Monitoring report form
(Version 05.1)

MONITORING REPORT		
Title of the project activity	IOT Mabagas Limited power plant, Pudhuchatram	
UNFCCC reference number of the project activity	8288[1]	
Version number of the monitoring report	1	
Completion date of the monitoring report	28/08/2015	
Monitoring period number and duration of this monitoring period	Monitoring Period – 01 Duration of Monitoring Period – 01/01/2013 to 31/07/ 2015	
Project participant(s)	IOT Mabagas Limited (IML) Carbonbay GmbH & Co. KG	
Host Party	India	
Sectoral scope(s)	1 : Energy industries (renewable - / non-renewable sources) 13 : Waste handling and disposal	
Selected methodology(ies)	AMS-III.AO. - Methane recovery through controlled anaerobic digestion AMS-I.D. ver. 17 - Grid connected renewable electricity generation	
Selected standardized baseline(s)	NA	
Estimated amount of GHG emission reductions or net GHG removals by sinks for this monitoring period in the registered PDD	57,750	
Total amount of GHG emission reductions or net GHG removals by sinks achieved in this monitoring period	GHG emission reductions or net GHG removals by sinks reported up to 31 December 2012	GHG emission reductions or net GHG removals by sinks reported from 1 January 2013 onwards
	00	21,991

[1] https://cdm.unfccc.int/Projects/DB/PJR%20CDM1353323353.49/view

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

Project Participants

IOT Mabagas Limited (IML) is a 50: 50 joint venture (JV) company between M/s IOT Infrastructure & Energy Services Limited and Mabagas International, Germany. IOT is group company of M/s Indian Oil Corporation (State Owned Navarathna Oil Company in India) and Mabagas International is 100% subsidiary of Marquard & Bahls, Germany. IML is formed to invest, build, own and operate renewable energy projects in India with specific focus on waste to energy plants. IML believes that waste management and converting the waste into useful energy is on one hand a great challenge to society and on the other hand a great opportunity for a more sustainable future.

Project activity

In the village of Thattayangarpatti, in the Puduchatram block of Namakkal district, the project participant, IML, intends to build and operate an anaerobic digestion plant. The plant will produce biogas with which 2.4 MW of renewable electricity will be generated as part of the greenfield project activity. Through this project activity the amount of greenhouse gases (methane and carbon dioxide) emitted into the atmosphere will be reduced.

Pre-Project Scenario

In the pre-project scenario, poultry litter is generated at poultry farms in Namakkal district. The bottom of the cages is open, hence litter is allowed to drop down and pile up continuously. After a period of up to six months the litter will be collected and transported to a nearby drying yard or dumping area where it is allowed to further degrade. Such storage conditions and piling up results in anaerobic conditions, leading to methane emissions into the atmosphere due to anaerobic decomposition of the poultry litter. Further feedstock for the project activity are cow dung, and waste streams from the sugar and tapioca processing industries. These wastes are left to decay or not handled properly (stockpiled or treated in uncovered lagoons without proper aeration as further elaborated in table 4.1.c below) and therefore release methane into the atmosphere. This methane release is avoided by treating it in waste-to-energy plants such as the project activity. However, since the Project Participant cannot properly determine the exact baseline for these additional waste streams, their baseline emissions are not included in the emission reduction calculations as stipulated by the used small-scale methodology.

Post - Project Scenario

In the post-project scenario, the project participant procures the poultry litter from the nearby poultry farms in the district. The other wastes (cow dung and agri wastes.) are also procured from nearby sites. The litter will be collected each 10 to 15 days and will be delivered to a substrate storage area at site and is off-loaded onto a scraper floor (bunker type feeding system) together with the other wastes. All wastes are fed into 4 continuously stirred digesters with a total working volume of 16,000 m3. Under controlled conditions biogas is produced through a bio-methanation process, which recovers the methane (biogas) from the litter. The biogas that is generated in the digesters is taken out through a common pipe and is then cooled down to remove moisture before it is fed via blowers into 2 x 1.2 MW biogas engines (2.4 MW total capacity) for the generation of power. The generated electricity (after consuming for internal operation of the plant) is supplied to the state electricity board via a dedicated 22 kV transmission line feeder to the nearby substation. The supplied electricity is sold by the project participant to the distribution licensee as per the modalities of the Energy Biomass Purchase Agreement.

The basic technology concept for the project activity is reaching maturity in western countries especially in Germany (where Mabagas has prior experience with a biogas plant in Lünen) and the

Netherlands. IML is aiming to adapt the technology know-how existing in Europe to domestic circumstances and environments. However, the amount of poultry litter to be digested in the planned project activity is unusually high and poses technological challenges since no similar plant exists to serve as a role model. PP have a research lab in Mumbai conducting experiments on Continuous Stirred Tank Reactor (CSTR) models of digesters to simulate operating conditions of a prototype of biogas plant, which is envisaged in the project activity. So far around 10 batch tests are successfully conducted. Also the PP have been sending samples of solid and liquid fertilizers to other reputed labs for substantiations of results.

The plant is designed to operate on a mix of approximately 37,000 metric tonnes per annum of poultry litter, 58,000 metric tonnes per annum of agricultural waste streams from the sugar and tapioca processing industries and 1,825 metric tonnes per annum of cow dung. This should result in generation of around 7.9 million cubic meters per annum of biogas, which is expected to generate around 15.4 GWh of gross electricity. Thus, the project activity contributes to the reduction in GHG emissions on account of:

- Methane Avoidance: The project activity avoids methane release in the atmosphere that would have occurred due to uncontrolled poultry litter disposal / storage practices in the district.
- Power generation: The project activity generates electricity from the biogas generated from the poultry litter and organic wastes thereby replacing equivalent grid mix in the Southern grid.

It is estimated that the project activity will abate approximately **21,991** tCO2e per annum.

A.2. Location of project activity

Village - SF. Nos.52/1, 52/2, 53/1A and 53/2A Thattayangarpatti,
Block - Pudhuchatram,
District - Namakkal
State - Tamil Nadu
Host Country - India

The unique coordinates (latitude and longitude) are 11°23'29.64"N by 78°10'41.44"E.

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 whether the Party involved wishes to be considered as project participant (yes/no)
India	IOT Mabagas Limited	N
Germany	Carbonbay GmbH & Co. KG	N

A.4. Reference of applied methodology and standardized baseline

AMS-I.D (version 17) Grid connected renewable electricity generation
AMS-III.AO (version 01) Methane recovery through controlled anaerobic digestion

The tools used in calculating the emission reductions of the project activity are:

- Tool to calculate the emission factor for an electricity system. Ver 02.2.1
- Tool to determine project emissions from flaring gases containing methane. Ver 01

- Tool to calculate project or leakage CO2 emissions from fossil fuel combustion. Ver 02
- Tool to calculate baseline, project and /or leakage emissions from electricity consumption Ver 01

A.5. Crediting period of project activity

Type of crediting period: 10 years fixed crediting period

Starting date of the crediting period: 01/01/2013

Length of the crediting period corresponding to this monitoring period: 10 years and 00 month from 01/01/2013 to 31/12/2022

A.6. Contact information of responsible persons/entities

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SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

In the post-project scenario, the project participant procures the poultry litter from the nearby poultry farms in the district. The other wastes (cow dung and agri wastes.) are also procured from nearby sites. The litter will be collected each 10 to 15 days and will be delivered to a substrate storage area at site and is off-loaded onto a scraper floor (bunker type feeding system) together with the other wastes. All wastes are fed into 4 continuously stirred digesters with a total working volume of 16,000 m3. Under controlled conditions biogas is produced through a bio-methanation process, which recovers the methane (biogas) from the litter. The biogas that is generated in the digesters is taken out through a common pipe and is then cooled down to remove moisture before

it is fed via blowers into 2 x 1.2 MW biogas engines (2.4 MW total capacity) for the generation of power. The generated electricity (after consuming for internal operation of the plant) is supplied to the state electricity board via a dedicated 22 kV transmission line feeder to the nearby substation. The supplied electricity is sold by the project participant to the distribution licensee as per the modalities of the Energy Biomass Purchase Agreement.

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B.2. Post-registration changes

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

Not Applicable.

B.2.2. Corrections

Not Applicable.

B.2.3. Changes to start date of crediting period

Not Applicable.

B.2.4. Inclusion of a monitoring plan to the registered PDD that was not included at registration

Not Applicable.

B.2.5. Permanent changes from registered monitoring plan, applied methodology or applied standardized baseline

Not Applicable.

B.2.6. Changes to project design of registered project activity

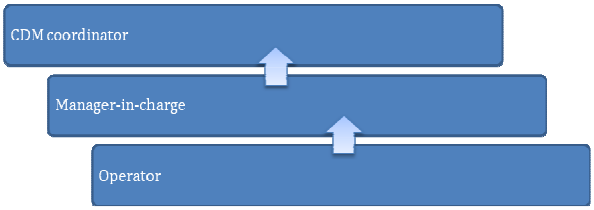
Not Applicable.

B.2.7. Types of changes specific to afforestation or reforestation project activity

Not Applicable

SECTION C. Description of monitoring system

IOT Mabagas will ensure accuracy of the measurement system by adopting the following operational and management structure.

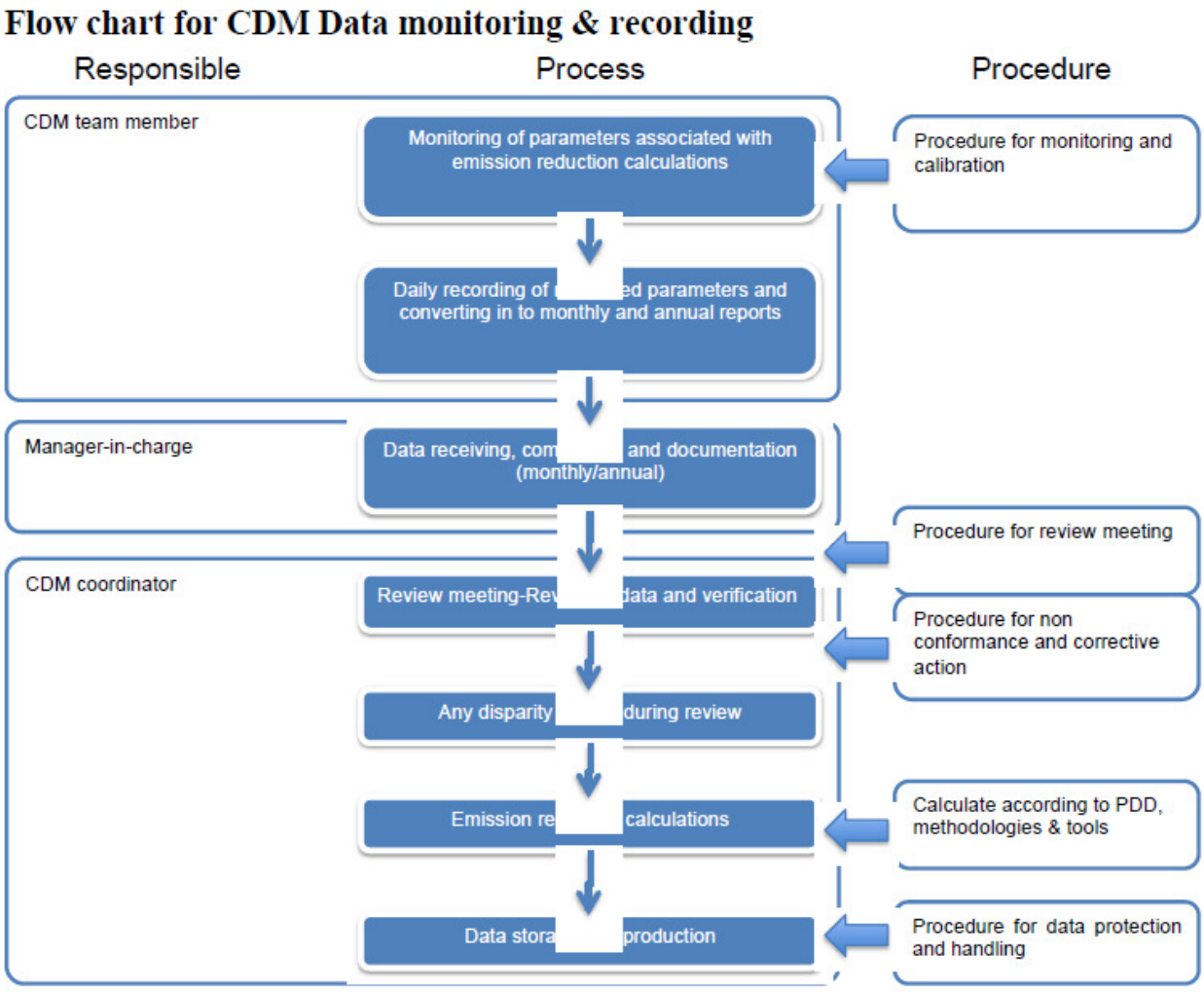


The parameters mentioned above are monitored and recorded electronically and / or in log sheets by the Operator. Based on the logged data recorded in the panel log sheets, a monthly report consisting of above parameters is prepared by the manager-in-charge in a soft copy and is forwarded to the CDM coordinator through email on monthly basis. The report received from respective department through e-mail is compiled by the CDM Coordinator. The reports will be retained till two years after the end of crediting period or the last issuance of CERs for this project activity, whichever occurs later. A CDM Manual is prepared, which illustrates the detailed roles and responsibilities of individuals involved in the project activity.

To ensure Quality Control and Quality Assurance of the monitored parameters following procedures is adopted:

- The data used is reviewed by conducting a inter department review meeting once in 6 months. The CDM Coordinator will discuss the data (received from respective departments) with the Operator of concerned departments. Once data is compiled and checked, it will be handed to verifying DOE for verification.

Flow chart for CDM Data monitoring & recording



Specific monitoring aspects regarding AMS-III.D. Methane recovery in manure management systems – version 18.

The emission reductions achieved by the project activity will be determined ex post through direct measurement of the amount of methane fuelled, flared or gainfully used. It is likely that the project activity involves manure treatment steps with higher methane conversion factors (MCF) than the MCF for the manure treatment systems used in the baseline situation, therefore

the emission reductions achieved by the project activity is limited to the ex post calculated baseline emissions minus project emissions using the actual monitored data for the project activity. The emission reductions achieved in any year are the lowest value of the following:

$$ER_{y,ex\ post} = min\begin{bmatrix}(BE_{y,ex\ post} - PE_{y,ex\ post} - LE_{y,ex\ post}),(MD_y - PE_{y,power,ex\ post} - \\ PE_{y,transp,ex\ post} - PE_{y,res\ waste,ex\ post} - PE_{y,phy\ leakage,ex\ post} - LE_{y,ex\ post})\end{bmatrix}$$

(Equation 19)

Where:

$ER_{y,ex\ post}$	Emission reductions achieved by the project activity based on monitored values for year y (tCO_2e)
$BE_{y,ex\ post}$	Baseline emissions calculated using equation 6 using *ex post* monitored values (e.g. Q_y) (tCO_2e)
$PE_{y,ex\ post}$	Project emissions calculated using equation (10) using *ex post* monitored values (e.g. Q_y, transport distances, the amount of electricity/fossil fuels used, emissions from anaerobic storage). This calculation shall include project emissions from physical leakage (tCO_2e)
$LE_{y,ex\ post}$	Leakage emissions calculated using *ex post* monitored values (tCO_2e)
MD_y	Methane captured and destroyed or used gainfully by the project activity in year y (tCO_2e)
$PE_{y,transp,ex\ post}$	Emissions from incremental transportation based on monitored values in the year y (tCO_2e)
$PE_{y,power,ex\ post}$	Emissions from the use of fossil fuel or electricity for the operation of the installed facilities based on monitored values in the year y (tCO_2e)
$PE_{y,res\ waste,ex\ post}$	Methane emissions from the anaerobic decay/treatment of the residual waste/products based on monitored values in the year y (tCO_2e)
$PE_{y,phy\ leakage,ex\ post}$	Methane emissions from physical leakages of the anaerobic digester based on monitored values in year y (tCO_2e)

Total biogas production and electricity generation will be monitored as part of standard operating procedures of the project. Methane destruction will occur primarily through the combustion of biogas in the gas engines. Only in case of emergency biogas will be flared. The operations of the flare will be monitored separately.

Formulas to determine $PE_{y,ex\ post}$

$$PE_y = \begin{Bmatrix}PE_{transp,y} + PE_{power,y} + PE_{res\ waste,y} \\ + PE_{phy\ leakage,y} + PE_{flaring,y}\end{Bmatrix} \quad \text{(Equation 10)}$$

$PE_{power,y}$

Monitoring parameters to determine ex-post methane capture & destroyed (MD_y)
According to paragraph 19 (b) of AMS-III.AO (Version 01): flaring/ combustion MD_y will be measured using the conditions of the flaring process:

$$MD_y = BG_{burnt,y} * w_{CH4,y} * D_{CH4} * FE * GWP\_CH_4 \quad \textbf{(Equation 20)}$$

Where:

$BG_{burnt,y}$	Biogas[89] flared/combusted in year y (m^3)
$w_{CH4,y}$	Methane content in the biogas in the year y (volume fraction)
D_{CH4}	Density of methane at normal conditions (20°C at 1 atmosphere) (tonnes/m^3)
FE	Flare efficiency in the year y (fraction). If the biogas is combusted for gainful purposes, e.g. fed to an engine, an efficiency of 100% may be applied (see parameter ID.14)

As per paragraph 19 (c) of AMS-III.AO (Version 01):

> *The method for integration of the terms to calculate MD_y to obtain the results for one year of measurements within the confidence level, as well as the methods and instruments used for*
> *metering, recording and processing the data obtained, shall be described in the project design document and monitored during the crediting period;*

The methods and instruments used for metering, recording and processing are described in the relevant parameter boxes for $BG_{flared,y}$, $BG_{combusted,y}$, w_{CH4}, D_{CH4} and FE. The monitored parameters are w_{CH4} (ID.23) $BG_{combusted,y}$ (ID.24), $BG_{flared,y}$ (ID.25) and T_{flare} (ID.28).

ID		Description	Measurement point	How monitored
23	w_{CH4}	Methane content in the biogas	Control room	Values are logged every half hour. This results in 17520 measurement points (365 days * 24 hours *
24	$BG_{combusted,y}$	The total amount of the biogas combusted	Control room	Values are logged every half hour. This results in 17520 measurement points (365 days * 24 hours *
25	$BG_{flared,y}$	The amount of biogas generated that is flared	Control room	Values are logged every half hour. This results in 17520 measurement points (365 days * 24 hours *

28	T_{flare}	Temperature in the exhaust gas of the flare.	Flare	Using a Type N thermocouple the temperature is monitored continuously; the average value is logged every half hour by the system. This results in 17520 measurement points (365 days * 24 hours * 2 measurements per hour) values. These values are then exported using a CSV file into Excel. Here the project participant checks if they should be taken into account (see parameter box ID.14 FE_y) and

The data is integrated as per below table. The logged data are matched for each interval. Per interval the FE is determined. The MD is calculated as per equation 23 for each interval. MD_y is calculated by summing all MD values for the monitoring period.

