426.06	63.27	3,362.79
Feb-10	1,137.45	47.06	1,090.39
Mar-10	3,649.38	92.08	3,557.30
Apr-10	2,754.26	117.48	2,636.78
May-10	3,425.96	93.79	3,332.18
Jun-10	2,988.66	85.17	2,903.49
Jul-10	3,894.99	93.22	3,801.77
Aug-10	4,635.21	102.19	4,533.02
Total	**33,675.84**	**833.43**	**32,842.41**

Total baseline emissions: **33,675.84 tCO_2e**
Total project emissions: **833.43 tCO_2e**
Total leakage: **0 tCO_2e**
Total emission reductions: **32,842.41 tCO_2e, rounded down to 32,842.00 tCO_2e**

E.5. Comparison of actual emission reductions with estimates in the CDM-PDD

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Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reductions (tCO_2e)	**37,959 (12 months period)** **34,795 (11 months period)**	**32,842 (11 months period)**

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

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As the comparison under E.5 shows, there is no increase in emission reductions compared to the ex-ante calculation.

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History of the document

Version	Date	Nature of revision
01	EB 54, Annex 34 28 May 2010	Initial adoption.
Decision Class: Regulatory **Document Type**: Guideline, Form **Business Function**: Issuance		