EID Parry (India) Limited

UNFCCC Ref No: 1139

Project title: Bagasse based Cogeneration Project at Pudukkottai
Tamil Nadu, India

Clean Development Mechanism
Emission Reduction Monitoring Report

Monitoring period: 14.09.2007 to 30.09.2008
(Includes starting and ending days)
for
Initial and First Periodic Verification

PARRYS
Go beyond

A Murugappa Group Company

Version: 01
08 January 2009

Purpose of the report:

This monitoring report has been prepared for the purpose of independent verification of the Green House Gas (GHG) emission reductions achieved by EID Parry (India) Limited's Clean Development Mechanism (CDM) project titled "Bagasse based Cogeneration Project at Pudukkottai Tamil Nadu, India" during the period "14 September 2007 to 30 September 2008" (includes starting and ending days). This monitoring report is for the initial and first periodic verification.

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1. BACKGROUND OF THE PROJECT PROMOTER

E.I.D. Parry (India) Limited (EID Parry) is a part of the Murugappa Group, one of the biggest industrial houses in India. EID Parry is engaged in the manufacture and marketing of a wide-range of products; Sugar, Alcohol, Power and Bio-products.

The company has been a pioneer in many fields, including setting up of India's first chemical fertiliser plant - at Ennore and Sugar plant - at Nellikuppam. A strong sense of ***commitment*** and adherence to business ethics has helped EID Parry succeed in bringing to life the larger picture and to ***'Go Beyond'*** in all their ventures.

EID Parry has always been a pioneer- be it in developing and introducing quality products in the market or conforming to environmental standards even before they become mandatory. Some notable achievements of EID Parry in environmental management include:

- ISO 14001 certification in Pudukottai & Nellikuppam
- The recipients of the Green Tech Award on Safety

The GHG reduction project activity at EID Parry's Pudukkottai sugar plant is one of the many initiatives of the company towards sustainable development contribution.

2. INTRODUCTION TO THE PROJECT ACTIVITY

This project activity involves implementation of a bagasse based cogeneration plant ("project activity") in one of the sugar plants of EID Parry located at Pudukkottai District, Tamil Nadu, India. The cogeneration plant has been implemented with the objective of increasing the efficiency of electricity generation by substituting the existing low efficiency cogeneration system with a high efficiency cogeneration system. As a result of the project activity, the net electricity generation on site has increased enabling the export of electricity to the regional grid[1]. The export of the incremental electricity generation displaces an equivalent amount of electricity that would otherwise have been generated in fossil fuel intensive grid connected power plants and thereby reduces equivalent amount of Green House Gases (GHGs) from these power plants.

The project activity has been registered with the United Nations Framework Convention on Climate Change (UNFCCC) as a CDM project activity (Reference No. 1139[2]) on 14 September 2007.

Technical details of the project activity:

Turbine Generator details:

Rated output capacity:	18 MW
Type:	Extraction condensing system

Boiler details:

Rated steam output capacity:	100 Tonnes Per Hour
Rated pressure:	86 kg/cm^2
Rated temperature:	510$\pm$5 degree Celsius

[1] Electricity is exported to the Tamil Nadu Electricity Board (TNEB) which is part of the southern regional grid of India

[2] https://cdm.unfccc.int/Projects/DB/SGS-UKL1179758404.75/view.html

3. SUSTAINABLE DEVELOPMENT ASPECTS OF THE PROJECT ACTIVITY

Contribution to socio-economic well being:

The export of electricity to the grid by the project activity has helped to reduce power outages and thereby improving industrial output and quality of life resulting in socio-economic development of the region. The improved power situation encourages new small and medium industries in the region improving the rural employment scenario. These would indirectly contribute to reducing the population migration to cities.

Contribution to technological development:

The project activity is one of the first of its kind in the region in adopting an advanced high efficiency technology (steam pressure of 86 kg/cm^2). This has facilitated to establish the successful performance of this technology in the region thus encouraging other similar ventures in the region. It is also the first in the region with such a configuration to get registered as a CDM project activity with the UNFCCC.

Contribution to environmental well-being:

The project activity reduces exploitation of natural resources (fossil fuels) for energy generation by supplementing the local electricity grid with a sizeable quantity of renewable[3] power. Further, the project reduces other negative environmental aspects of conventional power plants like emission of particulate matter and ash disposal. The project promotes the usage of renewable sources for power generation by successful demonstration of biomass based power generation.

[3] Power generated from renewable biomass residues (bagasse)

4. SUMMARY OF EMISSION REDUCTIONS:

Emission Reductions during the period 14.09.2007 to 30.09.2008 (including start and end days)						
S.No	**Notation**	**Parameter**	**Unit**	**Total**	**2007[4]**	**2008**
1	$ER_{el,y}$	Emission reduction from electricity displacement	tCO_2	74,826	14,226	60,600
2	PE_y	Project emissions	tCO_2	13,695	2,110	11,585
3	ER_y	Emission reductions	tCO_2	61,131	12,116	49,015

[4] In the context of this report, 2007 would represent the period 14.09.2007 to 31.12.2007. 2008 represents the period 01.01.2008 to 30.09.2008

5. MONITORED PARAMETERS

5.1 Gross Energy Generation in the project plant:

Data / Parameter:	$EG_{Gross, project\ plant,y}$
Data unit:	MWh
Description:	Gross quantity of electricity generated in the project plant
Source of data to be used:	EID Parry's energy meter log books
Description of measurement methods and procedures applied:	The data has been recorded in log books on a daily basis based on energy meter readings of EID Parry. Monitoring frequency: Continuously
QA/QC procedures applied	Energy meters have been calibrated. (see table below) The generation data when cross-checked with the biomass residue consumption results in a reasonable efficiency as estimated in the registered PDD. Please refer enclosed excel sheet for efficiency values.
Any comment:	-

Serial No.	Accuracy class	Calibration date	Prev. Calibration	Result
ELI 04157	0.2	Report awaited	01.01.2007	Error % within limits

5.2 Auxiliary energy consumption in the project plant:

Data / Parameter:	$EG_{Aux, project\ plant,y}$
Data unit:	MWh
Description:	Auxiliary electricity consumption in the project plant
Source of data to be used:	EID Parry's energy meter log books
Description of measurement methods and procedures applied:	The data has been recorded in log books on a daily basis based on energy meter readings of EID Parry. The auxiliary equipments are supplied through two transformers (called DTR and CTR) during normal operation. During emergency, the equipments are also supplied from the DG set. The energy supply through all the three sources is monitored through three energy meters, which is summed up to calculate the total auxiliary consumption. $EG_{Aux} = EG_{Aux, DTR} + EG_{Aux, CTR} + EG_{DG}$ Monitoring frequency: Continuously
QA/QC procedures applied	Energy meters have been calibrated. (see table below)

Source	Serial No.	Accuracy class	Calibration date	Prev. Calibration	Result
Aux. DTR	ELI04161	0.2	Report awaited	01.01.2007	Error % within limits
Aux. CTR	ELI04167	0.2	Report awaited	01.01.2007	Error % within limits
Aux. DG	5298399	0.5	Report awaited	05.03.2008	Error % within limits

	The auxiliary consumption figure (11%) is within the range for cogeneration power plants.
Any comment:	-

5.3 Net energy generation in the project plant:

Data / Parameter:	**$EG_{project\ plant,y}$**
Data unit:	MWh
Description:	Net quantity of electricity generated in the project plant
Source of data to be used:	EID Parry's energy meter log books
Description of measurement methods and procedures applied:	Calculated by deducting the auxiliary consumption from the gross electricity consumption. $EG_{project\ plant} = EG_{gross} - EG_{Aux}$ Monitoring frequency: Continuously
QA/QC procedures applied	Energy meters have been calibrated. The net generation data when cross-checked with the biomass residue consumption results in a reasonable efficiency as estimated in the registered PDD. Refer enclosed excel sheet for efficiency values.
Any comment:	-

5.4 On-site electricity consumption (Energy imported from the grid):

<table>
<tr><td>Data / Parameter:</td><td>$EC_{PJ,y}$</td></tr>
<tr><td>Data unit:</td><td>MWh</td></tr>
<tr><td>Description:</td><td>On-site electricity consumption attributable to the project activity during the year y. During start-up, the plant imports electricity from the grid.</td></tr>
<tr><td>Source of data to be used:</td><td>EID Parry energy meter log books.</td></tr>
<tr><td>Description of measurement methods and procedures applied:</td><td>The data has been recorded in log books on a daily basis by EID Parry and monthly in TNEB meters based on TNEB's energy meter readings. There are two energy meters connected in parallel to monitor this data. One is the main meter and another is the check meter, which is used to cross-check the main meter.
Monitoring frequency: Continuously</td></tr>
<tr><td>QA/QC procedures applied</td><td>The metered electricity generation is cross-checked with monthly TNEB records and is found consistent. Energy meters are calibrated.
<table>
<tr><td>Serial No.</td><td>Accuracy class</td><td>Calibration date</td><td>Prev. Calibration</td><td>Result</td></tr>
<tr><td>5462951</td><td>0.2</td><td>07.05.2008</td><td>09.08.2007</td><td>Error % within limits</td></tr>
<tr><td>6489252</td><td>0.2</td><td>07.05.2008</td><td>09.08.2007</td><td>Error % within limits</td></tr>
</table>
</td></tr>
<tr><td>Any comment:</td><td>-</td></tr>
</table>