Time interval	**BG_{flared}**	**$BG_{combusted}$**	**T_{flare}**	**w_{CH4}**	**FE**	**MD**
	Monitored	Monitored	Monitored	Monitored	Default (see parameter box ID.14)	Calculated (See equation
00:30:00	m^3	m^3	°C	%	100%; 90%; 50%; 0%	tCO2e
01:00:00	m^3	m^3	°C	%	100%; 90%; 50%; 0%	tCO2e
Etc.						
…						
Annual Total						**TOTAL tCO2e/y (sum of above**

Since BG_{flared}, $BG_{combusted}$ and T_{flare} are monitored continuously, confidence level is 100% (no statistical sampling; entire population is measured), hence the results for one year of measurements are within the confidence level.

As per paragraph 19 (d) of AMS-III.AO (Version 01):

> *Project activities where a portion of the biogas is destroyed through flaring and the other portion is used for energy may consider to apply the flare efficiency to the portion of the biogas used for energy, if separate measurements are not performed; When the amount of methane that is combusted for energy and that is flared is separately monitored, a destruction efficiency of 100% can be used for the amount that is combusted for energy;*

A portion of the biogas is destroyed through flaring and another portion us used for

energy generation. Hence:

$$BG_{burnt,y} = BG_{combusted.y} + BG_{flared,y}$$ **(Equation 21)**

Hence equation (18) is rewritten:

$$MD_y = \left(BG_{flared,y} * w_{CH4,y} * D_{CH4} * FE * GWP\_CH_4\right) + \left(BG_{combusted,y} * w_{CH4,y} * D_{CH4} * GWP\_CH_4\right)$$

(Equation 22)

As per paragraph 19 (e) of AMS-III.AO (Version 01):

> *Flow meters, sampling devices and gas analysers shall be subject to regular maintenance, testing and calibration to ensure accuracy;*

The devices used to monitor the following parameters are subject to regular maintenance, testing and calibration as per §17 of the General Guidelines to SSC CDM methodologies (Version 17):

ID. 23	$\mathbf{w_{CH4}}$	gas analyser	see parameter box
ID. 24	$\mathbf{FV_{RG,h}}$	flow meter	see parameter box
ID. 25	$BG_{combusted,y}$	flow meter	see parameter box
ID. 26	$BG_{flared,y}$	flow meter	see parameter box

As per paragraph 19 (f) of AMS-III.AO (Version 01):

> *The monitoring plan should include onsite inspections for each individual digester included in the project boundary where the project activity is implemented for each verification period.*

Each individual digester included in the project boundary will be inspected on site for each verification period.

Monitoring requirement for verification of proper soil application

As per AMS-III.F paragraph 25 the project participant will archive all sales records for the treated residue (compost). The conditions for proper soil application ensuring aerobic conditions have been established by a local expert

Baseline emissions (BE) are discussed in table 4.1.c. in the PDD. Since PP cannot demonstrate the BE for agri waste or cow dung, the BE has been set to zero in line with the methodology (conservative approach).

To further show that the methodology is conservative below argument shows that using (Equation 19 will always result in a conservative approach, in line with CDM:

$$ER_{y,ex\ post} = min\left[\begin{array}{l}(BE_{y,ex\ post} - PE_{y,ex\ post} - LE_{y,ex\ post}), (MD_y - PE_{y,power,ex\ post} - \\ PE_{y,transp,ex\ post} - PE_{y,res\ waste,ex\ post} - PE_{y,phy\ leakage,ex\ post} - LE_{y,ex\ post})\end{array}\right]$$

$$ER_{y,ex\ post} = min\left[BE_{y,ex\ post} - \left(PE_{y,transp,ex\ post} - PE_{y,res\ waste,ex\ post} - PE_{y,phy\ leakage,ex\ post} - LE_{y,ex\ post}\right)\right]$$

Based on the mass balance (supporting document SD_14) the MD_y of the gas will be 7.5 mln m^3 * density * methane content * 21 ~ 65,000 CERs. Equation (6) would result in ~ 13,200 CERs claimed ($BE_{y,expost}$), in which case ER would equal MIN ($BE_{y,expost}$, MD_y) = 13,200 CERs.

$BE_{y,expost}$ will basically always be more conservative than MD_y:

- If $Q_{chickenlitter,expost}$ would be 100% of Q_{total} then MD_y would still be approx 65,000 BE would be approx 26,400[91];
- Hence $BE_{y,expost}$ would still be more conservative;
- If $Q_{chickenlitter,expost}$ would be 0%, then $BE_{y,expost}$ would be 0 CERs.

In every case $BE_{y,expost}$ would be more conservative; hence project is in line with methodology.

Apportioning Procedure

If $EG_{BL,y}$ is does not cover the monitoring period, e.g. the period is two weeks shorter, the project participant may opt to extrapolate the measured data to cover the short fall. Any discrepancy will be corrected in the following monitoring period.

To determine electricity consumed on site:

Partial days of generation as per the log book records	=	X
Total Generation as per the log book records	=	Y
% Generation for partial days	=	Z = (X / Y) * 100
Total Generation as per generation statement	=	G
Partial days of generation as per Generation statement	=	(G * Z/100)

SECTION D. Data and parameters

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

(Copy this table for each piece of data and parameter)

Data/parameter:	**ID. 1./ $EF_{grid,CM,y} = EF_{EL,y}$**
Unit	tCO_2/GWh
Description	EFy is the CO2 emission factor of the Southern grid, in which the project activity displaced the electricity during the year y.
Source of data	The CEA CO2 Emission Database Version 6.0, March 2011
Value(s) applied)	865
Choice of data or measurement methods and procedures	Since the CEA is the prime authority for publishing all relevant data regarding the Indian power sector, the choice of the data is conservative. The emission factor is calculated from the CEA's OM and BM values of the Indian regional grid systems. The parameter is calculated according to the guidelines of CDM modalities and procedures.
Purpose of data	Determination of Emission Reductions
Additional comments	In equation 5 of this PDD defined as $EF_{grid,CM,y}$ and in equation 13 defined as $EF_{EL,y}$

Data/parameter:	ID. 2./ $EF_{grid,OM,y}$
Unit	tCO2/GWh
Description	Operating Margin Emission Factor of the Southern grid.
Source of data	The CEA CO2 Emission Database Version 6.0, March 2011[77].
Value(s) applied)	966
Choice of data or measurement methods and procedures	Since the CEA is the prime authority for publishing all relevant data regarding the Indian power sector, the choice of the data is conservative. The emission factor is calculated from the CEA's data. The parameter is calculated according to the guidelines of CDM modalities and procedures.
Purpose of data	Determination of Emission Reductions
Additional comments	-

Data/parameter:	ID. 3./ $EF_{grid,BM,y}$
Unit	tCO2/GWh
Description	Build Margin Emission Factor of the Southern grid.
Source of data	The CEA CO2 Emission Database Version 6.0, March 2011[78].
Value(s) applied)	763
Choice of data or measurement methods and procedures	Since the CEA is the prime authority for publishing all relevant data regarding the Indian power sector, the choice of the data is conservative. The emission factor is calculated from the CEA's data. The parameter is calculated according to the guidelines of CDM modalities and procedures.
Purpose of data	Determination of Emission Reductions
Additional comments	-

Data/parameter:	ID. 4./ GWP_{CH4}
Unit	CH_4
Description	Global Warming Potential (GWP) of methane. The factor describes the conversion of 1 tCH4 into 1 tCO2equivalent emissions.
Source of data	AMS-III.AO version 01..
Value(s) applied)	21
Choice of data or measurement methods and procedures	as per methodology AMS-III.AO version 01, equations 1 where $GWP_{CH4} = 21$
Purpose of data	Determination of Emission Reductions
Additional comments	

Data/parameter:	ID. 5./ $D_{CH4} = \rho_{CH4,n}$
Unit	kg/m^3
Description	Density of methane at normal conditions (20 ºC and 1 atm pressure)

Source of data	IPCC 2006 default factor, see Equation 10.23 on pg.10.41 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Use..
Value(s) applied)	0.67
Choice of data or measurement methods and procedures	The value is taken from the IPCC 2006 tables, see above. In absence of choice of data, the IPCC default value is the best option to use.
Purpose of data	Determination of Emission Reductions
Additional comments	In equation 7 and 20 defined as D_{CH4}; in equation 16 defined as $\rho_{CH4,n}$ Data

Data/parameter:	**ID. 6./ MCF_j**
Unit	%
Description	Methane conversion factor for manure management. Only for poultry litter.
Source of data	Department of Bioenergy, Tamil Nadu Agricultural University (Tamil Nadu), Methane Emission Potential of Poultry Litter (October 2011).
Value(s) applied)	22.84%
Choice of data or measurement methods and procedures	The data is derived from a report from Tamil Nadu Agricultural University based on field studies of a sample of poultry farms in the Namakkal district. This report is the most recent relevant source for the project activity.
Purpose of data	Determination of Emission Reductions
Additional comments	-

Data/parameter:	**ID 7./ $B_{o, LT}$**
Unit	$m^3_{CH\ 4}$/kg
Description	Maximum methane production potential (in the baseline situation). LT = Livestock = poultry.
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories under the volume 'Agriculture, Forestry and other Land use' for 'Emissions from Livestock and Manure Management' Table 10A-9, page 10.82.
Value(s) applied)	0.24
Choice of data or measurement methods and procedures	As no country specific factor is available, the IPCC 2006 default factor is used
Purpose of data	Determination of Emission Reductions
Additional comments	-

Data/parameter:	**ID. 8./ $VS_{default}$**
Unit	Kg/head/day
Description	Volatile solids for livestock LT
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories under the volume 'Agriculture, Forestry and other Land use' for 'Emissions from Livestock and Manure Management', Table 10A-9, page 10.82.

Value(s) applied)	0.02
Choice of data or measurement methods and procedures	As no country specific factor is available, the IPCC 2006 default factor is used.
Purpose of data	Determination of Emission Reductions
Additional comments	-

Data/parameter:	**ID. 9./ $MS\%_{BL,j,y}$**
Unit	%
Description	Fraction of manure handled in baseline animal manure management system j in year y.
Source of data	Department of Bioenergy, Tamil Nadu Agricultural University (Tamil Nadu), Methane Emission Potential of Poultry Litter (October 2011). Document made available to the DOE as SD_04.
Value(s) applied)	100%
Choice of data or measurement methods and procedures	100% of the poultry litter at poultry farms sourced by PP is managed under anaerobic conditions. PP refer to Department of Bioenergy, Tamil Nadu Agricultural University (Tamil Nadu), Methane Emission Potential of Poultry Litter (October 2011). Document made available to the DOE as SD_04.
Purpose of data	Determination of Emission Reductions
Additional comments	-

Data/parameter:	**ID. 10./ $EF_{CO2,diesel,y}$**
Unit	tCO_2/TJ
Description	CO_2 emission factor of diesel used in the year y.
Source of data	IPCC 2006 guidelines.
Value(s) applied)	74.8

<table>
<tr><td>Choice of data
or measurement methods
and procedures</td><td>As per tool “Tool to calculate project or leakage CO2 emissions from fossil fuel combustion” the following data sources may be used if the relevant conditions apply:

<table>
<tr><th>Data source</th><th>Conditions for using the data source</th></tr>
<tr><td>a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr>
<tr><td>b) Measurements by the project participants</td><td>If a) is not available</td></tr>
<tr><td>c) Regional or national default values</td><td>If a) is not available

These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances)</td></tr>
<tr><td>d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If a) is not available</td></tr>
</table>

As Project Participants do not have invoices from suppliers (option a), they have opted for option (d), the IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter 1 of
Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories.</td></tr>
<tr><td>Purpose of data</td><td>Determination of Emission Reductions</td></tr>
<tr><td>Additional comments</td><td>-</td></tr>
</table>

Data/parameter:	**ID. 11./ NCV $_{Diesel}$**
Unit	GJ/t
Description	Net calorific value of diesel.
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy, Table 1.2
Value(s) applied)	43.3

<table>
<tr><td>Choice of data
or measurement methods
and procedures</td><td>As per tool “Tool to calculate project or leakage CO2 emissions from fossil fuel combustion” the following data sources may be used if the relevant conditions apply:

<table><tr><th>Data source</th><th>Conditions for using the data source</th></tr><tr><td>a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source if the carbon fraction of the fuel is not provided (Option A)</td></tr><tr><td>b) Measurements by the project participants</td><td>If a) is not available</td></tr><tr><td>c) Regional or national default values</td><td>If a) is not available

These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances).</td></tr><tr><td>d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If a) is not available</td></tr></table>
As Project Participants do not have invoices from suppliers (option a), they have opted for option (d). The IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.2 of Chapter 1 of
Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories.</td></tr>
<tr><td>Purpose of data</td><td>Determination of Emission Reductions</td></tr>
<tr><td>Additional comments</td><td>-</td></tr>
</table>

Data/parameter:	**ID. 12./ ρ_{diesel}**
Unit	t/m^3
Description	Density of diesel.
Source of data	CEA’s CO_2 Emission Database Version 6.0, March 2011. Appendix B (page 25)of the CO_2 Baseline Database for the Indian Power Sector User Guide, accessed at: http://www.cea.nic.in/reports/planning/cdm_co2/user_guide_ver6.pdf
Value(s) applied)	0.83

Choice of data or measurement methods and procedures	As per tool "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" the following data sources may be used if the relevant conditions apply: **Data source** / **Conditions for using the data source** a) Values provided by the fuel supplier in invoices — This is the preferred source b) Measurements by the project participants — If a) is not available c) Regional or national default values — If a) is not available These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances). Since (a) is not available to the PP, option (c) is opted and the value from the Central Electricity Authority (CEA) is used. The CEA is the statutory organisation under Ministry of Power who collects and records data concerning the generation, transmission, trading, distribution and utilization of electricity.
Purpose of data	Determination of Emission Reductions
Additional comments	-

Data/parameter:	**ID. 13./ $EF_{CO2,transport}$**
Unit	$kgCO_2/km$
Description	CO_2 emission factor from fuel use due to transportation.
Source of data	Based on 8 km/ litre of average fuel consumption ($F_{diesel,avg}$) value determined as per contracts obtained from logistics company[79].
Value(s) applied)	0.326
Choice of data or measurement methods and procedures	Transport is subcontracted; value determined as per contracts obtained from logistics company[80].
Purpose of data	Determination of Emission Reductions
Additional comments	= (NCV_{Diesel} x ρ_{Diesel} x $EF_{CO2,diesel,y}$)/ $F_{diesel,avg}$ / liter x 1/1000 hence since: NCV_{Diesel} = ID.11 ρ_{Diesel} = ID.12 $EF_{CO2,diesel,y}$ = ID.10 $F_{diesel,avg}$ = 8 km/liter, as per SD_28. The result = (42*0.83*74.8)/8/1000 = 0.326

Data/parameter:	**ID. 14./ $\eta_{flare,h} = FE_y$**
Unit	%
Description	Flare efficiency in hour h based on measurements or default values.
Source of data	Default values given in the Methodological Tool to determine project emissions from flaring gases containing methane (Version 01).
Value(s) applied)	90%

Choice of data or measurement methods and procedures	Under the project activity an enclosed flare will be installed. For enclosed flares the Tool to determine project emissions from flaring gases containing methane (Version 01) stipulates two options: a) To use a 90% default value. Continuous monitoring of compliance with manufacturer's specification of flare (temperature, flow rate of residual gas at the inlet of the flare) must be performed. If in a specific hour any of the parameters are out of the limit of manufacturer's specifications, a 50% default value for the flare efficiency should be used for the calculations for this specific hour.; or b) continuous monitoring of the methane destruction efficiency of the flare (flare efficiency). For determination of the flare efficiency option (a) – use of default values – has been chosen for the project activity In case of enclosed flares and use of default values the following flare efficiency values shall be applied: • 0% if the temperature in the exhaust gas of the flare (T_{flare}) is below 500°C for more than 20 minutes during the hour h; • 50%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500°C for more than 40 minutes during the hour h, but the manufacturer's specifications on proper operation of the flare are not met at any point in time during the hour h; • 90%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour h and the manufacturer's specifications on proper operation of the flare are met continuously during the hour h. • As per paragraph 19 (b) of AMS-III.AO (Version 01) if the biogas is combusted for gainful purposes, e.g. fed to an engine, an efficiency of 100% may be applied Based on continuous measured T_{flare}, η_{flare} is determined based upon above default values.
Purpose of data	Determination of Emission Reductions
Additional comments	Used to calculate Project Emissions from flaring ($PE_{flare,y}$) as per Methodological Tool to determine project emissions from flaring gases containing methane (Version 01) (formula 15); Used to calculate Methane destructed in year y (MD_y) as per AMS-III.D (formula 18)

Data/parameter:	**ID.15./ $fv_{CH4,RG,h}$**
Unit	mg/m^3
Description	Volumetric fraction of CH4 in the residual gas in the hour h.
Source of data	Page 2, 2nd line below figure 01 of TNAU report[81]
Value(s) applied)	60%
Choice of data or measurement methods and procedures	Only used for ex-ante estimation of the methane content in the residual gas since PP opts to use option (a) page 3 of the "Tool to determine project emissions from flaring gases containing methane" (version 01), $fv_{CH4,RG,h}$ is only required in step 5 to calculate the ex-ante value of $TM_{FG,h}$ since under step 6 PP opts to use default values and enclosed flare.
Purpose of data	Determination of Emission Reductions
Additional comments	-

Data/parameter:	ID. 16./ $TDL_{j,y}$
Unit	-
Description	Average technical transmission and distribution losses for providing electricity to source j in year y.
Source of data	Use as default values of 20% for project or leakage electricity consumption sources as per methodological tool "Tool to calculate baseline, project and/or leakage emissions from electricity consumption (Version 01).
Value(s) applied)	20%
Choice of data or measurement methods and procedures	As per methodological; "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (Version 01) in case of scenario B and scenario C, case C.II, assume TDLj/k/l,y = 0 as a simplification. In case of other scenarios (scenario A and scenario C, cases C.I and C.III), choose one of the following options:, • Use recent, accurate and reliable data available within the host country; • Use as default values of 20% for (a) project or leakage electricity consumption sources; (b) baseline electricity consumption sources if the electricity consumption by all project and leakage electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies is larger than the electricity consumption of all baseline electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies. • Use as default values of 3% for (a) baseline electricity consumption sources; (b) project and leakage electricity consumption sources if the electricity consumption by all project and leakage electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies is smaller than the electricity consumption of all baseline electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies. In light of the options above, Project Participants have opted for the following: In light of the options above, Project Participants have opted for the following: $TDL_{j,y}$ | Grid | 20% | as per tool 2nd bullet option (a) above Gen Set | 3% | as per tool 3rd bullet option (b) above
Purpose of data	Determination of Emission Reductions
Additional comments	-

D.2 Data and parameters monitored

(Copy this table for each piece of data and parameter)

Data/parameter:	ID. 18./ $EG_{gross,y}$
Unit	GWh/y
Description	The gross electricity generated by the project activity.
Measured/calculated/default	Measured
Source of data	Energy meter

Value(s) of monitored parameter	Refer Emission Reduction Sheet to get values for different period
Monitoring equipment	Energy Meter
Measuring/reading/recording frequency:	Monthly Report on PLC
Calculation method (if applicable):	The gross electricity generated by the project activity would be monitored based on an energy meter on the generator panel of the engines which is logged on PLC (programmable logic controller).
QA/QC procedures:	The data is monitored continuously. The Operator reports the readings on a monthly basis. Based on the logged data, a monthly report is prepared by Manager-in-Charge and is forwarded to CDM Coordinator through email on monthly basis. The data used is reviewed by conducting an inter department review meeting once in 6 months. The Coordinator CDM will discuss the data (received from respective departments) with the operators of the concerned departments. Accuracy class is 0.2S class as per IEC62053-22. Once the data is compiled and checked, it will be handed over to Verifier for verification. The measuring equipment used for monitoring data is calibrated as per manufacturers specifications, but at least once in three years as per § 17.c of the general guidelines to SSC CDM methodologies (version 17).
Purpose of data:	Determination of Emission Reductions
Additional comments:	The data will be archived until two years after the end of crediting period or the last issuance of CERs for this project activity, whichever occurs later.

Data/parameter:	**ID. 19./EG_{BL}**
Unit	GWh/y
Description	Net electricity supplied by the project activity to the grid.
Measured/calculated/default	Measured
Source of data	TANGEDCO (Tamil Nadu Generation and Distribution Corporation) report based on this which PP will raise the invoice to TANGEDCO along with duly signed report.
Value(s) of monitored parameter	Refer Emission Reduction Sheet to get values for different period
Monitoring equipment	Energy Meter
Measuring/reading/recording frequency:	Monthly basis
Calculation method (if applicable):	The energy meter operates continuously. TANGEDCO official will check the energy meter (primary) once per month and the reading will be recorded in the log books. The TANGEDCO official will issue a monthly consumption statement, which will be used as source of data. Based on this statement PP will raise the invoice to TANGEDCO along with the monthly consumption statement.

QA/QC procedures:	If primary energy meter fails to read then TANGEDCO will refer the secondary energy meter. If both energy meters fails then source of data will be used from the previous last 3 months reports mutually agreed by PP & TANGEDCO. Based on the logged data, a report is prepared by Manager-in-Charge and is forwarded to CDM Coordinator through email on monthly basis. The data used is reviewed by conducting an inter department review meeting once in 6 months. The Coordinator CDM will discuss the data (received from respective departments) with the operators of the concerned departments. Once the data is compiled and checked, it will be handed over to Verifier for verification. The metering arrangements with facilities to record export and import of energy shall be provided in accordance with the Central Electricity Authority (installation and Operation of Meters) Regulations, 2006, Commission's Intra State Open Access Regulations 2005. Tamil Nadu Electricity Distribution Code, 2004 and Tamil Nadu Grid Code, 2004 in consultation with Distribution Licensee / State transmission Utility. The periodicity of testing, checking, calibration etc., will be governed by the Regulations issued by the Central Electricity Authority / Commission[84] The energy meters healthiness will be checked by TANGEDCO at regular intervals will be decided by TANGEDCO on time to time basis. The measuring equipment used for monitoring data is calibrated as per manufacturers specifications, but at least once in three years as per § 17.c of the general guidelines to SSC CDM methodologies (version 17).
Purpose of data:	Determination of Emission Reductions
Additional comments:	The above methodology is accepted by PP in EPA signed with TANGEDCO. The data will be archived electronically until two years after the end of crediting period or the last issuance of CERs for this project activity, whichever occurs later as per § 17.a of the general guidelines to SSC CDM methodologies (version 17).

Data/parameter:	**ID. 20./ $EC_{PJ,y}$**
Unit	GWh/y
Description	Net electricity imported from the grid in case the Power units are not operating.
Measured/calculated/default	Measured
Source of data	TANGEDCO (Tamil Nadu Generation and Distribution Corporation) report based on this which PP will raise the invoice to TANGEDCO along with duly signed report.
Value(s) of monitored parameter	Refer Emission Reduction Sheet to get values for different period

Monitoring equipment	Energy Meter
Measuring/reading/recording frequency:	Monthly basis
Calculation method (if applicable):	The energy meter operates continuously. TANGEDCO official will check the energy meter (primary) once per month and the reading will be recorded in the logbooks. The TANGEDCO official will issue a monthly consumption statement, which will be used as source of data. Based on this statement TANGEDCO will raise an invoice along with duly signed report if the Net electricity supplied by the project activity to the grid minus the net electricity imported is negative over the reporting period (if more electricity is imported than supplied).
QA/QC procedures:	If primary energy meter fails to read then TANGEDCO will refer the secondary energy meter. If both energy meters fail then source of data will be used from the previous last 3 months reports mutually agreed by PP & TANGEDCO. The metering arrangements with facilities to record export and import of energy shall be provided in accordance with the Central Electricity Authority (installation and Operation of Meters) Regulations, 2006, Commission's Intra State Open Access Regulations 2005. Tamil Nadu Electricity Distribution Code, 2004 and Tamil Nadu Grid Code, 2004 in consultation with Distribution Licensee / State transmission Utility. The periodicity of testing, checking, calibration etc., will be governed by the Regulations issued by the Central Electricity Authority / Commission[85] The energy meters healthiness will be checked by TANGEDCO at regular intervals will be decided by TANGEDCO on time to time basis. The measuring equipment used for monitoring data is calibrated as per manufacturers specifications, but at least once in three years as per § 17.c of the general guidelines to SSC CDM methodologies (version 17).
Purpose of data:	Determination of Emission Reductions
Additional comments:	The data will be archived until two years after the end of crediting period or the last issuance of CERs for this project activity, whichever occurs later.

Data/parameter:	**ID. 21./ $Q_{i,y}$**
Unit	t/y
Description	Amount of waste type *i* (poultry litter, agricultural wastes, cow dung) used at the plant.
Measured/calculated/default	Measured
Source of data	Weigh bridge records.
Value(s) of monitored parameter	Refer Emission Reduction Sheet to get values for different period

Monitoring equipment	Weigh bridge
Measuring/reading/recording frequency:	Each truck loading is monitored and then monthly reports
Calculation method (if applicable):	All incoming trucks transporting poultry litter shall be directly measured using the onsite weighbridge. The delta in weight between the empty truck and the loaded truck is taken as the weight of the poultry litter.
QA/QC procedures:	Each weigh instance is monitored and logged in the log book by the Operator. Based on the logged data, a monthly report is prepared by Manager-in-Charge and is forwarded to CDM Coordinator through email on monthly basis. Once the data is compiled and checked, it will be handed over to Verifier for verification. The measuring equipment (electronic weigh bridge) is designed as per IS: 9281 manufacturing standard specifications (+/- 0.025% of FS)[86]. The measuring equipment used for monitoring data is calibrated as per manufacturers specifications, but at least once in three years as per § 17.c of the general guidelines to SSC CDM methodologies (version 17)..
Purpose of data:	Determination of Emission Reductions
Additional comments:	The data will be archived until two years after the end of crediting period or the last issuance of CERs for this project activity, whichever occurs later.

Data/parameter:	**ID. 22./$Q_{res\ waste,y}$**
Unit	t/y
Description	Amount of treated residue (compost) shipped off.
Measured/calculated/default	Measured
Source of data	Weigh bridge records.
Value(s) of monitored parameter	Refer Emission Reduction Sheet to get values for different period
Monitoring equipment	Weigh bridge
Measuring/reading/recording frequency:	Each truck, daily report and monthly report
Calculation method (if applicable):	All trucks transporting compost would be measured for both empty weight and also with loaded compost. The difference is the weights would be measured for amount of treated compost shipped off from the plant. This is also substantiated with invoices/payment receipts to the buyers of the treated compost
QA/QC procedures:	Each weigh instance is monitored and logged in the log book on a daily basis by the Operator. Based on the logged data, a monthly report is prepared by the Manager-in-Charge and is forwarded to the CDM Coordinator through email on monthly basis. Once the data is compiled and checked, it will be handed over to the Verifier for verification. The measuring equipment (electronic weigh bridge) is designed as per IS:9281 manufacturing standard specifications (+/- 0.025% of FS). The measuring equipment used for monitoring data is calibrated as per manufacturers specifications, but at least once in three years as per § 17.c of the general guidelines to SSC CDM methodologies (version 17).

Purpose of data:	Determination of Emission Reductions
Additional comments:	The data will be archived until two years after the end of crediting period or the last issuance of CERs for this project activity, whichever occurs later.

Data/parameter:	**ID.23./ w_{CH4}**
Unit	%
Description	Methane content in the biogas (dry).
Measured/calculated/default	Measured
Source of data	Gas analyser.
Value(s) of monitored parameter	Refer Emission Reduction Sheet to get values for different period
Monitoring equipment	Gas analyser
Measuring/reading/recording frequency:	Half hour values, based on which monthly report is generated
Calculation method (if applicable):	Data is monitored continuously. Values are logged every half hour. The CH4 content is analysed by NDIR (non-dispersive infrared sensor) and is hence measured directly and the measurement point is close to the biogas flow rate measurement point (ID.24).
QA/QC procedures:	The 30 minutes interval assures a confidence/ precision level higher than the 90/10 level required (see appendix 4 regarding the required sample size). Based on the logged data, a monthly report is prepared by Manager-in-Charge which is forwarded to the CDM Coordinator. The data used is reviewed by conducting a inter department review meeting once in 6 months. Once the data is compiled and checked, it will be handed over to the Verifier for verification. The measuring equipment (Gas analyser) is designed as per ANSI/API RP 555- 2001 manufacturing standard specifications. The measuring equipment used for monitoring data is calibrated as per manufacturers specifications, but at least once in three years as per § 17.c of the general guidelines to SSC CDM methodologies (version 17).
Purpose of data:	Determination of Emission Reductions
Additional comments:	The data will be archived until two years after the end of crediting period or the last issuance of CERs for this project activity, whichever occurs later as per § 17.a of the general guidelines to SSC CDM methodologies (version 17). Value is used in equation 23
Data/parameter:	**ID. 24./$FV_{RG,h}$**
Unit	m^3/h
Description	Volumetric flow rate of the residual gas in dry basis at normal conditions in hour *h*.
Measured/calculated/default	Measured
Source of data	Measurements by project participants using a Thermal mass flow meter.
Value(s) of monitored parameter	Refer Emission Reduction Sheet to get values for different period

Monitoring equipment	Thermal mass flow meter
Measuring/reading/recording frequency:	Half hour values, based on which monthly report is generated from PL
Calculation method (if applicable):	Will be continuously measuring the gas flow rate and the value will be logged in PLC on a half hourly basis. Accuracy measurement: ± 1.8% of reading + 0.1% full scale. PP will ensure that the same basis (dry) is considered for this measurement.
QA/QC procedures:	Data is monitored continuously. Values are logged every half hour. Based on the logged data, a monthly report is prepared by Manager-in-Charge which is forwarded to CDM Coordinator. The measuring equipment is designed using IS/ANSI manufacturing standard specifications. The measuring equipment used for monitoring data is calibrated as per manufacturers specifications, but at least once in three years as per § 17.c of the general guidelines to SSC CDM methodologies (version 17).
Purpose of data:	Determination of Emission Reductions
Additional comments:	The data will be archived until two years after the end of crediting period or the last issuance of CERs for this project activity, whichever occurs later as per § 17.a of the general guidelines to SSC CDM methodologies (version 17). In § III of the "Tool to determine project emissions from flaring gases containing methane" (version 01) in the parameter box for $FV_{RG,h}$ under "Measurement procedures" the following sentence is included ("[…] and the measurement of volumetric fraction of all components in the residual gas ($fv_{i,h}$) when the residual gas temperature exceeds 60 ^{o}C]. Since PP opts to use option (a) page 3 of the "Tool to determine project emissions from flaring gases containing methane" (version 01), this part of the sentence is not relevant and has hence been left out.

Data/parameter:	**ID.25./ $BG_{combusted,y}$**
Unit	m^3/y (normalized)
Description	The amount of the biogas combusted, measured on a dry basis.
Measured/calculated/default	Measured
Source of data	Flow meter.
Value(s) of monitored parameter	Refer Emission Reduction Sheet to get values for different period
Monitoring equipment	Flow meter
Measuring/reading/recording frequency:	Half hour values, based on which monthly report is generated from PLC
Calculation method (if applicable):	The quantity of biogas generated is measured using a calibrated flow meter. The flow meter values are logged in the system. The accuracy class of the flow meter for is +0.1% of full scale.

QA/QC procedures:	Data is monitored continuously. Values are logged every half hour. Based on the logged data, a monthly report is prepared by Manager-in-Charge which is forwarded to CDM Coordinator. The data used is reviewed by conducting a inter department review meeting once in 6 months. Once the data is compiled and checked, it will be handed over to Verifier for verification. The measuring equipment used for monitoring data is calibrated as per manufacturers specifications, but at least once in three years as per § 17.c of the general guidelines to SSC CDM methodologies (version 17).
Purpose of data:	Determination of Emission Reductions
Additional comments:	The data will be archived until two years after the end of crediting period or the last issuance of CERs for this project activity, whichever occurs later.

Data/parameter:	**ID.26./ $BG_{flared,y}$**
Unit	m^3/y(normalized)
Description	The amount of biogas generated that is flared, measured on a dry basis.
Measured/calculated/default	Measured
Source of data	Project participants will monitor which will provide the actual value with flow meter.
Value(s) of monitored parameter	Refer Emission Reduction Sheet to get values for different period
Monitoring equipment	Flow meter
Measuring/reading/recording frequency:	Half hour values, based on which monthly report is generated
Calculation method (if applicable):	The quantity of biogas flared is measured using a calibrated flow meter. The flow meter values are logged in the system. The accuracy class of the flow meter for is ±0.1% of full scale.
QA/QC procedures:	Data is monitored continuously. Values are logged every half hour.. Based on the logged data, a monthly report is prepared by Manager-in-Charge which is forwarded to CDM Coordinator. The data used is reviewed by conducting a inter department review meeting once in 6 months. Once the data is compiled and checked, it will be handed over to Verifier for verification. The measuring equipment used for monitoring data is calibrated as per manufacturers specifications, but at least once in three years as per § 17.c of the general guidelines to SSC CDM methodologies (version 17).
Purpose of data:	Determination of Emission Reductions
Additional comments:	The data will be archived until two years after the end of crediting period or the last issuance of CERs for this project activity, whichever occurs later

Data/parameter:	**ID. 27./ Frequency of tilling**
Unit	Number
Description	Number of times each batch is tilled.
Measured/calculated/default	Calculated
Source of data	Plant records (Log book maintained at drying yard).

Value(s) of monitored parameter	Refer Emission Reduction Sheet to get values for different period
Monitoring equipment	Daily count
Measuring/reading/recording frequency:	Once per day
Calculation method (if applicable):	The digester sludge output will be separated in a common separation system. The solid phase will be solar dried in a dedicated fertilizer yard. The piles are regularly turned (once or twice in a day) to improve porosity and oxygen content of the piles, thus ensuring that the solids are aerobically handled. Each batch is dried for approximately 12 - 13 days.
QA/QC procedures:	The Operator reports the readings at each tilling in the plant records, as well as when the sludge is removed. Based on the logged data, a monthly report is prepared by the Manager-in-Charge and is forwarded to the CDM Coordinator. The data used is reviewed by conducting a inter department review meeting once in 6 months. Once the data is compiled and checked, it will be handed over to the Verifier for verification. The measuring equipment used for monitoring data is calibrated as per manufacturers specifications, but at least once in three years as per § 17.c of the general guidelines to SSC CDM methodologies (version 17).
Purpose of data:	Determination of Emission Reductions
Additional comments:	The data will be archived until two years after the end of crediting period or the last issuance of CERs for this project activity, whichever occurs later.

Data/parameter:	**ID. 28./FC_{Diesel}**
Unit	Litres
Description	Amount of diesel consumption for operation at site for e.g. tillers and diesel generator set.
Measured/calculated/default	Calculated
Source of data	Zero
Value(s) of monitored parameter	Refer Emission Reduction Sheet to get values for different period
Monitoring equipment	NA
Measuring/reading/recording frequency:	Daily monitoring and Monthly compilation
Calculation method (if applicable):	Consumed during operation of tillers and DG set at the site.
QA/QC procedures:	This can be cross checked with the fuel receipts / invoices raised by the to be applied.
Purpose of data:	Determination of Emission Reductions
Additional comments:	The data will be archived until two years after the end of crediting period or the last issuance of CERs for this project activity, whichever occurs later.

Data/parameter:	**ID. 29./ T_{flare}**
Unit	^{o}C

Description	Temperature in the exhaust gas of the flare.
Measured/calculated/default	Measured
Source of data	Measurements by project participants.
Value(s) of monitored parameter	Refer Emission Reduction Sheet to get values for different period
Monitoring equipment	Type N thermocouple
Measuring/reading/recording frequency:	Half hour values, based on which monthly report is generated from PLC
Calculation method (if applicable):	Measure the temperature of the exhaust gas stream in the flare by a Type N thermocouple. A temperature above 500 ^{O}C indicates that a significant amount of gases are still being burnt and that the flare is operating.
QA/QC procedures:	Data is monitored continuously. Values are logged every half hour. Based on the logged data, a monthly report is prepared by the Accounts Manager in hard or soft copy and is forwarded to the CDM Coordinator through email on monthly basis. Once the data is compiled and checked, it will be handed over to the Verifier for verification. The thermocouples are manufactured as per ANSI standard specifications. Thermocouples are replaced or calibrated every year as per the manufacturer recommendations.
Purpose of data:	Determination of Emission Reductions
Additional comments:	An excessively high temperature at the sampling point (above 700 ^{O}C) may be an indication that the flare is not being adequately operated or that its capacity is not adequate to the actual flow. The data will be archived until two years after the end of crediting period or the last issuance of CERs for this project activity, whichever occurs later

Data/parameter:	**ID. 30./ $N_{LT,y}$**
Unit	Individual bird.
Description	Livestock population.
Measured/calculated/default	Measured
Source of data	Based on back-calculation of poultry litter requirement of the plant (i.e. design capacity) and average generation data (i.e. 40 g / head / day)
Value(s) of monitored parameter	Refer Emission Reduction Sheet to get values for different period
Monitoring equipment	NA
Measuring/reading/recording frequency:	Annual report
Calculation method (if applicable):	As per report from Tamil Nadu Agricultural University, poultry produces 35 – 40 grams of litter per day per head[88]. The value $N_{LT,y}$ is determined through back-calculation of the poultry litter requirement of the plant on an annual basis. In addition, each farm has records for its livestock population. Through sampling, the records can be compared with sales records of manure from the respective farm and the data can be compared to calculate livestock population.

QA/QC procedures:	The consistency between these values and indirect information (records of sales, records of food purchases) shall be assessed. Significant changes in livestock population will be explained.
Purpose of data:	Determination of Emission Reductions
Additional comments:	The data will be archived until two years after the end of crediting period or the last issuance of CERs for this project activity, whichever occurs later. For 100% of the population the used value is then based on the following back calculation: ~ 2.5 million heads * ~ 40 grams per head per day * 365 operational days ≈ 37,000 tonne of poultry litter per year. As the animal manure is not treated in different treatment systems, the parameter $MS\%_{i,y}$ doesn't have to be monitored as is defined in section 26 no. 15 of AMS-III.D version 18.

Data/parameter:	**ID. 31./$DAF_{w,i}$**
Unit	km/truck
Description	Average incremental distance for waste type *i* (poultry litter, agri waste and cow dung) transportation.
Measured/calculated/default	Measured
Source of data	Records (TRIPSHEETS) showing from which location the waste originates.
Value(s) of monitored parameter	Refer Emission Reduction Sheet to get values for different period
Monitoring equipment	Plant records
Measuring/reading/recording frequency:	Sampling from complete set of records of each truck loading
Calculation method (if applicable):	The "average incremental distance" of 25 km is taken as a conservative average. This is as per SD_03, Detailed Project Report, pages 53 through 63 and also based on TIDE Technocrat report; Since PP cannot calculate the baseline distance; PP has opted to monitor (sample) the distances and use the sampled values without subtracting the baseline (original) distance. Hence the "average incremental distance was determined based on all the distances provided in pages 53 through 63 of the DPR, which are based on SD_02 Tide Technocrats Report. The average distance is less, which is below 25 km. PP considering a conservative value of 25 KM, and therefore; the project activity complies with this requirement.
QA/QC procedures:	Records (TRIPSHEETS) showing from which location the waste originates. Through statistically sound sampling the distance between those locations and the project (plant) site is determined and verified
Purpose of data:	Determination of Emission Reductions
Additional comments:	-

Data/parameter:	**ID. 32./ $DAF_{res\ waste}$**
Unit	km/truck

Description	Average incremental distance for compost transportation.
Measured/calculated/default	Measured
Source of data	Records i.e. TRIPSHEETS
Value(s) of monitored parameter	Refer Emission Reduction Sheet to get values for different period
Monitoring equipment	Plant records
Measuring/reading/recording frequency:	Sampling from complete set of records of each truck loading
Calculation method (if applicable):	50 km is taken as a conservative average. The parameter will be determined through sampling (see Annex 4 sampling plan). For determining the ex-ante value: this was based on SD_02 Tide Technocrats Report: the survey conducted for compost sales. The area covered for 50 kms radius distance from project site, the compost can be sold to farmers for agricultural purpose. Page 25 table 10 of the Tide Technocrats Private Limited (Bangalore), *Assessment Report of feedstock availability and market for biomethanation solids* (April 2011). Document made available to the DOE
QA/QC procedures:	The location of each batch of compost sold will be registered and documented via sales records and TRIPSHEETS. The distances from the project (plant) site to these sample soil application locations of the compost are averaged and cross-referenced with the compost sales records.
Purpose of data:	Determination of Emission Reductions
Additional comments:	-

Data/parameter:	**ID. 33./ APP_{comp}**
Unit	%-age
Description	Proper application of compost
Measured/calculated/default	Measured
Source of data	An external local expert shall execute the sampling.
Value(s) of monitored parameter	Refer Emission Reduction Sheet to get values for different period
Monitoring equipment	Plant records
Measuring/reading/recording frequency:	Sampling from complete set of records of each truck loading
Calculation method (if applicable):	The soil application should be monitored to ensure that there is proper application of compost. A sample of 20 hectares of land per annum to check on proper application of compost and condition during application which does not lead to any further emissions. Final crop for which compost is used should be recorded.
QA/QC procedures:	The location of each batch of compost sold will be registered and documented via sales records and TRIPSHEETS. A statistically sound test sample land area totalling 20 hectares is determined from locations where soil application of the compost takes place (as per SD_32 Tide Compost Report made available to the DOE).
Purpose of data:	Determination of Emission Reductions

Additional comments:	The data will be archived until two years after the end of crediting period or the last issuance of CERs for this project activity, whichever occurs later as per § 17.a of the general guidelines to SSC CDM methodologies (version 17).

D.3 Implementation of sampling plan

The purpose of sampling is to obtain unbiased and reliable estimates of the mean value of parameters used in the calculations of greenhouse gas emission reductions. 'Unbiased' in this case indicates that the sampling will not systematically underestimate or overestimate the mean value determined. The design of the sampling plan follows the outline set in Appendix 3 of the 'standard for sampling and surveys for CDM project activities and programme of activities (Version 2.0)'.

The sampling plan contains information relating to: (a) sampling design; (b) data to be collected; and (c) implementation plan.

(**a) Sampling design**

(i) Objectives and Reliability Requirements

Objective of determining the**:**

1. Average incremental distance for waste type i (poultry litter, agri waste and cow dung) transportation ($DAF_{w,i}$)
2. Average incremental distance for compost transportation ($DAF_{res\ waste}$)
3. Compost application (APP_{comp})

These values are determined for every monitoring period. As there is no specific guidance in the applicable methodologies, project proponents will use 90/10 confidence/precision as the criteria for reliability of sampling efforts for small-scale project activities as per paragraph 9 of the Standard for sampling and surveys for CDM project activities and programme of activities (Version 2.0).

(ii) Target Population

Target population for $DAF_{w,i}$ comprises the incremental distances (in kilometres) the incoming waste streams (in tonnes) are transported under the project activity. The waste will be transported using trucks. The average capacity is 8 tonnes per truck (CT_y; monitored). The incoming waste (Q_y; monitored) = 95.000 tonnes/ year, hence an approximate 11.900 truck movements will be required. These consist of the following waste types (stata):

Waste type ($Q_{y,i}$)	Tonnes	expected annual truck movements (rounded)
$Q_{y,poultry\ litter}$	37,000	4630
$Q_{y,cow\ dung}$	1,825	230
$Qy_{,agri}$ agricultural wastes	58,000	7250
Total (rounded up)	95,000	12150

Target population for $DAF_{res\ waste}$ an approximate 3000 truck movements will be required ($Qy_{,treatment}$ ~24.000 tonnes per year/ 8 tonnes per truck = 3000 trucks per year).

For compost application the volume is approximately 110.000 hectares on which the compost is applied. This compost is expected to be very homogeneous throughout the year.

(iii) Sampling Method

Parameter	Sampling Method	Comment
$DAF_{w,i}$	Stratified Random Sampling	The average incremental distance is expected to be different for each strata (but homogeneous within the strata).
$DAF_{w, poultry}$	Stratum	
$DAF_{w,cow\ dung}$	Stratum	
$DAF_{w, agri}$	Stratum	
$DAF_{res, waste}$	Simple Random Sampling	The average incremental distance is expected to be homogeneous within sample group.
APP_{comp} Compost application	Simple Random Sampling	The application is expected to be homogeneous within sample group.

(iv) Sample Size

The sample size is determined based on a 10% error margin at 90% confidence level. Per sample (orstratum) the sample size is determined based on the formula for either percentage data or numerical data.The results are presented in the table below.

Parameter	sampling type	N (population)	p (expected proportion)	z @ 90% conf. interval	mean	SD	Sample size
Average incremental distance for poultry litter, agri waste and cow dung transportation ($DAF_{w,i}$)							
$DAF_{w, poultry}$	numerical data	4900 truck movements		1.645	15km	5km	30 truck movements (rounded-up to 32)
$DAF_{w,cow\ dung}$	numerical data	280 truck movements		1.645	15km	5km	28 truck movements (rounded-up to 30)
$DAF_{w, agri}$	numerical data	7250 truck movements		1.645	46km	12km	19 truck movements (rounded-up to 20)

$DAF_{res, waste}$	percentage data	3000 truck movements	0.95 (expected proportion of the sites within 50 km distance	1.645			13 truck movements (rounded-up to 20)
APP_{comp}	percentage data	110.000 hectares	0.95	1.645			20 ha (see Tide compost application report)

(v) Sampling Frame

Parameter	**Sampling Frame**
DAF_{W}	
$DAF_{W, poultry}$	records of all incoming trucks from poultry farms (Trip sheet)
$DAF_{W,cow\ dung}$	records of all incoming trucks from dairy farms (Trip sheet)
$DAF_{W, agri}$	records of all incoming trucks from agri waste factories (Trip sheet)
$DAF_{res, waste}$	records of outgoing trucks carrying compost (Trip sheet)
APP_{comp}	records of outgoing trucks carrying compost (Trip sheet)

(b) Data

(i) Field measurements

Parameter	**Field measurements**
DAF_{W}	
$DAF_{W, poultry}$	the samples will be selected randomly from the sample frame. The travelled distance will be determined based on GPS/ Google Maps directions or similar of the shortest route between the respective poultry farm and the site.
$DAF_{W,cow\ dung}$	the samples will be selected randomly from the sample frame. The travelled distance will be determined based on GPS/ Google Maps directions or similar of the shortest route between the respective poultry farm and the site.
$DAF_{W, agri}$	the samples will be selected randomly from the sample frame. The travelled distance will be determined based on GPS/ Google Maps directions or similar of the shortest route between the respective factory and the site.
$DAF_{res, waste}$	During operations the samples will be selected randomly from the sample frame. The distance will be measured/ recorded. To derive the incremental distance
APP_{comp}	See Tide report [source] for data form.

(ii) Quality Assurance/Quality Control:

Sample size is increased to 20 samples per sample (32 for poultry litter). The two most extreme outliers (lowest and highest sampling result) are subsequently eliminated. The effect of this is that potential sampling errors are further minimised.

The following Quality Assurance/Quality Control procedures have to be in place**.**

Table 9: QA/QC

Parameter to be sampled	Quality Assurance/Quality Control
$DAF_{w, poultry}$	Tripsheet data will be checked on regular basis by Manager In Charge and during the interdepartmental review meeting by the CDM coordinator as per PDD
$DAF_{w,cow\ dung}$	Tripsheet data will be checked on regular basis by Manager In Charge and during the interdepartmental review meeting by the CDM coordinator as per PDD
$DAF_{w, agri}$	Tripsheet data will be checked on regular basis by Manager In Charge and during the interdepartmental review meeting by the CDM coordinator as per PDD
$DAF_{res, waste}$	If the $DAF_{res, waste}$ value calculated based on the samples is larger than the expected value (50km), then the larger value will be used as the new value for $DAF_{res, waste}$. Also the sample size will be increased to 68 (= sample size at 90/10 for p equals 0.5; which is statistically the lowest expected proportion.
APP_{comp}	For each improper soil application determined, the related leakage emissions will be calculated and taken into account when claiming emission reductions. Also if more than 1 improper application is determined, the sample size will be increased to 68 (= sample size at 90/10 for p equals 0.5; which is statistically the lowest expected proportion.

(iii) Analysis: Describe how the data will be used.

Parameter to be sampled	How data will be used
$DAF_{w,i}$	The average value calculated from the sample size will be used as $DAF_{w,i}$ value
$DAF_{res, waste}$	Data will be used to verify the assumed average value of 50km incremental distance.
APP_{comp}	Data will be used to conclude that soil is properly applied.

(c) Implementation

The PP will train the CDM team members to perform the sampling. The sampling will be embedded in the operational procedures and in the monitoring plan as per PDD.

Verification

Based on the data gathered a written monitoring report will be provided to the verifying DOE to demonstrate compliance with the monitoring requirements corresponding to the preceding monitoring period.

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

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

Baseline emissions:
Baseline emissions from electricity generation

EGBL,y : 15.4 GWh/y - monitored
EFCO2,grid,y: 865 tCO2/GWh – ex-ante
Calculations
*BEElec,y = EGBL,y * EFCO2,grid,y*
Results
BEElec,y = 13,318 tCO2e/y

Baseline emissions from poultry litter

The table below provides the anticipated quantities of substrate to the anaerobic digester:

Sr. No.	Waste	Quantity (t/y)
1	Poultry Litter	37,000
2	Agricultural biomass residue	58,000
3	Cow Dung	1,825

The table below provides the overview of data used to determine the baseline emission related to avoidance of methane production.

Input data			
Variable	**Value applied**	**Unit**	**Source**
$VS_{default}$[82]	0.02	kg	IPCC
days per year	365	d	Default
Calculations			
$VS_{LT,y} = VS_{default} * 365$			
Results			
$VS_{LT,y}$= 7.3 kg/y			

Input data			
Variable	**Value applied**	**Unit**	**Source**
GWP_{CH4}	21	-	ex-ante; see parameter ID.4 in § B.6.2
D_{CH4}	0.67	kg/m^3	ex-ante; see parameter ID.5 in § B.6.2
UF_b	0.94	-	ex-ante; Model correction factor to account for model uncertainties (0.94)[83]
MCF_j	22.84	%	ex-ante; see parameter ID.6 in § B.6.2
$B_{0,\ LT}$	240	M^3CH_4/t	ex-ante; see parameter ID.7 in § B.6.2
$N_{LT,y}$	2,500,000	birds	Calculated
$VS_{LT,y}$	7.3	kg/y	Calculated above
	100%	-	ex-ante; see parameter

$MS\%_{BI,u}$			ID.9 in § B.6.2
Calculations			
$BE_{manure,y} = GWP_{CH4} * D_{CH4} * UF_b * \sum_{j,LT} MCF_j * B_{0,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{Bl,j}$			
Results			
$BE_{manure,y}$ = 13,231 tCO_2e/y			

Hence baseline emissions are:

Input data
$BE_{Elec,y}$ = **13,318** tCO_2e/y
$BE_{manure,y}$ = **13,231** tCO_2e/y
Calculations
$BE_y = BE_{Elec,y} + BE_{manure,y}$
Results
BE_y = 26,549 tCO_2e/y

Above mentioned calculation is as per Registered PDD.

For review the actual emission reductions kindly refer the emission reduction sheets. Following are the results of it as -

	A	B	C=A+B	D	E	F=D+E	G=C-F
Month	BE (AMS I D)	BE (AMS III A O)	BE	PE (AMS I D)	PE (AMS III A O)	PE	ER
	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2	tCO2
Jan-13	87.05	345.47	432.52	0	80.16	80.16	352.36
Feb-13	80.62	791.13	871.75	0	316.64	316.64	555.10
Mar-13	87.78	898.59	986.37	0	387.69	387.69	598.68
Apr-13	525.09	996.78	1521.86	0	205.41	205.41	1316.46
May-13	250.23	447.99	698.22	0	178.04	178.04	520.18
Jun-13	207.91	6.84	214.76	0	127.11	127.11	87.64
Jul-13	205.18	169.87	375.05	0	144.79	144.79	230.26
Aug-13	270.12	267.93	538.05	0	119.21	119.21	418.84
Sep-13	301.44	84.23	385.66	0	143.69	143.69	241.98
Oct-13	427.55	134.43	561.99	0	199.16	199.16	362.83
Nov-13	369.32	284.22	653.54	0	189.28	189.28	464.26
Dec-13	439.77	259.18	698.94	0	164.69	164.69	534.25
Jan-14	476.06	278.27	754.33	0	148.66	148.66	605.67
Feb-14	571.25	321.41	892.65	0	177.47	177.47	715.18
Mar-14	520.97	396.55	917.52	0	174.41	174.41	743.11
Apr-14	617.30	548.73	1166.03	0	215.49	215.49	950.54
May-14	500.07	497.09	997.16	0	214.25	214.25	782.91
Jun-14	541.77	607.78	1149.55	0	189.64	189.64	959.91
Jul-14	488.90	767.07	1255.96	0	183.91	183.91	1072.06
Aug-14	483.54	765.69	1249.23	0	251.28	251.28	997.95
Sep-14	423.43	729.54	1152.98	0	208.29	208.29	944.68
Oct-14	390.63	666.62	1057.25	0	150.23	150.23	907.02
Nov-14	512.91	572.73	1085.64	0	156.29	156.29	929.35
Dec-14	605.36	465.91	1071.27	0	195.33	195.33	875.95
Jan-15	595.95	404.51	1000.46	0	170.94	170.94	829.52
Feb-15	525.64	324.49	850.14	0	157.34	157.34	692.80
Mar-15	605.60	401.05	1006.65	0	165.36	165.36	841.29
Apr-15	576.19	467.63	1043.82	0	162.36	162.36	881.46
May-15	541.42	502.09	1043.51	0	164.83	164.83	878.68
Jun-15	688.21	404.78	1092.99	0	198.58	198.58	894.42
Jul-15	598.48	384.02	982.50	0	175.72	175.72	806.78

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

Refer Section E.1.

E.3. Calculation of leakage

As per registered PDD and methodology applied its considered as Zero.

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

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)	GHG emission reductions or net GHG removals by sinks (t CO_2e) achieved in the monitoring period		
				Up to 31/12/2012	From 01/01/2013	Total amount
Total	27,709	5,716	0	0	21991	21991

E.5. Comparison of actual emission reductions or net 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)	57,750	21,991

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

Due to less Plant Load Factor, emission reductions are less.

Appendix 1. Contact information of project participants and responsible persons/entities

Project participant and/or responsible person/ entity	☒ Project participant ☒ Person/entity responsible for completing the CDM-MR-FORM
Organization name	IOT Mabagas Limited (IML)
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Contact person	
Title	Chief Operating Officer
Salutation	Mr
Last name	Ali
Middle name	
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Project participant and/or responsible person/ entity	☒ Project participant ☒ Person/entity responsible for completing the CDM-MR-FORM
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