CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

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IOT Mabagas Limited power plant, Pudhuchatram
Version: 2.2
02/12/2011

A.2. Description of the small-scale project activity:

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Project Proponent
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 proponent, IML, intends to build and operate an anaerobic digestion plant to generate 2.4 MW of renewable electricity as part of the proposed 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, all of which release methane into the atmosphere, unless treated in waste-to-energy plants such as the proposed project activity.

In this regard the Indian Ministry of New and Renewable Energy reports that rapid industrialization is responsible for huge quantity of wastes, both solid and liquid, in industrial sectors such as sugar (Press mud – is a waste product of the sugar industry), sago (sago water is an effluent from the sago industry where tapioca is transformed to sago) / starch, poultries etc., which are typically dumped on land or discharged into water bodies, without the use of adequate treatment, thereby causing environmental pollution and hazard to health[1]. Similarly, FICCI reports[2] (section 3.3.4) that methane release during the treatment of press mud by sugar mills and distilleries during composting and ill-operated aerobic

[1] http://mnre.gov.in/energy-iwaste.htm

[2] www.globalmethane.org/Data/292_5_ficci_resource_assess_jan_10.pdf

treatment is not uncommon in India (although the majority of methane release is from anaerobic open lagoons for the treatment of spent wash). FICCI also reports that animal husbandry practices in India cause GHG emissions at the stage of manure management. Besides MNRE and FICCI, the UNDP reports the GHG savings that can be made from switching from open lagoon systems as commonly used for sago waste water treatment to closed anaerobic digesters[3].

Post - Project Scenario

In the post-project scenario, the project proponent procures the poultry litter from the nearby poultry farms in the district. 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) for continuous feeding into 4 continuously stirred digesters with a total working volume of 16,000 m^3. 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 proponent to the distribution licensee as per the modalities of the Energy Biomass Purchase Agreement.[4]

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.

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 18.2 GWh of gross electricity. Thus, the project activity contributes to the reduction in GHG emissions on account of:

a. 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.
b. 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 proposed project activity will abate approximately 22,654 tCO_2e per annum.

[3] see IRR Annex 15 page 33ff.

[4] Biomass Energy Purchase Agreement document made available to DOE.

Sustainable development:

The project activity contributes to the sustainable development criteria set by the host country Designated National Authority (DNA), the National Clean Development Mechanism Authority (NCDMA), for CDM projects in the following manner:

Social well-being

The project activity is expected to contribute to social well-being by:

- Creating direct and indirect employment for the local rural population. Many people would be employed directly on site by the private entity (approx. 30), whereas numerous indirect jobs would be created in the collection and logistics activity of the biogas plants to ensure continuous substrate supply. Further, indirect jobs are needed in the upgrading, bagging and distribution of the organic fertilizer from the plant. Thus the project activity will contribute to raising the living standard of the local rural population.
- Improving the waste management practice and thereby improving the environmental quality of life of the local community: the frequent removal of poultry litter is required to sustain the continuous feeding of the biogas plant and would replace the otherwise uncontrolled disposal practices of the litter. This would lead to a reduction of bad odour and vector breeding in the surrounding areas of the poultry farm and help alleviate this clearly felt nuisance by the local population.

Economic well-being

The project activity is expected to contribute to economic well-being by:

- Contributing to the economic development of the region through the capital investment required for the construction of the plant;
- Creating economic activities and thereby creating jobs for the rural population;
- Diversifying the national energy supply;
- Reducing the power deficit in the state of Tamil Nadu.

Environmental well-being

The project activity is expected to contribute to environmental well-being by:

- Utilizing biomass residues and poultry litter which, in the absence of the project activity, would be left to decay and thus lead to uncontrolled methane emissions to the atmosphere as a result of the decaying process;
- Displacing carbon intensive grid-based power supply and hence reduce the carbon intensity of power production in Tamil Nadu by generating electricity from a renewable source;
- Providing high quality organic fertilizer and soil conditioner to local farmers and traders, which is produced as a by-product of the biogas production process;
- Reducing the danger of disease in people and animals as the controlled two-stage anaerobic digestion process nearly completely eliminates pathogens, germs and parasites.

Technological well-being

The project activity is expected to contribute to technological well-being by:

- Disseminating technological knowledge and know-how by introducing state-of-the-art technology adapted to local circumstances;
- Promoting technology transfer and encouraging further project development by demonstrating the feasibility of such a biogas plant in India;
- Increase security of electricity supply by adding local generation capacity.

A.3. Project participants:

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Table 1 Participants of the project IOT Mabagas Limited power plant, Pudhuchatram

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
India (Host)	Private Entity: IOT Mabagas Limited (IML)	No
Netherlands	Private Entity: Mabanaft Carbon B.V.	No

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

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Thattayangarpatti Village, Pudhuchatram, Namakkal District, Tamil Nadu, India.

A.4.1.1. Host Party(ies):

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India.

A.4.1.2. Region/State/Province etc.:

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Tamil Nadu

A.4.1.3. City/Town/Community etc:

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Namakkal District.

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :

The project is located at SF. Nos.52/1, 52/2, 53/1A and 53/2A at Thattayangarpatti Village, Pudhuchatram block, Namakkal taluk in Namakkal District - 637018, Tamil Nadu, India. The unique coordinates (latitude and longitude) are 11°23'29.64"N by 78°10'41.44"E.

The physical location of the project activity is indicated on the maps below.

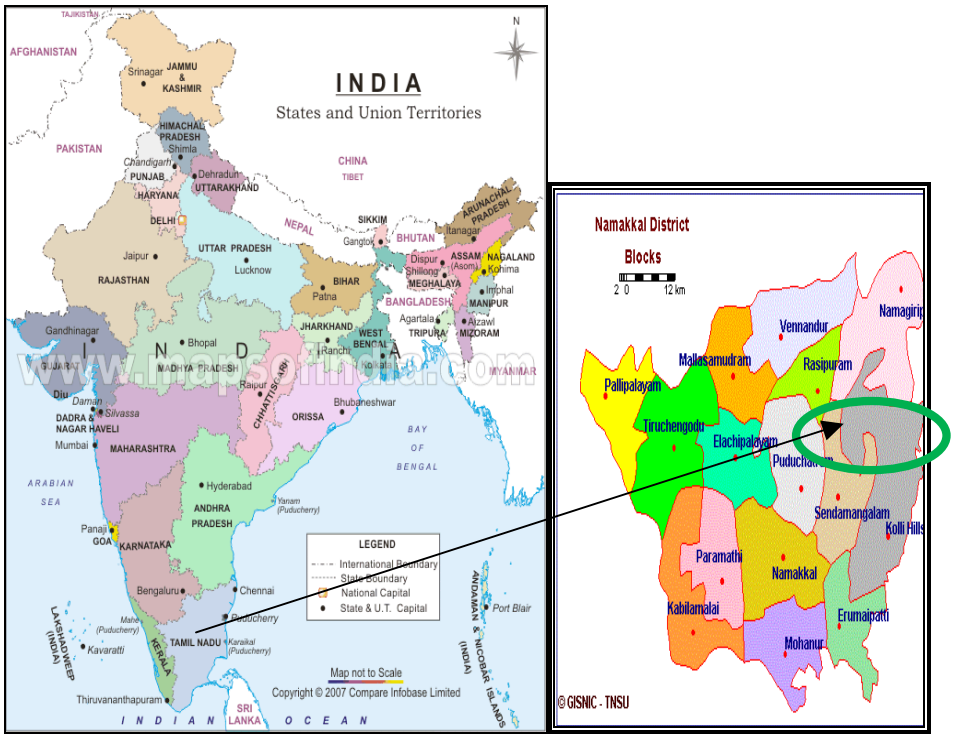

Figure 1. Maps showing the physical location of the project activity.

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

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As per Appendix B of the Simplified Modalities and Procedures for Small-Scale clean development mechanism project activities, the proposed project activity belongs to the following types of small-scale project activity:

Type	**Category**	**Sectoral scope**
I: Renewable energy projects	D - Electricity generation for a system[5]	Scope 1, Energy industries (renewable / non-renewable sources)
III: Other project activities	M - Methane recovery[6]	Scope 13, Waste handling and disposal

Technology/ measures of the small-scale project activity

PROCESS PRINCIPLE

Biogas typically refers to gas produced by the biological break-down of organic matter by concerted action of various groups of anaerobic bacteria in the absence of oxygen (anaerobic process). The Gas comprises mainly of methane and carbon dioxide.

[5] http://cdm.unfccc.int/methodologies/DB/RSCTZ8SKT4F7N1CFDXCSA7BDQ7FU1X/view.html

[6] http://cdm.unfccc.int/methodologies/DB/F5U41CTG7ENWK9RSSL5BV1LUPDG76W/view.html

The Principle equipment for enabling the biogas production process are temperature controlled digesters to enable bacterial activity. The digesters are sealed vertical vessels, where fermentation takes place to produce CH_4 (methane) and CO_2 (carbon dioxide). A nutrient rich sludge is produced as a residue and continuously removed from the digesters.

For efficient biogas production, various factors such as biogas potential of waste, design of digester, inoculums, nature of substrate, pH, temperature, loading rate, hydraulic retention time (HRT), C:N ratio, and volatile fatty acids (VFA) play a major role. The basic design of the biogas plant is based on these. A process scheme has been developed for its efficient production.

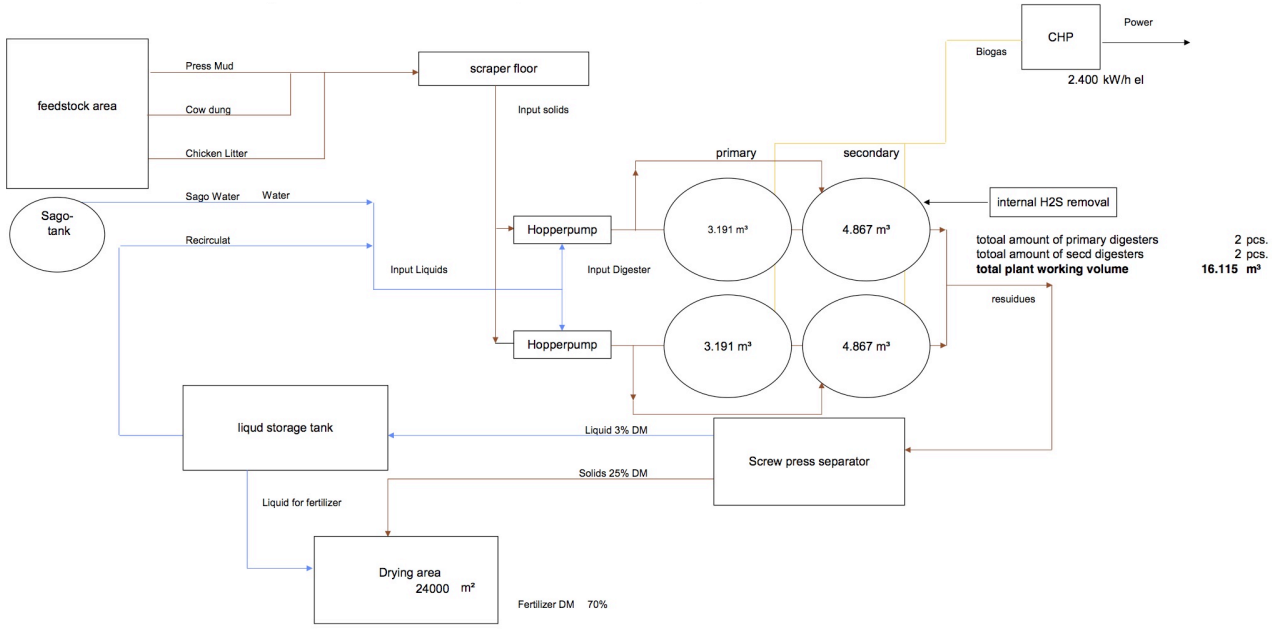

Figure 2. Process scheme[7]

PROCESS DESCRIPTION

Waste & Storage

The waste includes animal waste (poultry litter and cow dung) and industrial waste (press mud and sago water). It is brought from its source destination to the storage area of the plant by means of trucks and tankers. The storage area has a capacity of 1.950 m³. The daily input of substrate will be 210 metric tonnes (300 m³) hence the storage area is able to store substrate for 6,5 days.

Sago water is stored in a tank with a capacity of 1,000 m^3. Sago water from the sago water tank is fed directly into the digesters. The re-circulate water (from the primary and secondary digesters) is fed to the feed mixing pump and pumped to feed hopper pump. It is mixed with the solid substrate in the feed hopper pump and fed to the primary digester.

Using poultry litter as a mono substrate causes many problems. One is the high ammonia concentration. This will cause a slow down of the degradation process up to an intoxication of the bacteria. Second, due to its high dry matter content poultry litter needs a high dilution rate. If this is only achieved by water the

[7] Mass balance/ detailed project scheme is provided to the DOE

organic load of the digester becomes too low or the retention time is to short. For this reason we are adding agricultural waste products which also stabilize the biological process

The storage area stores poultry litter, press mud and cow dung. Substrate will be handled on a "first in, first out" base to avoid rotting of the substrate in the storage area. Two bunkers are provided for two Digester lines. Each bunker, rectangular box type is designed for a storage capacity of 12 hours provided with load cells for weighing. These bunkers have a scraper floor mechanism to transfer the feed to the Feed Hopper Pump.

Primary Digester

Two digester lines, with each one primary digester, will be running in parallel to ensure continuous running of the Biogas plant The two digesters shall have a volume of 3,200 m^3 volume each. The material of construction shall be carbon steel. Four agitators per digester shall be provided to achieve the uniform mixing. Agitators shall be propeller type.

Double gas membranes shall be mounted on top of each digester to allow for gas storage for at least 3 hours operations. Digesters shall be envisaged as per the requirement of local and statutory authority to prevent ground water and soil contamination

Secondary Digester

Digesters shall be sized for 4,900 m^3 volume each. The construction is similar to the primary digesters. Secondary digesters will each have five agitators per digester to achieve the uniform mixing. All other design parameters are similar to the primary digesters.

In order to maintain the balance in organic loading, inter-tank transfer of the substrate will be done as and when required, with the aid of pumps and inter-connections provided.

In the digester, the degradation process of the organic components is affected by means of micro-organisms. The total retention time in the digesters is about 35 days during which biogas generation happens. With continuous feed and mixing arrangement within the digester, the generation of biogas is sustained as a continuous process.

CHP (Combined Heat & Power) Unit

The biogas collected at the gas membrane located on top of the primary & secondary digester, is directed to the 2 x 1.2 MWe (2.4 MWe) Combined Heat and Power (CHP) units. According to the O&M contract the engines are expected to run 8,000 hours per year and generate 18.2 GWh gross per year. After utilization for internal plant operation, approximately 15.6 GWh of electricity will be evacuated at 22 kV level to the power grid through a transformer and switch guard.

Manure Drying & Compost Upgradation

The digested slurry from the secondary digester is pumped by means of extruder pumps to a screw extruder.

The solid phase (containing 70-80 % moisture) from the extruder will drop down into a dumper and be taken to the manure-drying yard, which is an open space drying area by natural solar drying process. The dried solid manure will be bagged and marketed.

The liquid phase (containing 2 - 3 % dry solids) from the extruder will be collected in a liquid filtrate tank. The liquid is rich in organic matter. Part of the liquid will be used as process water for dilution; the rest of the liquid phase will be spread over the solid fertilizer to add the nutrients to the fertilizer. The

expected volume of the liquid fraction is around 85,000 t/y of which 50% is recirculated into the digester system, and 50% is sprayed as liquid fertilizer on the drying compost.

Back-up & emergency flare
In case of prolonged maintenance schedules the gas can be stored in four gas holding roofs and if need be burnt in a dedicated on-site emergency flare to avoid methane emissions.

Technology Transfer
As described in the "Personal & Training plan"[8] the unique joint venture between Mabagas International and IOT will lead to one of the first large-scale indigenous biogas plants with a sophisticated process control system to deliver reliable level of automation (combining German process know-how, considering both local Indian Building & Process Standards and employment regulations). Over the past two years over 20 visits (with a total of over 150 man days) by Mabagas personnel to IOTM headquarters have taken place to develop and a design the plot and process layout between IOT Infra and Mabagas International. Mabagas International will continue this partnership to transfer the needed knowledge and technology for the complete plant operation. Further key plant staff of the Puduchatram biogas plant will be trained in Germany in process logic control and also in biogas plant management.