Table T5.1: Monitored data for electricity parameters

Period	Gross Electricity Generation	Auxiliary Consumption				Net Electricity Generation	Electricity Imported for on-site use
		DTR	CTR	DG	Total		
	MWh	MWh	MWh	MWh	MWh	MWh	MWh
Sep-07	7201.9	220.0	524.6	1.4	745.9	6456.0	2.0
Oct-07	12147.8	411.7	890.4	7.2	1309.3	10838.5	27.0
Nov-07	626.4	197.0	68.1	18.2	283.4	343.0	193.0
Dec-07	5113.4	278.3	435.5	28.6	742.4	4371.0	136.0
Jan-08	9502.7	345.1	728.4	8.7	1082.1	8420.6	97.0
Feb-08	12439.6	383.8	871.8	0.0	1255.7	11183.9	0.0
Mar-08	12167.3	411.0	843.8	5.7	1260.4	10906.9	38.0
Apr-08	12885.6	412.9	889.0	2.4	1304.3	11581.3	6.0
May-08	13645.8	425.6	962.0	3.0	1390.6	12255.2	5.0
Jun-08	12710.8	406.6	935.7	0.9	1343.2	11367.6	1.0
Jul-08	12472.9	404.7	896.8	8.8	1310.2	11162.7	11.0
Aug-08	10087.3	389.2	791.8	15.3	1196.3	8891.0	21.0
Sep-08	8795.7	375.9	757.6	2.5	1136.0	7659.7	7.0
2007 (Total)	25089.5	1107.0	1918.6	55.4	3081.0	22008.5	358.0
2008 (Total)	104707.7	3554.8	7676.9	47.3	11278.9	93428.8	186.0
Total	129797.2	4661.8	9595.4	102.7	14359.9	115437.3	544.0

5.5 Biomass residue combustion in the project plant:

Data / Parameter:	**$BF_{k,y}$**
Data unit:	Tonnes
Description:	Quantity of biomass residues type k combusted in the project plant
Source of data to be used:	EID Parry fuel log books
Description of measurement methods and procedures to be applied:	Fuel consumption is measured in on-line weighing scale installed in the fuel conveyors. This gives the wet fuel quantity. The dry fuel quantity is calculated by adjusting for the moisture content as follows: Dry fuel = Wet fuel * (100- moisture %) Monitoring frequency: Continuously
QA/QC procedures applied	The measured values are cross-checked with annual energy balance as follows: "Fuel combusted = Fuel generated in-house + Fuel purchased + Opening stock - Closing stock in fuel yard" Monitored fuel consumption figures has been cross-checked with monthly/annual manufacturing reports and stock exchanges and found to be consistent
Any comment:	-

5.6 Moisture content of biomass residues:

Data / Parameter:	**Moisture content of biomass residues**
Data unit:	% water content
Description:	Moisture content of biomass residue type k
Source of data to be used:	EID Parry log books / electronic records
Description of measurement methods and procedures to be applied:	The moisture content is measured on-site using the "weights method" described below and recorded in log books / electronic records. Weights method: The weight of fuel with moisture and without moisture (after drying in oven) is measured to arrive at the moisture content. Monitoring frequency: Continuously
QA/QC procedures to be applied:	Mass balance used is calibrated.
Any comment:	As per ACM0006 methodology, the mean values would be calculated annually.

5.7 Fossil fuel consumption (co-fired) in the project plant:

Data / Parameter:	**$FF_{project\ plant,\ i,y}$**
Data unit:	Tonnes
Description:	Onsite fossil fuel consumption for co-firing in the project plant
Source of data to be	EID Parry fuel log books

used:	
Description of measurement methods and procedures to be applied:	Fuel consumption is measured in on-line weighing scale installed in the fuel conveyors. Monitoring frequency: Continuously
QA/QC procedures applied	The measured values are cross-checked with annual energy balance as follows: "Fuel combusted = Fuel generated in-house + Fuel purchased + Opening stock - Closing stock in fuel yard" Monitored fuel consumption figures has been cross-checked with purchase receipts and stock exchanges and found to be consistent
Any comment:	-

5.8 Fossil fuel consumption (on-site) due to the project activity:

Data / Parameter:	$\mathbf{FF}_{\text{project site, i,y}}$
Data unit:	Tonnes
Description:	Onsite fossil fuel consumption (diesel) used in the project site apart from co-firing as a result of the project activity. The only incremental electricity consumption due to the project activity is the diesel consumption in DG sets to run the cogeneration plant auxiliaries during emergencies.
Source of data to be used:	EID Parry fuel log books
Description of measurement methods and procedures to be applied:	The quantity of fossil fuel (diesel) consumed in the DG sets is measured using the volume meter (dip-stick) method. Monitoring frequency: Continuously
QA/QC procedures applied	Monitored quantity of fuel consumption is cross-checked with efficiency (kWh/litre) of DG generation and is found within the allowable range.
Any comment:	-

5.9 Net Calorific Value of biomass residue type k:

Data / Parameter:	$\mathbf{NCV}_{k}$
Data unit:	kCal/kg
Description:	Net calorific value of biomass residue type k
Source of data to be used:	Analysis report of reputed laboratory.
Description of measurement methods and procedures to be applied:	Determined by a third party laboratory Monitoring frequency: Once in six months
QA/QC procedures applied	NCV determined based on third party analysis report is consistent with standard NCV for that type of biomass residue.
Any comment:	-

5.10 Net Calorific Value of fossil fuel type i:

Data / Parameter:	**NCV_i**
Data unit:	kCal/kg
Description:	Calorific value of fossil fuel type i
Source of data to be used:	Analysis report of reputed laboratory
Description of measurement methods and procedures to be applied:	Determined by a third party laboratory Monitoring frequency: Once in six months when used
QA/QC procedures applied	NCV determined based on third party analysis report is consistent with standard NCV for fossil fuels
Any comment:	-

