

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

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**Revision history of this document**

| <b>Version Number</b> | <b>Date</b>      | <b>Description and reason of revision</b>                                                                                                                                                                                                                                                                                                                                                       |
|-----------------------|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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.<br>As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at < <a href="http://cdm.unfccc.int/Reference/Documents">http://cdm.unfccc.int/Reference/Documents</a> >. |
| 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.                                                                                                                                                                                                                                                    |

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**SECTION A. General description of small-scale project activity****A.1 Title of the small-scale project activity:**

&gt;&gt;

IOT Mabagas Limited power plant, Pudhuchatram

Version: 5.2

03/11/2012

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

&gt;&gt;

**Project Participants**

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

**Project activity**

In the village of Thattayangarpatti, in the Puduchatram block of Namakkal district, the project participant, IML, intends to build and operate an anaerobic digestion plant. The plant will produce biogas with which 2.4 MW of renewable electricity will be generated as part of the 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. These wastes are left to decay or not handled properly (stockpiled or treated in uncovered lagoons without proper aeration as further elaborated in table 4.1.c below) and therefore release methane into the atmosphere. This methane release is avoided by treating it in waste-to-energy plants such as the proposed project activity. However, since the Project Participant cannot properly determine the exact baseline for these additional waste streams, their baseline emissions are not included in the emission reduction calculations as stipulated by the used small-scale methodology.

International Business Publications states that in this regard the Indian Ministry of New and Renewable Energy (MNRE) is acting upon the notion 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

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the use of adequate treatment, thereby causing environmental pollution and hazard to health<sup>1</sup>. Similarly, FICCI reports<sup>2</sup> (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). 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<sup>3</sup>.

**Post - Project Scenario**

In the post-project scenario, the project participant procures the poultry litter from the nearby poultry farms in the district. The other wastes (cow dung and agri wastes.) are also procured from nearby sites. The litter will be collected each 10 to 15 days and will be delivered to a substrate storage area at site and is off-loaded onto a scraper floor (bunker type feeding system) together with the other wastes. All wastes are fed into 4 continuously stirred digesters with a total working volume of 16,000 m<sup>3</sup>. Under controlled conditions biogas is produced through a bio-methanation process, which recovers the methane (biogas) from the litter. The biogas that is generated in the digesters is taken out through a common pipe and is then cooled down to remove moisture before it is fed via blowers into 2 x 1.2 MW biogas engines (2.4 MW total capacity) for the generation of power. The generated electricity (after consuming for internal operation of the plant) is supplied to the state electricity board via a dedicated 22 kV transmission line feeder to the nearby substation. The supplied electricity is sold by the project participant to the distribution licensee as per the modalities of the Energy Biomass Purchase Agreement.<sup>4</sup>

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

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

- 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.

<sup>1</sup> International Business Publications paragraph 4.39 page 110 Energy Policy, Laws and Regulations Handbook, Volume 1: [http://books.google.nl/books?id=nB2XgE\\_JvWcC&lpg=PA1&hl=nl&pg=PA20#v=onepage&q&f=false](http://books.google.nl/books?id=nB2XgE_JvWcC&lpg=PA1&hl=nl&pg=PA20#v=onepage&q&f=false)

<sup>2</sup> [www.globalmethane.org/Data/292\\_5\\_ficci\\_resource\\_assess\\_jan\\_10.pdf](http://www.globalmethane.org/Data/292_5_ficci_resource_assess_jan_10.pdf)

<sup>3</sup> see IRR Annex 15 page 33ff.

<sup>4</sup> Biomass Energy Purchase Agreement document made available to DOE.

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It is estimated that the proposed project activity will abate approximately **22,355 tCO<sub>2</sub>e** per annum.

**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.

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**A.3. Project participants:**

&gt;&gt;

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

| <b>Name of Party involved (*)<br/>((host) indicates a host<br/>Party)</b> | <b>Private and/or public entity(ies)<br/>project participants (*) (as<br/>applicable)</b> | <b>Kindly indicate if the Party<br/>involved wishes to be considered as<br/>project participant (Yes/No)</b> |
|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| India (Host)                                                              | Private Entity:<br>IOT Mabagas Limited (IML)                                              | No                                                                                                           |
| Netherlands                                                               | Private Entity:<br>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:**

&gt;&gt;

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

**A.4.1.1. Host Party(ies):**

&gt;&gt;

India.

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

&gt;&gt;

Tamil Nadu

**A.4.1.3. City/Town/Community etc:**

&gt;&gt;

Namakkal District.

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

&gt;&gt;

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.

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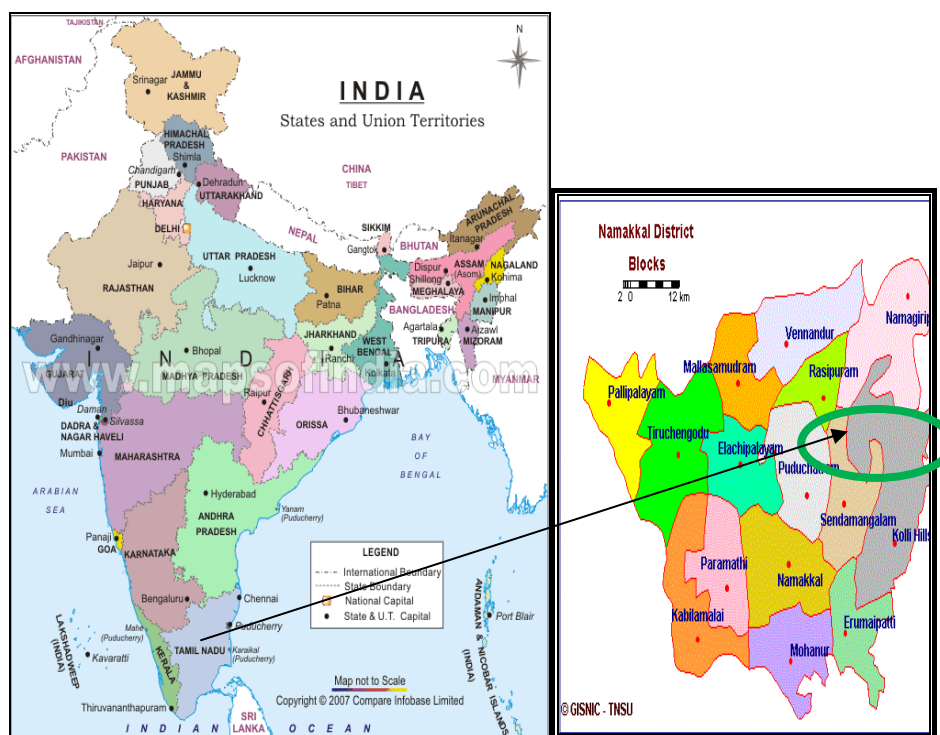


Figure 1. Maps showing the physical location of the project activity.

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

&gt;&gt;

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 <sup>5</sup> | Scope 1, Energy industries (renewable / non-renewable sources) |
| III: Other project activities | M - Methane recovery <sup>6</sup>                    | 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.

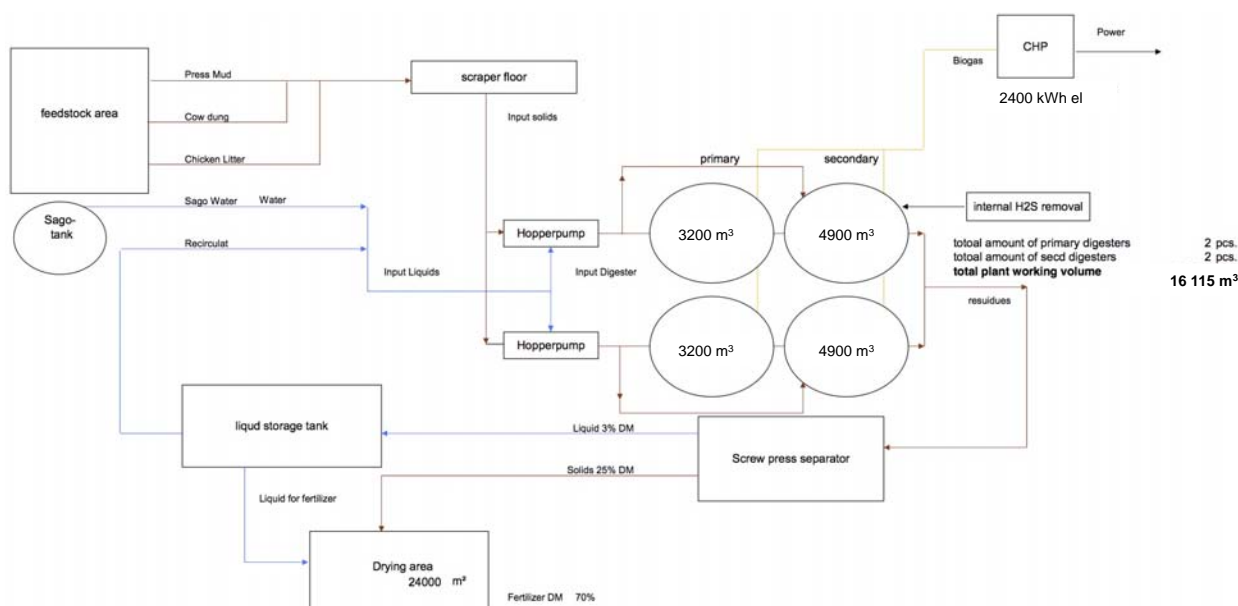
<sup>5</sup> <http://cdm.unfccc.int/methodologies/DB/RSCTZ8SKT4F7N1CFDXCSA7BDQ7FU1X/view.html>

<sup>6</sup> <http://cdm.unfccc.int/methodologies/DB/F5U41CTG7ENWK9RSSL5BV1LUPDG76W/view.html>

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The Principle equipment for enabling the biogas production process is temperature controlled digesters to enable bacterial activity. The digesters are sealed vertical vessels, where fermentation takes place to produce CH<sub>4</sub> (methane) and CO<sub>2</sub> (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<sup>7</sup>**PROCESS DESCRIPTION****Waste & Storage**

The waste includes animal waste (poultry litter and cow dung) and industrial waste (press mud and sago water)<sup>8</sup>. 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 m<sup>3</sup>. The solid wastes are mixed at the storage area thus creating a solid substrate. The daily input of substrate will be 210 metric tonnes (300 m<sup>3</sup>) 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<sup>3</sup>. 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

<sup>7</sup> Mass balance/ detailed project scheme is provided to the DOE

<sup>8</sup> As per SD\_14 Mass balance, made available to DOE.



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to its high dry matter content poultry litter needs a high dilution rate. If this is only achieved by water the organic load of the digester becomes too low or the retention time is too 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<sup>3</sup> 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<sup>3</sup> 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.

**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) Power 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

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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 enclosed emergency flare to avoid methane emissions.

**Technology Transfer**

As described in the “Personal & Training plan”<sup>9</sup> 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:**

&gt;&gt;

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

| Years                                                                                          | Estimation of annual emission reductions<br>in tonnes of CO <sub>2</sub> e |
|------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| 2013                                                                                           | 22,355                                                                     |
| 2014                                                                                           | 22,355                                                                     |
| 2015                                                                                           | 22,355                                                                     |
| 2016                                                                                           | 22,355                                                                     |
| 2017                                                                                           | 22,355                                                                     |
| 2018                                                                                           | 22,355                                                                     |
| 2019                                                                                           | 22,355                                                                     |
| 2020                                                                                           | 22,355                                                                     |
| 2021                                                                                           | 22,355                                                                     |
| 2022                                                                                           | 22,355                                                                     |
| <b>Total estimated reductions</b>                                                              | <b>223,550</b>                                                             |
| <b>Total number of crediting years</b>                                                         | <b>10</b>                                                                  |
| <b>Annual average of the estimated reductions over the crediting period (tCO<sub>2</sub>e)</b> | <b>22,355</b>                                                              |

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

&gt;&gt;

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:**

&gt;&gt;

<sup>9</sup> IOTM training and org personnel 3.11.2011.pdf made available to the DOE.

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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:

>>

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 <sup>10</sup> .         |
| AMS-III.AO (version 01)          | Methane recovery through controlled anaerobic digestion <sup>11</sup> . |

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

| Title | Version |
|-------|---------|
|-------|---------|

<sup>10</sup>

[http://cdm.unfccc.int/filestorage/V/9/L/V9LRSXKP24Q7YT6HZDUBO3C0ING8AJ.1/EB61\\_repan17\\_Revision\\_A\\_MS-I.D\\_ver17.pdf?t=NEp8bTl3OXdfDAURFeTc9mjSNFlv4Ut8sIc](http://cdm.unfccc.int/filestorage/V/9/L/V9LRSXKP24Q7YT6HZDUBO3C0ING8AJ.1/EB61_repan17_Revision_A_MS-I.D_ver17.pdf?t=NEp8bTl3OXdfDAURFeTc9mjSNFlv4Ut8sIc)

<sup>11</sup>

[http://cdm.unfccc.int/filestorage/C/D/M/CDM\\_AMSU745LJQM81SDJJOJ2S4G7ID9EIKFGD/EB58\\_repan16\\_AMS-III.AO.pdf?t=Vkh8bTl3OXl0fDDDIH2CC5hdt\\_Ueh3CV\\_10i](http://cdm.unfccc.int/filestorage/C/D/M/CDM_AMSU745LJQM81SDJJOJ2S4G7ID9EIKFGD/EB58_repan16_AMS-III.AO.pdf?t=Vkh8bTl3OXl0fDDDIH2CC5hdt_Ueh3CV_10i)

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|                                                                                             |        |
|---------------------------------------------------------------------------------------------|--------|
| 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 <sub>2</sub> 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:**

&gt;&gt;

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  | <p><i>This methodology comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass:</i></p> <p><i>(a) Supplying electricity to a national or a regional grid; or</i></p> <p><i>(b) Supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling.</i></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <p>The project activity involves renewable energy generation by utilizing biogas originating from the digestion of renewable biomass and will supply electricity to the national grid of India (option a).</p> <p>The national grid of India is divided into two regional grids, the NEWNE Grid and the Southern Grid. The project will supply electricity to the Southern Grid.<sup>12</sup></p> |              |         |         |         |   |                                                          |  |   |  |   |                                                                                                                                                                                    |  |  |   |   |                                                                                                                                                 |  |   |  |   |                                                                                                                                                   |  |  |   |   |                                                                                                              |   |  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 2  | <p><i>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 3.</i></p> <p style="text-align: center;">Table 2: Applicability of AMS I.D, AMS I.F and AMS I.A based on project types</p> <table><tr><th></th><th>Project type</th><th>AMS-I.A</th><th>AMS-I.D</th><th>AMS-I.F</th></tr><tr><td>1</td><td>Project supplies electricity to a national/regional grid</td><td></td><td>√</td><td></td></tr><tr><td>2</td><td>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)</td><td></td><td></td><td>√</td></tr><tr><td>3</td><td>Project supplies electricity to an identified consumer facility via national/regional grid (through a contractual arrangement such as wheeling)</td><td></td><td>√</td><td></td></tr><tr><td>4</td><td>Project supplies electricity to a mini grid<sup>11</sup> system where in the baseline all generators use exclusively fuel oil and/or diesel fuel</td><td></td><td></td><td>√</td></tr><tr><td>5</td><td>Project supplies electricity to household users (included in the project boundary) located in off grid areas</td><td>√</td><td></td><td></td></tr></table> |                                                                                                                                                                                                                                                                                                                                                                                                   | 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 <sup>11</sup> 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 | √ |  |  | <p>As per <i>Definition of renewable biomass</i>, EB 23, Annex 18 and <i>Glossary of CDM terms</i> (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.</p> <p>The generated electricity is sold to the Southern Grid of India, hence the project activity complies with this requirement.</p> |
|    | 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 <sup>11</sup> 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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | √                                                                                                                                                                                                                                                                                                                                                                                                 |              |         |         |         |   |                                                          |  |   |  |   |                                                                                                                                                                                    |  |  |   |   |                                                                                                                                                 |  |   |  |   |                                                                                                                                                   |  |  |   |   |                                                                                                              |   |  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 3  | <p><i>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</i></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <p>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)).</p>                                                                                                                                                               |              |         |         |         |   |                                                          |  |   |  |   |                                                                                                                                                                                    |  |  |   |   |                                                                                                                                                 |  |   |  |   |                                                                                                                                                   |  |  |   |   |                                                                                                              |   |  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

<sup>12</sup>Biomass Energy Purchase Agreement dated 9<sup>th</sup> Feb 2011 made available to the DOE.

## CDM – Executive Board

| Nr | Applicability Conditions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Justifications                                                                                                                                                                                                             |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | <i>(an) existing plant(s).</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                            |
| 4  | <p><i>Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology:</i></p> <ul style="list-style-type: none"> <li><i>The project activity is implemented in an existing reservoir with no change in the volume of reservoir;</i></li> <li><i>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/m<sup>2</sup>;</i></li> <li><i>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/m<sup>2</sup>.</i></li> </ul> | These conditions are not applicable as the project activity is not a hydro project.                                                                                                                                        |
| 5  | <i>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.</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | The unit has only a renewable component. Its installed capacity will be 2.4MW and hence does not exceed 15MW.                                                                                                              |
| 6  | <i>Combined heat and power (co-generation) systems are not eligible under this category.</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | The project activity will convert biogas to electricity using gas engines, and hence cannot be classified as a co-generation system.                                                                                       |
| 7  | <i>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.</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | The project activity comprises a Greenfield project; hence this criterion is not applicable.                                                                                                                               |
| 8  | <i>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.</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 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  | <p><i>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.</i></p> <p>The project activity comprises of wastes that would most likely have otherwise been left to decay anaerobically in the baseline. For chicken litter the PP can prove this. Due to the lack of numeric data and scientific assessments the PP cannot prove this for the other waste streams considered (cow dung, agricultural waste). Hence – as per methodology – the baseline emissions for these other waste are assumed zero (see below under 1.c. for more details). The baseline emissions are avoided by introducing an anaerobic digestion system with closed reactors. The biogas is either combusted or flared.</p> <p><i>The following conditions apply:</i></p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|    | <p>(a) <i>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;</i></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <p>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(a) is not applicable.</p>                                                                                                                                                                                                                                                                                                                                                                                           |
|    | <p>(b) <i>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;</i></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <p>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.</p> <p>In the absence of the project activity these biomass substrates would mostly be left to decay in uncontrolled manner, leading to (partial) anaerobic decomposition without biogas recovery (see also response under condition (c) below).</p> <p>In the proposed project activity the recovered biogas will be fed into gas engines for power generation.</p> <p>Hence, the proposed project activity meets requirement 1(b).</p> |
|    | <p>(c) <i>If for one or more sources of substrates, it cannot 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</i></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <p>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.</p> <p>Cow dung:<br/>Animal husbandry in India contributes overwhelmingly to the total greenhouse gas emissions of the Indian</p>                                                                                                                                                                                                            |

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|  | <p><i>calculated according to the procedures presented in this methodology for all co-digested substrates;</i></p> | <p>agricultural sector. The Federation of Indian Chamber of Commerce and Industry (FICCI)<sup>13</sup> reports (especially section 3.1 &amp; 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</p> <ul style="list-style-type: none"> <li>➤ 40% is aerobically treated for composting,</li> <li>➤ 40% is piled up or dumped in pits thus resulting in CH<sub>4</sub> emissions; and</li> <li>➤ 20% is used as cooking fuel or heating purposes</li> </ul> <p>It is evident from the animal husbandry practices in India that GHG emissions (both CO<sub>2</sub> during combustion and CH<sub>4</sub> in anaerobic condition of stockpiling (SWDS) and dumping (AWMS)) occur at the stage of manure management.</p> <p>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.</p> <p>Agricultural wastes:<br/>The below links it is noted that there are no regulations from the Government of India for starch industry to recover methane from the waste water.<br/> <a href="http://envirocare.co.in/environmental-standards-in-india.htm">http://envirocare.co.in/environmental-standards-in-india.htm</a><br/> <a href="http://cpcb.nic.in/Industry_Specific_Standards.php">http://cpcb.nic.in/Industry_Specific_Standards.php</a><br/> <a href="http://cpcb.nic.in/Industry-Specific-Standards/Effluent/453-1.pdf">http://cpcb.nic.in/Industry-Specific-Standards/Effluent/453-1.pdf</a><br/> <a href="http://www.methanetomarketsindia.com/htm/indian-regulation.htm">http://www.methanetomarketsindia.com/htm/indian-regulation.htm</a></p> <p>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</p> |
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<sup>13</sup> [www.globalmethane.org/Data/292\\_5\\_ficci\\_resource\\_assess\\_jan\\_10.pdf](http://www.globalmethane.org/Data/292_5_ficci_resource_assess_jan_10.pdf)

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|                                                                                                                                                                                                     | <p>release is from anaerobic open lagoons for the treatment of spent wash (WWTS)). 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.</p> <p>In consideration of the reported environmental pollution by MNRE (quoted by IBP)<sup>14,15</sup>, the UNDP<sup>16</sup> and FICCI<sup>17</sup> 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.</p> <p>A quantitative analysis of the described qualitative baseline practice cannot be computed due to the lack of numeric data and scientific assessment.</p> <p>Total gas production of all substrates is taken into account when calculating <math>PE_{flare}</math>, <math>PE_{leakage}</math>. PE for transport are calculated for each substrate.</p> <p>Therefore, the proposed project activity complies with this requirement.</p>                                                                                                                  |
| <p>(d) <i>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;</i></p> | <p>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.</p> <p><u>The quantities for the biomass generated in the region are as follows:</u></p> <ul style="list-style-type: none"> <li>-Poultry litter generated (tons/day): 436 tons;</li> <li>- Agricultural biomass residues (tons/day): 110-290 tons (depending on the season);</li> <li>- Agricultural biomass residues (<math>m^3/day</math>): <math>775 m^3</math> (approx. 775 tons when assuming density is close to <math>1 t/m^3</math>)</li> <li>-Cow dung generated (tons/day): 2242 tons;</li> </ul> <p><u>The quantities for the biomass required for the proposed project activity are as follows:</u></p> <ul style="list-style-type: none"> <li>-Poultry litter required (tons/day): 101 tons hence the quantity of available biomass in the region is more than</li> </ul> |

<sup>14</sup> International Business Publications paragraph 4.39 page 110 Energy Policy, Laws and Regulations Handbook, Volume 1: [http://books.google.nl/books?id=nB2XgE\\_JvWcC&lpg=PA1&hl=nl&pg=PA20#v=onepage&q&f=false](http://books.google.nl/books?id=nB2XgE_JvWcC&lpg=PA1&hl=nl&pg=PA20#v=onepage&q&f=false)

<sup>15</sup> <http://www.mnre.gov.in/related-links/offgrid/waste-to-energy>

<sup>16</sup> see IRR Annex 15 page 33ff – report made available to the validator.

<sup>17</sup> section 3.3.4 [http://www.globalmethane.org/Data/292\\_5\\_ficci\\_resource\\_assess\\_jan\\_10.pdf](http://www.globalmethane.org/Data/292_5_ficci_resource_assess_jan_10.pdf)



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|                                                                                                                                                                                                                                                                                                                                      | <p>300% larger than the quantity needed by the project, this is more than the required 25% threshold;</p> <p>-Agricultural biomass residues mainly obtained from the sugar &amp; starch industry (tons/day): 159 tons (hence the quantity of available biomass in the region (<math>\approx 110 + 775</math> tons) is more than 450% larger than the quantity needed by the project, this is more than the required 25% threshold);</p> <p>-Cow dung required (tons/day): 5 tons (hence the quantity of available biomass in the region (2242 tons) is more than 447 times larger than the quantity needed by the project, this is more than the required 25% threshold);</p> <p>For the quantities of biomass generated in the region, reference is made to Tide Technocrats Private Limited (Bangalore), <i>Assessment Report of feedstock availability and market for biomethanation solids</i> (April 2011), which is the most recent relevant study available for the aforementioned biomass in the project region.<sup>18</sup></p> <p>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.<sup>19</sup></p> <p>The leakage referred to in General Guidance on leakage in biomass project activities (version 03), paragraph 18 is not applicable to the proposed project activity.</p> <p>The proposed project activity complies with the General guidance on leakage in biomass project activities. Hence the project complies with this requirement.</p> |
| (e) <i>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.</i> | The proposed project activity involves co-digestion of animal manure and other organic matters and as per §3 of AMS-III.Dv18, the proposed project activity shall use the methodology AMS-III.AO “Methane recovery through controlled anaerobic digestion”. Therefore, condition 1(e) is not applicable to the proposed project activity.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| (f) <i>The project activity does not</i>                                                                                                                                                                                                                                                                                             | The proposed project activity:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

<sup>18</sup>Tide Technocrats Private Limited (Bangalore), *Assessment Report of feedstock availability and market for biomethanation solids* (April 2011). Document made available to the DOE

<sup>19</sup>IOT Mabagas Limited, *Detailed Project Report of 2.0 MW biogas to power generation project at Puduchatram, Namakkal, Tamil Nadu*, (13 December 2010) made available to the DOE.

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|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p><i>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.</i></p>                                                                                                                                                                                              | <ul style="list-style-type: none"> <li>• does not recover or <input type="checkbox"/> combust landfill gas from disposal site (unlike AMS-III.G);</li> <li>• does not undertake controlled combustion of the waste that is not treated biologically in a first step (unlike AMS-III.E);</li> <li>• does not recover biogas from solely wastewater treatment, therefore AMS-III.H is not applicable.</li> </ul> <p>Therefore, the proposed project activity complies with this requirement.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 2 | <p><i>Measures are limited to those that result in emission reductions of less than or equal to 60 kt CO<sub>2</sub> equivalent annually.</i></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <p>As per the calculation using equation 4 from methodology AMS-III.AOv01 PP have to take the minimal value resulting from equation 4, which makes it impossible that emission reductions cross the 60kt CO<sub>2</sub> equivalent threshold<sup>20</sup>.</p> <p>Therefore, the proposed project activity complies with this requirement.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 3 | <p><i>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.</i></p> <p><i>The following requirement shall be checked ex ante at the beginning of each crediting period:</i></p> <p><i>(a) Establish that identified landfill(s)/stockpile(s) can be</i></p> | <p>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. The locations of the disposal sites in the baseline are the participating poultry farms with whom a Memorandum of Understanding (MOU) is signed. The characteristics of these sites (AWMS) are described in section A.2 “Pre-project scenario” and under Table 5. Section 1.a.</p> <p>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.</p> <p>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), <i>Assessment Report of feedstock availability</i></p> |

<sup>20</sup> Additional demonstration that measures are limited to those that result in emission reductions of less than or equal to 60 kt CO<sub>2</sub> equivalent annually has been provided in section B.7.2 page 82 (and to the DOE in supporting document SD\_20).

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|   | <p><i>expected to accommodate the waste to be used for the project activity for the duration of the crediting period;</i></p> <p><i>or</i></p> <p><i>(b) Establish that it is common practice in the region to dispose off the waste in solid waste disposal site (landfill/stockpile).</i></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <p><i>and market for biomethanation solids</i> (April 2011) which is the most recent relevant study available for the aforementioned biomass in the project region.<sup>21</sup></p> <p>With respect to condition 3 (b): it is common practice in the region of Tamil Nadu, Republic of India to dispose off the waste in solid waste disposal site (landfill/stockpile)<sup>22</sup>.</p> <p>Hence the proposed project activity complies with this requirement.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 4 | <p><i>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).</i></p> | <p>Project participants define the geographical boundary of the region referred to in 3(b) as having a radius of 200km around the project activity for the duration of the crediting period as per Tide Technocrats Private Limited (Bangalore), <i>Assessment Report of feedstock availability and market for biomethanation solids</i> (April 2011)</p> <p>Poultry litter will be transported within 15 km distance from the project location. Most of the poultry farms are less than 10 km and some are less than 5 km from the proposed project activity plant site.</p> <p>Cow dung will be transported within 15 km from the project location;</p> <p>Press mud will be transported within 55 to 60 km from the project location;</p> <p>Sago water will be transported within 15 km from the project location. Most of the sago water source locations are less than 10 km and some are less than 5 km from the proposed project activity plant site.</p> <p>Above distances are substantiated in the Detailed Project Report<sup>23</sup>.</p> <p>Compost will be transported within 50 km from the project location<sup>24</sup>.</p> <p>Hence as a conservative average incremental distance of 25</p> |

<sup>21</sup>Tide Technocrats Private Limited (Bangalore), *Assessment Report of feedstock availability and market for biomethanation solids* (April 2011). Document made available to the DOE (PP refer to SD\_02 and acknowledged copy in SD\_31).

<sup>22</sup> Department of Bioenergy, Tamil Nadu Agricultural University (Tamil Nadu), *Methane Emission Potential of Poultry Litter* (October 2011). Document made available to the DOE as SD\_04.

<sup>23</sup> Pages 54 through 64 of SD\_60\_DPR\_addendum\_pages\_54\_to\_64\_distances; document made available to the DOE.

<sup>24</sup> 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

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|   |                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   |                                                                                                                                                                                                                                                                                                                                             | km is assumed for feed stock and 50 km is assumed for compost for ex-ante emission reduction calculations. Actual values will be monitored through sampling.                                                                                                                                                                                                                                                                                                                                                                                       |
| 5 | <i>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.</i>                                                                                   | 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), this will be monitored through parameter APP <sub>COMP</sub> the proper application of compost <sup>25</sup> . |
| 6 | <i>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.</i>                                                                                                                                                                   | The residual waste from the digestion is not treated thermally/ mechanically, hence this requirement is not applicable.                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 7 | <i>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”.</i> | 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 <sup>26</sup> .                                                                                                                                                                                                                                                                                                                                                                |
| 8 | <i>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.</i>                                                                                              | PP has defined the condition of zero-liquid discharge in the DPR as has been consented by Pollution Control Board which copy has been handed over to the DOE PJRCMD <sup>27</sup> . Expected volume of the liquid fraction is around 85,000 t/y of which 50% is re-circulated into the project plant system and 50% is sprayed as liquid fertilizer on drying compost <sup>28</sup> . Therefore, condition 8 is not applicable to the proposed project activity.                                                                                   |
| 9 | <i>Technical measures shall be used to ensure that all biogas captured from the digester is combusted /flared.</i>                                                                                                                                                                                                                          | As per the project activity PP put up a power generation unit where all the biogas is combusted. Only in emergency situations, when the power generation through the combustion of biogas is not happening, the biogas is diverted to an enclosed flare. Hence all the biogas is either combusted or flared. Therefore, the proposed project                                                                                                                                                                                                       |

<sup>25</sup> SD\_32 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

<sup>26</sup> SD\_32 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.

<sup>27</sup> SD\_03, Detailed Project Report (December 2010) made available to DOE.

<sup>28</sup> As per SD\_14, Mass balance, made available to the DOE.

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|    |                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    |                                                                                                                                                                                                                     | activity complies with this requirement.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 10 | <i>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.</i> | 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. Therefore, the proposed project activity complies with this requirement. |

**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  | <i>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:</i> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|    | <i>(a) The livestock population in the farm is managed under confined conditions;</i>                                                                                                                                                                                                                                                                                                                                               | 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. Hence, the livestock population in the farms from which the proposed project activity obtains poultry litter, is managed under confined conditions. Therefore, the proposed project activity complies with this requirement. |
|    | <i>(b) Manure or the streams</i>                                                                                                                                                                                                                                                                                                                                                                                                    | The material resulting from the co-digestion process can be                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

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| Nr | Applicability Conditions                                                                                                                                                                                             | Justifications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | <i>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;</i>                          | 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 re-circulated 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) <i>The annual average temperature of baseline site where anaerobic manure treatment facility is located is higher than 5°C;</i>                                                                                  | The <u>minimal</u> annual average temperature of baseline site where anaerobic manure treatment facility is located is above 20°C which is higher than 5°C required by methodology AMS-III.Dv18, applicability criterion 1 (c). This is substantiated by official measurements as explained in the footnote with web-links to official data sources. <sup>29</sup> Therefore, the project activity complies with this requirement.                                                                                                                                                                                                                                                                                                                                 |
|    | (d) <i>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;</i> | As confirmed by the TNAU report, in the region of Tamil Nadu the current practice of poultry litter management involves open dumping of litter posing negative health impacts to the poultry. The poultry litter in open dumps decomposes over a period of about six months liberating methane, carbon dioxide and nitrous oxide into the atmosphere as a consequence of anaerobic digestion of the organic fraction of waste by naturally present microbial consortia. Hence, in the baseline scenario the retention time of manure waste in the anaerobic treatment system <sup>30</sup> is greater than one month <sup>31</sup> . The baseline scenario does not involve anaerobic lagoons. Hence the proposed project activity complies with this requirement. |
|    | (e) <i>No methane recovery and destruction by flaring, combustion or gainful use takes place in the baseline scenario.</i>                                                                                           | For <u>poultry litter</u> :<br><br>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 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 outside the farm                                                                                                                                                                                                                                                                          |

<sup>29</sup> PP refer to the following web links:

<http://www.tn.gov.in/deptst/climateandrainfall.pdf>

<http://www.myweather2.com/City-Town/India/Namakkal/climate-profile.aspx?month=4>

These web links indicate that the value of the minimal annual average temperature of baseline site where anaerobic manure treatment facility is located is above 20°C which is higher than 5°C. The period referred is 2009 and 2010.

<sup>30</sup> PP refer to the SD\_03 Detailed Project Report (December 2010), especially to pages 53 to 63 listing sources of substrates, including manure waste for the proposed project activity; also reflected in SD\_02 Tide Technocrats Report. The DPR has been consented by Pollution Control Board and copy has been handed over to the DOE.

<sup>31</sup> 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 as SD\_04.

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| Nr | Applicability Conditions                                                                                                                                                                                                                                                                                                                                                                                                                          | Justifications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <p>but within the project boundary. As a layered pile, with continuous fresh manure being dropped on top, the poultry litter it maintains a largely semi-solid consistency. This leads to natural decomposition of the poultry litter and methane is emitted into the atmosphere.</p> <p>Hence, in the baseline, for poultry litter, no methane recovery and destruction by flaring, combustion or gainful use takes place.</p> <p>For <u>cow dung</u>, PP is not required to demonstrate that in the baseline no methane recovery and destruction by flaring, combustion or gainful use takes place. This is because PP have clearly stated in the PDD that for the proposed project activity, methane emissions are claimed only for poultry litter and not for biomass residues or cow dung because PP can not demonstrate that the organic matter would otherwise been left to decay anaerobically. Hence, PP accounts baseline emissions for cow dung as zero, <u>as per AMS-III.AOv01, §3</u> which states that 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.</p> <p>In light of the above, the proposed project activity complies with this requirement.</p> |
| 2  | <p><i>The project activity shall satisfy the following conditions:</i></p> <p><i>(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 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.</i></p> | <p>As described in PDD-section A.2 (under Post-Project Scenario), the storage time of the manure after removal from the animal barns, including transportation is 10-15 days before being fed into the anaerobic digester.</p> <p>Furthermore, in PDD-section A.4.2 (under Process Description) it is explained that: the storage area of the plant has a capacity of 1,950 m<sup>3</sup> and the daily input of substrate will be 210 metric tonnes (300 m<sup>3</sup>) hence the storage area is able to store substrate for 6.5 days (= 1,950m<sup>3</sup>/300m<sup>3</sup>).</p> <p>The timeframe specified above, ensures that the storage time of the manure will not exceed 45 days before being fed into the anaerobic digester. Therefore, the proposed project complies with this requirement.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

**B.3. Description of the project boundary:**

&gt;&gt;

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

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project activities<sup>32</sup>, 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 (Version17): ‘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:

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<sup>32</sup>[http://cdm.unfccc.int/methodologies/SSCmethodologies/approved/history/guid\\_ssc\\_meth/guid\\_ssc\\_v12\\_1.pdf](http://cdm.unfccc.int/methodologies/SSCmethodologies/approved/history/guid_ssc_meth/guid_ssc_v12_1.pdf)  
(accessed November 18 2011)



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| AMS-III.AO (version 01), paragraph 11<br>Project boundary condition |                                                                                                                                                                                | Compliance of the proposed project activity with the given condition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11                                                                  | <i>The project boundary is the physical, geographical site:</i>                                                                                                                | The project boundary includes:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| a                                                                   | <i>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;</i> | <p><u>For poultry litter:</u></p> <p>The open dumps at farms where the poultry litter would have been decomposing over a period of about six months and the open fields where – after the period of about six months at the farms – the poultry litter would have been dumped<sup>33</sup>.</p> <p>It is noted that for cow dung (which PP will obtain from gaushala cow farms), sago water (which PP will obtain from sago industries) and press mud (which PP will obtain from sugar industries)<sup>34</sup> PP states in this PDD that PP cannot demonstrate that this organic matter would otherwise have been left to decay anaerobically and that therefore, as per §1(c) of AMS-III.AOv01, baseline emissions related to such organic matter shall be accounted for as zero. In other words, baseline emissions from cow dung, sago water and press mud are not claimed. Consequently, condition 11 (a) of AMS-III.AOv01 only applies to poultry litter as described above in this cell.</p> <p>It is noted that the transport emissions from transporting the substrates from the sources to the project plant are included in the project boundary as stated in PP's justification for boundary condition 11(f) of AMS-III.AOv01 as noted in the last row of this table.</p> |
| b                                                                   | <i>In the case of projects co-digesting wastewater, where the wastewater would have been treated anaerobically in the absence of the project activity;</i>                     | <p>In the absence of the project activity, treated sago water is discharged in ponds. With reference to the justification for project boundary condition 11(a), it is noted that for sago water no baseline emissions are claimed, because, as stated in this PDD, PP cannot demonstrate that this organic matter would otherwise have been left to decay anaerobically and that therefore, as per §1(c) of AMS-III.AOv01, baseline emissions related to such organic matter shall be accounted for as zero.</p> <p>It is noted that the transport emissions from transporting the</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

<sup>33</sup> PP refer to the SD\_03 Detailed Project Report (December 2010), especially to pages 53 to 63 listing sources of poultry litter for the proposed project activity; also reflected in SD\_02 Tide Technocrats Report. The DPR has been consented by Pollution Control Board and copy has been handed over to the DOE PJRCMD.

<sup>34</sup> PP refer to the SD\_03 Detailed Project Report (December 2010), especially to pages 53 to 63 listing sources of substrates for the proposed project activity; also reflected in SD\_02 Tide Technocrats Report. The DPR has been consented by Pollution Control Board and copy has been handed over to the DOE PJRCMD. PP also refer to their response to applicability criterion 1(c) of methodology AMS-III.AOv01 in table 4 of this PDD.

<sup>35</sup> SD\_03, Detailed Project Report (December 2010) made available to the DOE

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|   |                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   |                                                                                                                                                                                                    | sago water from the sago industries sources to the project plant are included in the project boundary as stated in PP's justification for boundary condition 11(f) of AMS-III.AOv01 and as referenced in the Detailed Project Report <sup>35</sup> .                                                                                                                                                                                                                                                                                                                                               |
| c | <i>Where the treatment of biomass or other organic matters through anaerobic digestion takes place;</i>                                                                                            | The four closed digesters and the power plant of which they are a part, are included in the project boundary.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| d | <i>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;</i> | The dedicated drying yard for the residual waste from the digestion is included in the project boundary. The farmlands where the composted residual waste from the project plant is submitted to soil are not at the project site, they are included in the project boundary.                                                                                                                                                                                                                                                                                                                      |
| e | <i>Where biogas is burned/flared or gainfully used, including biogas sale points, if applicable;</i>                                                                                               | As described in the justification for applicability condition 1(c) of methodology AMS-III.AOv01 <sup>36</sup> and in the justification to applicability condition 1(e) of methodology AMS-III.Dv18 <sup>37</sup> , for poultry litter, sago water, and press mud there is no burning/flaring or gainful use of biogas in the baseline scenario.<br><br>In the project scenario, all biogas is burned/flared at the project plant, with the burning of biogas constitutes gainful use of biogas. There are no biogas sale points. Therefore, the project plant is included in the project boundary. |
| f | <i>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.</i>              | PP include in the project boundary, the itineraries between a, c, d and e, where the transportation of waste, wastewater, manure, residual waste after digestion, occurs <sup>38</sup> .                                                                                                                                                                                                                                                                                                                                                                                                           |

The project boundary is graphically represented in below figure:

<sup>36</sup> Please refer to table 4 in this PDD.

<sup>37</sup> Please refer to table 5 in this PDD.

<sup>38</sup> PP refer to SD\_03 Detailed Project Report (December 2010), especially to pages 53 to 63 listing sources of substrates for the proposed project activity; also reflected in SD\_02 Tide Technocrats Report. The DPR has been consented by Pollution Control Board and copy has been made available to DOE.

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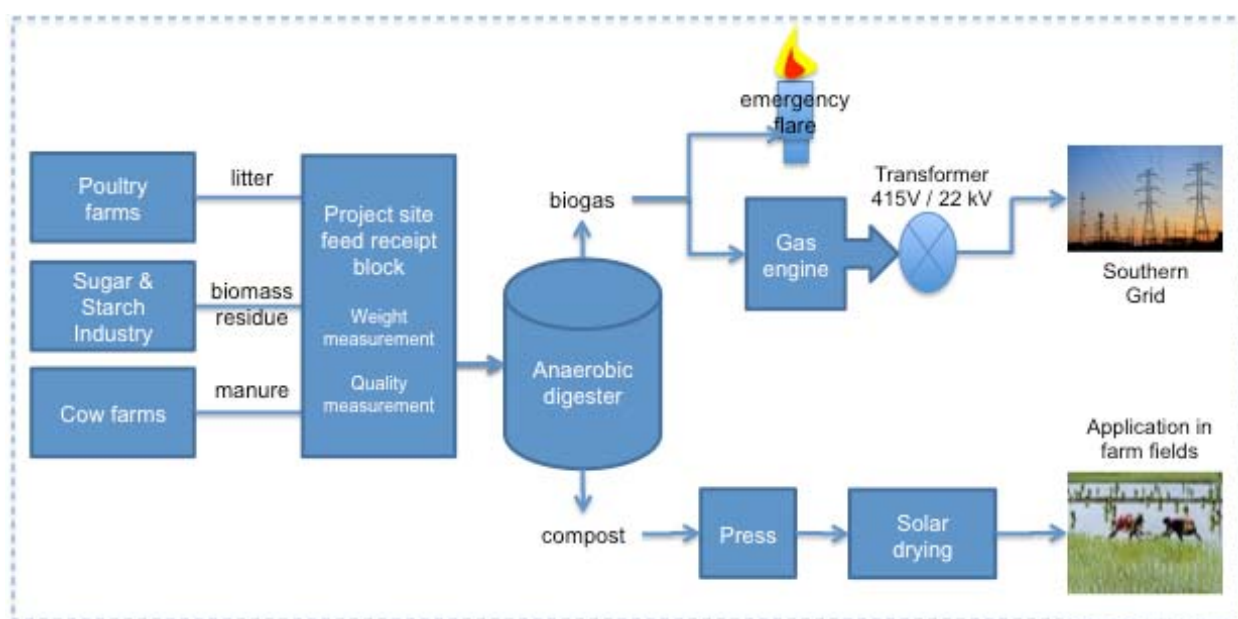


Figure 3 Project boundary

Table 6 Emissions sources

|                  | Source                                                                                            | Gas              | Included? | Justification / Explanation                                                                                                                                                  |
|------------------|---------------------------------------------------------------------------------------------------|------------------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Baseline         | Emissions from decomposition of poultry litter                                                    | CH <sub>4</sub>  | Yes       | The major source of emissions in the baseline.                                                                                                                               |
|                  |                                                                                                   | N <sub>2</sub> O | No        | N <sub>2</sub> O emissions are present in decaying poultry litter but few reliable studies are available for reliable quantification. Exclusion of this gas is conservative. |
|                  |                                                                                                   | CO <sub>2</sub>  | No        | CO <sub>2</sub> emissions from the decomposition of organic waste are not accounted                                                                                          |
|                  | Emissions from electricity consumption                                                            | CO <sub>2</sub>  | Yes       | Electricity may be consumed from the grid or generated onsite/offsite in the baseline scenario                                                                               |
|                  |                                                                                                   | CH <sub>4</sub>  | No        | Excluded for simplification. This is conservative.                                                                                                                           |
|                  |                                                                                                   | N <sub>2</sub> O | 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 <sub>2</sub>  | Yes       | May be an important emission source                                                                                                                                          |
|                  |                                                                                                   | CH <sub>4</sub>  | No        | Excluded for simplification. This emission source is assumed to be very small.                                                                                               |
|                  |                                                                                                   | N <sub>2</sub> O | No        | Excluded for simplification. This emission source is assumed to be very small.                                                                                               |
|                  | Emissions from on-site electricity use                                                            | CO <sub>2</sub>  | Yes       | May be an important emission source                                                                                                                                          |
|                  |                                                                                                   | CH <sub>4</sub>  | No        | Excluded for simplification. This emission source is assumed to be very small.                                                                                               |
|                  |                                                                                                   | N <sub>2</sub> O | No        | Excluded for simplification. This emission source is assumed to be very small.                                                                                               |
|                  | Emissions from transportation                                                                     | CO <sub>2</sub>  | Yes       | May be an important emission source                                                                                                                                          |
|                  |                                                                                                   | CH <sub>4</sub>  | No        | Excluded for simplification. This emission source is assumed to be very small.                                                                                               |
|                  |                                                                                                   | N <sub>2</sub> O | No        | Excluded for simplification. This emission source is assumed to be very small.                                                                                               |

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|  |                                                  |                  |     |                                                                                     |
|--|--------------------------------------------------|------------------|-----|-------------------------------------------------------------------------------------|
|  | Emissions from flaring                           | CO <sub>2</sub>  | No  | CO <sub>2</sub> emissions from the decomposition of organic waste are not accounted |
|  |                                                  | CH <sub>4</sub>  | Yes | May be an important emission source.                                                |
|  |                                                  | N <sub>2</sub> O | No  | Excluded for simplification. This emission source is assumed to be very small.      |
|  | Project Emissions due to Physical Leakage of gas | CO <sub>2</sub>  | No  | CO <sub>2</sub> emissions from the decomposition of organic waste are not accounted |
|  |                                                  | CH <sub>4</sub>  | Yes | May be an important emission source.                                                |
|  |                                                  | N <sub>2</sub> O | No  | Excluded for simplification. This emission source is assumed to be very small.      |

**B.4. Description of baseline and its development:**

&gt;&gt;

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.

As per *General Guidelines to SSC CDM methodologies* (Version 17) section 19 footnote 10: “Specific procedures for Greenfield project activities provided in the respective methodology have precedence”.

**Baseline for electricity:**

As per AMS-I.D. version 17 section 10: “If the project activity is the installation of a new grid-connected renewable power plant/unit, the baseline scenario is the electricity delivered to the grid by the project activity that otherwise would have been generated by the operation of grid-connected power plants and by the addition of new generation sources.”

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<sub>2</sub>e/MWh.

The grid emission factor or CO<sub>2</sub> 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<sub>2</sub> emission baseline. The latest version of the database, the ‘CO<sub>2</sub> 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.

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**Baseline for avoidance of methane production from biomass:**

AMS-III.AO *Methane recovery through controlled anaerobic digestion* (Version 01) section 12 states: “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.”

In the baseline, in the absence of the project activity, the following waste streams 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 since the PP cannot quantify the described qualitative baseline practice and can hence not compute the baseline emissions caused by the degradation of agricultural biomass nor cow dung due to the lack of numeric data and scientific assessment as described in table 4 point (c) above. Hence 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 more than 1 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.

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.

After being cleared away after the accumulation period, the litter would mostly be stockpiled for another period of time<sup>39</sup>.

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<sup>40</sup>.

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.<sup>41</sup>

<sup>39</sup> PP refer to Department of Bioenergy, Tamil Nadu Agricultural University (Tamil Nadu), *Methane Emission Potential of Poultry Litter* (October 2011). Document made available to the DOE as SD\_04.

<sup>40</sup> “The Ministry of Agriculture, Government of India does not have regulations, policies or programmes, which would directly address and encourage recovery and use of methane as an alternate source for clean energy from agriculture and livestock”. <http://www.methanetomarketsindia.com/htm/indian-regulation.htm>

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**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:**

&gt;&gt;

The chronology of events is represented in the below table:

| Key event                                                      | Date          | Comment/ supporting document                                                                                                      |
|----------------------------------------------------------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------|
| Letter from Tamil Nadu Electricity Board with approval for 2MW | 17/09/2010    | PP refer to SD_34 made available to DOE.                                                                                          |
| Investment decision at Board meeting.                          | 28/01/2011    | PP refer to SD_59 made available to DOE.                                                                                          |
| Prior consideration document submission with UNFCCC and NCDMA  | 22/02/2011    | Prior consideration documentation signed by project participant & 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.                                                                |
| 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                                                                                     |
| Board decision to increase from 2.0 to 2.4 MW.                 | 12/05/2011    | PP refer to SD_77 made available to DOE.                                                                                          |
| Initial global stakeholder consultation                        | 01-30/07/2011 | Weblink <sup>42</sup> .                                                                                                           |
| Purchase Order for 2.4MW engines                               | 22/07/2011    | PP refer to supporting document SD_35a made available to DOE. This date is taken as the <b>start date</b> as per annex 63 of EB66 |
| DOE site visit                                                 | 07-08/09/2011 | Email correspondence with DOE.                                                                                                    |
| Issuance of draft validation report (version 01)               | 19/10/2011    | Email correspondence with DOE.                                                                                                    |
| Letter from TANGEDCO to PP for amendment of EPA to 2.4 MW      | 13/02/2012    | PP refer to SD_40a made available to DOE.                                                                                         |

**CDM awareness and prior consideration**

Since the PDD has been published for global stakeholder consultation<sup>43</sup> before the project activity start date (see section C.1.1), no prior consideration notification is necessary as per paragraph 2 of the Guidelines On The Demonstration And Assessment Of Prior Consideration Of The CDM Version 04 (EB62 annex 13)<sup>44</sup>.

**Barrier analysis**

<sup>41</sup>Tide Technocrats Private Limited, Bangalore, *Assessment report of feedstock availability and market for Biomethanation Solids*, April 2011 - - Made available to the DOE

<sup>42</sup><http://cdm.unfccc.int/Projects/Validation/DB/O48X2OYZJE0Z9GM5X1PUXX8JD9MM83/view.html>

<sup>43</sup><http://cdm.unfccc.int/Projects/Validation/DB/G3WO8B7ORRKL2GC0109MBN4AF65MCF/view.html>

<sup>44</sup>[http://cdm.unfccc.int/EB/062/eb62\\_repan13.pdf](http://cdm.unfccc.int/EB/062/eb62_repan13.pdf)

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As per Attachment A to Appendix B the project participant provides an explanation to show that the project activity would not have occurred due to at least one of the barriers mentioned. Project participant opts to provide explanations on the following barriers: Technological barrier and investment 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<sup>45</sup>.

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<sup>46</sup>. 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.

**Investment barrier**

As per Attachment A to Appendix B the project participant provides an explanation to show that the project activity would not have occurred due the 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 simple cost analysis is not applicable for the proposed project because the project activity will produce economic benefit other than the CDM related income, notably from electricity sale. Instead, the Benchmark Analysis will be used.

Paragraph 12 of the *Guidelines on the Assessment of Investment Analysis* (Version 05) states: “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** are appropriate benchmarks for equity IRR. (...)”. Paragraph 13 states: “In the cases of projects which could be developed by an entity other than the project participant the benchmark should be based on parameters that are standard in the market. (...)”.

Hence project participant opts to benchmark post-tax equity IRR against the required/ expected returns on equity.

As per § 15 it is stated that if “the benchmark is based on parameters that are standard in the market, the cost of equity should be determined either by: (a) selecting the values provided in Appendix A; or by (b) calculating the **cost of equity** using best financial practices, based on data sources which can be clearly validated by the DOE, while properly justifying all underlying factors”.

Project Participant will calculate cost of equity as per option (b) using the Capital Asset Pricing Model (CAPM) is used to determine the benchmark (cost of equity). This model takes into account the non-diversifiable risk of the asset, the expected return of the market and the expected return of a risk-free asset.

<sup>45</sup> page 7: [www.globalmethane.org/expo/docs/postexpo/ag\\_dhussa.pdf](http://www.globalmethane.org/expo/docs/postexpo/ag_dhussa.pdf)

<sup>46</sup> <http://cdm.unfccc.int/UserManagement/FileStorage/TCMZPJ70U0EDR9YH8QB63521NA4WI>

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The equation is as follows<sup>47</sup>:

$$\bar{r}_a = r_f + \beta_a (\bar{r}_m - r_f)$$

(Equation 1)

Where:

$r_f$  = Risk free rate

$\beta_a$  = Beta of the security

$\bar{r}_m$  = Expected market return

Table 7 Main parameters to determine the Cost of Equity

| Applicable Beta <sup>48</sup><br>$\beta_a$ | Risk Free Rate <sup>49</sup><br>$r_f$ | Market Return <sup>50</sup><br>$r_m$ | Market Risk Premium<br>( $r_m - r_f$ ) | Cost of Equity |
|--------------------------------------------|---------------------------------------|--------------------------------------|----------------------------------------|----------------|
| 1.06                                       | 8.69 %                                | 13.15%                               | 4.46%                                  | <b>13.42%</b>  |

**Applicable Beta (1.06)**

Beta is a measure of the volatility, or systematic risk, of a security or a portfolio in comparison to the market as a whole. Beta is used in the CAPM model<sup>51</sup>. Beta is calculated using regression analysis, and you can think of beta as the tendency of a security's returns to respond to swings in the market. A beta of 1 indicates that the security's price will move with the market. A beta of less than 1 means that the security will be less volatile than the market. A beta of greater than 1 indicates that the security's price will be more volatile than the market. For example, if a stock's beta is 1.2, it's theoretically 20% more volatile than the market. Many utilities stocks have a beta of less than 1. Conversely, most high-tech Nasdaq-based stocks have a beta of greater than 1, offering the possibility of a higher rate of return, but also posing more risk.

The two key revenue streams from operating a biogas plants are from the production and sale of electricity (power sector), as well as the sale of organic compost/fertilizer (fertilizer sector), but requires timely and cost effective construction of the plant.

The biogas industry (renewable energy sector) in India is in its very early stages and there is no single company listed at the Indian stock-markets yet that develops and operates biogas plants alone. The project proponent has therefore selected the business sectors that correspond to project activity (i.e. power sector and fertilizer sector). The PP uses the leveraged betas (including debt). PP has opted for leveraged beta vs unleveraged beta since the leveraged beta is most often lower than the unlevered beta (that is, the leveraged beta indicates less volatility) because debt can result in tax advantages that reduce volatility<sup>52</sup>. The beta is calculated over a representative period of time of 2 years. In determining this 2-year period of analysis, the project participant considered that the period should be "for as long as there is a [relevant]

<sup>47</sup> <http://www.investopedia.com/terms/c/capm.asp#axzz1p4puxkch> (accessed 14/03/2012)

<sup>48</sup> Data also provided in SD\_16 CDM financial analysis.xlsx, made available to the DOE.

<sup>49</sup> Based on the average Yield on State Government Securities as provided in the Annual report of the Reserve Bank of India (see (table VII.6 [http://rbidocs.rbi.org.in/rdocs/AnnualReport/PDFs/ORBIAN240810\\_F.pdf](http://rbidocs.rbi.org.in/rdocs/AnnualReport/PDFs/ORBIAN240810_F.pdf)) for the year ended June 30, 2010. Data also provided in SD\_16 CDM financial analysis.xlsx, made available to the DOE.

<sup>50</sup> Based on the average return of the SENSEX over a period of 15 years (between February 1996 and January 2011) [http://beta.bseindia.com \(select 'historical data'; select 'SENSEX'; select 'Monthly'; select range from February 1996; data also provided in SD\\_16 CDM financial analysis.xlsx, made available to the DOE.](http://beta.bseindia.com (select 'historical data'; select 'SENSEX'; select 'Monthly'; select range from February 1996; data also provided in SD_16 CDM financial analysis.xlsx, made available to the DOE.)

<sup>51</sup> <http://www.investopedia.com/terms/b/beta.asp#ixzz1yywHHv64>

<sup>52</sup> <http://financial-dictionary.thefreedictionary.com/Leveraged+Beta>



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history" and that one should then account for the earnings (for the compared companies) "for the same time period"<sup>53</sup>. Since in this case the private company has no history, we assumed a 'relevant' assessment period (and for a period of which we have sufficient relevant data available). The beta reflects the firm's business mix over the period of the regression, not the current mix<sup>54</sup>, and since the market is new and dynamic; a long evaluation period is therefore not relevant and distorts the picture. Hence the PP opted a 2 year period as a relevant valuation period to determine the Beta; for this period data was available on the stock market of relevant sectors and companies and will reasonably well reflect the current business mix.

| Sector            | Beta | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Power Sector      | 0.95 | BSE Power index                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Fertilizer Sector | 1.17 | Beta of companies in the fertilizer sector with a listing on the BSE. The following companies have been taken into account:<br><br>Coromandel International Ltd<br>Chambal Fertilizers & Chemicals Ltd<br>Deepak Fertilizers & Petrochemicals Corporation Ltd<br>Gujarat Narmada Valley Fertilizers Co Ltd<br>Gujarat State Fertilizers & Chemicals Ltd<br>Mangalore Chemicals & Fertilizers Ltd<br>National Fertilizers Ltd<br>Rashtriya Chemicals & Fertilizers Ltd<br>Southern Petrochemicals Ind Ltd<br>TATA Chemicals Ltd<br>Nagarjuna Fertilizers & Chemicals Ltd<br>Zuari Industries Ltd |
| Average           | 1.06 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

\*As explained above, the beta expresses a tendency of a security's returns to respond to swings in the market, and as such one tries to calculate the beta over a prolonged period. The Beta has been calculated over a period of approximately 2 years (2 year) as can be seen in the snapshot of each Beta calculation (i.e. from 1<sup>st</sup> February 2009 to 23 January 2011)<sup>55</sup>.

**Risk Free Rate (8.69%)**

The risk free rate is the theoretical rate of return of an investment with zero risk. The risk-free rate represents the interest an investor would expect from an absolutely risk-free investment over a specified period of time. Thus, the average Yield on State Government Securities<sup>56</sup> with a 10-year tenure is used as the risk-free rate, as it most closely represents a risk-free investment in the host country.

**Market Return (13.15%)**

To calculate the cost of equity, you must look at factors such as the return of the market as a whole, the rate you could get if you took on no risk (the risk free rate), and the overall cost of funding the project: the market return. The PP has analysed the average return of the BSE SENSEX over a period of 15 years and taken this as an objective and verifiable value for the market return and for a period of time similar to the expected lifetime of the project activity.

<sup>53</sup> <http://people.stern.nyu.edu/adamodar/pdfiles/eqnotes/pvt.pdf> page 184

<sup>54</sup> <http://people.stern.nyu.edu/adamodar/pdfiles/country/Indiaval04.pdf> page 26

<sup>55</sup> See SD\_68\_Beta\_Explanation

<sup>56</sup> State Government Securities - These are securities issued by the state governments and are also known as State Development Loans (SDLs). The issues are also managed and serviced by the Reserve Bank of India (<http://www.rbi.org.in/scripts/FAQView.aspx?Id=48> accessed 28/9/2012).

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**Market Risk Premium (4.46%)**

The Market Risk Premium is a parameter required in the CAPM model. To obtain the value of this parameter the Risk Free Rate is subtracted from the Market Return.

**Cost of Equity**

Hence the Cost of Equity equals the risk free return plus the product of the beta and the market risk premium:

$$\bar{r}_a = r_f + \beta_a (\bar{r}_m - r_f) = 8.69\% + 1.06 * (4.46\%) = 13.42\%$$

Hence the benchmark applied for the comparison with the financial indicator – the equity IRR – is 13.42%.

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.

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

**Table 8. Assumptions used to Calculate equity IRR**

| Sl No                           | Data/Parameters                        | Value (in INR)     | Inflation (%) | Source/ remarks                                                                                                                                                                                                                                                                            |
|---------------------------------|----------------------------------------|--------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Capital Expenditure</b>      |                                        |                    |               |                                                                                                                                                                                                                                                                                            |
| 1                               | Fixed Assets                           | 284,000,000        | -             | The fixed costs stated in the board meeting of 28/01/2011 when the investment decision was made, related to an installed capacity of 2.0MW. As per board meeting dd May 12 2011 <sup>57</sup> the the installed capacity was increased 2.4MW. See also the time line above in section B.5. |
| 2                               | Land purchase cost                     | 13,000,000         | -             | As per deed of sale and Land development agreement <sup>58</sup>                                                                                                                                                                                                                           |
| 3                               | <b>Total capital expenditure</b>       | <b>297,000,000</b> | -             |                                                                                                                                                                                                                                                                                            |
| <b>O&amp;M cost (per annum)</b> |                                        |                    |               |                                                                                                                                                                                                                                                                                            |
| 4                               | Power Unit O&M                         | (6,393,000)        | 5.0%          | As per SD_03 DPR made available to DOE (page 129 for inflation rate & page 134 item 12 for Power Unit O&M costs).                                                                                                                                                                          |
| 5                               | Biogas Plant O&M (incl. Insurance)     | (25,777,000)       | 5.0%          | As per SD_03 DPR made available to DOE (page 129 for inflation rate & page 134 sub B + sub – item 12 for cost).                                                                                                                                                                            |
| <b>Tariffs and Receipts</b>     |                                        |                    |               |                                                                                                                                                                                                                                                                                            |
| 6                               | Biomass power tariff (INR/kWh) in 2012 | 4.92               | 3.0%          | Escalation is assumed at 3%. Value as understood at time of the investment decision TNERC Tariff Orders <sup>59</sup> .                                                                                                                                                                    |
|                                 | Fertilizer revenue                     | 39,735,500         |               |                                                                                                                                                                                                                                                                                            |
| 7                               | Fertilizer sales price (INR/t)         | 1,750              |               | Revenue based on consultant report (i.e. Tide Technocrats) which estimates the revenue of                                                                                                                                                                                                  |

<sup>57</sup> SD\_77 minutes of board meeting dd 12 May 2011 – Document made available to DOE

<sup>58</sup> IRR Annex 2 Deed of sale & SD\_41\_I ML\_LAND\_Development\_Agreement\_22\_09\_2010 – Documents made available to DOE

<sup>59</sup> 1)

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|                             |                                                               |            |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------------------|---------------------------------------------------------------|------------|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             |                                                               |            |  | the digestate to be between 1400-1800 INR/t. PP estimates a price of 1750 to be realistic basis for estimating the economic yield in this yet unstructured and little organized organic fertilizer market. <sup>60</sup>                                                                                                                                                                                                                                                                    |
| <b>Financial parameters</b> |                                                               |            |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 8                           | 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 pegged at 19.93% and has been considered under the financial analysis <sup>61</sup> . |
| 9                           | Tax rate year 11-15 (Corporate Tax)                           | 32.4%      |  | As per Income Tax Act 1961 <sup>62</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 10                          | Interest Rate of Bank Loan                                    | 13.25%     |  | As per the Central Electricity Regulatory Commission regulations 2009 (Terms and Conditions for Tariff determination from Renewable Energy Sources) <sup>63</sup>                                                                                                                                                                                                                                                                                                                           |
| 11                          | Bank Loan Duration (years)                                    | 10         |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 12                          | Equity (%)                                                    | 30.0%      |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 13                          | Debt (%)                                                      | 70.0%      |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 14                          | Benchmark                                                     | 13.42%     |  | See Table 7 above                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 15                          | Exchange rate 1 EUR                                           | 63         |  | INR EUR Exchange rate on 28 January 2011 <sup>64</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 16                          | One time subsidy                                              | 36,000,000 |  | See page 46 of SD_03 Detailed Project Report of 2.0 MW biogas to power generation project at Puduchatram which states 15,000 INR per kW installed. As PP schedules to install 2.4 MW subsidy is expected to be 15,000 INR/kW x 2400 kW = 36,000,000 INR                                                                                                                                                                                                                                     |
| 17                          | Lifetime of system (years)                                    | 20         |  | TNERC note on lifetime <sup>65</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 18                          | Depreciation Rate (digressive, in years) for tax calculations | 15         |  | 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                                                                                                                                                                                                                            |

<sup>60</sup>Tide Technocrats Private Limited, Bangalore, *Assessment report of feedstock availability and market for Biomethanation Solids*, April 2011 – Made available to the validator

<sup>61</sup>[http://www.incometaxindiapr.gov.in/incometaxindiacr/contents/forms2010/pamphlets/COMPANIES\\_2012\\_13.htm](http://www.incometaxindiapr.gov.in/incometaxindiacr/contents/forms2010/pamphlets/COMPANIES_2012_13.htm) (accessed November 3 2011)

<sup>62</sup>page#5[http://www.deloitte.com/assets/Dcom-Global/Local%20Assets/Documents/Tax/dtt\\_corporate\\_tax\\_rates\\_2011.pdf](http://www.deloitte.com/assets/Dcom-Global/Local%20Assets/Documents/Tax/dtt_corporate_tax_rates_2011.pdf) (accessed November 3 2011)

<sup>63</sup>See IRR Annex 11 Annexure 3H – made available to the DOE (Date of order: 15th September, 2010) ([http://www.cercind.gov.in/2010/November/Signed\\_Order\\_256-2010\\_RE\\_Tariff\\_FY\\_11-12.pdf](http://www.cercind.gov.in/2010/November/Signed_Order_256-2010_RE_Tariff_FY_11-12.pdf))

<sup>64</sup>SD\_21 INR EUR Exchange rate on 28 January 2011

<sup>65</sup>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))

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|    |                                                                                                                                                                                                                                                                                      |            |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    |                                                                                                                                                                                                                                                                                      |            |  | approximately 5% is also in line with proposed depreciation recommendations by Indian Government Institutions being between 4.5% to 7.84% <sup>69, 66</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 19 | Depreciation rate to determine fair value (years)                                                                                                                                                                                                                                    | 20         |  | to determine fair value the depreciation has been taken over the life time of the system (assumption 17 above).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 20 | Salvage value after 20 years:                                                                                                                                                                                                                                                        | 5%         |  | According to Indian company act sec 205                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 21 | Fair value of the project activity assets used in the last year in the financial model = (Investment (assumption 1 – ass. 2 = 29.7 cr) – Capital Assistance (ass. 16 = 3.6 cr) – Depreciation (15 years (=last year of the fin. model) x ((ass. 1 – ass. 2) / ass. 19) = 1.178 cr)). | 84,300,000 |  | As per paragraph 3 of the GUIDELINES ON THE ASSESSMENT OF INVESTMENT ANALYSIS (Version 05), EB62 annex 05 “(...) Both project IRR and equity IRR calculations shall as a preference reflect the period of expected operation of the underlying project activity (technical lifetime), or - if a shorter period is chosen - include the fair value of the project activity assets at the end of the assessment period. In general a minimum period of 10 years and a maximum of 20 years will be appropriate. (...)”. PP has taken a fair value of the assets at the end of the assessment period and hence complies with paragraph 3 of the guidelines. |

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 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 |
|-------------------------|------------------------------|
| 6.71%                   | 13.42%                       |

Therefore it may be concluded that the project activity has a less favourable indicator than the benchmark.

**Sensitivity analysis**

As per paragraph 20 of Guidelines on the assessment of investment analysis (Version 05; EB 62 annex 5), only those variables, that constitute more than 20% of either total project costs or total project revenues should be subjected to reasonable variation. The following variables constitute more than 20% and are therefore subjected to reasonable variation:

- Capital expenditure (more than 20% of the project costs)
- Biogas Plant O&M (more than 20% of the project costs)
- Substrate purchase (more than 20% of the project costs)
- Revenue from fertilizer sales (more than 20% of project revenue)

<sup>66</sup> 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](http://www.cercind.gov.in/2010/ORDER/Sept10/Order_256-2010_RE_Tariff_FY_11-12.pdf) (accessed November 3 2011)

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- Revenue from electricity sales<sup>67</sup> (more than 20% of project revenue)

As per guidance the results of this variation are presented in the table below and in SD\_16 CDM Financial Analysis made available to the DOE.

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 13.42% |        |                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-----------------------------------------------------------|--------|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Critical Items                                            |        | Comment                 | Justification of probability of occurrence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Capital expenditure                                       | -26.6% | cost reduction needed   | A reduction in the capital expenditure of 26.6% 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 & Power Plant O&M                            | -33.0% | cost reduction needed   | A cost reduction of 33% 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 47% 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                                            | -32.0% | 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 32% therefore seems highly unlikely                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Fertilizer Revenue                                        | 37.5%  | 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 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 37.5% would result in the need to sell organic fertilizer (untreated or upgraded – i.e. raw dried bio-digestate in bulk) at 2406 INR/tonne which is above the estimated maximum value of 2100 INR/t by Tide Technocrats – the lowest value is at 1400 INR/tonne. <sup>68</sup> |
| Electricity Revenue                                       | 16.8%  | revenue increase needed | The electricity tariff is fixed by the TNERC and the expectation of an increase in 16.8% is therefore not applicable.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

<sup>67</sup>As noted in the *Biomass Energy Purchase Agreement* between the project participant 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.

<sup>68</sup>Tide Technocrats Private Limited, Bangalore, *Assessment report of feedstock availability and market for Biomethanation Solids*, April 2011 – Made available to the DOE

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In accordance to paragraph 21 of the Guidelines on the assessment of investment analysis (Version 05; EB 62 annex 5) the above sensitivity analysis covers the required range of +10% and -10%.

**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.

**Conclusion on the Investment Analysis**

Based upon the above analysis it may be concluded that the project activity has a less favourable indicator (post-tax equity IRR = 6.71 %) than the benchmark (13.42 %). When varying the main variables the above analysis proves that the project activity still remains less favourable than the benchmark and hence the project activity is deemed additional.

**National and/or sectoral policies applicable to project activity**

Taking into account the *clarifications on the consideration of national and/or sectoral policies and circumstances in baseline scenarios* (Version 02) (EB22 annex 3) the project participant has assessed the national and/ or sectoral policies applicable to the project activity. No policies have been identified to be applicable to project activity as has been justified in table 4 1.c. in section B.2.

**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<sub>2</sub> emission reductions as result of electricity generation) and AMS-III.AO, *Methane recovery through controlled anaerobic digestion* (Version 01) (for CH<sub>4</sub> 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:**

$$BE_y = BE_{Elec,y} + BE_{CH_4,y} \quad \text{(Equation 2)}$$

Where,

|               |                                                                                                  |
|---------------|--------------------------------------------------------------------------------------------------|
| $BE_y$        | Baseline emissions in year y, in tCO <sub>2</sub> /y                                             |
| $BE_{Elec,y}$ | Baseline CO <sub>2</sub> emissions from electricity used in the baseline, in tCO <sub>2</sub> /y |
| $BE_{CH_4,y}$ | Baseline methane emissions in year y, in tCO <sub>2</sub> /y                                     |

**Baseline CO<sub>2</sub> 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.

$$BE_{Elec,y} = EG_{BL,y} * EF_{CO_2,grid,y} \quad \text{(Equation 3)}$$

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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)

$EF_{CO_2, grid, y}$  CO<sub>2</sub> emission factor of the grid in year  $y$  (t CO<sub>2</sub>/MWh)

### Calculation of CO<sub>2</sub> 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<sub>2</sub>/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<sub>2</sub> Emission Database Version 6.0, March 2011, by the Central Electricity Authority (CEA), Ministry of Power, Government of India.<sup>69</sup> 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).

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

<sup>69</sup>[http://www.cea.nic.in/reports/planning/cdm\\_co2/cdm\\_co2.htm](http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm) (accessed November 3 2011)

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

- Simple Operating Margin;
- Simple Adjusted Operating Margin;
- Dispatch data analysis Operating Margin;
- 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.

|       | 2005-06 | 2006-07 | 2007-08 | 2008-09 | 2009-10 | 5-years average |
|-------|---------|---------|---------|---------|---------|-----------------|
| South | 27.0%   | 28.3%   | 27.1%   | 22.8%   | 20.6%   | 25.2%           |

Source: the CEA's CO<sub>2</sub> Emission Database Version 6.0, March 2011<sup>70</sup>.

#### 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<sub>2</sub> emissions per unit net electricity generation (tCO<sub>2</sub>/MWh) of all generating power plants serving the system, excluding low-cost / must-run power plants / units.

The simple OM may be calculated by one of the following two options:

- Option A: Based on the net electricity generation and a CO<sub>2</sub> emission factor of each power unit;  
or  
Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

As per tool PP choses option A as option B can only be chosen if the information under option A is not available. Hence PP has to opt for Option A under step 4 and the following equation is used:

$$EF_{grid,OMsimple,y} = \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

(Equation 4)

Where:

$EF_{grid,OMsimple,y}$  = Simple operating margin CO<sub>2</sub> emission factor in year y (t CO<sub>2</sub>/MWh)

$EG_{m,y}$  = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)

$EF_{EL,m,y}$  = CO<sub>2</sub> emission factor of power unit m in year y (t CO<sub>2</sub>/MWh)

<sup>70</sup> [http://www.cea.nic.in/reports/planning/cdm\\_co2/Database\\_publishing\\_ver6.zip](http://www.cea.nic.in/reports/planning/cdm_co2/Database_publishing_ver6.zip)



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- m = All power plants/units serving the grid in the year y except low-cost/must-run power plants/units
- Y Three most recent years for which data is available at the time of submission of the project (2007-08, 2008-09, 2009-10)

Net generation of power plants included in the operating margin is presented in the table below.

| Net Generation in Operating Margin (GWh) |         |         |         |         |
|------------------------------------------|---------|---------|---------|---------|
|                                          | 2007-08 | 2008-09 | 2009-10 | Total   |
| South                                    | 114,634 | 121,471 | 134,717 | 370,822 |

Source: the CEA's CO<sub>2</sub> Emission Database Version 6.0, March 2011<sup>71</sup>.

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:

| Simple Operating Margin (tCO <sub>2</sub> /MWh) (excl. Imports) |         |         |         |                  |
|-----------------------------------------------------------------|---------|---------|---------|------------------|
|                                                                 | 2007-08 | 2008-09 | 2009-10 | Weighted average |
| South                                                           | 0.991   | 0.970   | 0.941   | 0.966            |

Source: the CEA's CO<sub>2</sub> Emission Database Version 6.0, March 2011<sup>72</sup>.

**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:

- Identifying SET<sub>5-units</sub>: 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<sub>SET-5-units</sub>, in MWh);
- Identifying SET<sub>≥20%</sub>: 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<sub>total</sub>, in MWh), and determine their annual electricity generation (AEG<sub>SET≥20%</sub>, in MWh);
- Determining SET<sub>sample</sub> from SET<sub>5-units</sub> and SET<sub>≥20%</sub>, by selecting the set of power units that comprises the larger electricity generation.

SET<sub>sample</sub> is determined by comparing AEG<sub>SET-5-units</sub> to AEG<sub>SET≥20%</sub>. The data are sourced from the CEA CO<sub>2</sub> Emission Database Version 6.0, March 2011.

The dataset for AEG<sub>SET-5-units</sub><sup>73</sup>:

| Name of power plant | Data of commissioning | Electricity generation [MWh] |
|---------------------|-----------------------|------------------------------|
| KONDAPALLI GT       | 05-12-09              | 462,713                      |

<sup>71</sup> [http://www.cea.nic.in/reports/planning/cdm\\_co2/Database\\_publishing\\_ver6.zip](http://www.cea.nic.in/reports/planning/cdm_co2/Database_publishing_ver6.zip)

<sup>72</sup> [http://www.cea.nic.in/reports/planning/cdm\\_co2/Database\\_publishing\\_ver6.zip](http://www.cea.nic.in/reports/planning/cdm_co2/Database_publishing_ver6.zip)

<sup>73</sup> See tab BM in SD\_13 Database\_ver6-1.0\_calculations\_JM.xls, which is provided to the DOE.

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|                     |          |           |
|---------------------|----------|-----------|
| 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 |

|                       |                  |
|-----------------------|------------------|
| <b>AEGSET-5-units</b> | <b>6,943,431</b> |
|-----------------------|------------------|

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

|                                   | <b>Electricity generation [MWh]</b> |
|-----------------------------------|-------------------------------------|
| AEGtotal                          | 169,765,092                         |
| 20% of AEGtotal                   | 33,953,018                          |
| <b>AEGSET<math>\geq</math>20%</b> | <b>36,099,907</b>                   |

Hence, the data show that  $AEG_{SET \geq 20\%}$  is higher than  $AEG_{SET-5-units}$ , 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  $SET_{\geq 20\%}$ . All power plants included in the  $SET_{sample}$  group started to supply electricity to the grid less than 10 years ago. Therefore,  $SET_{sample}$  can be used to calculate the build margin for each grid.

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.

The latest available data for the BM emission factor for  $SET_{sample}$  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:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$

**(Equation 5)**

$EF_{grid,BM,y}$  = 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 (%)

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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:

$$EF_{grid,CM,y} = 0.966 \times 0.5 + 0.763 \times 0.5 = 0.865 \text{ tCO}_2/\text{MWh} = \mathbf{865 \text{ tCO}_2/\text{GWh}}$$

The Combined Margin emission factor ( $EF_{grid,CM,y}$ ) refers to the  $\text{CO}_2$  emission factor of the grid in year  $y$  ( $EF_{\text{CO}_2,grid,y}$ ) as stated in the equation 3 above. This will be the grid emission factor for the entire crediting period.

**Baseline Methane Emissions ( $BE_{CH_4,y}$ ) 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, paragraph 12, 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.

$$BE_{CH_4} = BE_{SWDS,y} + BE_{ww,y} + BE_{manure,y} - MD_{reg,y} * GWP_{CH_4} \quad \text{(Equation 6)}$$

Where:

$BE_{CH_4}$   $BE_y$  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” ( $\text{tCO}_2\text{e}$ ). 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.

Hence:

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$$BE_{CH4} = BE_{manure,y}^{74}$$

Equation 7

**$BE_{manure,y}$  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 participant has chosen the option (a). Therefore, for the proposed project activity, the baseline emissions for poultry litter are calculated according to the following equation:

$$BE_{manure,y} = GWP_{CH4} * D_{CH4} * UF_b * \sum_{j,LT} MCF_j * B_{0,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{Bl,j} \text{ (Equation 8)}$$

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 <sup>3</sup> at room temperature (20 °C) 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 <sup>3</sup> $CH_4$ /kg dm) $LT$ is poultry. |
| $N_{LT,y}$      | Annual average number of animals of type $LT$ in year $y$ (numbers)                                                                      |

<sup>74</sup> (note  $GWP_{CH4}$  is already taken into account when calculating  $BE_{manure,y}$ ;

$$\text{see } BE_{manure,y} = GWP_{CH4} * D_{CH4} * UF_b * \sum_{j,LT} MCF_j * B_{0,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{Bl,j} \text{ (Equation 8))}$$

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|               |                                                                                                                                               |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| $VS_{LT,y}$   | 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) <sup>75</sup>                                                               |

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;*

PP's genetic source does not originate from an Annex 1 country. PP does not use formulated feed rations. PP cannot validate this, and 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 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;*

PP's genetic source does not originate from an Annex 1 country. PP does not use formulated feed rations. PP cannot validate this, and 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 )  $VS_{\text{default}} = 0.02$  kg VS/d. 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*

<sup>75</sup> Reference: FCCC/SBSTA/2003/10/Add.2, page 25.

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*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<sub>j</sub> (22.84%) 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.<sup>76</sup>

$$N_{LT,y} = N_{da,y} * \left( \frac{N_{p,y}}{365} \right) \quad \text{(Equation 9)}$$

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<sub>y</sub>)**

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:

- CO<sub>2</sub> emissions due to incremental transportation distances;
- CO<sub>2</sub> emissions from electricity and/or fossil fuel consumption by the project activity facilities;
- 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;
- Methane emissions from physical leakages of the anaerobic digester;
- Methane emissions due to flare inefficiency;

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

Where:

$PE_y$  Project activity emissions in the year y (tCO<sub>2</sub>e)  
 $PE_{transp,y}$  Emissions from incremental transportation in the year y (tCO<sub>2</sub>e)  
 $PE_{power,y}$  Emissions from electricity or fossil fuel consumption in the year y (tCO<sub>2</sub>e)  
 $PE_{res\ waste,y}$  In case residual wastes are subjected to anaerobic storage, or disposed in a landfill: methane emissions from storage/disposal/treatment of waste (tCO<sub>2</sub>e)  
 $PE_{phy\ leakage,y}$  Methane emissions from physical leakages of the anaerobic digester in year y (tCO<sub>2</sub>e)  
 $PE_{flaring,y}$  Methane emissions due to incomplete flaring in year y as per the “Tool to determine project emissions from flaring gases containing methane”(tCO<sub>2</sub>e)

<sup>76</sup> Department of Bioenergy, Tamil Nadu Agricultural University (Tamil Nadu), *Methane Emission Potential of Poultry Litter* (October 2011). Document made available to the DOE as SD\_04.

**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.

$$PE_{transp,y} = (Q_y / CT_y) * DAF_w * EF_{CO2,transport} + (Q_{res-waste,y} / CT_{res-waste,y}) * DAF_{res-waste} * EF_{CO2,transport} \quad \text{(Equation 11)}$$

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 <sub>2</sub> emission factor from fuel use due to transportation (kgCO <sub>2</sub> /km, IPCC default values or local values may be used) |
| $Q_{res-waste,y}$    | Quantity of residual waste produced in year y (tonnes)                                                                                       |
| $CT_{res-waste,y}$   | Average truck capacity for residual waste transportation (tonnes/truck)                                                                      |
| $DAF_{res-waste}$    | Average distance for residual waste transportation (km/truck)                                                                                |

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

$$PE_{power} = PE_{power\_own\_gen} + PE_{power\_elec} + PE_{power\_DG} \quad \text{(Equation 12)}$$

 **$PE_{power\_own\_gen}$** 

The project activity operations will be mainly powered by the Power 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 Power Units are not operating formula 1 applies:

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{j,y}) \quad \text{(Equation 13)}$$

Where

|               |                                                                                                                                                                                                                                                             |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $PE_{EC,y}$   | $PE_{power,elec}$ = Project emissions from electricity consumption in year y (tCO <sub>2</sub> /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 <sub>2</sub> /MWh). Defined as $EF_{grid,CM,y}$ in equation 5 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). |

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 **$PE_{power\_DG}$** 

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

CO<sub>2</sub> emissions from fossil fuel combustion in process  $j$  are calculated based on the quantity of fuels combusted and the CO<sub>2</sub> emission coefficient of those fuels, as follows:

$$PE_{FC,j,y} = \sum_i FC_{i,j,y} \times COEF_{i,y} \quad (\text{Equation 14})$$

Where:

- $PE_{FC,j,y}$  Are the CO<sub>2</sub> emissions from fossil fuel combustion in process  $j$  during the year  $y$  (tCO<sub>2</sub>/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<sub>2</sub> emission coefficient of fuel type  $i$  in year  $y$  (tCO<sub>2</sub>/mass or volume unit);
- $i$  Are the fuel types combusted in process  $j$  during the year  $y$ ;

The CO<sub>2</sub> 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 participant option B is used.

Option B = The CO<sub>2</sub> emission coefficient  $COEF_{i,y}$  is calculated based on net calorific value and CO<sub>2</sub> emission factor of the fuel type  $i$ , as follows:

$$COEF_{diesel,y} = NCV_{diesel,y} \times EF_{CO2,diesel,y} \quad (\text{Equation 15})$$

Where:

- $COEF_{diesel,y}$  Is the CO<sub>2</sub> emission coefficient of diesel in year  $y$  (tCO<sub>2</sub>/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<sub>2</sub> emission factor of diesel in year  $y$  (tCO<sub>2</sub>/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 m<sup>3</sup> biogas leaked/m<sup>3</sup> 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  $\text{tCO}_2$ ), represented as  $PE_{\text{flaring},y}$  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 ( $PE_{\text{flare},y}$ ) 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 3 and 4 of the *Tool to determine project emissions from flaring gases containing methane* (Version 01) are only applicable in case of both enclosed flares and continuous monitoring of the flare efficiency. Since PP opts for option (a) of the tool (hence to use 90% default value) steps 3 and 4 are not applicable. Since steps 1 and 2 are only required to calculate data for steps 3 and 4.

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:

$$TM_{RG,h} = FV_{RG,h} \times fv_{CH_4, RG,h} \times \rho_{CH_4,n} \quad \text{(Equation 16)}$$

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 $h$ ( $\text{m}^3/\text{h}$ )                                    |
| $fv_{CH_4, RG,h}$ | Volumetric fraction of methane in the residual gas on dry basis in hour $h$                                                                         |
| $\rho_{CH_4,n}$   | Density of methane at normal conditions ( $\text{kg}/\text{m}^3$ ), referred to as $D_{CH_4}$ 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).

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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 ( $T_{\text{flare}}$ ) is below 500 °C for more than 20 minutes during the hour  $h$ ;
- 50%, if the temperature in the exhaust gas of the flare ( $T_{\text{flare}}$ ) 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 ( $T_{\text{flare}}$ ) 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:

$$PE_{\text{flare},y} = \sum_{h=1}^{8760} TM_{RG,h} \times (1 - \eta_{\text{flare},h}) \times \frac{GWP_{CH_4}}{1000} \quad (\text{Equation 17})$$

Where:

- $PE_{\text{flare},y}$  = Project emissions from flaring of the residual gas stream in year  $y$  (tCO<sub>2</sub>e)  
 $TM_{RG,h}$  = Mass flow rate of methane in the residual gas in the hour  $h$  (kg/h)  
 $\eta_{\text{flare},h}$  = Flare efficiency in hour  $h$ , referred to as  $FE_y$  in methodology AMS-III.AO (Version 01)  
 $GWP_{CH_4}$  = Global Warming Potential of methane valid for the commitment period (tCO<sub>2</sub>e/tCH<sub>4</sub>)

**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<sub>y</sub>)**

$$ER_y = BE_y - (PE_y + LE_y) \quad (\text{Equation 18})$$

Where:

- $ER_y$  = Emission reductions in year  $y$ , in tCO<sub>2</sub>/y  
 $BE_y$  = Baseline emissions in year  $y$ , in tCO<sub>2</sub>/y  
 $PE_y$  = Project emissions in year  $y$ , in tCO<sub>2</sub>/y  
 $LE_y$  = Leakage emissions in year  $y$ , in tCO<sub>2</sub>/y

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

>>

| Data / Parameter:                      | ID. 1./ $EF_{\text{grid},CM,y} = EF_{EL,y}$                                                                                                                   |
|----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data unit:                             | tCO <sub>2</sub> /GWh                                                                                                                                         |
| Description:                           | $EF_y$ is the CO <sub>2</sub> 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 <sub>2</sub> Emission Database Version 6.0, March 2011.                                                                                            |
| Value applied:                         | 865                                                                                                                                                           |
| Justification of the choice of data or | 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 |

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|                                                                      |                                                                                                                                                                                     |
|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| description of measurement methods and procedures actually applied : | 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 equation 5 of this PDD defined as $EF_{grid,CM,y}$ and in equation 13 defined as $EF_{EL,y}$                                                                                     |

|                                                                                                             |                                                                                                                                                                                                                                                                                                   |
|-------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>                                                                                    | <b>ID. 2./ <math>EF_{grid,OM,y}</math></b>                                                                                                                                                                                                                                                        |
| Data unit:                                                                                                  | tCO <sub>2</sub> /GWh                                                                                                                                                                                                                                                                             |
| Description:                                                                                                | Operating Margin Emission Factor of the Southern grid.                                                                                                                                                                                                                                            |
| Source of data used:                                                                                        | The CEA CO <sub>2</sub> Emission Database Version 6.0, March 2011 <sup>77</sup> .                                                                                                                                                                                                                 |
| Value applied:                                                                                              | 966                                                                                                                                                                                                                                                                                               |
| 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 data. The parameter is calculated according to the guidelines of CDM modalities and procedures. |
| Any comment:                                                                                                | -                                                                                                                                                                                                                                                                                                 |

|                                                                                                             |                                                                                                                                                                                                                                                                                                   |
|-------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>                                                                                    | <b>ID. 3./ <math>EF_{grid,BM,y}</math></b>                                                                                                                                                                                                                                                        |
| Data unit:                                                                                                  | tCO <sub>2</sub> /GWh                                                                                                                                                                                                                                                                             |
| Description:                                                                                                | Build Margin Emission Factor of the Southern grid.                                                                                                                                                                                                                                                |
| Source of data used:                                                                                        | The CEA CO <sub>2</sub> Emission Database Version 6.0, March 2011 <sup>78</sup> .                                                                                                                                                                                                                 |
| Value applied:                                                                                              | 763                                                                                                                                                                                                                                                                                               |
| 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 data. The parameter is calculated according to the guidelines of CDM modalities and procedures. |
| Any comment:                                                                                                | -                                                                                                                                                                                                                                                                                                 |

|                                                                                                             |                                                                                                                                                    |
|-------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>                                                                                    | <b>ID. 4./ <math>GWP_{CH_4}</math></b>                                                                                                             |
| Data unit:                                                                                                  | CH <sub>4</sub>                                                                                                                                    |
| Description:                                                                                                | Global Warming Potential (GWP) of methane. The factor describes the conversion of 1 tCH <sub>4</sub> into 1 tCO <sub>2</sub> equivalent emissions. |
| Source of data used:                                                                                        | AMS-III.AO version 01..                                                                                                                            |
| Value applied:                                                                                              | 21                                                                                                                                                 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | as per methodology AMS-III.AO version 01, equations 1 where $GWP_{CH_4} = 21$                                                                      |
| Any comment:                                                                                                |                                                                                                                                                    |

<sup>77</sup> [http://www.cea.nic.in/reports/planning/cdm\\_co2/Database\\_publishing\\_ver6.zip](http://www.cea.nic.in/reports/planning/cdm_co2/Database_publishing_ver6.zip)

<sup>78</sup> [http://www.cea.nic.in/reports/planning/cdm\\_co2/Database\\_publishing\\_ver6.zip](http://www.cea.nic.in/reports/planning/cdm_co2/Database_publishing_ver6.zip)

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|                                                                                                             |                                                                                                                                                                                    |
|-------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>                                                                                    | <b>ID. 5./ <math>D_{CH_4} = \rho_{CH_4,n}</math></b>                                                                                                                               |
| Data unit:                                                                                                  | kg/m <sup>3</sup>                                                                                                                                                                  |
| Description:                                                                                                | Density of methane at normal conditions (20 °C and 1 atm pressure)                                                                                                                 |
| Source of data used:                                                                                        | IPCC 2006 default factor, see Equation 10.23 on pg.10.41 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Use.. |
| Value 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 equation 7 and 20 defined as $D_{CH_4}$ ; in equation 16 defined as $\rho_{CH_4,n}$                                                                                             |

|                                                                                                             |                                                                                                                                                                                                                                           |
|-------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>                                                                                    | <b>ID. 6./ <math>MCF_j</math></b>                                                                                                                                                                                                         |
| 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), <i>Methane Emission Potential of Poultry Litter</i> (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:                                                                                                | -                                                                                                                                                                                                                                         |

|                                                                                                             |                                                                                                                                                                                                        |
|-------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>                                                                                    | <b>ID 7./ <math>B_{o,LT}</math></b>                                                                                                                                                                    |
| Data unit:                                                                                                  | m <sup>3</sup> <sub>CH<sub>4</sub></sub> /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:                                                                                                | -                                                                                                                                                                                                      |

|                          |                                          |
|--------------------------|------------------------------------------|
| <b>Data / Parameter:</b> | <b>ID. 8./ <math>VS_{default}</math></b> |
| Data unit:               | Kg/head/day                              |
| Description:             | Volatile solids for livestock LT         |

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|                                                                                                             |                                                                                                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 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:                                                                                                | -                                                                                                                                                                                                       |

|                                                                                                             |                                                                                                                                                                                                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>                                                                                    | <b>ID. 9./ MS%<sub>BL,j,y</sub></b>                                                                                                                                                                                                                                                                     |
| Data unit:                                                                                                  | %                                                                                                                                                                                                                                                                                                       |
| Description:                                                                                                | Fraction of manure handled in baseline animal manure management system j in year y.                                                                                                                                                                                                                     |
| Source of data used:                                                                                        | Department of Bioenergy, Tamil Nadu Agricultural University (Tamil Nadu), <i>Methane Emission Potential of Poultry Litter</i> (October 2011). Document made available to the DOE as SD_04.                                                                                                              |
| Value applied:                                                                                              | 100%                                                                                                                                                                                                                                                                                                    |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | 100% of the poultry litter at poultry farms sourced by PP is managed under anaerobic conditions. PP refer to Department of Bioenergy, Tamil Nadu Agricultural University (Tamil Nadu), <i>Methane Emission Potential of Poultry Litter</i> (October 2011). Document made available to the DOE as SD_04. |
| Any comment:                                                                                                | -                                                                                                                                                                                                                                                                                                       |

|                                                                                                             |                                                                                                                                                                                   |
|-------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>                                                                                    | <b>ID. 10./ EF<sub>CO<sub>2</sub>,diesel,y</sub></b>                                                                                                                              |
| Data unit:                                                                                                  | tCO <sub>2</sub> /TJ                                                                                                                                                              |
| Description:                                                                                                | CO <sub>2</sub> 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 tool "Tool to calculate project or leakage CO <sub>2</sub> emissions from fossil fuel combustion" the following data sources may be used if the relevant conditions apply: |

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|                                                                                                                                                                                                                                                                                                                      | Data source                                                                                                                                                                                                | Conditions for using the data source                                                                                                                                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                      | a) Values provided by the fuel supplier in invoices                                                                                                                                                        | This is the preferred source                                                                                                                                              |
|                                                                                                                                                                                                                                                                                                                      | b) Measurements by the project participants                                                                                                                                                                | If a) is not available                                                                                                                                                    |
|                                                                                                                                                                                                                                                                                                                      | c) Regional or national default values                                                                                                                                                                     | If a) is not available<br><br>These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances) |
|                                                                                                                                                                                                                                                                                                                      | d) 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 | If a) is not available                                                                                                                                                    |
| As Project Participants do not have invoices from suppliers (option a), they have opted for option (d), the IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories. |                                                                                                                                                                                                            |                                                                                                                                                                           |
| Any comment:                                                                                                                                                                                                                                                                                                         | -                                                                                                                                                                                                          |                                                                                                                                                                           |

|                                                                                                             |                                                                                                                                                                                   |
|-------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>                                                                                    | <b>ID. 11./ NCV</b> Diesel                                                                                                                                                        |
| Data unit:                                                                                                  | GJ/t                                                                                                                                                                              |
| Description:                                                                                                | Net calorific value of diesel.                                                                                                                                                    |
| Source of data used:                                                                                        | 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy, Table 1.2                                                                                         |
| Value applied:                                                                                              | 43.3                                                                                                                                                                              |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | As per tool “Tool to calculate project or leakage CO <sub>2</sub> emissions from fossil fuel combustion” the following data sources may be used if the relevant conditions apply: |

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|                                                                                                                                                                                                                                                                                                                      | Data source                                                                                                                                                                                                | Conditions for using the data source                                                                                                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                      | a) Values provided by the fuel supplier in invoices                                                                                                                                                        | This is the preferred source if the carbon fraction of the fuel is not provided (Option A)                                                                                 |
|                                                                                                                                                                                                                                                                                                                      | b) Measurements by the project participants                                                                                                                                                                | If a) is not available                                                                                                                                                     |
|                                                                                                                                                                                                                                                                                                                      | c) Regional or national default values                                                                                                                                                                     | If a) is not available<br><br>These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances). |
|                                                                                                                                                                                                                                                                                                                      | d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories | If a) is not available                                                                                                                                                     |
| As Project Participants do not have invoices from suppliers (option a), they have opted for option (d). The IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories. |                                                                                                                                                                                                            |                                                                                                                                                                            |
| Any comment:                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                            |                                                                                                                                                                            |

| <b>Data / Parameter:</b>                                                                                    | <b>ID. 12./ <math>\rho_{\text{diesel}}</math></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |                                      |                                                     |                              |                                             |                        |                                        |                                                                                                                                                                            |
|-------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------------------|-----------------------------------------------------|------------------------------|---------------------------------------------|------------------------|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data unit:                                                                                                  | t/m <sup>3</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |                                      |                                                     |                              |                                             |                        |                                        |                                                                                                                                                                            |
| Description:                                                                                                | Density of diesel.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |                                      |                                                     |                              |                                             |                        |                                        |                                                                                                                                                                            |
| Source of data used:                                                                                        | CEA's CO <sub>2</sub> