CLEAN DEVELOPMENT MECHANISM
1ST CDM MONITORING REPORT:

MONITORING PERIOD: 08/03/2008 – 31/12/2008

PROJECT 1483: ENERGETICOS JAREMAR – BIOGAS RECOVERY FROM PALM OIL EFFLUENT (POME) PONDS, AND HEAT & ELECTRICITY GENERATION, HONDURAS

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SECTION A. General project activity information

A.1 Title of the project activity

Project: Energeticos Jaremar – Biogas recovery from Palm Oil Mill Effluent (POME) ponds, and heat & electricity generation, Honduras

A.2. CDM registration:

Registration number:	1483
Registration date:	08 March 2008

A.3. Short description of the project activity:

The project activity involves the recovery and energetic use of biogas. The biogas is originally produced by the palm oil mill effluent (POME) ponds at Agrotor palm oil mill located in Honduras. The effluent waste water treatment system converts the organic content of the waste water to biogas. As part of the biogas, methane is formed and released into the atmosphere. The CDM-project activity establishes a biogas recovery system which covers the lagoons with floating plastic membranes. This system captures the biogas, which is then utilised on-site for the production of heat & electricity for internal processes of Agrotors production facility. The project reduces greenhouse gas emissions in three ways:

1) by preventing methane emissions resulting from the anaerobic conversion of the POME, to the atmosphere by biogas capture,
2) by replacing residual fuel oil (bunker) with biogas and
3) by replacing electricity consumption from the grid with electricity generated from biogas.

The recovered biogas will primarily be fed into two boilers for the production of heat and into the generator for generation of electricity. Biogas that is not used for the generation of heat and electricity will be flared. In the boilers the biogas will replace bunker consumption at the refinery located near the palm oil mill. Boiler 1 is used for the production of steam for internal production processes at the palm oil refinery. Boiler 2 is for the heating of thermal oil internal production processes at the palm oil refinery. The electricity produced by biogas generation system will avoid electricity imports from the grid. All electricity generated will be used at the palm oil mill and the refinery.

A.4. Monitoring period:

Monitoring period covered by this report: 08 March 2008 – 31 December 2008 (both days are included)

A.5. Methodology applied to the project activity:

The references for Baseline and Monitoring methodologies are the following approved small-scale methodologies:

Type III.H. Methane Recovery in Wastewater Treatment (Version 05; Scope: 13; EB31)[1]

Type I.C. Thermal Energy for User (Version 11; Scope: 1; EB32)[2]

[1] http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_UOWMJU5ZNUE0SGBGAZZNVFU9HVOV99

[2] http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_NZ0ZPDY2NRQS6A8ZLT9JSXTBZNFKX2

A.6. Status of implementation including time table for major project parts:

The project installation is finished according to the description in the PDD and completely operational. The most important milestones are included in the following table:

Date	Milestone
Aug 2007	Completion of biogas recovery system implementation
31 January 2008	Flare is operational
08 March 2008	Registration of project activity
End of March 2008	Boiler 2 starts operation
End of March 2008	Boiler 1 (Cleaver) starts operation
April - June 2008	Start up phase of project activity
30 June 2008	Installation and initial operation of gas engine; start of electricity generation

A.7. Intended deviations or revisions to the registered PDD or monitoring plan:

No deviations to the monitoring procedure documented in the registered monitoring plan occurred.

A.8. Changes since last verification:

N/A

A.9. Person(s) responsible for the preparation and submission of the monitoring report:

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SECTION B. Key monitoring activities according to the monitoring plan for the monitoring period stated in A.4.

B.1. Monitoring equipment:

B.1.1. Table providing information on the equipment used:

Description	Manufacturer	Model	Serial number	Installation	Last Calibration
CH4 fraction out of two digesters	Sewerin	SR2-DO	046 03 000555	10/02/2008	21/05/2008
			046 03 000553	3/12/2007	12/12/2008
flow meter out of digesters	Magnetrol	TA2 (Biogas)	618962-03-001	25/02/2008	8/11/2007
Flow meter to Boiler 1 (cleaver)	Magnetrol	TA2 (Biogas)	618962-05-001	25/02/2008	5/11/2007
Flow meter to Boiler 2 (HTT)	Magnetrol	TA2 (Biogas)	618962-04-001	25/02/2008	6/11/2007
Flow meter to biogas generator	Magnetrol	TA2 (Biogas)	618962-02-001	25/02/2008	5/11/2007
Flow meter to flare	Magnetrol	TA2 (Biogas)	618962-06-001	25/02/2008	5/11/2007
Flow meter additional unit	Magnetrol	TA2 (Biogas)	618962-01-001	Not installed	8/11/2007
Temperature of flare	Siemens	TH200,TC type K	AZB/U9007276	29/03/2008	5/02/2008
Electricity consumption from recovery equipment	Suntec S.A.	OTHV3	073201H	08/04/2008	21/09/2007
			073101H		
Electricity generation of generator	Jenbacher	JGC 316 GS-B.L	542199 1	30/06/2008	N/A[3]

[3] Factory calibration

B.1.2. Calibration procedures:

The calibration of the monitoring equipment was carried out according to the suppliers' manuals.

B.2. Data collection (accumulated data for the whole monitoring period):

B.2.1. List of fixed default values:

Parameter	Default value	Description
T_{flare}	300°C	The minimum temperature at the flare to indicate its operation, according to the technology provider[4].
GWP_{CH4}	21	Global Warming Potential, value for methane (IPCC 2006 Guidelines)
D_{CH4}	0.0007168 tCH4/m³CH4	Density of methane at STP (273.15 K and 1,013 bar) (IPCC 2006 Guidelines)
EF_{grid}	646 tCO_2/GWh	Grid Emission Factor, Honduras; determined ex-ante in PDD
EF_{CO2}	77.4 tCO_2/TJ	Carbon emission factor of residual fuel oil (bunker) (IPCC 2006 Guidelines)
NCV_{biogas}	50.4 TJ/Gg	NCV of methane (IPCC 2006 Guidelines)
η_{SB}	86%	Efficiency of the steam boiler using bunker (manufacture values)
η_{Sp}	81%	Efficiency of the steam boiler using biogas (manufacture values)
η_{thb}	85%	Efficiency of the thermal oil heater using bunker (manufacture values)
η_{thp}	85%	Efficiency of the thermal oil heater using biogas (manufacture values)
η_{flare}	50%	Flare efficiency (acc. to methodology tool)

B.2.2. Data concerning GHG emissions by sources of the project activity:

Data variable	Unit	Description
EC	MWh	Electricity consumption (two meters installed)

B.2.3. Data concerning GHG emissions by sources of the baseline:

Data variable	Unit	Description
w_{CH4}	%	Methane fraction of biogas
$BG_{boiler1}$	Nm³	Biogas combusted in boiler 1
$BG_{boiler2}$	Nm³	Biogas combusted in boiler 2
$BG_{generator}$	Nm³	Biogas combusted in generator
BG_{flared}	Nm³	Biogas flow to flare
BG	Nm³	Biogas combusted in additional unit – not installed yet
EG	MWh	Electricity generation

[4] According to request for clarification 199 of SSC Meth.-panel. The relevant Request for Clarification and the reply are found at (as of 30.1.2009) http://cdm.unfccc.int/UserManagement/FileStorage/7UE8OF5N5EKYIV2SW99H2OU9AKG7HM http://cdm.unfccc.int/UserManagement/FileStorage/AM_CLAR_HIOZ5CS1PASC187C0JQ668L2E9RCRJ

B.2.4. Additional data to be monitored:

Data variable	Unit	Description
T_{flare}	°C	Temperature measurement is used to detect if the flare is operational
End use of final sludge	-	Use of final sludge

B.2.5. Data concerning leakage:

Since the used technology does not involve equipment transferred from another activity and the existing equipment is not transferred to another activity, no leakage needs to be considered.

B.2.6. Data concerning environmental impacts:

For this paragraph we refer to the Gold Standard monitoring report (Annex 2).

B.3. Data processing and archiving:

Data handling was carried out according to the description in the PDD (see B.7)

B.4. Special event log:

Date	Special event
01 April – 14 June	Automated reading of data with problems

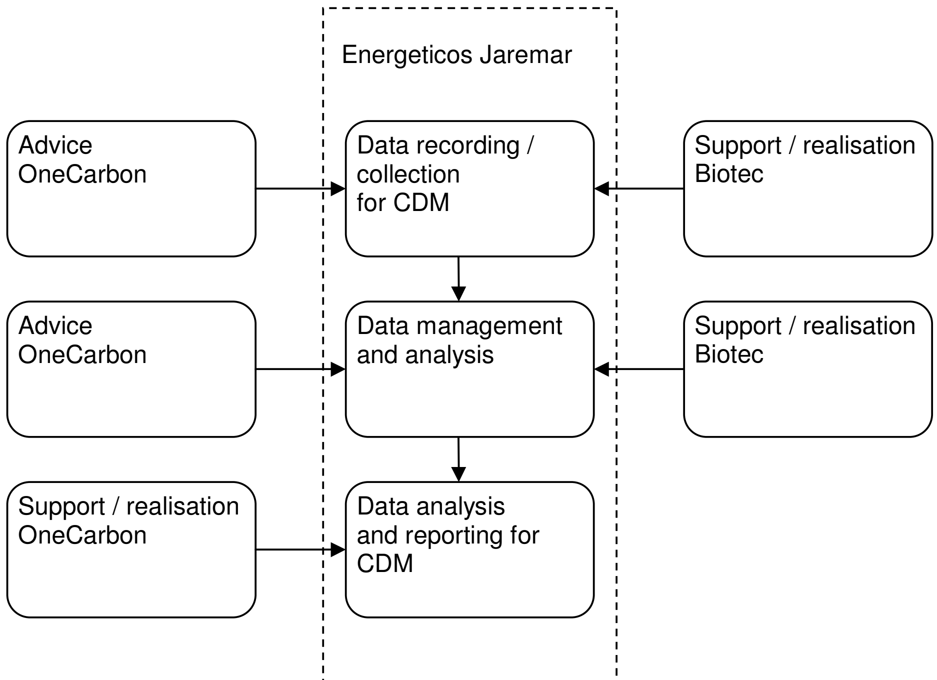
Within the start-up phase of the project activity an inconsistent data reading was noticed for the parameter ID24 (Biogas to boiler 1). Only the parameter ID24 was affected. Therefore the manual recorded data are used for the emission reduction calculation. On 14 June the updating of software corrected the error. The explanation of the program error can be explained by the programming company during the verification on-site visit.

SECTION C. Quality assurance and quality control measures

C.1. Documented procedures and management plan:

C.1.1. Roles and responsibilities:

The project owner is Energeticos Jaremar. Energeticos Jaremare is therefore responsible for the operation and the monitoring of the project activities. Energeticos Jaremare is responsible for the monitoring and is supported by the technology provider Biotec and the CDM-consultant OneCarbon International B.V.



C.1.2. Trainings:

The technical team of Energeticos Jaremar have been introduced to the system by the Belgian technology provider Biotec and Austrian gas engine manufacture Jenbacher. OneCarbon consultants gave training concerning CDM-monitoring.

C.2. Involvement of Third Parties:

Support and consultancy regarding the CDM obligations is provided by the company OneCarbon International B.V., a subsidiary from the Dutch company Econcern.

C.3. Internal audits and control measures:

Since 2008 Agrotor, a subsidiary of Jaremar Group, is certificated according the international quality standard ISO 9001. Internal audits and control measures are part of defined procedures of Jaremar Group.

C.4. Troubleshooting procedures:

In case of emergency cases or failures of the data recording system or the PLC the operating staff will switch to manual readings of all meters. This procedure is well defined and trained to the people since manual readings as backup for the computerised data readings are part of the normal operation during the starting period of this project. Furthermore, a log-book will be written and all the time where observations and all other information necessary to document are included. In this way jumps or periods with not normal operating conditions can be identified and explained.
In cases where no data are available due to failures of the monitoring equipment the responsible for the monitoring decides as soon as possible which actions will be undertaken to minimise the amount of not registered GHG emission reduction. In this case the CDM-consultant OneCarbon will be consulted.

SECTION D. Calculation of GHG emission reductions

D.1. Table providing the formulas used:

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 (1) is as follows:

$$ER_y = BE_y - (PE_y + L_y) \quad (1)$$

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

Total emission reduction (ex-post):
The calculation of emission reductions shall be based on the amount of methane recovered and fuelled or flared that is monitored ex-post, considering also emission reductions from power and heat generation minus the electricity consumption from the project activity. By monitoring the above parameters the total emission reductions can be calculated ex-post according to:

$$ER_y = ER_{MD,y} + ER_{thermal,y} + ER_{power,y} - PE_{Power,y} \quad (2)$$

ER_y = Emission reductions in tCO_{2eq}/y
ER_{MDy} = Emission reductions from the CH4 combusted and destroyed as fuel and flared in tCO_{2eq}/y
$ER_{thermal,y}$ = Emission reductions due to displacement of bunker fuel for the generation of heat in tCO_{2eq}/y
$ER_{power,y}$ = Emission reductions due to displacement of electricity in tCO_{2eq}/y
$PE_{power,y}$ = Project emissions due to electricity consumption in tCO_{2eq}/y

Methane destruction:
According to the PDD, the small scale methodology Type III.H (version 5) and the “Tool to determine project emissions from flaring gases containing methane” provides the way to calculate the emission reduction resulting from avoided methane emissions. The actual achieved emission reduction is calculated according to the following equation:

I- Ex-post determination of methane combusted and destroyed.
The amount of methane combusted and destroyed is determined by summation of the amount of methane fed into the two boilers, the generator and the flare minus the amount of emission resulting from incomplete combustion at the flare as follows:

$$ER_{MD,y} = (\Sigma_i MD_{boiler,i,y} + \Sigma_i MD_{generator,y} + MD_{flared,y}) \times GWP_{CH4} \quad (3)$$

Where:

$ER_{MD,y}$	= Emission reductions from the CH4 combusted and destroyed as fuel and flared in tCO_{2eq} /y
$MD_{boiler,i,y}$	= Amount of CH_4 combusted in boiler i in tCH_4 /y
$MD_{generator,y}$	= Amount of CH_4 combusted in generator in tCH_4 /y
$MD_{flared,y}$	= Amount of CH_4 combusted in flare in tCH_4 /y
GWP_{CH4}	= Global warming potential for CH_4 (see B.2.1)

The amount of CH_4 combusted by the boiler i is calculated according to:

$$MD_{boiler,i,y} = BG_{boiler,i,y} \times w_{CH4,y} \times D_{CH4} \quad (4)$$

Where:

$BG_{boiler,i,y}$	= The quantity of biogas fed into boiler i in Nm^3 /y (see B.2.2)
$w_{CH4,y}$	= The average CH_4 fraction of the biogas as measured and expressed as a fraction in m^3 CH_4/m^3 (see B.2.1)
D_{CH4}	= The CH_4 density in tCH_4/m^3CH_4 (see B.2.1)

The amount of CH4 combusted by the biogas generator is calculated according to:

$$MD_{generator,y} = BG_{generator,y} \times w_{CH4,y} \times D_{CH4} \quad (5)$$

Where:

$BG_{generator,y}$	= The quantity of biogas fed into the generator in Nm^3/y (see B.2.2)
$w_{CH4,y}$	= The average CH_4 fraction of the biogas as measured and expressed as a fraction in m^3 CH_4/m^3 (see B.2.1)

The amount of CH_4 destroyed by the flare is calculated according to:

$$MD_{flared,y} = BG_{flare,y} \times w_{CH4} \times D_{CH4} \times \eta_{flare} \quad (6)$$

Where:

$BG_{flare,y}$	= The quantity of biogas fed into the flare in year "y" in Nm^3/y (see B.2.2)
$w_{CH4,y}$	= The average CH4 fraction of the biogas as measured and expressed as a fraction in m^3 CH_4/m^3 (see B.2.1)
η_{flare}	= Flare efficiency (open flare, 50%) (see B.2.1)

If there is an excess of biogas, it will be flared by a flare. The project uses an open flare, and therefore the flare efficiency cannot be measured in a reliable manner (i.e. external air will be mixed and will dilute the remaining methane) and a default value of 50% is used, as requested by the applicable small scale methodology.

II- Ex-post emission reduction from heat generation
The following equations are included to estimate the thermal energy delivered and the emission reductions from the replacement of bunker:

For the steam boiler (boiler 1):

$$HG_{1,y} = MD_{boiler,1,y} \times NCV_{biogas} \times \eta s_p \times 1/1000 \quad (7)$$

$HG_{1,y}$ = The net quantity of thermal energy supplied by the steam boiler to the process in the project activity in TJ/year
$MD_{boiler,1,y}$ = Amount of CH_4 combusted by the steam boiler in tCH_4/y (see B.2.2)
NCV_{biogas} = Net calorific value CH_4 in TJ/Gg (see B.2.1)
ηs_p = The efficiency of the steam boiler using biogas (see B.2.1)

For the thermal oil heater (boiler 2):

$$HG_{2,y} = MD_{boiler,2,y} \times NCV_{biogas} \times \eta th_p \times 1/1000 \quad (8)$$

$HG_{2,y}$ = The net quantity of thermal energy supplied by the steam boiler to the process in the project activity in TJ/year
$MD_{boiler,2,y}$ = Amount of CH_4 combusted by the steam boiler in tCH_4/y (see B.2.2)
NCV_{biogas} = Net calorific value CH_4 in TJ/Gg (see B.2.1)
ηth_p = The efficiency of the thermal oil heater using biogas (see B.2.1)

The use of bunker as an auxiliary fuel does not need to be monitored or subtracted from total emission reductions, since emission reductions from heat generation will be based on biogas flow and not in the total heat generation.
The emission reductions related to the heat/steam generation component are calculated as follows:

$$ER_{thermal,y} = \left(\frac{HG_{1,y}}{\eta s_b} + \frac{HG_{2,y}}{\eta th_b} \right) \cdot EF_{CO_2} \quad (10)$$

Where:
EF_{CO2} = The CO_2 emission factor per unit of energy of bunker that would have been used in the baseline plant in tCO_2 / TJ (see B.2.1)
ηs_b = The efficiency of the steam boiler using bunker that would have been used in the absence of the project activity (see B.2.1)
ηth_b = The efficiency of the thermal oil heater using bunker that would have been used in the absence of the project activity (see B.2.1)

Since for the bunker replacement part no project and leakage emissions have to be considered the above calculated baseline emissions are equal to the emission reduction.

III- Ex-post emission reductions from electricity generation (AMS-I.C)

$$ER_{power,y} = EG_y \times EF_{grid} \qquad (11)$$

Where:
EG_y = Net amount of electricity produced by the project activity in GWh /y (see B.2.2)
EF_{grid} = Emission factor of the Honduran grid, determined ex ante in tCO_{2eq}/GWh (see B.2.1)

The net amount of electricity generated will include the electricity delivered by the 0.848 MW_{el} generator plus any future installed generator which operates on the captured biogas.

IV- Ex-post project emission from electricity consumption (AMS-III.H)

$$PE_{power,y} = EC_y \times EF_{grid} \qquad (12)$$

Where:
EC_y = Electricity consumption of the project activity in GWh /y (see B.2.2)

The calculation steps explained above are also transferred to the CDM-monitoring Excel sheet, which will be used for the calculation and the summary of the achieved emission reduction.

D.2. GHG emission reductions (referring to B.2. of this document):

D.2.1. Project emissions:

The project emissions for the project activity according to the PDD are included in the following table:

Month	ID30: EC_y [GWh]	Project emission AMS-III.H [tCO_{2eq}]
Mar. 08	-[5]	-[5]
Apr. 08	0.0114	7.4
May 08	0.0149	9.6
Jun. 08	0.0219	14.2
Jul. 08	0.0249	16.1
Aug. 08	0.0243	15.7
Sep. 08	0.0303	19.6
Oct. 08	0.0313	20.2
Nov. 08	0.0259	16.7
Dec. 08	0.0222	14.3
Sum	**0.2071**	**133.8**

The total amount of Project Emissions during this monitoring period is therefore **133.8 t CO_{2eq}**

Furthermore the used quantity of the final sludge has to be monitored. Sludge removed from the system is applied as fertilizer to the surrounding land. So there are no additional project emissions by the usage of the final sludge. Evidence is available in form of a log-book that is available to the DOE on-site.

D.2.2. Baseline emissions:

The baseline emissions according to AMS-III.H for the project activity the PDD are included in the following table:

[5] March 2008 is not considered in the emission reduction calculation due to incompletion of monitoring system.

Month	ID24: CH4 comb. Boiler 1 [Nm³]	ID25: CH4 comb. Boiler 2 [Nm³]	ID26: CH4 comb. Generator [Nm³]	ID27: CH4 comb. Flare [Nm³]	Baseline emission CH4 comb. AMS III.H [tCO_{2eq}]
Mar. 08	-[6]	-[6]	-[6,7]	-[6]	-[6]
Apr. 08	194,922	40,216	-[7]	-	1,920.2
May 08	260,053	3,682	-[7]	7,411	2,184.0
Jun. 08	340,386	2	-[7]	13,920	2,836.5
Jul. 08	252,977	17,170	101,910	44,987	3,222.0
Aug. 08	323,899	43,890	58,942	54,961	3,709.2
Sep. 08	250,529	87,467	247,736	34,476	4,923.9
Oct. 08	308,822	92,652	267,863	18,737	5,542.4
Nov. 08	304,316	90,731	177,148	857	4,676.1
Dec. 08	324,866	89,843	13,647	139	3,498.6
Sum	**2,560,770**	**465,651**	**867,246**	**175,487**	**32,512.8**

The baseline emissions according to AMS-I.C for the project activity the PDD are included in the following table:

Month	ID31: Electricity gen. EG_y [GWh]	Baseline Emission Heat gen. [tCO_{2eq}]	Baseline Emission Electricity gen. [tCO_{2eq}]	Baseline Emissions AMS-I.C [tCO_{2eq}]
Mar. 08	-[6,7]	-[6]	-[6]	-[6]
Apr. 08	-[7]	339.5	-[7]	339.5
May 08	-[7]	377.1	-[7]	377.1
Jun. 08	-[7]	486.3	-[7]	486.3
Jul. 08	0.1988	387.5	128.4	515.9
Aug. 08	0.1142	529.3	73.8	603.1
Sep. 08	0.5181	490.6	334.7	825.3
Oct. 08	0.4887	581.8	315.7	897.5
Nov. 08	0.3021	572.4	195.2	767.6
Dec. 08	0.0220	600.4	14.2	614.7
Sum	**1.6439**	**4,365.1**	**1,062.0**	**5,427.0**

[6] March 2008 is not considered in the emission reduction calculation due to incompletion of monitoring system.
[7] March – June 2008 are not considered in the emission reduction calculation due to the installation of the gas engine (Jenbacher) in end of June 2008.

The total baseline emissions are given as the sum of baseline emission from AMS-III.H and AMS-I.C.

Baseline emissions AMS-III.H	**32,512.8**	[t CO_{2eq}]
Baseline emissions AMS-I.C	**5,427.0**	[t CO_{2eq}]
Total Baseline emissions	**37,939.8**	[t CO_{2eq}]

One of the main parameters to determine the baseline emissions and subsequently the emission reductions is the fraction of methane in the biogas. The PDD and the used methodology define for this project activity that these measurements have to be carried out at least quarterly and should meet a confidence level of at least 95 %. This condition has been met by the project activity. The average value for these measurements equals 55.2%. The 95% confidence interval applied to those is 0.95%. For the ER calculations the average methane concentration value was discounted by the value of the 95% confidence level as shown in the following equation:

55.2% - 0.95% = 54.25%

The calculation can be found in the CDM-monitoring Excel-file.

D.2.3. Leakage:

Leakage is considered to be zero (see also section B.2.4).

D.2.4. Summary of the emissions reductions during the monitoring period:

According to the general equation (equation 1)

$$ER_y = BE_y - (PE_y + L_y)$$

$$Emission\ reduction = Baseline\ emissions_{total} - (Project\ emissions + Leakage)$$

The emission reduction according to AMS-III.H is therefore given through the baseline emissions due to recovered and destroyed methane minus project emissions due to electricity consumption of the biogas recovery equipment:

AMS-III.H

Baseline emissions:	**32,512.8**	[t CO_{2eq}]
Project emissions:	**133.8**	[t CO_{2eq}]
Leakage:	**0.0**	[t CO_{2eq}]
Emission reduction:	**32,379.0**	[t CO_{2eq}]

The emission reduction according to AMS-I.C is therefore given through the baseline emissions due to replaced grid electricity and bunker replacement.

AMS-I.C

Baseline emissions:	**5,427.0**	[t CO_{2eq}]
Project emissions:	**0.0**	[t CO_{2eq}]
Leakage:	**0.0**	[t CO_{2eq}]
Emission reduction:	**5,427.0**	[t CO_{2eq}]

Summary of emission reduction:

Total Baseline emissions:	**37,939.8**	[t CO_{2eq}]
Total Project emissions	**133.8**	[t CO_{2eq}]
Total Leakage	**0.0**	[t CO_{2eq}]
Total emission reduction:	**37,806.0**	[t CO_{2eq}]

The emission reductions for the period which is covered by this monitoring report is therefore

37,806 tCO_{2eq}

Annex 1

Definitions and acronyms

AMS	: Approved Small Scale Methodology
CDM	: Clean Development Mechanism
COD	: Chemical Oxygen Demand
DOE	: Designated Operational Entity
EB	: Executive Board
GHG	: Greenhouse Gases
IPCC	: Intergovernmental Panel on Climate Change
NCV	: Net Calorific Value
PDD	: Project Design Document
PLC	: Programmable Logic Controllers
POME	: Palm Oil Mill Effluent
STP	: Standard temperature and pressure