Table T5.2: Fuel consumption and NCV parameters monitored

Parameters	Unit	Sep-07	Oct-07	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08
Own bagasse (wet)	Tonnes	16200.0	19432.0	-	6041.0	16928.0	22364.0	21287.0	21951.0	25308.0	25242.0	24717.0	20581.0	20868.0
Moisture content	%	53.9	54.0	-	54.0	52.3	50.3	50.4	50.6	50.7	50.9	50.9	51.0	51.7
Own bagasse (dry)	Tonnes	7466.6	8942.6	-	2778.3	8071.3	11119.4	10560.5	10852.6	12474.3	12406.4	12136.0	10076.5	10079.2
NCV	Mcal/T	3692.0	3692.0	3692.0	3692.0	3608.0	3608.0	3608.0	3608.0	3690.0	3690.0	3690.0	3675.0	3675.0
Heat equivalent	MWh	32054.2	38390.8		11927.1	33861.8	46649.7	44304.9	45530.3	53523.5	53232.3	52072.1	43059.3	43071.2
Purchased bagasse (wet)	Tonnes	753.0	6912.0	1114.0	3552.0	210.0	1549.0	476.0	785.0	328.0	161.0	63.0	0.0	0.0
Moisture content	%	51.2	50.8	50.6	50.7	50.4	50.3	50.3	50.5	50.6	50.9	50.8		
Purchased bagasse (dry)	Tonnes	367.8	3397.9	550.3	1752.2	104.3	770.0	236.7	388.5	162.1	79.0	31.0	0.0	0.0
NCV	Mcal/T	3692.0	3692.0	3692.0	3692.0	3608.0	3608.0	3608.0	3608.0	3690.0	3690.0	3690.0	3675.0	3675.0
Heat equivalent	MWh	1578.8	14587.4	2362.5	7522.2	437.4	3230.5	992.9	1629.9	695.5	339.0	133.0	0.0	0.0
Groundnut shell (wet)	Tonnes								349.0	1725.0	651.0	997.0	915.0	540.0
Moisture content	%								13.9	13.8	13.9	13.7	13.2	14.3
Groundnut shell (dry)	Tonnes								300.7	1487.8	560.3	860.1	794.0	463.0
NCV	Mcal/T								3809.0	3809.0	3809.0	3809.0	3826.0	3826.0
Heat equivalent	MWh								1331.7	6589.6	2481.4	3809.5	3532.5	2059.8
Cane trash	Tonnes												33.0	4.0

(wet)														
Moisture content	%												30.8	30.8
Cane trash (dry)	Tonnes												22.8	2.8
NCV	Mcal/T												3594.0	3594.0
Heat equivalent	MWh												95.5	11.6
Coal	Tonnes							965.0	86.0					
NCV	Mcal/T							6152.0	6152.0					
Heat equivalent	MWh							6903.1	615.2					
Lignite	Tonnes		293.0	55.0	1266.0	2373.0	1939.0	1402.0	2754.0	132.0				
NCV	Mcal/T		2400.0	2400.0	2400.0	2400.0	2400.0	2400.0	2400.0	2400.0				
Heat equivalent	MWh		817.7	153.5	3533.0	6622.3	5411.2	3912.6	7685.6	368.4				
Heat equivalent of all fuels combusted in the project activity	MWh	33633.0	53795.9	2516.0	22982.4	40921.5	55291.3	56113.5	56792.7	61177.0	56052.7	56014.6	46687.3	45142.6
Fossil Fuel consumption on-site attributable to the project activity														
Diesel consumption in standby DG sets	litres	300.00	2450.00	7310.00	8725.00	2640.00	0.00	1445.00	700.00	825.00	300.00	2480.00	4650.00	808.00
Density of diesel	kg/l	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Diesel consumption in standby DG sets	Tonnes	0.26	2.08	6.21	7.42	2.24	0.00	1.23	0.60	0.70	0.26	2.11	3.95	0.69

Summary of Fuel consumption and NCV parameters monitored

Parameters	Unit	Total	2007	2008
Own bagasse (wet)	Tonnes	240919.0	41673.0	199246.0
Own bagasse (dry)	Tonnes	116963.7	19187.4	97776.2
Heat equivalent	MWh	497677.2	82372.1	415305.1
Purchased bagasse (wet)	Tonnes	15903.0	12331.0	3572.0
Purchased bagasse (dry)	Tonnes	7839.8	6068.2	1771.5
Heat equivalent	MWh	33509.2	26051.0	7458.1
Groundnut shell (wet)	Tonnes	5177.0	0.0	5177.0
Groundnut shell (dry)	Tonnes	4465.9	0.0	4465.9
Heat equivalent	MWh	19804.5	0.0	19804.5
Cane trash (wet)	Tonnes	37.0	0.0	37.0
Cane trash (dry)	Tonnes	25.6	0.0	25.6
Heat equivalent	MWh	107.0	0.0	107.0
Coal	Tonnes	1051.0	0.0	1051.0
Heat equivalent	MWh	7518.3	0.0	7518.3
Lignite	Tonnes	10214.0	1614.0	8600.0
Heat equivalent	MWh	28504.2	4504.2	24000.0
Heat equivalent of all fuels combusted in the project activity	MWh	89443.2	30555.2	58888.0
Fossil Fuel consumption on-site attributable to the project activity				
Diesel consumption in standby DG sets	litres	32633.00	18785.00	13848.00
Density of diesel	kg/l	0.85	0.85	0.85
Diesel consumption in standby DG sets	Tonnes	27.74	15.97	11.77