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

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Table 2 Estimated amount of emission reductions over the chosen crediting period

Years	Estimation of annual emission reductions in tonnes of CO_2 e
2013	22,654
2014	22,654
2015	22,654
2016	22,654
2017	22,654
2018	22,654
2019	22,654
2020	22,654
2021	22,654
2022	22,654
Total estimated reductions (tonnes of CO2e)	226,540
Total number of crediting years	10
Annual average of the estimated reductions over the crediting period (tCO_2e)	**22,654**

A.4.4. Public funding of the small-scale project activity:

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The project activity does not obtain any public funding.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

[8] IOTM training and org personnel 3.11.2011.pdf made available to the validator.

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As per Appendix C of the Simplified Modalities and Procedures for Small-Scale clean development mechanism project activities and as per the Guidelines on assessment of debundling for SSC project activities (Version 03):

"A proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

(a) *With the same project participants;*
(b) *In the same project category and technology/measure; and*
(c) *Registered within the previous two years; and*
(d) *Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point".*

In the case of the proposed project activity, there is no registered small scale CDM project activity or an application to register another small-scale CDM project activity:

- With the same project participants;
- In the same project category and technology/measure;
- Registered within the previous two years;
- Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point".

Therefore, the proposed project activity is not a debundled component of a larger project activity.

Considering the above, the proposed project is not a debundled component of a larger project.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the small-scale project activity:

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The approved baseline and monitoring methodologies and methodological tools applied to the project activity are:

Methodology number (and version)	Title
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:

Title	Version
Tool to calculate the emission factor for an electricity system.	02.2.1
Tool to determine project emissions from flaring gases containing methane.	01
Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion.	02
Tool to calculate baseline, project and /or leakage emissions from electricity consumption	01

B.2 Justification of the choice of the project category:

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Justification of the choice of baseline methodology and its applicability to the project activity:

Applicability conditions of AMS-I.D (version 17):

The applicability conditions as per methodology AMS I.D. Grid connected renewable electricity generation (version 17), are as follows:

Table 3 Applicability conditions of AMS-I.D version 17

Nr	Applicability Conditions	Justifications
1	*This methodology comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass:* ***(a)*** *Supplying electricity to a national or a regional grid; or* ***(b)*** *Supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling.*	The national grid of India is divided into two regional grids, the Northern and the Southern. The project will supply electricity to the Southern Grid.[9]
2	*Illustration of respective situations under which each of the methodology (i.e. AMS-I.D, AMS-I.F and AMS-I.A) applies is included in Table 2.* **Table 2: Applicability of AMS-I.D, AMS-I.F and AMS-I.A based on project types** Project type / AMS-I.A / AMS-I.D / AMS-I.F 1 Project supplies electricity to a national/regional grid — √ 2 Project displaces grid electricity consumption (e.g. grid import) and/or captive fossil fuel electricity generation at the user end (excess electricity may be supplied to a grid) — √ 3 Project supplies electricity to an identified consumer facility via national/regional grid (through a contractual arrangement such as wheeling) — √ 4 Project supplies electricity to a mini grid[17] system where in the baseline all generators use exclusively fuel oil and/or diesel fuel — √ 5 Project supplies electricity to household users (included in the project boundary) located in off grid areas — √	The project activity involves renewable energy generation by utilizing biogas originating from the digestion of renewable biomass. As per *Definition of renewable biomass*, EB 23, Annex 18 and *Glossary of CDM terms* (Version 05) the renewable biomass used in the proposed project activity will fall under the renewable biomass sub-category "biomass residue", which is defined as biomass by-products, residues and waste streams from agriculture, forestry, and related industries. The generated electricity is supplied to the Southern Grid of India, hence the project activity complies with this requirement.
3	*This methodology is applicable to project activities that: (a) Install a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity (Greenfield plant); (b) Involve a capacity addition; (c) Involve a retrofit of (an) existing plant(s); or (d) Involve a replacement of (an) existing plant(s).*	The project activity comprises the installation of a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity (greenfield plant, option (a)).
4	*Hydro power plants with reservoirs that satisfy at*	These conditions are not applicable as the

[9] Biomass Energy Purchase Agreement dated 9th Feb 2011 made available to the DOE.

Nr	Applicability Conditions	Justifications
	least one of the following conditions are eligible to apply this methodology: • *The project activity is implemented in an existing reservoir with no change in the volume of reservoir;* • *The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the project emissions section, is greater than 4 W/m2;* • *The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the project emissions section, is greater than 4 W/m2.*	project activity is not a hydro project.
5	*If the new unit has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the new unit co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW.*	The unit has only a renewable component. Its installed capacity will be 2.4MW and hence does not exceed 15MW.
6	*Combined heat and power (co-generation) systems are not eligible under this category.*	The project activity will convert biogas to electricity using gas engines, and hence cannot be classified as a co-generation system.
7	*In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units.*	The project activity comprises a greenfield project; hence this criterion is not applicable.
8	*In the case of retrofit or replacement, to qualify as a small-scale project, the total output of the retrofitted or replacement unit shall not exceed the limit of 15 MW.*	The project activity envisages the installation of a new facility with a power generation potential of 2.4 MW. Throughout the project lifetime it will remain less than 15 MW. This criterion is therefore not applicable.

In sum, the project activity meets all applicability criteria of the methodology AMS I.D. Grid connected renewable electricity generation - version 17.

Applicability conditions of AMS-III.AO (version 01):

The applicability conditions as per methodology AMS-III.AO Methane recovery through controlled anaerobic digestion (version 01), are as follows:

Table 4 Applicability conditions of AMS-III.AO version 01

Nr	Applicability Conditions	Justifications

1	*(a) Co-digestion of multiple sources of biomass substrates, e.g. MSW, organic waste, animal manure, wastewater, where those organic matters would otherwise have been treated in an anaerobic treatment system without biogas recovery is also eligible;*	The project activity involves the co-digestion of multiple sources of biomass substrate i.e. poultry litter, cow dung and organic wastes from sugar and starch processing. In the absence of the project activity these biomass substrate would be left to decay, leading to anaerobic decomposition without biogas recovery. In the proposed project activity the recovered biogas will be fed into gas engines for power generation. Hence, the proposed project activity meets requirement 1(a).
	This methodology comprises measures to avoid the emissions of methane to the atmosphere from biomass or other organic matter that would have otherwise been left to decay anaerobically in a solid waste disposal site (SWDS), or in an animal waste management system (AWMS), or in a wastewater treatment system (WWTS). In the project activity, controlled biological treatment of biomass or other organic matters is introduced through anaerobic digestion in closed reactors equipped with biogas recovery and combustion /flaring system. *The following conditions apply:*	
	(b) Digestion of biomass or other organic matter (excluding animal manure and sludge generated in the wastewater treatment works) as a single source of substrate is included;	The project activity involves the co-digestion of multiple sources of biomass substrate i.e. poultry litter, cow dung and organic wastes from sugar and starch processing. Hence, requirement 1(b) is not applicable.

	(c) If for one or more sources of substrates, it can not be demonstrated that the organic matter would otherwise been left to decay anaerobically, baseline emissions related to such organic matter shall be accounted for as zero, whereas project emissions shall be calculated according to the procedures presented in this methodology for all co-digested substrates;	In the proposed project activity, emission reductions specific to methane avoidance are claimed only for poultry litter, and not for cow dung or agricultural waste. The baseline scenario related to methane emission is explained in detail only for poultry litter. Cow dung: Animal husbandry in India contributes overwhelmingly to the total greenhouse gas emissions of the Indian agricultural sector. The Federation of Indian Chamber of Commerce and Industry (FICCI)[10] reports (especially section 3.1 & 3.2) that manure management of livestock in India contributes 9% (or 1.09 Tg) of total methane emissions from the livestock sector (91% due to enteric fermentation). The FICCI report further describes that of the manure ➲ 40% is aerobically treated for composting, ➲ 40% is piled up or dumped in pits thus resulting in CH4 emissions; and ➲ 20% is used as cooking fuel or heating purposes It is evident from the animal husbandry practices in India that GHG emissions (both CO2 during combustion and CH4 in anaerobic condition of stockpiling and dumping) occur at the stage of manure management. Small holder farmers in the vicinity of the project location hold 1 to 5 cows in semi-confined conditions. Conditions are not equal in all situations; hence it is impossible for the PP to prove the baseline emissions. In line with §1 (c) of AMS-III.AO PP sets baseline emissions of cow dung to zero.

[10] www.globalmethane.org/Data/292_5_ficci_resource_assess_jan_10.pdf

		Agricultural wastes: The Indian Ministry of New and Renewable Energy reports that rapid industrialization is responsible for huge quantity of wastes, both solid and liquid, in industrial sectors such as sugar, sago / starch, poultries etc., which are typically dumped on land or discharged into water bodies, without the use of adequate treatment, thereby causing environmental pollution and hazard to health. Similarly, FICCI reports (section 3.3.4) that methane release during the treatment of press mud by sugar mills and distilleries during composting and ill-operated aerobic treatment is not uncommon in India (although the majority of methane release is from anaerobic open lagoons for the treatment of spent wash). Besides MNRE, the UNDP reports the GHG savings that can be made from switching from open lagoon systems as commonly used for sago waste water treatment to closed anaerobic digesters. In consideration of the reported environmental pollution by MNRE[11], the UNDP[12] and FICCI[13] for the current waste management practices of sugar starch mills and sago water, assuming a baseline of "zero" greenhouse gas emission is a conservative approach. A quantitative analysis of the described qualitative baseline practice cannot be computed due to the lack of numeric data and scientific assessment. Total gas production of all substrates is taken into account when calculating PE_{flare}, $PE_{leakage}$. PE for transport are calculated for each substrate. Therefore, the proposed project activity complies with this requirement.

[11] http://mnre.gov.in/energy-iwaste.htm

[12] see IRR Annex 15 page 33ff – report made available to the validator.

[13] section 3.3.4 www.globalmethane.org/Data/292_5_ficci_resource_assess_jan_10.pdf

	(d) Project participants shall apply the procedures related to the "competing use for the biomass" according to the latest General guidance on leakage in biomass project activities;	In compliance with paragraph 18 of the General guidance on leakage in biomass project activities (Version 03), it is demonstrated at the beginning of the crediting period of the proposed project activity, that the quantity of available biomass in the region is at least 25% larger than the quantity of biomass that is utilised including the project activity. The quantities for the biomass generated in the region are as follows: -Poultry litter generated (tons/day): 436 tons; -Press mud generated (tons/day): 110-290 tons (depending on the season); -Cow dung generated (tons/day): 2242 tons; -Starch water generated (m^3/day): 775 m^3; The quantities for the biomass required for the proposed project activity are as follows: -Poultry litter required (tons/day): 101 tons; -Press mud required (tons/day): 104 tons; -Sago water required (m^3/day): 55 tons; -Cow dung required (tons/day): 5 tons For the quantities of biomass generated in the region, reference is made to Tide Technocrats Private Limited (Bangalore), *Assessment Report of feedstock availability and market for biomethanation solids* (April 2011), which is the most recent relevant study available for the aforementioned biomass in the project region.[14] For the quantities required by the project plant reference is made to the Detailed Project Report of the proposed project activity, made available to the DOE.[15] Hence the proposed project activity complies with this requirement and the leakage referred to in General Guidance on leakage in biomass project activities (version 03), paragraph 18 can be neglected.

[14]Tide Technocrats Private Limited (Bangalore), *Assessment Report of feedstock availability and market for biomethanation solids* (April 2011). Document made available to the DOE

[15]IOT Mabagas Limited, *Detailed Project Report of 2.0 MW biogas to power generation project at Puduchatram, Namakkal, Tamil Nadu*, made available to the DOE.

	(e) Project activities treating animal manure as single source substrate shall apply AMS-III.D. Methane recovery in animal manure management systems, similarly projects only treating wastewater and/or sludge generated in the wastewater treatment works shall apply AMS-III.H.Methane recovery in wastewater treatment.	Not applicable to the proposed project activity.
	(f) The project activity does not recover or combust landfill gas from the disposal site (unlike AMS-III.G. Landfill methane recovery), and does not undertake controlled combustion of the waste that is not treated biologically in a first step (unlike AMS-III.E. Avoidance of methane production from decay of biomass through controlled combustion, gasification or mechanical/thermal treatment.). Project activities that recover biogas from wastewater treatment shall use methodology AMS-III.H.	The proposed project activity: • does not recover or combust landfill gas from disposal site (unlike AMS-III.G); • does not undertake controlled combustion of the waste that is not treated biologically in a first step (unlike AMS-III.E); • does not recover biogas from solely wastewater treatment, therefore AMS-III.H is not applicable. Therefore, the proposed project activity complies with this requirement.
2	*Measures are limited to those that result in emission reductions of less than or equal to 60 kt CO2 equivalent annually.*	The project is expected to generate in the order of 25,000 tCO2e per year, which is lower than the threshold of 60 ktCO2e. Therefore, the proposed project activity complies with this requirement.

3	*The location and characteristics of the disposal site of the biomass used for digestion in the baseline condition shall be known, in such a way as to allow the estimation of its methane emissions. Guidelines in AMS-III.G, AMS-III.D, AMS-III.E (concerning stockpiles) and AMS-III.H (as the case may be) shall be followed in this regard. Project activities for co-digestion of animal manure shall also meet the requirements under paragraphs 1 and 2(c) of AMS- III.D.* *The following requirement shall be checked ex ante at the beginning of each crediting period:* *(a) Establish that identified landfill(s)/stockpile(s) can be expected to accommodate the waste to be used for the project activity for the duration of the crediting period;* *or* *(b) Establish that it is common practice in the region to dispose off the waste in solid waste disposal site (landfill/stockpile).*	The project activity involves anaerobic digestion of multiple sources of biomass substrates, like organic waste, animal manure and wastewater. However, in the proposed project activity, emission reductions specific to methane avoidance are claimed from poultry litter only. To enhance the reader-friendliness of this section of the PDD, the applicability and compliance check of the proposed project activity regarding the requirements under paragraphs 1 and 2(c) of AMS- III.D. shall be presented in Table 5. With respect to condition 3 (a): the identified stockpile(s) can be expected to accommodate the waste to be used for the project activity for the duration of the crediting period. Reference is made to Tide Technocrats Private Limited (Bangalore), *Assessment Report of feedstock availability and market for biomethanation solids* (April 2011) which is the most recent relevant study available for the aforementioned biomass in the project region.[16] With respect to condition 3 (b): it is common practice in the region to dispose off the waste in solid waste disposal site (landfill/stockpile)[17]. Hence the proposed project activity complies with this requirement.

[16]Tide Technocrats Private Limited (Bangalore), *Assessment Report of feedstock availability and market for biomethanation solids* (April 2011). document made available to the DOE

[17] Department of Bioenergy, Tamil Nadu Agricultural University (Tamil Nadu), *Methane Emission Potential of Poultry Litter* (October 2011). document made available to the DOE

4	*The project participants shall clearly define the geographical boundary of the region referred to in 3(b), and document it in the CDM-PDD. In defining the geographical boundary of the region, project participants should take into account the source of waste, i.e. if waste is transported up to 50 km, the region may cover a radius of 50 km around the project activity. In addition, it should also consider the distances to which the final product after digestion will be transported. In either case, the region should cover a reasonable radius around the project activity that can be justified with reference to the project circumstances but in no case it shall be more than 200 km. Once defined, the boundary should not be changed amidst the crediting period(s).*	Poultry litter will be transported within 15 km distance from the project location. Cow dung will be transported within 15 km from the project location; Press mud will be transported within 55 to 60 km from the project location; Sago water will be transported within 15 km from the project location; Above distances are substantiated in the Detailed Project Report[18]. Compost will be transported within 50 km from the project location[19]. Hence as a conservative average incremental distance of 25 km is assumed.
5	*In case residual waste from the digestion is handled aerobically and submitted to soil application, the proper conditions and procedures (not resulting in methane emissions) for storage and transportation and soil application must be ensured.*	The proper conditions will be ensured. The residual waste from the digestion is handled aerobically: it will be spread out in thin layers on plateaus and dried in the sun (not resulting in methane emissions). When dried, the residual waste will be bagged and sold as compost for farm application. The farmers will also spread the compost in thin layers when using it on their farms (not resulting in methane emissions)[20].
6	*In case residual waste from the digestion is treated thermally/mechanically, the provisions in AMS-III.E related to thermal/mechanical treatment shall be applied.*	Not applicable.

[18] Pages 53 through 63 of the Detailed Project Report Of 2.0 Mw Biogas To Power Generation Project At Puduchatram, Namakkal, Tamil Nadu; document made available to the DOE.

[19] 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

[20] Tide Technocrats Private Limited (Bangalore), *Lifecycle of compost from production center to its final use and procedures to ensure aerobic Condition* (November 2011). document made available to the DOE

7	*In case residual waste from the digestion is stored under anaerobic conditions and/or delivered to a landfill, emissions from the residual waste shall to be taken into account and calculated as per the latest version of the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site".*	Residual waste from biological treatment will not be stored under anaerobic conditions and not be delivered to a landfill. Hence this requirement is not applicable[21].
8	*In case the outflow from the digestion is discharged to a subsequent wastewater treatment system or to the natural water receiving body, relevant procedure in AMS-III.H shall be followed to estimate the resultant project emissions.*	Expected volume of the liquid fraction is around 85,000 t/y of which 50% is recirculated into the project plant system and 50% is sprayed as liquid fertilizer on drying compost.
9	*Technical measures shall be used to ensure that all biogas captured from the digester is combusted /flared.*	All biogas captured shall be combusted/ flared and this will be monitored by a gas flow meter.
10	*All the applications to utilize the recovered biogas detailed in paragraph 3 of AMS-III.H are eligible for use under this methodology. The relevant procedure in AMS-III.H shall be followed in this regard.*	In the proposed project activity, all biogas captured shall be combusted/ flared and used for 'electrical energy generation directly' (paragraph 3 (a) of AMS-III.H Methane recovery in wastewater treatment (Version 16). Paragraph 4 of the same methodology states: "If the recovered biogas is used for project activities covered under paragraph 3 (a), that component of the project activity can use a corresponding methodology under Type I. Hence PP follows AMS-I.D Grid connected renewable electricity generation - version 17

Applicability conditions of AMS-III.D (version 18), paragraphs 1 and 2(c)

The applicability conditions as per paragraphs 1 and 2(c) of methodology AMS-III.D Methane recovery in animal manure management systems(version 18) are as follows:

Table 5 Applicability conditions of AMS-III.D (version 18), paragraphs 1 and 2 (c)

Nr	Applicability Conditions	Justifications
1	*This methodology covers project activities involving the replacement or modification of anaerobic animal manure management systems in livestock farms to achieve methane recovery and destruction by flaring/combustion or gainful use of the recovered methane. It also covers treatment of manure collected from several farms in a centralized plant. This methodology is only applicable under the following conditions:*	

[21] Tide Technocrats Private Limited (Bangalore), *Lifecycle of compost from production center to its final use and procedures to ensure aerobic Condition* (November 2011). document made available to the DOE

Nr	Applicability Conditions	Justifications
	(a) The livestock population in the farm is managed under confined conditions;	The livestock population in the farms from which the proposed project activity obtains poultry litter, is managed under confined conditions (as described in the baseline for avoidance of methane under section B.4. of this PDD).
	(b) Manure or the streams obtained after treatment are not discharged into natural water resources (e.g. river or estuaries), otherwise AMS-III.H "Methane recovery in wastewater treatment" shall be applied;	The material resulting from the co-digestion process can be divided into residual waste and leachate. Neither will be discharged into natural water resources (e.g. river or estuaries). Of the expected liquid fraction, 50% is recirculated into the project plant system and 50% is sprayed as liquid fertilizer on drying compost. Therefore the proposed project activity complies with this requirement.
	(c) The annual average temperature of baseline site where anaerobic manure treatment facility is located is higher than 5°C;	The annual average temperature of baseline site where anaerobic manure treatment facility is located is higher than 5°C. This is substantiated by official measurements as explained in the footnote with weblink to official data sources.[22]
	(d) In the baseline scenario the retention time of manure waste in the anaerobic treatment system is greater than one month, and in case of anaerobic lagoons in the baseline, their depths are at least 1 m;	In the baseline scenario the retention time of manure waste in the anaerobic treatment system is greater than one month[23]. The baseline scenario does not involve anaerobic lagoons. Hence the proposed project activity meets this requirement.
	(e) No methane recovery and destruction by flaring, combustion or gainful use takes place in the baseline scenario.	In the baseline scenario, no methane recovery or destruction by flaring, combustion or gainful use takes place at the farms from which the poultry litter is sourced.
2	*The project activity shall satisfy the following conditions:* *(c) The storage time of the manure after removal from the animal barns, including transportation, should not exceed 45 days before being fed into the anaerobic digester. If the project proponent can*	As described in the Process Description in section A.4.2 the storage time of the manure after removal from the animal barns, including transportation shall not exceed 45 days before being fed into the anaerobic digester.

[22] For an archival record of minimum temperatures measured for the district of Namakkal and surrounding districts, please refer to the website of the Agricultural Meteorology Division of the India Meteorology Department of the Ministry of Earth Sciences, currently located at http://www.imdagrimet.gov.in/agroawsdataminitemp

[23] Chapter 3 in Department of Bioenergy, Tamil Nadu Agricultural University (Tamil Nadu), *Methane Emission Potential of Poultry Litter* (October 2011). document made available to the DOE

Nr	Applicability Conditions	Justifications
	demonstrate that the dry matter content of the manure when removed from the animal barns is larger than 20%, this time constraint will not apply.	Hence the proposed project complies with this requirement.

B.3. Description of the project boundary:

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The project boundary is defined as the spatial extent around a project within which the project's impact, in terms of carbon emission reductions, will be assessed. As referred to in Appendix B for small-scale CDM project activities[24], the project boundary shall be limited to the physical project activity. Project activities that displace energy supplied by external sources shall earn certified emission reductions (CERs) for the emission reductions associated with the reduced supply of energy by those external sources.

As mentioned in paragraph 9 of methodology AMS-I.D (Version 17): 'The spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to'. The grid boundary is defined as the Southern grid system in India, and will include all direct emissions related to the electricity produced by power plants to be displaced by the project activity.

As per paragraph 11 of methodology AMS-III.AO (Version 01): the project boundary includes the physical, geographical site:

AMS-III.AO (version 01), paragraph 11		Proposed project activity
11	*The project boundary is the physical, geographical site:*	The project boundary includes:
a	*Where the solid waste (including animal manure, where applicable) would have been disposed and the methane emission occurs in absence of the proposed project activity;*	The poultry farms where the poultry litter will obtained. Baseline emissions for cow dung, press mud are not claimed. However, as per the methodology AMS-III.AO (Version 01) transport emissions are included in the project boundary.
b	*In the case of projects co-digesting wastewater, where the wastewater would have been treated anaerobically in the absence of the project activity;*	Baseline emissions of sago water are not claimed. However, as per the methodology AMS-III.AO (Version 01) transport emissions are included in the project boundary.
c	*Where the treatment of biomass or other organic matters through anaerobic digestion takes place;*	The four closed digesters and the power plant of which they are a part, are included in the project boundary.
d	*Where the residual waste from biological treatment or products from those treatments, like slurry, are handled, disposed, submitted to soil application, or treated thermally/mechanically;*	The dedicated drying yard for the residual waste from the digestion, the farmlands where the composted residual waste from the project plant is submitted to soil are included in the project boundary.
e	*Where biogas is burned/flared or gainfully used,*	Where biogas is burned/flared or gainfully

[24] http://cdm.unfccc.int/methodologies/SSCmethodologies/approved/history/guid_ssc_meth/guid_ssc_v12_1.pdf (accessed November 18 2011)

	including biogas sale points, if applicable;	used.
f	*And the itineraries between them (a, b, c, d and e), where the transportation of waste, wastewater, where applicable manure, residual waste after digestion, or biogas occurs.*	The itineraries between them (a, b, c, d and e), where the transportation of waste, wastewater, manure, residual waste after digestion, occurs.

The project boundary is graphically represented in below figure:

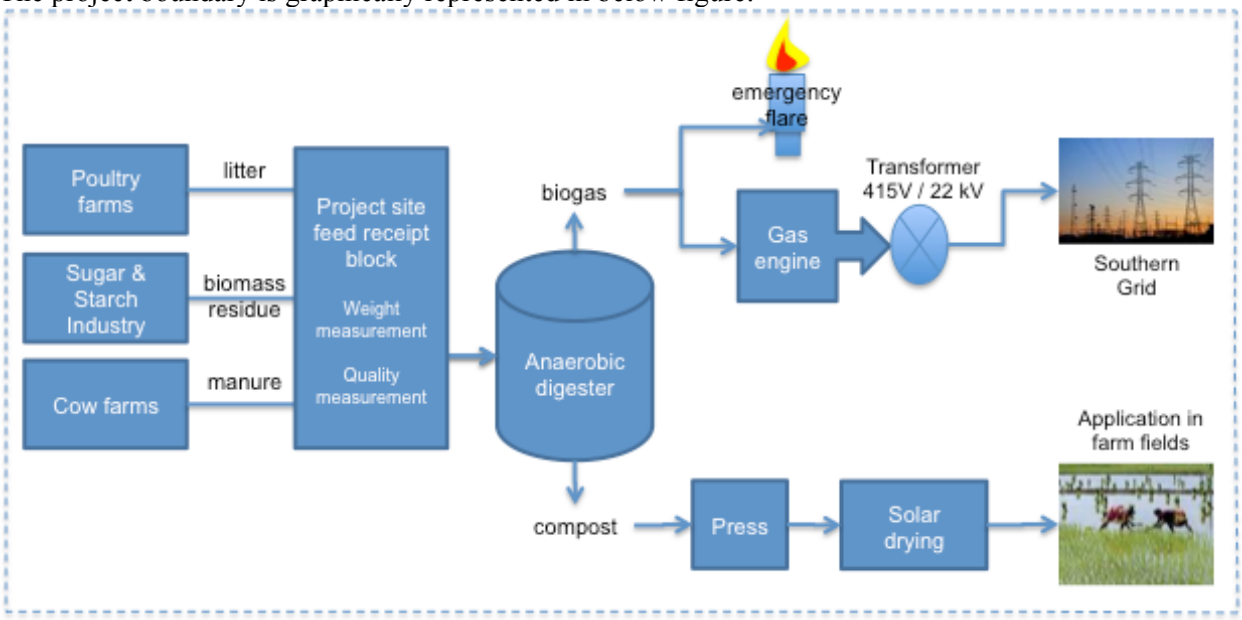

Figure 3 Project boundary

Table 6 Emissions sources

Source		Gas	Included?	Justification / Explanation
Baseline	Emissions from decomposition of poultry litter	CH_4	Yes	The major source of emissions in the baseline.
		N_2O	No	N_2O emissions are present in decaying poultry litter but few reliable studies are available for reliable quantification. Exclusion of this gas is conservative.
		CO_2	No	CO2 emissions from the decomposition of organic waste are not accounted
	Emissions from electricity consumption	CO_2	Yes	Electricity may be consumed from the grid or generated onsite/offsite in the baseline scenario
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.
Project Activity	On-site fossil fuel consumption due to the project activity other than for electricity generation	CO_2	Yes	May be an important emission source
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
	Emissions from	CO_2	Yes	May be an important emission source

	on-site electricity use	CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
	Emissions from transportation	CO_2	Yes	May be an important emission source
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.

B.4. Description of baseline and its development:

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As per the *General Guidelines to SSC CDM methodologies* (Version 17), paragraph 19, Type III Greenfield projects (new facilities) may use a Type III small- scale methodology provided that they can demonstrate that the most plausible baseline scenario for this project activity is the baseline provided in the respective Type III small-scale methodology.

In line with the requirements specified in paragraph 19 of the *General Guidelines to SSC CDM methodologies* (Version 17), an assessment is made of the alternatives of the project activity using the following steps:

Step 1:

Identify the various alternatives available to the project proponent that deliver comparable level of service including the proposed project activity undertaken without being registered as a CDM project activity.

Nr	Name of alternative	Description
1	Business as usual	Continuation of the existing situation, which would mean that poultry litter on poultry farms within the project boundary of the proposed project activity would continue to accumulate under anaerobic conditions, resulting in methane emissions without recovery of biogas. Moreover, the business as usual scenario would also imply no displacement by the proposed project activity of any electricity from the fossil fuel dominated electricity grid.
2	The proposed project activity without being registered as a CDM project activity	The proposed project activity without being registered as a CDM project activity.

Step 2:

List the alternatives identified per Step 1 in compliance with the local regulations (if any of the identified baseline is not in compliance with the local regulations, then exclude the same from further consideration).

Nr	Name of alternative	In compliance with local regulations (Yes/No)

1	Business as usual	Yes
2	The proposed project activity without being registered as a CDM project activity	Yes

Step 3:
Eliminate and rank the alternatives identified in Step 2 taking into account barrier tests specified in attachment A to Appendix B of the simplified modalities and procedures of SSC CDM.

Nr	Name of alternative	Barriers?
1	Business as usual	No
2	The proposed project activity without being registered as a CDM project activity	Yes, for description of existing barrier please refer to section B.5 of this PDD.

Step 4:
If only one alternative remains that is:
Not the proposed project activity undertaken without being registered as a CDM project activity; and
It corresponds to one of the baseline scenarios provided in the methodology; then the project activity is eligible under the methodology.

Hence, the most plausible baseline scenario for this project activity is Business as usual. This scenario corresponds to the following methodologies:

- Baseline for electricity: methodology AMS-I.D *Grid connected renewable electricity generation* (Version 17) as described below;
- Baseline for avoidance of methane production from biomass: methodology AMS-III.AO *Methane recovery through controlled anaerobic digestion* (Version 01) as described below.

Baseline for electricity:
The project activity comprises the installation of a new grid-connected renewable electricity generation plant. The baseline scenario of the electricity delivered to the grid by the project activity is established as electricity that otherwise would have been generated by the operation of grid-connected power plants and by the addition of new generation sources.

In accordance with methodology AMS I.D, *Grid connected renewable electricity generation* (Version 17), the baseline is developed in accordance with paragraph 11 of the methodology, where the baseline emissions are the product of electrical energy baseline $EG_{BL,y}$ expressed in MWh of electricity produced by the renewable generating unit multiplied by the grid emission factor expressed in tCO_2e/MWh.

The grid emission factor or CO_2 emission factor of the grid is calculated in a transparent and conservative manner according to paragraph 12(a) or 12(b) of AMS I.D. *Grid connected renewable electricity generation* (Version 17).

Option 12 (a) has been chosen for the project activity and a Combined Margin (CM) according to the *Tool to calculate the emission factor for an electricity system* (Version 02.2.1). In India, the Central Electricity Authority (CEA) developed an official database of all grid-connected power stations in order to establish a consistent quantification of the CO_2 emission baseline. The latest version of the database, the 'CO_2 Emission Database Version 6.0, March 2011' has been used for the project activity: the

megawatt hours (MWh) produced by the project activity multiplied by the grid emission factor of the Southern grid, calculated as a Combined Margin of the Operating Margin and the Build Margin.

Baseline for avoidance of methane production from biomass:
The baseline scenario for the project activity has been calculated in accordance with the methodology AMS-III.AO *Methane recovery through controlled anaerobic digestion* (Version 01). The project activity involves the following waste streams into the bio-digestion process, which in the absence of the project activity would be left to decay anaerobically within the project boundary causing methane emission to the atmosphere:

1. Poultry litter;
2. Agricultural biomass residues mainly obtained from the sugar & starch industry. From the sugar industry press mud can be obtained and from the starch industry sago water can be obtained;
3. Cow dung.

For the proposed project activity methane emissions are claimed only for poultry litter, and not for biomass residues or cow dung. This is a conservative approach. The baseline scenario related to methane emission is explained in detail only for poultry litter.

In the typical poultry farm from which the proposed project activity will obtain the poultry litter, the birds (egg layers) are housed in cages. The cages are built in rows, with each cage containing 3 to 5 egg layers and each entire row (barn) containing between 25,000 and 50,000 birds. Large poultry farms will have up to several dozens of these barns. Cages are built at a maximum height of approximately 1.8 – 2.5 meters above the ground. Cages have openings in the bottom so that the poultry litter accumulates as droppings below. Typically, the litter is left as such to accumulate for periods up to six months or more before it is cleared away manually to another area on the farm, awaiting removal by trucks.

The poultry litter generates excessive odours. As a layered pile, with continuous fresh manure being dropped on top, it maintains a largely semi-solid consistency. This leads to natural decomposition of the poultry litter and methane is emitted into the atmosphere.

In the baseline, no flaring/ combustion/ containment management for methane emissions takes place, and there is no regulatory requirement to recover or flare methane originating from the poultry litter management system.

The project activity/ power generation facility is located in a central location to collect the poultry litter from various farms. The distance between the project activity and the farms is less than 25 kilometres. A detailed analysis of the waste generation is presented in the third party biomass assessment report.[25]

B.5.	**Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:**

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The chronology of events is represented in the below table:

Key event	**Date**	**Comment/ supporting document**

[25]Tide Technocrats Private Limited, Bangalore, *Assessment report of feedstock availability and market for Biomethanation Solids*, April 2011 - – Made available to the DOE

Prior consideration document submission with UNFCCC and NCDMA	22/02/2011	Prior consideration documentation signed by project proponent & acknowledgement from UNFCCC dated 16.03.2011
LOI with EPC contractor	23/02/2011	LOI from IML to IOT IES for the total construction of the project. This date is taken as the **starting date** as per §67 of EB41.
Stake holders meeting	18/03/2011	MOM of stake holders meeting
Appointment of validation agency (DOE)	03/05/2011	Contract agreement signed between IML and PJR
Initial global stakeholder consultation	01-30/07/2011	
DOE site visit	07-08/09/2011	
Issuance of draft validation report (version 01)	19/10/2011	

The project proponent refers to the "General Guidelines to SSC CDM methodologies" (Version 17), paragraph 7 (a), which refers to "Non-binding best practice examples to demonstrate additionality for SSC project activities", EB 35, Annex 34.

According to the "Non-binding best practice examples to demonstrate additionality for SSC project activities" (EB 35, Annex 34), project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers: investment barrier, access-to-finance barrier, technological barrier, barrier due to prevailing practice or other barriers. In this regard, the project proponent has chosen the option provided in paragraph 1 (a) of EB 35, Annex 34, namely: investment barrier and technological barrier.

Technological barrier

The Ministry of New and Renewable Energy (MNRE) claims that technology barriers for biogas plant investment exist mainly due to difficulties in finance, technological process, lack of organic fertilizer markets etc[26].

Presently, small rural household biogas digesters (with a digester volume of several cubic meters) are common in India to generate biogas for cooking. Large scale biogas plants with a capacity of more than 1 Megawatt (electric) based on solid agricultural waste streams as a substrate are extremely few and rare (since they require technological processes not yet established in India). For example, one of the few large-scale biogas plants in Namakkal/Tamil Nadu that are based on poultry litter as a substrate is running at much lower than expected capacity[27]. This is most likely due to faulty technology design and insufficient operating and maintenance know-how.

The unique partnership between Mabagas International and IOT will transfer the needed knowledge and technology for the complete plant operation as described in the last paragraph of section A.4.2 above.

[26] page 7: www.globalmethane.org/expo/docs/postexpo/ag_dhussa.pdf

[27] http://cdm.unfccc.int/UserManagement/FileStorage/TCMZPJK7OU0EDR9YH8QB63521NA4WI).

Investment barrier

Best practice examples mentioned by name in paragraph 1 (a) of EB 35, Annex 34 are investment comparison analysis, benchmark analysis and simple cost analysis. The project proponent uses a benchmark analysis as per paragraph 14 of the "Guidelines on the Assessment of Investment Analysis" (Version 05) states "Internal company benchmarks should only be applied in cases were there is only one possible project developer", PP is only possible project developer as described in technological barrier and hence the benchmark analysis is the appropriate tool as per paragraph 19 of the guidelines.

The *Guidelines on the Assessment of Investment Analysis* (Version 05), paragraph 12, states that "*In cases where a benchmark approach is used the applied benchmark shall be appropriate to the type of IRR calculated*." "*Required/expected returns on equity (RoE) are appropriate benchmarks for equity IRR*". Therefore the RoE of the Holding company is used as a benchmark value. The capital structure of the project involves both equity and debt. In line with the guidelines, in calculating the equity IRR only the portion of investment costs that is financed by equity is considered as the net cash outflow.

As stipulated in the project participant's investment guideline[28], the board of the project participant and its shareholder require a 12% return on equity for projects within Europe and a 15% return on equity for projects in India. As per *Guidelines on the Assessment of Investment Analysis* (Version 05), paragraph 14, when applying internal company benchmarks[29]/expected returns, it should be demonstrated that the expected return on equity has been used for similar projects with similar risks, developed by the same company. In this regard, reference is made to documentation of a project within Europe[30] and to documentation of a project in India.[31] These documents have been made available to DOE.

The assumptions used to calculate the equity IRR are as follows:

Table 7. Assumptions used to Calculate equity IRR

Sl No	Data/Parameters	Value (in INR)	Inflation (%)	Source/ remarks
Capital Expenditure				
1	Fixed Assets	284,000,000	-	As per signed EPC contract[32].
2	Land purchase cost	13,300,000	-	As per deed of sale[33]
	Total capital expenditure	**297,300,000**	-	
O&M cost (per annum)				
4	CHP O&M	(7,660,800)	6.1%	As per O&M term sheet[34] and maintenance schedule provided by the O&M company[35].

[28] *M&B Investment Guideline*, April 24th 2007, page 2. Document made available to DOE.

[29] Benchmark also based on parameters that are standard in the market, as per supporting documents Risk premiums I and Risk premiums II, made available to DOE.

[30] *Request for Board Approval.Oiltanking [XXX]. Investment in [XXX] for storage and handling of Gasoline, Blending components, Naphtha and Vacuum Gasoil for [XXX]*, page 7-9. Document made available to DOE.

[31] *Memo for the Supervisory Board. Tankage on BOOT Basis for [XXX] Refinery of [XXX]*, on page 3, section Project Financials an equity IRR of 16.3% is mentioned. Document made available to DOE.

[32] IRR Annex 1 Letter of Intent for lump sum EPC execution – Document made available to DOE

[33] IRR Annex 2 Deed of sale – Document made available to DOE

5	Biogas Plant O&M (incl. Insurance)	(17,567,400)	5.0%	Two recent studies have been used to verify internal know-how on the O&M cost of operating biogas plants; which technically differ substantially from biomass combustion technology[36] For determination of the escalation cost in India recommendation from a recent TNERC publication on renewable energy power plants has been used ("Comprehensive Tariff Order for Biomass based power plants", TNERC 2009)- i.e. 5 % per annum[37].
Tariffs and Receipts				
6	Biomass power tariff (INR/kWh) in 2012	4.63		TNERC Tariff Orders[38]
	Fertilizer revenue	39,735,500		
7	Fertilizer sales price (INR/t)	1,750		Revenue based on consultant report (i.e. Tide Technocrats) [39].
8	CER Revenue	12,522,217	-10%	Reduction of CER based on CER sharing order by CERC[40].
9	CER sales price (INR/t)	552.75		As per ERPA[41]
Financial parameters				
10	Tax rate year 1-10 (Minimum Alternate Tax)	19.9%		Under the section 80 IA of the Income Tax Act 1961, the project owner is exempted from income tax on all earning generated from the project for the period of 10 years. The owner can choose the tax holiday window for a single 10 year period anytime during the first 15 years of the project life. However, domestic companies are liable to pay a minimum alternate tax (MAT) which is currently

[34] IRR Annex 3 O&M Termsheet with Greenpower – Made available to the DOE

[35] IRR Annex 4 O&M Schedule – Made available to the DOE

[36] Page 13 of http://ec.europa.eu/energy/renewables/studies/doc/renewables/2011_financing_renewable.pdf and page 4 of http://www.iea-etsap.org/web/E-TechDS/PDF/E05-Biomass%20for%20HP-GS-AD-gct.pdf

[37] page 14 of Comprehensive Tariff Order for Biomass based power plants", TNERC 2009 http://tnerc.tn.nic.in/orders/Tariff%20Order%202009/Bio%20Mass%20Order%2027.04.2009.pdf

[38] 1) http://tnerc.tn.nic.in/orders/Tariff%20Order%202009/Bio%20Mass%20Order%2027.04.2009.pdf and 2) http://tnerc.tn.nic.in/orders/Tariff%20Order%202009/2011/T.O.2%20of%202011-Biomass-Based.pdf

[39] Tide Technocrats Private Limited, Bangalore, *Assessment report of feedstock availability and market for Biomethanation Solids*, April 2011 – Made available to the validator

[40] Page 18 of Comprehensive Tariff Order for Biomass based power plants", TNERC 2009 http://tnerc.tn.nic.in/orders/Tariff%20Order%202009/Bio%20Mass%20Order%2027.04.2009.pdf

[41] IRR Annex 8 EPRA – Made available to the DOE

				pegged at 19.93% and has been considered under the financial analysis[42].
11	Tax rate year 11-15 (Corporate Tax)	32.4%		As per Income Tax Act 1961[43]
12	Interest Rate of Bank Loan	11.50%		As per formal sanction of credit facilities[44]
13	Bank Loan Duration (years)	10		
14	Equity (%)	30.0%		
15	Debt (%)	70.0%		
16	Benchmark	15%		IOTM Board Protocol (Equity IRR to be at 15%) See paragraph above table and related documents (Foot notes 16 through 19)
17	Exchange rate 1 EUR	67		Exchange rate as per 3. Nov. 2011[45]
	One time subsidy	34,200,000		Capital Assistance Scheme offered by MNES (application planned but not yet filed - consideration in the model is a conservative assumption). The capital assistance scheme is used to reduce bank loan requirements - basically an interest free loan
18	Lifetime of system (years)	20		TNERC note on lifetime[46]
19	National Appropriate Depreciation Rate (digressive, in years)	20		Indian Tax Act always states digressive depreciation rules, depreciation is calculated as digressive depreciation over the project lifetime in the Indian Tax calculation. Otherwise a SLM has been opted over 20 years (i.e. 5% p.a.). A annual depreciation of approximately 5% is also in line with proposed depreciation recommendations by Indian Government Institutions being between 4.5% to 7.84%[34, 47]

As per point 10 of the Guidelines on the assessment of investment analysis (Version 05; EB 62 annex 5) the calculation of equity IRR only the portion of investment costs which is financed by equity should be considered as the net cash outflow, the portion of the investment costs which is financed by debt should

[42] http://www.incometaxindiapr.gov.in/incometaxindiacr/contents/forms2010/pamphets/COMPANIES_2012_13.htm (accessed November 3 2011)

[43] page 5 http://www.deloitte.com/assets/Dcom-Global/Local%20Assets/Documents/Tax/dtt_corporate_tax_rates_2011.pdf (accessed November 3 2011)

[44] IRR Annex 10 formal sanction of credit facilities- – Made available to the DOE

[45] http://www.xe.com/currencycharts/?from=EUR&to=INR (accessed November 3 2011)

[46] Page 14 of Comprehensive Tariff Order for Biomass based power plants", TNERC 2009 http://tnerc.tn.nic.in/orders/Tariff%20Order%202009/Bio%20Mass%20Order%2027.04.2009.pdf (accessed November 3 2011)

[47] Page 29 Petition No. 256/2010, Central Electricity Regulatory Commission New Delhi http://www.cercind.gov.in/2010/ORDER/Sept10/Order_256-2010_RE_Tariff_FY_11-12.pdf (accessed November 3 2011)

not be considered a cash outflow. Hence the PP only considered equity injection and dividend as net cash flow in calculating equity IRR. The summary of the financial analysis is provided below:

Equity IRR without CERs	Return on Equity - Benchmark	Equity IRR with CERs
10.3%	**15%**	**12.8%**

Therefore it may be concluded that the project activity has a less favourable indicator than the benchmark and only after the inclusion of CDM revenue, it crosses the benchmark.

Sensitivity analysis

The viability of the project depends upon following factors, namely:

- Capital expenditure
- Biogas Plant O&M
- Revenue / cost (fertilizer sales / substrate purchase / electricity sales[48])

The sensitivity analysis is performed by increasing and decreasing the assumptions for the above factors to the level where they would equal the benchmark:

At the following percentages the equity IRR equals 15%			
Critical Items		**Comment**	**Justification of probability of occurrence**
Capital expenditure	-18.50%	cost reduction needed	A reduction in the capital expenditure of 18.5% is not possible due to a turnkey delivery contract with IOT Infrastructure and Energy Services Ltd. which clearly defines a fixed lump sum payment.
Biogas Plant O&M	-27.00%	cost reduction needed	A cost reduction of 27% in the O&M expenditure seems highly unlikely if not impossible since 30% of the total O&M costs are based on agreed fixed cost as per O&M contract with Greenpower Int. Therefore a cost reduction of 39 % would be required on the remaining 70% O&M proportion which is not achievable without severely jeopardizing efficient operation, since it would necessitate the discontinuation of required maintenance and repair of technical equipment.
Substrate cost	-22.00%	cost reduction needed	The assumed substrate cost in the model as presently applied are already conservative estimates since the economic assessment does not take into consideration the inflationary trend observed in India at present. A cost reduction of 22% therefore seems highly unlikely
Fertilizer Revenue	26.00%	revenue increase needed	The fertilizer market for organic fertilizer is in its infancy and currently unstructured. While a price increase is not unrealistic it is the PPs conviction that an increase in the price for organic fertilizer will go hand in hand with a cost

[48] As noted in the *Biomass Energy Purchase Agreement* between the project proponent and the regional generation and distribution corporation, the rate of electricity could be subject to changes, such as policy changes in electricity tariffs. Document made available to DOE.

			increase for the substrate, which would result in a balanced margin. Currently the PP is assuming fertilizer revenues of 1750 INR/tonne. A required increase of 26% would result in the need to sell organic fertilizer (untreated or upgraded – i.e. raw dried bio-digestate in bulk) at 2200 INR/tonne which is above the estimated maximum value of 2100 INR/t by Tide Technocrats – the lowest value is at 1400 INR/tonne. [49]
Electricity Revenue	12.00%	revenue increase needed	The electricity tariff is fixed by the TNERC and the expectation of an increase in 12% is therefore not applicable.

Outcome of sensitivity analysis:

From the sensitivity analysis it is concluded that the proposed project activity is financially not attractive under all assumed parameter variations: the equity IRR remains below the benchmark.

The registration of the CDM project activity will overcome the investment barrier that prevents the proposed project activity from occurring in the absence of the CDM.

CDM awareness and prior consideration
The project participants have submitted a prior consideration notification to the Indian DNA and to the UNFCCC, which was received on 28 Feb 2011. The investment requests to the board of directors of the company (IOT Mabagas) and to the board of directors of the holding were discussed at the respective board meetings end of January and mid February 2011.

National and/or sectoral policies applicable to project activity
No national and/or sectoral policies have been identified to be applicable to project activity.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

>>
The proposed project activity will use two approved small-scale baseline methodologies, namely AMS-I.D, *Grid connected renewable electricity generation*(Version 17)(to account for CO_2 emission reductions as result of electricity generation) and AMS-III.AO, *Methane recovery through controlled anaerobic digestion*(Version 01)(for CH_4 avoidance from decay of poultry manure). In the following, the procedures of how to calculate baseline emissions, project emissions, and emission reductions are explained.

Baseline Emissions:

$$BE_y = BE_{Elec,y} + BE_{CH4,y} \quad (1)$$

Where,

[49] Tide Technocrats Private Limited, Bangalore, *Assessment report of feedstock availability and market for Biomethanation Solids*, April 2011 – Made available to the DOE

BE_y	Baseline emissions in year y, in tCO_2/y
$BE_{Elec,y}$	Baseline CO_2 emissions from electricity used in the baseline,in tCO_2/y
$BE_{CH4,y}$	Baseline methane emissions in year y, in tCO_2/y

Baseline CO_2 emissions from electricity ($BE_{Elec,y}$) is calculated as per AMS-I.D Grid connected renewable electricity generation, version 17 as follows:

The baseline emissions are the product of electrical energy baseline $EG_{BL,y}$ expressed in MWh of electricity produced by the renewable generating unit multiplied by the grid emission factor.

$$BE_{Elec,y} = EG_{BL,y} * EF_{CO_2,grid,y} \quad \textbf{(2)}$$

Where:

$EG_{BL,y}$	Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year *y* (MWh)
$EF_{CO2,grid,y}$	CO_2 emission factor of the grid in year *y* (t CO_2/MWh)

Calculation of CO_2 emission factor of the grid:
Based on methodology AMS I.D. "Grid connected renewable electricity generation version 17", paragraph 12, the Emission Factor can be calculated in a transparent and conservative manner as follows:

(a) By calculating the Combined Margin (CM), consisting of the Operating Margin (OM) and the Build Margin (BM) according to the procedures prescribed in the "Tool to calculate the emission factor for an electricity system – version 02.2.1", or;

(b) By calculating the weighted average emissions (in tCO_2/MWh) of the current generation mix. The data of the year in which the project generation occurs must be used.

For the proposed project activity, option (a) is chosen.

The baseline data are taken from the CO_2 Emission Database Version 6.0, March 2011 by the Central Electricity Authority (CEA), Ministry of Power, Government of India.[50]The grid emission factor determined by the CEA follows the procedure as stipulated in the "Tool to calculate the emission factor for an electricity system- version 02.2.1" and the procedures are outlined below:

Step 1: Identify the relevant electricity systems.

The project, setup in the state of Tamil Nadu, falls under the Southern grid of India and the electricity generated by the project activity displaces the electricity from that grid. Each state that is part of a regional grid meets its own electricity demand, having its own generation facilities as well as allocation from power plants owned by the central sector. Due to the displacement of electricity the project activity would have impact on the Southern grid, serving the four Southern states and one union territory, namely Pondicherry. Hence the project also has an impact on all the generation facilities of the Southern grid. Since the Southern grid is the relevant electricity system for evaluating the baseline emissions, all the power generation facilities connected to the Southern grid fall within the project boundary.

Step 2: Choose whether to include off-grid power plants in the project electricity system (optional).

[50] http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm (accessed November 3 2011)

Project participants can choose between the following two options to calculate the OM and BM emission factor:

Option I: Only grid power plants are included in the calculation.
Option II: Both grid power plants and off-grid power plants are included in the calculation.

Since only grid power plants are included in the calculation of the CEA, and in the statistical data available, option I is chosen.

Step 3: Select a method to determine the Operating Margin

According to the tool, the following four methods can be used to calculate the OM emission factor ($EF_{grid,OM,y}$):

a) Simple Operating Margin;
b) Simple Adjusted Operating Margin;
c) Dispatch data analysis Operating Margin;
d) Average Operating Margin;

According to the tool, the Simple OM method (a) is applicable to the project if the low-cost resources constitute less than 50% of the total grid generation. Since the five most recent years average percentage contribution of low- cost / must run resources is 25.2% for the project activity, which is less than 50% of the total generation of the Southern grid, option a) is chosen. As stipulated in the tool, the data vintage option of an *ex-ante* approach with a 3-year generation weighted average value based on the most recent data available will be used, without the necessity to recalculate during the chosen crediting period. Hence, the parameters for the calculation of OM do not need to be monitored and the OM does not need to be calculated during the chosen first crediting period.

Step 4: Calculate the Operating Margin emission factor according to the selected method.

The Simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, excluding low-cost / must-run power plants / units. Net electricity generation and fuel consumption of each power plant is sourced from the CEA Database.

The OM in the three most recent years for which the data are available, i.e. 2007-08, 2008-09, and 2009-10, is presented in the following table:

Operating Margin (OM)

Most recent three years	**2007-08**	**2008-09**	**2009-10**
Operating Margin* (OM) in t CO_2e /MWh	0.991	0.970	0.941
Average of 3 years in tCO_2e / MWh		**0.966**	

Source: the CEA's CO_2 Emission Database Version 6.0, March 2011

Step 5: Calculate the Build Margin (BM) emission factor

In terms of vintage data, option 1 is selected: for the first crediting period, calculate the build margin emission factor *ex ante* based on the most recent information available on units already built for sample group "m" at the time of CDM-PDD submission to the DOE for validation.

According to the "Tool to calculate the emission factor for an electricity system- version 02.2.1", the sample group of power units "m" is determined by:

(a) Identifying $SET_{5\text{-units}}$: the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently, and determine their annual electricity generation ($AEG_{SET\text{-}5\text{-}units}$, in MWh);

(b) Identifying $SET_{\geq 20\%}$: the set of power units,excluding power units registered as CDM project activities, that started to supply the grid most recently and that comprise 20% of the annual electricity generation of the project activity system (AEG_{total}, in MWh), and determine their annual electricity generation ($AEG_{SET\geq 20\%}$, in MWh);

(c) Determining SET_{sample} from $SET_{5\text{-units}}$and $SET_{\geq 20\%}$, by selecting the set of power units that comprises the larger electricity generation.

SET_{sample} is determined by comparing $AEG_{SET\text{-}5\text{-}units}$ to $AEG_{SET\geq 20\%}$. The data are sourced from the CEA CO_2 Emission Database Version 6.0, March 2011.

The dataset for $AEG_{SET\text{-}5\text{-}units}$[51]:

Name of power plant	Data of commissioning	Electricity generation [MWh]
KONDAPALLI GT	05-12-09	462,713
VIJAYWADA TPP-IV	08-10-09	615,630
TORANGALLU EXT	24-08-09	2,904,960
PRIYADARSHNI JURALA	27-06-09	79,248
GAUTAMI CCCP	03-05-09	2,880,880
	AEGSET-5-units	**6,943,431**

The data set for $AEG_{SET\geq 20\%}$

	Electricity generation [MWh]
AEGtotal	169,765,092
20% of AEGtotal	33,953,018
AEGSET≥20%	**36,099,907**

Hence, the data show that $AEG_{SET\geq 20\%}$ is higher than $AEG_{SET\text{-}5\text{-}units}$, therefore $SET_{\geq 20\%}$ (the set of power units, excluding power units registered as CDM project activities, that started to supply the grid most recently and that comprise 20% of the annual electricity generation of the project activity system) is the right sample group of power units.
SET_{sample} therefore equals $SET_{\geq 20\%}$.

According to the tool, the BM emissions factor is the generation-weighted average emission factor (tCO_2e /MWh) of all power units *m* during the most recent year y for which power generation data are available.

[51] See tab BM in Database_ver6.0_calculations_JM.xls, which is provided to the DOE.

The latest available data for the BM emission factor for SET_{sample} (the set of power units, excluding power units registered as CDM project activities, that started to supply the grid most recently and that comprise 20% of the annual electricity generation of the project activity system) were used for an ex-ante estimation of emission reduction estimates for the entire crediting period. These data comprise the years 2009-2010.

The Build Margin emission factor for SET_{sample} of the Southern grid (not adjusted for imports), as calculated by the CEA is given below:

Build Margin for 2009-10	0.763	tCO_2e / MWh

Step 6: Calculate the Combined Margin emissions factor

For the calculation of the Combined Margin emission factor ($EF_{grid,CM,y}$), the weighted average CM is chosen (option A), since it is stated in the "Tool to calculate the emission factor for an electricity system-version 02.2.1", as the 'preferred option'.

The CM emission factor is calculated as:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \quad \textbf{(3)}$$

$EF_{grid,BM,y}$ = Build Margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$ = Operating Margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM} = Weighting of Operating Margin emissions factor (%)
w_{BM} = Weighting of Build Margin emissions factor (%)

The "Tool to calculate the emission factor for an electricity system - version 02.2.1" states that as default values should be used: w_{OM} = 0.5 and w_{BM} = 0.5 for the first crediting period, if the project is other than Wind or Solar. Hence the grid emission factor for the Southern grid equals:

$EF_{grid,CM,y}$= 0.966 x 0.5 + 0.763 x 0.5 = 0.865 tCO_2/MWh = **865 tCO_2/GWh**

The Combined Margin emission factor ($EF_{grid,CM,y}$) refers to the CO_2 emission factor of the grid in year *y* ($EF_{CO2,grid,y}$) as stated in the formula 2 above. This will be the grid emission factor for the entire crediting period.

Baseline Methane Emissions ($BE_{CH4,y}$) are calculated as per approved methodology AMS-III.AO. Methane recovery through controlled anaerobic digestion, version 01 as follows:
According to methodology AMS-III.AO. Methane recovery through controlled anaerobic digestion, version 01, the baseline scenario is the situation where, in the absence of the project activity, biomass and other organic matter (including manure where applicable) are left to decay within the project boundary and methane is emitted to the atmosphere. The baseline emissions are the amount of methane emitted from the decay of the degradable organic carbon in the biomass and other organic matter. Baseline emissions shall exclude emissions of methane that would have to be captured, fuelled or flared or gainfully used to comply with national or local safety requirement or legal regulations.

$$BE_{CH4} = BE_{SWDS,y} + BE_{ww,y} + BE_{manure,y} - MD_{reg,y} * GWP_{CH4} \quad \textbf{(4)}$$

Where:

BE_{CH4}	BE_y in equation (1) of methodology AMS-III.AO (Version 01)
$BE_{SWDS,y}$	Where applicable, yearly methane generation potential of the solid waste anaerobically digested by the project activity during the year x from the beginning of the project activity (x=1) up to the year y estimated as per the latest version of the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" (tCO_2e). The tool may be used with the factor "f=0.0" assuming that no biogas is captured, flared or used. With the definition of year x as the base year since the project activity started diverting wastes from the SWDS/landfill site. x runs from the first year of the crediting period(x=1) to the year for which emissions are calculated (x=y). Where applicable, baseline emission determination of digested waste that would otherwise have been disposed in stockpiles shall follow relevant procedures in AMS-III.E
$BE_{manure,y}$	Where applicable, baseline emissions from the manure co-digested by the project activities, calculated as per the relevant procedures of AMS-III.D
$BE_{ww,y}$	Where applicable, baseline emissions from the wastewater co-digested, calculated as per the procedures of AMS-III.H
$MD_{reg,y}$	Amount of methane that would have to be captured and combusted in the year y to comply with the prevailing regulations (tonne)
GWP_{CH_4}	GWP for CH_4 (value of 21 is used)

The project activity is not claiming methane avoidance from biomass residues; therefore $BE_{SWDS,y}$ is considered zero.

The project activity involves treatment of wastewater but it is not considered for claiming methane avoidance. Moreover there is no regulatory compliance to capture and combust methane. Therefore, $MD_{reg,y}$ and $BE_{ww,y}$ will be zero.

$BE_{manure,y}$ is calculated as per AMS-III.D Methane recovery in animal manure management systems, version 18:

As per methodology AMS-III.AO Methane recovery through controlled anaerobic digestion, version 01, $BE_{manure,y}$ will be calculated as per the relevant procedures of AMS-III.D. version 18.

According to paragraph 9 of methodology AMS-III.D. Methane recovery in animal manure management systems - version 18, $BE_{manure,y}$ can be calculated by using one of the following two options:

(a) Using the amount of the waste or raw material that would decay anaerobically in the absence of the project activity, with the most recent IPCC tier 2 approach (please refer to the chapter 'Emissions from Livestock and Manure Management' under the volume 'Agriculture, Forestry and other Land use' of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories). For this calculation, information about the characteristics of the manure and of the management systems in the baseline is required. Manure characteristics include the amount of volatile solids (VS) produced by the livestock and the maximum amount of methane that can be potentially produced from that manure (B_o);

(b) Using the amount of manure that would decay anaerobically in the absence of the project activity based on direct measurement of the quantity of manure treated together with its specific volatile solids (SVS) content.

The project proponent has chosen the option (a). Therefore, for the proposed project activity, the baseline emissions for poultry litter are calculated according to the following formula:

$$BE_{manure,y} = GWP_{CH4} * D_{CH4} * UF_b * \sum_{j,LT} MCF_j * B_{0,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{Bl,j} \quad \textbf{(5)}$$

Where:

$BE_{manure,y}$	BE_y in AMS-III.D version 18
GWP_{CH4}	Global Warming Potential (GWP) of CH_4 (21)
D_{CH4}	CH_4 density (0.00067 t/m^3 at room temperature (20 ºC) and 1 atm pressure)
LT	Index for all types of livestock
j	Index for animal manure management system
MCF_j	Annual methane conversion factor (MCF) for the baseline animal manure management system j
$B_{0,LT}$	Maximum methane producing potential of the volatile solid generated for animal type LT (m^3 CH_4/kg dm) LT is poultry.
$N_{LT,y}$	Annual average number of animals of type LT in year y (numbers)
$VS_{LT,y}$	Volatile solids for livestock LT entering the animal manure management system in year y (on a dry matter weight basis, kg dm/animal/year)
$MS\%_{Bl,j}$	Fraction of manure handled in baseline animal manure management system j
UF_b	Model correction factor to account for model uncertainties (0.94)[52]

In paragraph 10 (a) of AMS-III.D, version 18, it is stated that:

> *The maximum methane-producing capacity of the manure (B_o) varies by species and diet. The preferred method to obtain B_o measurement values is to use data from country-specific published sources, measured with a standardised method (B_o shall be based on total as-excreted VS). These values shall be compared to IPCC default values and any significant differences shall be explained. If country specific B_o values are not available, default values from tables 10 A-4 to 10 A-9 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10 can be used, provided that the project participants assess the suitability of those data to the specific situation of the treatment site;*

As no country specific B_o values are available for India, default value is used from table 10 A-9 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10. The data are suitable to the specific situation of the treatment site as they concern poultry in warm developing countries, which includes the project location.

In paragraph 10 (b) of AMS-III.D, version 18, it is stated that:

> *Volatile solids (VS) are the organic material in livestock manure and consist of both biodegradable and non-biodegradable fractions. For the calculations the total VS excreted by each animal species is required. The preferred method to obtain VS is to use data from nationally published sources. These values shall be compared with IPCC default values and any*

[52] Reference: FCCC/SBSTA/2003/10/Add.2, page 25.

significant differences shall be explained. If data from nationally published sources are not available, country-specific VS excretion rates can be estimated from feed intake levels, via the enhanced characterisation method (tier 2) described in section 10.2 in 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10. If country specific VS values are not available IPCC default values from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10 table 10 A-4 to 10 A-9 can be used provided that the project participants assess the suitability of those data to the specific situation of the treatment site particularly with reference to feed intake levels;

As no country specific *VS* values are available for India, default value is used from table 10 A-9 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10. The data are suitable to the specific situation of the treatment site, as they concern poultry in developing countries, which includes the project location.

In paragraph 10 (f) of AMS-III.D, version 18, it is stated that:

Methane Conversion Factors (MCF) values are determined for a specific manure management system and represent the degree to which B_o is achieved. Where available country-specific MCF values that reflect the specific management systems used in particular countries or regions shall be used. Alternatively, the IPCC default values provided in table 10.17 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 10 can be used;

For the proposed project activity data for MCF_j is derived from a report from Tamil Nadu Agricultural University based on field studies of a sample of poultry farms in the Namakkal district. The report from Tamil Nadu Agricultural University constitutes the most recent and most relevant data source for the proposed project activity. [53]

$$N_{LT,y} = N_{da,y} * \left(\frac{N_{p,y}}{365} \right) \quad (6)$$

Where:

$N_{da,y}$ Number of days animal is alive in the farm in the year "y" (numbers)

$N_{p,y}$ Number of animals produced annually of type "LT" for the year "y" (numbers)

Project Emissions (PE_y)

For AMS-I.D. Grid connected renewable electricity generation – version 17 the project emissions are zero as per paragraph 20 of AMS-I.D.

For AMS-III.AO Methane recovery through controlled anaerobic digestion, version 01, project emissions can consist of:

(a) CO_2 emissions due to incremental transportation distances;

(b) CO_2 emissions from electricity and/or fossil fuel consumption by the project activity facilities;

[53] Department of Bioenergy, Tamil Nadu Agricultural University (Tamil Nadu), *Methane Emission Potential of Poultry Litter* (October 2011). document made available to the DOE

(c) In case the residual waste from the digestion is stored under anaerobic conditions and/or delivered to a SWDS, or treated in a WWTS: the methane emissions from the disposal/storage/treatment of these residual waste;

(d) Methane emissions from physical leakages of the anaerobic digester;

(e) Methane emissions due to flare inefficiency;

$$PE_y = \begin{Bmatrix} PE_{transp,y} + PE_{power,y} + PE_{res\ waste,y} \\ + PE_{phy\ leakage,y} + PE_{flaring,y} \end{Bmatrix} \quad \textbf{(7)}$$

Where:

PE_y	Project activity emissions in the year y (tCO_2e)
$PE_{transp,y}$	Emissions from incremental transportation in the year y (tCO_2e)
$PE_{power,y}$	Emissions from electricity or fossil fuel consumption in the year y (tCO_2e)
$PE_{res\ waste,y}$	In case residual wastes are subjected to anaerobic storage, or disposed in a landfill: methane emissions from storage/disposal/treatment of waste (tCO_2e)
$PE_{phy\ leakage,y}$	Methane emissions from physical leakages of the anaerobic digester in year y (tCO_2e)
$PE_{flaring,y}$	Methane emissions due to incomplete flaring in year y as per the "Tool to determine project emissions from flaring gases containing methane"(tCO_2e)

Project emissions due to incremental transport distances ($PE_{transp,y}$) :

$PE_{transp,y}$ are calculated based on the incremental distances between:

(i) The collection points of biomass and/or manure and the digestion site as compared to the baseline solid waste disposal site or manure treatment site;

(ii) When applicable, the collection points of wastewater and treatment site as compared to baseline wastewater treatment site;

(iii) Treatment sites and the sites for soil application, landfilling and further treatment of the residual waste.

$$PE_{transp,y} = (Q_y / CT_y) * DAF_w * EF_{CO2,transport} + (Q_{res\cdot waste,y} / CT_{res\cdot waste,y}) * DAF_{res\cdot waste} * EF_{CO2,transport} \quad \textbf{(8)}$$

Where:

Q_y	Quantity of raw waste/manure treated and/or wastewater co-digested in the year y (tonnes)
CT_y	Average truck capacity for transportation (tonnes/truck)
DAF_w	Average incremental distance for raw solid waste/manure and/or wastewater transportation (km/truck)
$EF_{CO2,transport}$	CO_2 emission factor from fuel use due to transportation ($kgCO_2$/km, IPCC default values or local values may be used)
$Q_{res\cdot waste,y}$	Quantity of residual waste produced in year y (tonnes)
$CT_{res\cdot waste,y}$	Average truck capacity for residual waste transportation (tonnes/truck)
$DAF_{res\cdot waste}$	Average distance for residual waste transportation (km/truck)

Project emissions from electricity and/or fossil fuel consumption ($PE_{power,y}$):

$$PE_{power} = PE_{power\_own\ gen} + PE_{power\_elec} + PE_{power\_DG} \quad \textbf{(9)}$$

$PE_{power\_own\_gen}$

The project activity operations will be mainly powered by the CHP Units. As per methodology AMS-III.AO (Version 01), paragraph 15, project emissions for $PE_{power\_own\_gen}$ uses zero as its emission factor.

$PE_{power\ elec}$

As per "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (Version 01) scenario A applies when the onsite CHP Units are not operating formula 1 applies:

$$PE_{EC,y} = \sum_{j} EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{i,y}) \quad \textbf{(10)}$$

Where

$PE_{EC,y}$	$PE_{power,elec}$ = Project emissions from electricity consumption in year *y* (tCO_2/yr)
$EC_{PJ,j,y}$	Quantity of electricity consumed by the project electricity consumption source *j* in year *y* (MWh/yr). EC_{PJ} is monitored in line with $EG_{BL,y}$
$EF_{EL,j,y}$	Emission factor for electricity generation for source *j* in year *y* (tCO_2/MWh). Defined as $EF_{grid,CM,y}$ in formula 3 of this PDD
$TDL_{j,y}$	Average technical transmission and distribution losses for providing electricity to source *j* in year *y*. Default values of 20% are used as per the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (Version 01).

$PE_{power\ DG}$

$PE_{power\ DG}$ = $PE_{FC,j,y}$ as per "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (Version 02).

CO_2 emissions from fossil fuel combustion in process j are calculated based on the quantity of fuels combusted and the CO_2 emission coefficient of those fuels, as follows:

$$PE_{FC,j,y} = \sum_{i} FC_{i,j,y} \times COEF_{i,y} \quad \textbf{(11)}$$

Where:

$PE_{FC,j,y}$	Are the CO_2 emissions from fossil fuel combustion in process *j* during the year *y* (tCO_2/yr);
$FC_{i,j,y}$	Is the quantity of fuel type *i* combusted in process *j* during the year *y* (mass or volume unit/yr);
$COEF_{i,y}$	Is the CO_2 emission coefficient of fuel type *i* in year *y* (tCO_2/mass or volume unit);
i	Are the fuel types combusted in process *j* during the year *y*;

The CO_2 emission coefficient $COEF_{i,y}$ can be calculated using one of the following two Options, depending on the availability of data on the fossil fuel type *i*, as follows:

Only a diesel back-up power generator is available. Hence *i* is diesel.

As per "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (Version 02) Option A should be the preferred approach, if the necessary data is available. Since $w_{C,i,y}$ (the weighted average mass fraction of carbon in fuel type *i* in year y (tC/mass unit of the fuel) is not available to the project proponent option B is used.

Option B = The CO_2 emission coefficient $COEF_{i,y}$ is calculated based on net calorific value and CO_2 emission factor of the fuel type *i*, as follows:

$$COEF_{diesel,y} = NCV_{diesel,y} \times EF_{CO2,diesel,y} \quad (12)$$

Where:

$COEF_{diesel,y}$ Is the CO_2 emission coefficient of diesel in year y (tCO2/mass or volume unit)

$NCV_{diesel,y}$ Is the weighted average net calorific value of the diesel in year y (GJ/mass or volume unit);

$EF_{CO2,diesel,y}$ Is the weighted average CO_2 emission factor of diesel in year y (tCO2/GJ)

Project emissions from anaerobic storage and/or disposal in a landfill of the residual waste from the digestion ($PE_{res\ waste,y}$):

In the proposed project activity, residual waste from the digestion is not subjected to anaerobic storage, or disposed in a landfill, therefore $PE_{res\ waste,y}$ will be considered zero.

Project emissions from physical leakages of the anaerobic digester ($PE_{phy\ leakage,y}$):

In the proposed project activity, these shall be estimated using a default factor of 0.05 m³ biogas leaked/m³ biogas produced. For *ex ante* estimation the expected biogas production of the digester may be used, for *ex post* calculations the effectively recovered biogas amount shall be used for the calculation.

Project emissions due to flare inefficiency

According to paragraph 13 of methodology AMS-III.AO (Version 01):

Methane emissions due to incomplete flaring in year y (in tCO_2), represented as $PE_{flaring,y}$ is determined as per the *Tool to determine project emissions from flaring gases containing methane*(Version 01).

According to the *Tool to determine project emissions from flaring gases containing methane* (Version 01), The emissions resulting from the flaring ($PE_{flare,y}$) will be calculated with the tool *ex-post*.

This tool is applicable since:

- The residual gas stream to be flared contains no other combustible gases than methane, carbon monoxide and hydrogen;
- The residual gas stream to be flared is recovered from decomposition of organic materials.

Emissions from flaring of the residual gas stream are calculated based on the flare efficiency and the flow rate of methane in the residual gas stream that is flared. The flare efficiency depends on both the actual efficiency of combustion in the flare and the time that the flare is operating. Steps 5-7 of the *Tool to determine project emissions from flaring gases containing methane* (Version 01) will be used to determine default values and project emissions from flaring.

Step 5. Determination of methane mass flow rate in the residual gas on a dry basis

To determine of methane flow rate in the residual gas the following equation will be used:

$$TM_{RG,h} = FV_{RG,h} \times fv_{CH4,RG,h} \times \rho_{CH4,n} \quad (13)$$

Where:

$TM_{RG,h}$	Mass flow rate of methane in the residual gas in the hour *h* (kg/h)
$FV_{RG,h}$	Volumetric flow rate of the residual gas in dry basis at normal conditions in hour *h*(m^3/h)
$fv_{CH4,RG,h}$	Volumetric fraction of methane in the residual gas on dry basis in hour *h*
$\rho_{CH4,n}$	Density of methane at normal conditions (kg/m^3), referred to as D_{CH4} in AMS-III.D (Version 18) and AMS-III.AO (Version 01)

Step 6. Determination of the hourly flare efficiency

According to this step of the *Tool to determine project emissions from flaring gases containing methane* (Version 01) the determination of the hourly flare efficiency depends on the operation of flare (e.g. temperature), the type of flare used (open or enclosed) and, in case of enclosed flares, the approach selected by project participants to determine the flare efficiency (default value or continuous monitoring).

Under the proposed 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 default values of the flare efficiency; 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 proposed 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*.

Step 7. Calculation of annual project emissions from flaring

The following equation will be applied to calculate project emissions from flaring:

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} \times \left(1 - \eta_{flare,h}\right) \times \frac{GWP_{CH4}}{1000} \quad \textbf{(14)}$$

Where:

$PE_{flare,y}$	=	Project emissions from flaring of the residual gas stream in year *y* (tCO_2e)
$TM_{RG,h}$	=	Mass flow rate of methane in the residual gas in the hour *h* (kg/h)
$\eta_{flare,h}$	=	Flare efficiency in hour *h*, referred to as FE_y in methodology AMS-III.AO (Version 01)
GWP_{CH4}	=	Global Warming Potential of methane valid for the commitment period (tCO_2e/tCH_4)

Leakage

As per AMS-III.AO (Version 01), leakage effects are to be considered if the project technology is the equipment transferred from another activity or if the existing equipment is transferred to another activity. In the case of the proposed project activity, all equipment is new and not transferred from another activity. Therefore, leakage is considered as zero.

Emission reductions (ER_y)

$ER_y = BE_y – (PE_y = LE_y)$ **(15)**

Where:

ER_y Emission reductions in year y, in $tCO_2/_y$

BE_y Baseline emissions in year y, in $tCO_2/_y$

PE_y Project emissions in year y, in $tCO_2/_y$

Leakage emissions in year y, in $tCO_2/_y$

B.6.2. Data and parameters that are available at validation:

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Data / Parameter:	**ID. 1./ $EF_{grid,CM,y} = EF_{EL,y}$**
Data unit:	tCO_2/GWh
Description:	EF_y is the CO_2 emission factor of the Southern grid, in which the project activity displaced the electricity during the year *y*.
Source of data used:	The CEA CO_2 Emission Database Version 6.0, March 2011.
Value applied:	865
Justification of the choice of data or description of measurement methods and procedures actually applied :	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.
Any comment:	In formula 3 of this PDD defined as $EF_{grid,CM,y}$ and in formula 10 defined as $EF_{EL,y}$

Data / Parameter:	**ID. 2./ GWP_{CH4}**
Data unit:	CH_4
Description:	Global Warming Potential (GWP) of methane. The factor describes the conversion of 1 tCH_4 into 1 tCO_2equivalent emissions.
Source of data used:	IPCC Default value.
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	In order to be able to compare different types of greenhouse gases, the GWP factor of methane emissions is used to convert them into CO_2equivalent emissions. Established by the IPCC in 1996, the Kyoto Protocol considers this value applicable for CDM projects to convert CH_4 into CO_2e.
Any comment:	

Data / Parameter:	**ID. 3./ $D_{CH4} = \rho_{CH4,n}$**
Data unit:	kg/m^3
Description:	Density of methane at normal conditions.

Source of data used:	IPCC 2006 default factor, see Equation 10.23 on pg.10.41.
Value applied:	0.67
Justification of the choice of data or description of measurement methods and procedures actually applied :	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.
Any comment:	In formula 5 defined as D_{CH4}; in formula 6 defined as $\rho_{CH4,n}$

Data / Parameter:	**ID. 4./ MCF_j**
Data unit:	%
Description:	Methane conversion factor for manure management. Only for poultry litter.
Source of data used:	Department of Bioenergy, Tamil Nadu Agricultural University (Tamil Nadu), *Methane Emission Potential of Poultry Litter* (October 2011).
Value applied:	22.84%
Justification of the choice of data or description of measurement methods and procedures actually applied :	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 proposed project activity.
Any comment:	–

Data / Parameter:	**ID 5./ $B_{o, LT}$**
Data unit:	$m^3_{CH\ 4}/kg$
Description:	Maximum methane production potential (in the baseline situation). LT = Livestock = poultry.
Source of data used:	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 applied:	0.24
Justification of the choice of data or description of measurement methods and procedures actually applied :	As no country specific factor is available, the IPCC 2006 default factor is used.
Any comment:	–

Data / Parameter:	**ID. 6./ $VS_{LT,y}$**
Data unit:	Kg/head/day
Description:	Volatile solids for livestock LT
Source of data used:	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 applied:	0.02
Justification of the	As no country specific factor is available, the IPCC 2006 default factor is used.

choice of data or description of measurement methods and procedures actually applied :	
Any comment:	-

Data / Parameter:	**ID. 7./ $MS\%_{i,y}$**
Data unit:	%
Description:	Fraction of manure handled in system i in year y.
Source of data used:	Project proponent.
Value applied:	100%
Justification of the choice of data or description of measurement methods and procedures actually applied :	The anaerobic digestion system is considered a single unit system. All poultry litter will be used in this single system.
Any comment:	–

Data / Parameter:	**ID. 8./DAF_w**
Data unit:	km/truck
Description:	Average incremental distance for poultry litter, agri waste and cow dung transportation.
Source of data used:	Pages 53 through 63 of the Detailed Project Report Of 2.0 Mw Biogas To Power Generation Project At Puduchatram, Namakkal, Tamil Nadu; document made available to the DOE
Value applied:	25
Justification of the choice of data or description of measurement methods and procedures actually applied :	25 km is taken as a conservative average.
Any comment:	

Data / Parameter:	**ID. 9./ $DAF_{res\ waste}$**
Data unit:	km/truck
Description:	Average incremental distance for compost transportation.
Source of data used:	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
Value applied:	25
Justification of the choice of data or description of measurement methods and procedures actually	25 km is taken as a conservative average.

applied :	
Any comment:	

Data / Parameter:	**ID. 10./ $EF_{CO2,diesel,y}$**
Data unit:	tCO_2/TJ
Description:	CO_2 emission factor of diesel used in the year y.
Source of data used:	IPCC 2006 guidelines.
Value applied:	74.8
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per methodological; "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (Version 01), 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.
Any comment:	-

Data / Parameter:	**ID. 11./ NCV_{Diesel}**
Data unit:	GJ/t
Description:	Net calorific value of diesel.
Source of data used:	CEA's CO_2 Emission Database Version 6.0, March 2011.
Value applied:	41.7
Justification of the choice of data or description of measurement methods and procedures actually applied :	The Central Electricity Authority is the statutory organisation under Ministry of Power who collects and records data concerning the generation, transmission, trading, distribution and utilization of electricity.
Any comment:	

Data / Parameter:	**ID. 12./ ρ_{diesel}**
Data unit:	t/m^3
Description:	Density of diesel.
Source of data used:	CEA's CO_2 Emission Database Version 6.0, March 2011.
Value applied:	0.83
Justification of the choice of data or description of measurement methods and procedures actually applied :	The Central Electricity Authority is the statutory organisation under Ministry of Power who collects and records data concerning the generation, transmission, trading, distribution and utilization of electricity.
Any comment:	

Data / Parameter:	**ID. 13./ $EF_{CO2,transport}$**
Data unit:	$kgCO_2/km$
Description:	CO_2 emission factor from fuel use due to transportation.
Source of data used:	Based on 8 km/ litre of average fuel consumption ($F_{diesel,avg}$).
Value applied:	0.3229
Justification of the	Transport is subcontracted; value determined as per contracts obtained from

choice of data or description of measurement methods and procedures actually applied :	logistics company[54].
Any comment:	= (NCV $_{Diesel}$ x ρ_{Diesel} x **$EF_{CO2,diesel,y}$**)/ $F_{diesel,avg}$ / liter x 1/1000

Data / Parameter:	**ID. 14./ $\eta_{flare,h}$ = FE_y**
Data unit:	%
Description:	Flare efficiency in hour *h* based on measurements or default values.
Source of data used:	Default values given in the Methodological Tool to determine project emissions from flaring gases containing methane (Version 01).
Value applied:	90%
Justification of the choice of data or description of measurement methods and procedures actually applied :	For the closed combustion of the biogas in the flare, the default value of 90% would be used. (As recommended by the methodology AMS III.D - version 18). In case of enclosed flare, daily check of compliance with the manufacturer's specification (biogas flow rate etc.) would be done. If any of the parameters is out of the range of specifications, 50% of default value would be used for this specific hour. For open flare 50% default value would be used. If at any given time the temperature of the flare is below 500 °C, 0% default value would be used for this period. For this purpose, the temperature of the flare would also be monitored as specified below.
Any comment:	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 5); Used to calculate Methane destructed in year y (MD_y) as per AMS-III.D (formula 12)

Data / Parameter:	**ID. 15./ $TDL_{j,y}$**
Data unit:	-
Description:	Average technical transmission and distribution losses for providing electricity to source j in year y.
Source of data used:	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 applied:	20%
Justification of the choice of data or description of measurement methods and procedures actually applied :	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)
Any comment:	-

[54] Substrate Transport Quotation. Document made available to DOE.

B.6.3 Ex-ante calculation of emission reductions:

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Baseline emissions:

Baseline emissions from electricity generation (from equation 1 above)

Input data

Biogas production (net after losses)	Nm^3/y	7,585,568
Calorific value Biogas	kWh/Nm^3	6.0
Biogas needed for gas engine (Hs)	kWh/y	45,420,589
Gas engine PLF	%	91%
Gas engine (95% of nameplate capacity)	kW	2,280
Gas engine efficiency	%	40.2
Gross power production	kWh/y	18,240,000
Electricity auxiliary consumption	kWh/y	2,600,554
Electricity auxiliary consumption	%	14.3%
Net power sales	kWh/y	**15,639,446**

$EG_{BL,y}$: 15.64 GWh/y - monitored

$EF_{CO2,grid,y}$: 865 tCO_2/GWh – ex-ante

Calculations

Equation (2): $BE_{Elec,y} = EG_{BL,y} * EF_{CO_2,grid,y}$

Results

$BE_{Elec,y}$ = 13,528 tCO_2e/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	Agriculture biomass residue (starch & sugar industry)	58,000
3	Cow Dung	1,825

As mentioned in chapter B4, baseline emissions of waste types 2 and 3 are not taken into account (conservative assumption).

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
W_{site}	1	kg	ex-ante
$W_{default}$	1	kg	IPCC
$VS_{default}$	0.02	kg	IPCC
nd_y	365	d	ex-ante
Calculations			
$VS_{LT,y} = (W_{site}/ W_{default}) * VS_{default} * nd_y$			
Results			
$VS_{LT,y}$= 7.3 kg/y			

Input data			
Variable	**Value applied**	**Unit**	**Source**
GWP_{CH4}	21	-	ex-ante
D_{CH4}	0.67	kg/m^3	ex-ante
UF_b	0.94	-	ex-ante
MCF_j	22.84	%	ex-ante
$B_{0, LT}$	240	m^3 CH_4/t	ex-ante
$N_{LT,y}$	2,500,000	birds	Calculated
$VS_{LT,y}$	7.3	kg/y	Calculated above
$MS\%_{BI,u}$	100%		ex-ante
Calculations			
Equation (5): $BE_{manure,y} = GWP_{CH4} * D_{CH4} * UF_b * \sum_{j,LT} MCF_j * B_{0,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{Bl,j}$			
Results			
$BE_{manure,y}$ = 13,231 tCO_2e/y			

Hence baseline emissions are:

Input data
$BE_{Elec,y}$ = **13,528** tCO_2e/y
$BE_{manure,y}$ = **13,231** tCO_2e/y
Calculations
$BE_y = BE_{Elec,y} + BE_{manure,y}$
Results
BE_y = 26,752 tCO_2e/y

Project emissions:

Emissions due to transportation ($PE_{transp,y}$)

Calculate parameter EF_{CO2}

Input data			
Variable	**Value applied**	**Unit**	**Source**
NCV_{Diesel}	42	GJ/t	ex-ante
ρ_{Diesel}	0.83	t/m^3	ex-ante
$EF_{CO2,diesel,y}$	74.8	tCO_2/TJ	ex-ante
$F_{diesel,avg}$	8	km/l	ex-ante
Calculations			
$EF_{CO2} = ((NCV_{Diesel} * \rho_{Diesel} * EF_{CO2,diesel,y})/ F_{diesel,avg})/1000$			
Results			
$EF_{CO2} = 0.326$ $kgCO_2/km$			

Calculate parameter $PE_{transp,y}$

Input data			
Variable	**Value applied**	**Unit**	**Source**
Q_y	95,000	t/y	monitored
CT_y	8	t/truck	monitored
DAF_w	25	km	ex-ante
$Q_{res\ waste,y}$	22,706	t/y	monitored
$CT_{res\ waste,y}$	8	t/truck	monitored
$DAF_{res\ waste}$	25	km	ex-ante
Calculations			
Equation (8): $PE_{transp,y} = (Q_y / CT_y) * DAF_w * EF_{CO2,transport} + (Q_{res \cdot waste,y} / CT_{res \cdot waste,y}) * DAF_{res \cdot waste} * EF_{CO2,transport}$			
Results			
$PE_{transp,y} = PE_{y,transp,litter} + PE_{y,transp,treatment} =$ **119.9** tCO_2e/y			

Emissions from the use of fossil fuel i.e. diesel generator for the operation of the installed facilities in the year$_y$($PE_{power,y}$)

$PE_{power,y} = 0$ (The actual emissions will be calculated at the project site after implementation of the project activity).

Emissions due to physical leakage of biogas in the year y ($PE_{phy\ leakage,y}$)

Input data			
Variable	**Value applied**	**Unit**	**Source**
Biogas	7,984,808	m^3/y	Monitored
biogas leaked/ m^3 biogas	0.05	m^3/y	as per AMS-III.D
biogas leaked	399,240	m^3/y	Calculated
w_{CH4}	60%		Monitored
methane leaked	239,544	m^3/y	Calculated
$\rho_{CH4,n}$	0.67	kg/m^3	IPCC ex-ante
methane leaked	160.49	t/y	Calculated
GWP_{CH4}	21		IPCC ex-ante
Calculations			
$PE_{phy\ leakage,y}$ = methane leaked (t/y) * GWP			
Results			
$PE_{phy\ leakage,y}$ **= 3,370 tCO_2e/y**			

Emissions due to flaring ($PE_{flare,y}$)

Input data			
Variable	**Value applied**	**Unit**	**Source**
$FV_{RG,h}$	838	m^3/h	Monitored
$fv_{CH4,RG,h}$	60%	-	Monitored
$\rho_{CH4,n}$	0.67	kg/m^3	ex-ante
Calculations			
Equation (13): $TM_{RG,h} = FV_{RG,h} \times fv_{CH4,RG,h} \times \rho_{CH4,n}$			
Results			
$TM_{RG,h}$= *366* kg/h			

Input data			
Variable	**Value applied**	**Unit**	**Source**
$TM_{RG,h}$	366	kg/h	calculated above
$\eta_{flare,h}$	90%		ex-ante
GWP_{CH4}	21		ex-ante
time flare is burning	876	h	monitored
Calculations			

Equation (14): $PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} * (1 - \eta_{flare,h}) * \frac{GWP_{CH4}}{1000}$
Results
$PE_{flare,y}$ = **674.08 tCO_2e/y**

Emissions due to storage ($PE_{storage,y}$)

$PE_{storage,y} = 0$

Leakage:
$LE_y = 0\ tCO_2e$

Emission reductions:

$ER_y = BE_y - PE_y - LE_y$= **22,654 tCO_2e**

B.6.4 Summary of the ex-ante estimation of emission reductions:

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Year	Estimation of project activity emissions (tCO_2 e)	Estimation of baseline emissions (tCO_2 e)	Estimation of leakage (tCO_2 e)	Estimation of overall emission reductions (tCO_2 e)
2013	4.105	26.759	0	22.654
2014	4.105	26.759	0	22.654
2015	4.105	26.759	0	22.654
2016	4.105	26.759	0	22.654
2017	4.105	26.759	0	22.654
2018	4.105	26.759	0	22.654
2019	4.105	26.759	0	22.654
2020	4.105	26.759	0	22.654
2021	4.105	26.759	0	22.654
2022	4.105	26.759	0	22.654
Total (tonnes of CO_2 e)	**41.047**	**267.591**	**0**	**226.544**

B.7 Application of a monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	**ID. 16./ $EG_{gross,y}$**
Data unit:	GWh/y

Description:	The gross electricity generated by the project activity.
Source of data to be used:	Monitored by the project participant.
Value of data:	18.00
Description of measurement methods and procedures to be applied	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 to be applied:	The Operator reports the readings on a regular 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. Once the data is compiled and checked, it will be handed over to Verifier for verification.
Any comment:	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. 17./$EG_{BL,y}$**
Data unit:	GWh/y
Description:	Net electricity supplied by the project activity to the grid.
Source of data to be used:	
Value of data:	15.26
Description of measurement methods and procedures to be applied:	This is measured with help of an energy meter; audited energy bill documents are used as cross reference.
QA/QC procedures to be applied:	The Operator reports the readings on a regular 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. 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[55]
Any comment:	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. 18./ $EC_{PJ,y}$**
Data unit:	GWh/y
Description:	Net electricity imported from the grid in case the CHP units are not operating.
Source of data to be used:	
Value of data:	0
Description of measurement methods and procedures to be applied:	This is measured with help of an energy meter; audited energy bill documents are used as cross reference.
QA/QC procedures to be applied:	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 lntra 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[56]
Any comment:	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./ Q_y**
Data unit:	t/y
Description:	Amount of poultry litter, agricultural wastes, cow dung used at the plant.
Source of data to be used:	Weigh bridge records.
Value of data:	37,000 for poultry litter 58,000 for agricultural wastes 1,825 for cow dung
Description of measurement methods and procedures to be applied	All incoming trucks transporting poultry litter shall be directly measured using the on site 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 to be applied	The parameter 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 Manager-in-Charge and is forwarded to CDM Coordinator through email on monthly

[55] Biomass Energy Purchase Agreement. Document made available to DOE.

[56] Biomass Energy Purchase Agreement. Document made available to DOE.

	basis. Once the data is compiled and checked, it will be handed over to Verifier for verification. The instruments used for monitoring data are calibrated according to manufacturer's specifications.
Any comment:	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. 20./$Q_{res\ waste,y}$**
Data unit:	t/y
Description:	Amount of treated residue (compost) shipped off.
Source of data to be used:	Weigh bridge records.
Value of data:	22,706
Description of measurement methods and procedures to be applied	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 to be applied	The parameter 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 instruments used for monitoring data are calibrated according to manufacturer's specifications.
Any comment:	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./ $fv_{CH4,RG,h} = w_{CH4}$**
Data unit:	%
Description:	Methane content in the biogas.
Source of data to be used:	Monitored by the project participant.
Value of data:	60%
Description of measurement methods and procedures to be applied	Continuously. Values to be averaged hourly or at a shorter time interval.
QA/QC procedures to be applied	The 30 minutes interval assures a confidence/ precision level higher than the 90/10 level required (see appendix 4 regarding the required sample size). Analyser will be calibrated according to manufacturers specifications. The Operator records the readings. 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 instruments used for monitoring data are calibrated as per manufacturers specifications.
Any comment:	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. $fv_{CH4,RG,h}$ is used in formula 6 (as used in the Tool to determine project emissions from flaring gases containing methane – version 01); the value w_{CH4} is used in formulae 13 & 14 as per methodology AMS-III.D. version 18.

Data / Parameter:	**ID. 22./$FV_{RG,h}$**
Data unit:	Nm^3/h
Description:	Volumetric flow rate of the residual gas in dry basis at normal conditions in hour *h*.
Source of data to be used:	Monitored as per methodological "Tool to determine project emissions from flaring gases containing methane – version 01".
Value of data:	838
Description of measurement methods and procedures to be applied	Continuously. Values to be averaged hourly or at a shorter time interval.
QA/QC procedures to be applied	Meter will be calibrated according to manufacturers specification.
Any comment:	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./ $BG_{total,y}$**
Data unit:	Nm^3/y
Description:	The total amount of the biogas generated on a dry basis.
Source of data to be used:	Monitored by project proponent.
Value of data:	No value required for ex-ante calculation.
Description of measurement methods and procedures to be applied	The quantity of biogas generated is measured using a calibrated flow meter. Behind the flow meter are two automatic valves: one to the flare and one leading to the gas engines). The valves have end position detectors and a Process Logic Control will monitor these position. The valve position and the flow meter will allow a definite flow determination. The flow meter & the valve positions are logged in the system.
QA/QC procedures to be applied	The Operator records the readings. 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 instruments used for monitoring data are calibrated as per manufacturers' specifications.
Any comment:	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.24./ $BG_{flared,y}$**
Data unit:	Nm^3/y
Description:	The amount of biogas generated that is flared on a dry basis.
Source of data to be used:	Monitored by project proponent.
Value of data:	No value required for ex-ante calculation.
Description of measurement methods and procedures to be applied	The quantity of biogas generated is measured using a calibrated flowmeter. Behind the flow meter are two automatic valves: one to the flare and one leading to the gas engines). The valves have end position detectors and a Process Logic Control will monitor these position. The valve position and the flow meter will allow a definite flow determination. The flow meter & the valve positions are logged in the system.
QA/QC procedures to be applied	The Operator records the readings. 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 instruments used for monitoring data are calibrated as per manufacturers specifications.
Any comment:	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. 25./ Frequency of tilling**
Data unit:	No. of times each batch is tilled.
Description:	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.
Source of data to be used:	Plant records (Log book maintained at drying yard).
Value of data:	No value required for ex-ante calculations.
Description of measurement methods and procedures to be applied	Data logging.
QA/QC procedures to be applied	The Operator reports the readings regularly in the plant records, as and 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 instruments used for monitoring data are calibrated as per manufacturer's specifications.
Any comment:	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./FC_{Diesel}**

Data unit:	Litres
Description:	Amount of diesel consumption for operation at site for e.g. tillers and diesel generator set.
Source of data to be used:	Plant records (Stores).
Value of data:	This will be monitored *ex-post*.
Description of measurement methods and procedures to be applied	Monthly stock balance shall be used for calculating quantity of diesel consumed during operation of tillers and DG set at the site.
QA/QC procedures to be applied	This can be cross checked with the fuel receipts / invoices raised by the to be applied.
Any comment:	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./ T_{flare}**
Data unit:	^{o}C
Description:	Temeparature in the exhaust gas of the flare.
Source of data to be used:	Plant records.
Value of data applied for the purpose of calculating expected emission reductions in section B.5:	To be measured.
Description of measurement methods and procedures to be applied	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 to be applied	Data is logged continuously. 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 instruments used for monitoring data are calibrated as per manufacturer's specifications. Thermocouples are replaced or calibrated every year.
Any comment:	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./ nd_y**
Data unit:	d/y
Description:	The number of days that the animal manure management system capturing methane and flaring/combusting or gainfully using methane was operational.
Source of data to be	Company records.

used:	
Value of data:	365
Description of measurement methods and procedures to be applied	Data logging.
QA/QC procedures to be applied	
Any comment:	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./ $MS\%_{i,y}$**
Data unit:	-
Description:	Fraction of the manure handled in the animal manure management system in the baseline.
Source of data to be used:	Site visits/ sampling.
Value of data:	100%
Description of measurement methods and procedures to be applied	Based on the required sampling size (as per *General guidelines for sampling and surveys for small-scale CDM project activities' version 1.0*) site visits to the farms that supply the litter are made each year. The fraction of the manure that is handled using the said manure management system at that site is recorded.
QA/QC procedures to be applied	
Any comment:	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./ $N_{LT,y}$**
Data unit:	
Description:	Livestock population.
Source of data to be used:	Site visit.
Value of data:	2,500,000
Description of measurement methods and procedures to be applied	As per report from Tamil Nadu Agricultural University, poultry produces 35 – 40 grams of litter per day per head[57]. The value $N_{LT,y}$is determined through back-calculation of the poultry litter requirement of the plant. 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 to be applied	The consistency between these values and indirect information (records of sales, records of food purchases) shall be assessed. Significant changes in

[57] Department of Bioenergy, Tamil Nadu Agricultural University (Tamil Nadu), *Methane Emission Potential of Poultry Litter* (October 2011). document made available to the DOE

	livestock population will be explained.
Any comment:	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. 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.

B.7.2 Description of the monitoring plan:

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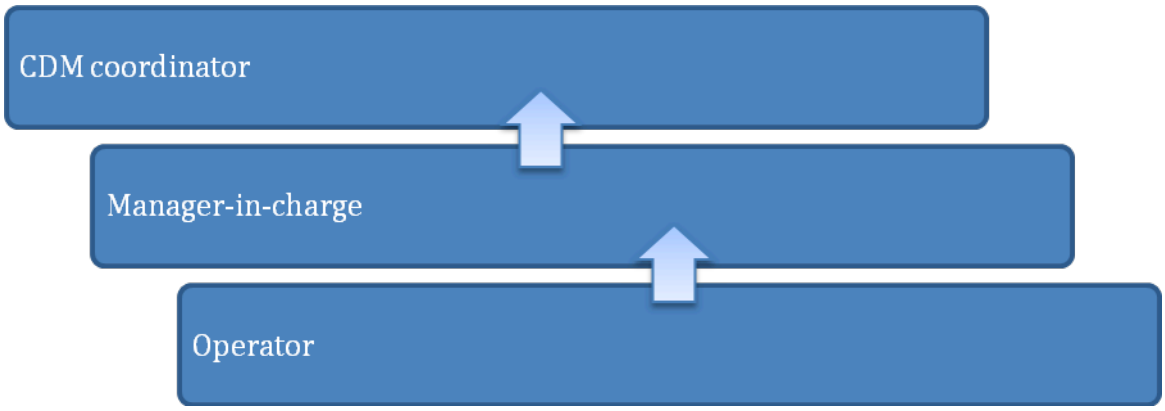
IOT Mabagas will ensure accuracy of the measurement system by adopting the following operational and management structure.



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.
- As per §17 of the General Guidelines to SSC CDM methodologies (Version 17):

Monitoring: while monitoring the emission reductions from the small-scale project activity, project participants shall:

(a) Electronically archive all data collected as part of monitoring for a period of two years from the end of the crediting period;

All data will be archived until two years after the end of the crediting period or the last issuance of CERs for this project activity, which ever occurs later.

(b) Data variables that are most directly related to the emission reductions (e.g. quantity of the fuel inputs, the amount of heat or electricity produced, gas captured) should be measured continuously. Data elements that are generally constant and indirectly related to the emission reductions (e.g. emission factors, calorific value, system efficiencies) should be measured or calculated at least once a year, unless detailed specifications are provided as part of the indicated methodology;

The measuring of the data variables is in line with this requirement as elaborated in Section B.7.1

(c) Measuring equipment should be certified to national or IEC standards and calibrated according to the national standards and reference points or IEC standards and recalibrated at appropriate intervals according to manufacturer specifications, but at least once in three years

All the measuring equipment will be calibrated as per manufacturers specification and recommendation and the calibration report will be maintained by the project proponent. This would be done at a frequency of less than 3 years in line with the guidance.

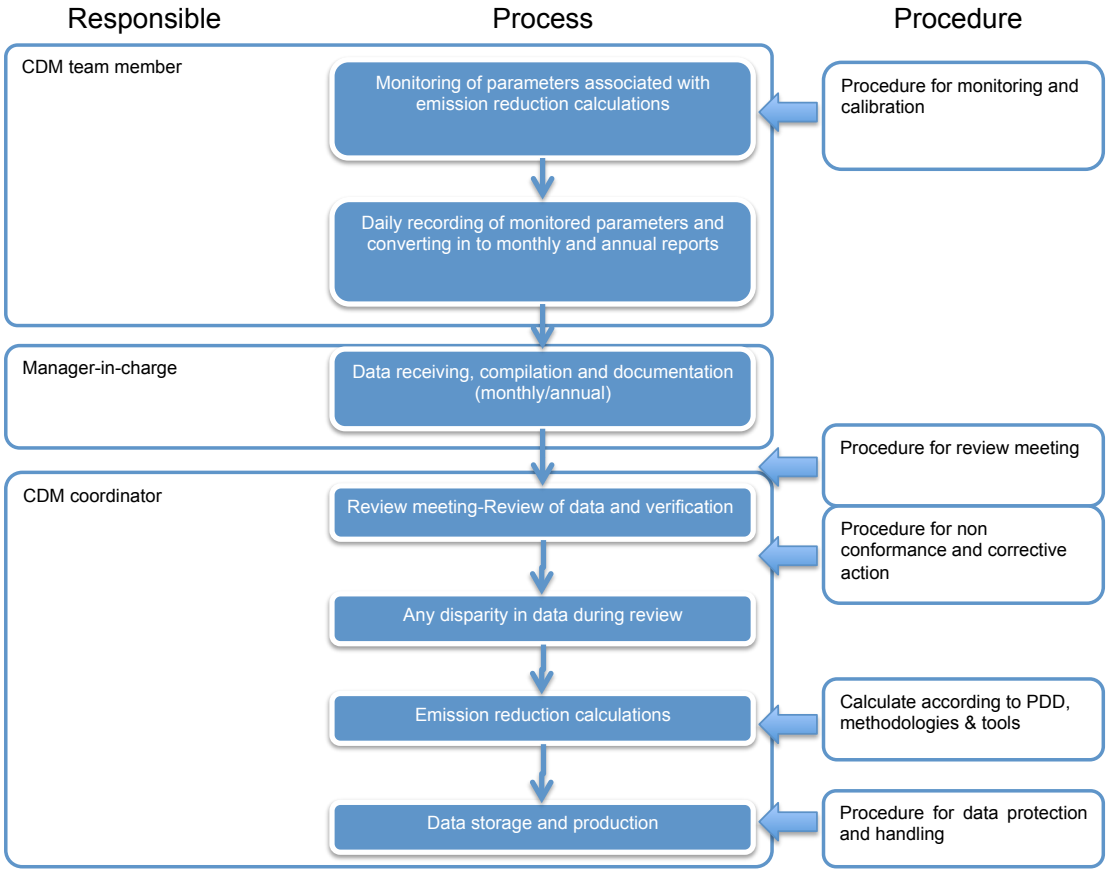
(d) The measured data with high levels of uncertainty or without adequate calibration should be compared with location/national data and commercial data to ensure consistency;

Not applicable.

(e) Wherever a statistical sample is proposed for monitoring, the 'General guidelines for sampling and surveys for small-scale CDM project activities' shall be referred.

Project participant will refer to the general guidelines for sampling when using statistical sampling.

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:

$$ER_{y,ex\ post} = min \begin{bmatrix} (BE_{y,ex\ post} - PE_{y,ex\ post} - LE_{y,ex\ post}), (MD_y - PE_{y,power,ex\ post} - \\ PE_{y,transp,ex\ post} - PE_{y,res\ waste,ex\ post} - PE_{y,phy\ leakage,ex\ post} - LE_{y,ex\ post}) \end{bmatrix} \quad \textbf{(16)}$$

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 (1) using *ex post* monitored values (e.g. Q_y) (tCO_2e)

$PE_{y,ex\ post}$	Project emissions calculated using equation (2) 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.

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:

$$MD_y = BG_{burnt,y} * w_{CH4,y} * D_{CH4} * FE * GWP\_CH_4 \quad \textbf{(17)}$$

Where:

$BG_{burnt,y}$	Biogas[58] 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 the temperature and pressure of the biogas in the year *y* ($tonnes/m^3$)
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

(b) 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;

(c) 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;

[58] Biogas and methane content measurements shall be on the same basis (wet or dry).

A portion of the biogas is destroyed through flaring and another portion us used for energy generation. Hence:

$BG_{burnt,y} = BG_{combusted,y} + BG_{flared,y}$ **(18)**

The project proponent will monitor $BG_{total,y}$ and $BG_{flared,y}$, hence:

$BG_{combusted,y} = BG_{total,y} - BG_{flared,y}$ **(19)**

Where:

$BG_{total,y}$ Total biogas recovered in year y (m^3).

Hence formula (17) is rewritten:

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

(17)

(d) Flow meters, sampling devices and gas analysers shall be subject to regular maintenance, testing and calibration to ensure accuracy;

As per §17 of the General Guidelines to SSC CDM methodologies (Version 17) as stated above.

Monitoring requirement for verification of proper soil application

As per AMS-III.F paragraph 25 the project proponent 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[59].

Apportioning Procedure

If $EG_{BL,y}$ is does not cover the monitoring period, e.g. the period is two weeks shorter, the project proponent 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 ($EG_{consumed,y}$) will be determined based on the electricity generated minus the electricity supplied to the grid:

$EG_{consumed,y} = EG_{gross,y} - EG_{BL,y}$ **(20)**

B.8	**Date of completion of the application of the baseline and monitoring methodology and the name of the responsible person(s)/entity(ies)**

>>

Date: 23/11/2011

Entity Name Address:
Do-inc. business B.V.
G.J. Eenhoorn
Do-it@do-inc.net
+31 20 846 36 50
Mauritskade 55-D
1092AD Amsterdam

[59] Tide Technocrats Private Limited, Bangalore, *Assessment report of feedstock availability and market for Biomethanation Solids*, April 2011 - – Made available to the DOE

SECTION C Duration of the project activity / crediting period

C.1. Duration of the project activity:

C.1.1. Starting date of the project activity:

>>

23/02/2011

C.1.2. Expected operational lifetime of the project activity:

>>

20 years 0 months

C.2 Choice of the crediting period and related information:

>>

Fixed crediting period

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

Not applicable.

C.2.1.2. Length of the first crediting period:

>>

Not applicable.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>

01/01/2013

C.2.2.2. Length:

>>

10 years 0 months

SECTION D. Environmental impacts

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D.1. If required by the host party, documentation on the analysis of the environmental impacts of the project activity:

The Ministry of Environment and Forests (MoEF), Government of India, under the Environment Impact Assessment Notification vide S.O. 1533(E) dated 14/09/2006 has listed a set of activities in Schedule I of

the notification which, for setting up new projects or modernization/ expansion, which require prior environmental clearance[60]. The proposed project activity is not listed in this schedule. Hence PP is not required to provide an Environmental Impact Assessment.

The project is situated at Pudhuchatram Village, Namakkal District, Tamil Nadu. The project is a CO_2 neutral power plant designed to envisage poultry litter and other biomass types for energy generation. As such, there is no emission of poisonous gases or effluents to pollute the atmosphere, water etc. Therefore, no additional anthropogenic emissions of GHGs due to the project activity are expected to be generated within the project boundary.

The proposed project will not undertake any other activity, which will adversely affect the ecological balance in area. The project will have local environmental benefits associated with the improved management of poultry litter waste. Poultry litter, composed of poultry faces, waste food and litter materials, is currently disposed of in an uncontrolled fashion, presenting an environmental and health hazard. It may present a hazard to human health as it is currently disposed of in open air. The project will collect poultry litter waste from nearby poultry farms, and transport the waste in such a manner to ensure that no waste spills from the trucks en route to the project site. The waste will then be digested anaerobically where during the project harmful bacteria and contaminants are destroyed. The remaining sludge is dried and is used as organic fertilizer.

Moreover, the project activity has obtained approval from the Tamil Nadu Pollution Control Board for setting up of the project. Towards this end the state government has given Consent for Establishment for the project activity. The project activity will reduce the carbon intensive nature of the Southern grid, which is dominated by fossil fuels such as coal and gas. The project activity will not cause any negative impact on the environment both on a local as well as on a global level.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

The environmental impacts anticipated from the project activity are not significant.

SECTION E. Stakeholders' comments

E.1. Brief description how comments by local stakeholders have been invited and compiled:

IOT Mabagas Ltd. organized a local stakeholder meeting on the 18th of March 2011 at the plant site in the village Pudhuchatram. Invitations were given to local villagers, direct stakeholders and government officials starting 4th March 2011. The invitation was pasted at the village panchayat notice board on 10th March 2011, and an advertisement was printed in the local and national newspaper on 16th March 2011.

During the stakeholder consultation Mr. Dr. A. Beer Ali informed the stakeholders about the project activity on behalf of the project participants and its impact on the environment, and mentioned the

[60] http://moef.nic.in/legis/eia/so1533.pdf

potential benefits of the project activity. Representatives from various groups attended the meeting to share their views on the project activity and provide comments. The project participants briefed the stakeholders about the objective, project description, environmental impacts and benefits, applicability of technology, global and local benefits, contribution towards sustainable development, and status of the project activity.

The list of identified stakeholders is given below:

(a) Village public
(b) Panchayat Officials
(c) Poultry Farm owners & association officials
(d) Sago Factory owners& association officials
(e) Sugar farmers (suppliers of press mud)
(f) Tamil Nadu pollution control board officials
(g) Tamil Nadu Electricity generation and distribution company, Namakkal circle office officials.
(h) District Industrial Centre, Namakkal officials
(i) Village administration officer (Pudhuchatram Panchayat union)
(j) Revenue department
(k) Salem Cooperative Sugar mills officials
(l) Jai shakti enterprises owner (logistics company)

After the introduction, a detailed open discussion took place with the identified stakeholders.
All stakeholders have issued their approvals/consents/licenses for setting up the project and no comments were received on the project. The stakeholder's minutes of the meeting report will be made available to the DOE (Designated Operational Entity) for validation.

E.2. Summary of the comments received:

No comments were received from the stakeholders, only a number of queries were raised. These were answered in a satisfactory manner by the project promoter during the meeting, see the summary below.

Question 1by Mr. Kumaresan – Vice president, Thattayangarpatti Panchayat: What would be the benefit of this project to the society?

The positive sustainable development effects of the project activity, as well as the negative impacts in absence of the project activity on human being health and atmosphere were explained by the project promoter.

Question 2 by a villager: Will IOT Mabagas consider providing the Organic Compost to the local farmers?

IOT Mabagas officials explained that they are very interested to sell the Organic Compost to the local farmers at a very competitive price. Furthermore they explained that the organic compost from a biomethanation plant is a very good soil conditioner.

Question 3by Mr. Shanmugam (Jai Shakti Enterprises) to IML & Tamilnadu Electricity Board: How will this project help in solving the power load shutdown pattern in the Village?

IOT Mabagas officials explained how the project will augment the power supplied to the grid through a local sub station and that it will not only contribute to enhancing the power availability but also reduce voltage fluctuations as experienced in others regions where decentralized power projects are implemented both within and outside Tamil Nadu.

The proceedings of the stakeholder consultation will be furnished to DOE.

E.3. Report on how due account was taken of any comments received:

No comments or concerns were raised during the consultation with stakeholders except for a number of questions, which were clarified during the consultation, which is captured in the minutes of the meeting. The minutes have been circulated to all the stakeholders who attended the meeting. Hence no actions were necessary in order to take due account of comments. Thus, the local stakeholder consultation process was adequate with respect to the identification of local stakeholders, seeking their views and taking due account of any comments and was conducted in a transparent manner. Further, as required by the CDM modalities and procedures, the PDD will be published at the Designated Operational Entity's (DOE) website for public comments.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

NOT APPLICABLE

Annex 3

BASELINE INFORMATION

The baseline data are taken from the CO2 Emission Database Version 6.0, March 2011 by CEA[61] (CEA Database). The data can be accessed through the following link:
http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm

Annex 4

MONITORING INFORMATION

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[61] http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm (accessed November 18 2011)