5.11 Average return trip distance between biomass supply sites and project site:

Data / Parameter:	**AVDy**
Data unit:	Kilometres (Kms)
Description:	Average return trip distance between biomass fuel supply sites and the project site
Source of data to be used:	Records of EID Parry on the origin of the biomass residues and distance provided by truck operators.
Description of measurement methods and procedures to be applied:	The truck operator will provide the distance traveled by the trucks between the fuel supply sites and the project activity. Monitoring frequency: Continuously
QA/QC procedures applied	Consistency of distance provided by truck operators have been verified by the project promoters using their own vehicles.
Any comment:	-

5.12 Number of truck trips for the transportation of biomass:

Data / Parameter:	N_y
Data unit:	Tonnes
Description:	Number of truck trips for the transportation of biomass
Source of data to be used:	EID Parry biomass purchase records
Description of measurement methods and procedures to be applied:	The stores department operator at the weigh bridge records each and every truck load before biomass is unloaded. All details including the vehicle number and weight of biomass are recorded by the operator in EID Parry's records. Frequency of monitoring: Continuously, aggregated annually
QA/QC procedures applied	The consistency of the number of truck trips have been cross-checked with the quantity of biomass purchased. This gives a reasonable value.
Any comment:	-

During the period 14.09.2007 to 30.09.2008, EID Parry has purchased bagasse from five sources. The name of the sources, return trip distance and number of truck trips to the project site are provided below:

S.No	Source	Return trip distance (kms)	No. of truck trips	Share (%)
1	Kothari Sugars and Chemicals, Kattur	220	18	1.7
2	EID Parry, Pettavaithalai	200	147	14.1
3	Arignar Anna Sugar Mill, Kurungulam	160	222	21.4

4	Chengalrayan Co-operative sugar mills	200	21	2.0
5	Kallakurichi Co-operative sugar mills	200	36	3.5
6	Groundnut shell source	200	569	54.8
7	Cane trash source	100	26	2.5
8	Total		**1039**	100
9	Mean Value	**189.3**		

5.13 Emission Factor of trucks:

Data / Parameter:	$EF_{km, CO2}$
Data unit:	tCO_2/km
Description:	Average CO_2 emission factor for transportation of biomass with trucks
Source of data to be used:	EID Parry records, Central Electricity Authority of India and IPCC
Description of measurement methods and procedures to be applied:	Sample measurements were conducted to determine the fuel efficiency of the trucks. This is multiplied with the net calorific value of diesel (national value from Central Electricity Authority) and CO_2 emission factor (IPCC default value). Monitoring frequency: Annually
QA/QC procedures applied	Value arrived is consistent with national/international default values
Any comment:	Refer calculation below

S.No	**Parameter**	**Units**	**Value**	**Comments**
1	Average truck mileage	kms/litre diesel	3.058	Based on sample measurements
2	Fuel consumption per kilometer	litres/km	0.327	1 / 3.058 = 0.327
3	Fuel consumption per kilometer	kg/kms	0.278	Based on diesel density of 0.85 kg/litre adopted from Bureau of Energy Efficiency data. 0.327 * 0.85 = 0.278
4	CO_2 emission factor	$kgCO_2$/kg fuel	3.16	IPCC 2006 default value for diesel
5	Average CO_2 emission factor of the trucks (EFkm)	$kgCO_2/km$	0.878	Calculated as (3*4) = (0.278*3.16)

5.14 Emission Factor of fossil fuel type i:

Data / Parameter:	$EF_{CO2,FF,i}$
Data unit:	tCO_2/TJ
Description:	CO_2 emission factor for fossil fuel type i

Source of data to be used:	IPCC 2006 Guidelines
Description of measurement methods and procedures to be applied:	The default value provided in IPCC 2006 guidelines has been adopted. Value adopted: 101 (lignite), xx (coal), 74.1 (diesel)
QA/QC procedures applied	-
Any comment:	-

6. CALCULATIONS

FORMULA APPLIED

6.1 PROJECT EMISSIONS:

As per ACM0006, project emissions are calculated using the below formula:

$$PE_y = PET_y + PEFF_y + PE_{EC,y} + GWP_{CH4} \cdot PE_{Biomass,CH4,y}$$

Where:

PET_y — CO_2 emissions during the year *y* due to transportation of the biomass residues to the project plant (tCO_2/yr)

$PEFF_y$ — CO_2 emissions during the year *y* due to fossil fuels co-fired by the generation facility or other fossil fuel consumption at the project site that is attributable to the project activity (tCO_2/yr)

$PE_{EC,y}$ — CO_2 emissions during the year *y* due to electricity consumption at the project site that is attributable to the project activity (tCO_2/yr)

GWP_{CH4} — Global Warming Potential for methane valid for the relevant commitment period

$PE_{Biomass,CH4,y}$ — CH_4 emissions from the combustion of biomass residues during the year *y* (tCH_4/yr). *Inline with guidelines in ACM0006, this is excluded for simplification, both in the calculation of project emissions and baseline emissions.*

6.1.1 CO2 emissions from biomass transportation to the project plant:

$$PET_y = N_y \times AVD_y \times EF_{km,CO2}$$

Where:

Ny — is the number of truck trips for transporting biomass from outside in year y,

AVDy — is the average return trip distance between the biomass fuel supply sites and the site of the project plant in kilometers (km), and

EF_{Km,CO_2} — is the average CO_2 emission factor for the trucks measured in tCO_2/km

6.1.2 CO2 emissions from on-site fossil fuel combustion:

$$PEFF_y = \sum_i (FF_{projectplant,i,y} + FF_{projectsite,i,y}) x NCV_i x EF_{co_2,FF,i}$$

where,

$PEFF_y$ is the project emission from fossil fuel co-firing during the year y in tons of CO_2,

$FF_{projectplanti,y}$ is the quantity of fuel type *i* combusted in the project activity during the year y in a volume or mass unit.

$FF_{projectsite,i,y}$ is the quantity of fuel type *i* combusted due to the project activity in the site during the year y in a volume or mass unit. Fossil fuel combustion in standby DG sets during start-up or maintenance activities would only be part of this parameter. Only that fossil fuel consumption attributable to the energy efficiency improvement would be included in this parameter.

$EF_{CO2,FF,i}$ is the CO_2 emission factor of the fossil fuel type 'i' in tCO_2/GJ

NCV_i is the calorific value of the fossil fuel in GJ per mass unit.

6.1.3 CO2 emissions from electricity consumption in the project activity:

$$PE_{EC,y} = EC_{PJ,y} \times EF_{grid,y}$$

$PE_{EC,y}$ Emissions from electricity consumption in the project activity in tCO_2
$EC_{PJ,y}$ Electricity consumption in the project activity in MWh
$EF_{grid,y}$ Electricity Emission factor in tCO_2/MWh

6.2 Emission reductions due to displacement of electricity:

$$ER_{electricity,y} = EG_y \,.\, EF_{electricity,y}$$

Where:

$ER_{electricity,y}$ Emission reductions due to displacement of electricity during the year *y* (tCO_2/yr)

EG_y Net quantity of increased electricity generation as a result of the project activity (incremental to baseline generation) during the year *y* (MWh)

$EF_{electricity,y}$ CO_2 emission factor for the electricity displaced due to the project activity during the year *y* (tCO_2/MWh)

6.2.1 Incremental Electricity Generation:

$$EG_y = EG_{projectplant,y} \times \left(1 - \frac{\in_{el,preproject}}{\in_{el,project\ plant,y}}\right)$$

Where:

EG_y - is the net quantity of increased electricity generation as a result of the project activity (incremental to baseline generation) during the year y in MWh,

$EG_{project\ plant,y}$ - is the net quantity of electricity generated in the project plant during the year y in MWh,

$\varepsilon_{el,pre\ project}$ - is the net efficiency of electricity generation in the project plant prior to project implementation, expressed in MWhel/MWhbiomass.

$\varepsilon_{el,project\ plant,y}$ -is average net energy efficiency of electricity generation in the project plant, expressed in MWhel/MWhbiomass calculated as below:

6.2.2 Efficiency of electricity generation in the project plant:

$\varepsilon_{el,project\ plant,y}$ -is average net energy efficiency of electricity generation in the project plant, expressed in MWhel/MWhbiomass calculated as below:

$$\varepsilon_{el,projectplant} = \frac{EG_{projectplant,y}}{\sum_k NCV_k . BF_{k.y} + \sum_i NCV_i . FF_{projectplant,i,y}}$$

Where,

NCV_k is the net calorific value of biomass residue type k

$BF_{k,y}$ is the quantity of biomass residue type k combusted in the project plant in year y

NCV_i is the net calorific value of fossil fuel type i

$FF_{project\ plant,i,y}$ is the quantity of fossil fuel type i combusted in the project plant during year y

6.2.2.1 Calculation of heat equivalent of fuels combusted in the project plant:

For biomass residues: $\sum BF_{project\ plant,k,y} . NCV_{,k,y}$.
For fossil fuels: $\sum FF_{project\ plant,k,y} . NCV_{,k,y}$.

6.2.3 Electricity baseline emission factor:

The baseline emission factor has been calculated ex-ante as per formula and guidelines of the methodology ACM0006. The baseline emission factor has been determined to be 0.85 tCO_2/MWh. This figure has been validated and will not change.

6.3 Emission reductions due to displacement of heat:

Since the efficiency of heat generation in the project activity is same as that of the pre-project scenario (validated), there is no increase or decrease of emission reductions due to the displacement of heat. This is as per ACM0006. $ER_{heat} = 0$.

6.4 Leakage:

The project activity falls under scenario 14 of ACM0006 and therefore does not require addressing leakage. There is no leakage of emission reductions. Ly = 0.

6.5 Emission reductions:

$$ER_y = ER_{heat,y} + ER_{electricity,y} + BE_{biomass,y} - PE_y - L_y$$

Where:

ER_y	Emissions reductions of the project activity during the year y (tCO_2/yr)
$ER_{electricity,y}$	Emission reductions due to displacement of electricity during the year y (tCO_2/yr)
$ER_{heat,y}$	Emission reductions due to displacement of heat during the year y (tCO_2/yr). This parameter is equal to zero since efficiency of heat generation in the project scenario is higher than the baseline scenario. $ER_{heat,y} = 0$.
$BE_{biomass}$	Baseline emissions due to biomass decay. This parameter is excluded from the project boundary and therefore is equal to zero. $BE_{biomass} = 0$.
PE_y	Project emissions during the year y (tCO_2/yr)
L_y	Leakage emissions during the year y (tCO_2/yr). For scenario 14 of ACM0006, leakage need not be separately estimated and therefore Ly = 0.

Since $ER_{heat,y} = 0$, $BE_{biomass,y}$ and $L_y = 0$ for this project activity, the above equation reduces to:

$$ER_y = ER_{electricity,y} - PE_y$$

CALCULATIONS AND RESULTS

Table T6.1.1: Project Emissions

Notation	Parameter	Unit	Total	2007	2008	Comments
PET_y	Emissions from biomass transportation	tCO_2	173	115	58	
$PEFF_y$	Emissions from on-site fossil fuel use	tCO_2	13056	1689	11368	
$PE_{EC,y}$	Emissions from electricity consumption	tCO_2	464	305	159	
$\boldsymbol{PE_y}$	Total project emissions	tCO_2	13693	2109	11584	

Table T6.1.2: Emissions due to biomass transportation

S.No.	Notation	Parameter	Unit	Total	2007	2008	Comments
1	N	Number of truck trips for biomass transported from outside	-	1039	704	335	
2	AVD	Average return trip distance between the biomass fuel supply sites and the project plant	kms	189.30	185.63	197.01	
3	$EF_{km,CO2}$	Average CO_2 emission factor of the trucks	$kgCO_2/km$	0.878	0.878	0.878	
4	PET_y (1*2*3)	CO_2 emissions from biomass transportation	tCO_2	172.8	114.8	58.0	

Table T6.1.3: Emissions due to combustion of fossil fuels in the project activity

S.No	Notation	Parameter	Unit	Total	2007	2008	Comments
1	$FF_{project\ plant,lignite}$	Quantity of lignite co-fired	T	10214	1614	8600	
2	$FF_{project\ plant,coal}$	Quantity of coal co-fired	T	1051	0	1051	
3	$FF_{project\ plant,diesel}$	Quantity of diesel co-fired	T	0	0	0	
4	$FF_{project\ site,lignite}$	Quantity of lignite use on-site due to project	T	0	0	0	

		activity					
5	$FF_{project\ site,coal}$	Quantity of coal use on-site due to project activity	T	0	0	0	
6	Intentionally blank						
7	$FF_{project\ site,diesel}$	Quantity of diesel use on-site due to project activity	T	28	16	12	
8	$NCV_{lignite}$	Calorific Value of lignite	kCal/kg	2400	2400	2400	
9	$NCV_{lignite}$	Calorific Value of lignite	TJ/T	0.010	0.010	0.010	Arrived from above value using conversion factor
10	NCV_{Coal}	Calorific Value of coal	kCal/kg	6152	-	6152	
11	NCV_{Coal}	Calorific Value of coal	TJ/T	0.0258	-	0.0258	
12	NCV_{diesel}	Calorific Value of diesel	kCal/kg	10,270	10,270	10,270	
13	NCV_{diesel}	Calorific Value of diesel	TJ/T	0.0430	0.0430	0.0430	Arrived from above value using conversion factor
14	$EF_{CO2,lignite}$	CO_2 emission factor of Lignite	tCO_2/TJ	101.00	101.00	101.00	
15	$EF_{CO2,coal}$	CO_2 emission factor of Coal	tCO_2/TJ	96.10	96.10	96.10	
16	$EF_{CO2,diesel}$	CO_2 emission factor of Diesel	tCO_2/TJ	74.10	74.10	74.10	
17	$PEFF_{lignite}$ (1+4)*9*14	Total CO_2 emissions from lignite combustion	tCO_2	10366	1638	8728	
18	$PEFF_{coal}$ (2+5)*11*15	Total CO_2 emissions	tCO_2	2602	0	2602	

		from coal combustion					
19	$PEFF_{diesel}$ (3+6)*13*16	Total CO_2 emissions from diesel combustion	tCO_2	88	51	38	
20	**PEFFy (17+18+19)**	**Total CO_2 emissions from fossil fuel combustion on-site due to the project activity**	**tCO_2**	**13056**	**1689**	**11368**	

Table T6.1.4: Emissions due to electricity consumption in the project activity:

S.No	Notation	Parameter	Unit	Value	2007	2008	Comments
1	$EC_{PJ,y}$	Quantity of electricity consumption	MWh	544	358	186	
2	EF_{grid}	Electricity emission factor	tCO_2/MWh	0.85	0.85	0.85	
3	$PE_{EC,y}$ (1*2)	Emissions from electricity consumption	tCO_2	464	305	159	

Baseline Emissions

Table T6.2.1: Emission reductions due to displacement of electricity

S.No	Notation	Parameter	Unit	Value	2007	2008	Comments
1	EG_y	Incremental Energy generation from the project activity	MWhe/yr	88031	16737	71294	
2	$EF_{electricity}$	Baseline emission factor for grid	tCO_2/MWh	0.85	0.85	0.85	
3	$ER_{el,y}$ (1*2)	Electricity emission	tCO_2/yr	74826	14226	60600	

		reduction					

Table T6.2.2: Incremental Electricity Generation

Determination of EGy:							
S.No	**Notation**	**Parameter**	**Unit**	**Total**	**2007**	**2008**	**Comments**
1	$EG_{project\ plant}$	Net Electricity Generation from the project plant	MWhe	115437	22009	93429	
2	$\varepsilon_{el,\ project\ plant}$	Project plant efficiency	MWhe/ $MWh_{biomass}$	0.1966	0.1949	0.1970	
3	$\varepsilon_{el,\ pre\text{-}project}$	Pre-project efficiency	MWhe/ $MWh_{biomass}$	0.0467	0.0467	0.0467	Historic efficiency
4	EG (1* (*1.0* - (3/2)))	Incremental Electricity generation from the project activity	MWh	**88031**	**16737**	**71294**	

Table T6.2.3: Efficiency of electricity generation in the project plant

The following table provides the heat equivalent of all fuels combusted, net electricity generation from all fuels and the overall efficiency of electricity generation.

Period	**Total heat content of all fuels combusted** $\sum BF_{project\ plant,k,y} \cdot NCV_{,k,y} + \sum FF_{project\ plant,k,y} \cdot NCV_{,k,y}$	**Net electricity generation** ($EG_{project\ plant,y}$)	**Efficiency of electricity generation** ($\varepsilon_{el,project\ plant,y}$)
	MWh	MWhe	(MWh electricity)/(MWh heat content)
	(1)	(2)	(3) = (2)/(1)
Sep-07	33633	6456	0.1920
Oct-07	53796	10839	0.2015
Nov-07	2516	343	0.1363
Dec-07	22982	4371	0.1902
Jan-08	40922	8421	0.2058
Feb-08	55291	11184	0.2023
Mar-08	56113	10907	0.1944
Apr-08	56793	11581	0.2039
May-08	61177	12255	0.2003
Jun-08	56053	11368	0.2028
Jul-08	56015	11163	0.1993
Aug-08	46687	8891	0.1904
Sep-08	45143	7660	0.1697
2007 (Total)	**112927**	**22009**	**0.1949**
2008 (Total)	**474193**	**93429**	**0.1970**
Total	**587120**	**115437**	**0.1966**

Table T6.2.7: Calculation of Emission Reductions

S.No	Notation	Parameter	Unit	Total	2007[5]	2008
1	$ER_{el,y}$	Emission reduction from electricity displacement	tCO_2	74,826	14,226	60,600
2	PE_y	Project emissions	tCO_2	13,695	2,110	11,585
3	ER_y	Emission reductions	tCO_2	61,131	12,116	49,015

[5] In the context of this report, 2007 would represent the period 14.09.2007 to 31.12.2007. 2008 represents the period 01.01.2008 to 30.09.2008

7. ABBREVIATIONS

CC	Climate Change
CDM	Clean Development Mechanism
CEA	Central Electricity Authority
CER	Certified Emission Reductions
CO_2	Carbon di-oxide
EID Parry	EID Parry (India) Limited
GHG	Greenhouse Gas
GWh	Giga Watt hour
IPCC	Inter-governmental Panel for Climate Change
KP	Kyoto Protocol
Km	Kilo meters
KV	Kilo Volt
KW	Kilo Watt
KWh	Kilo Watt hour
NCES	Non-Conventional Energy Sources
LP	Low Pressure
1 Lakh	1,00,000
MkWh	Million Kilo Watt hour
MT	Metric Ton
MW	Mega Watt
Nox	Nitrogen Oxides
p.a	Per annum
PLF	Plant Load Factor
SEB	State Electricity Board
SO_2	Sulphur Di-oxide
SPM	Solid Particulate Matter
STG	Steam Turbine Generator
TCD	Tones of Crushing per Day
TDS	Total Dissolved Solids

TJ	Trillion Joules
TNEB	Tamilnadu Electricity Board
TNPCB	Tamilnadu Pollution Control Board
TPH	Tones Per Hour
UNFCCC	United Nations Framework Convention on Climate Change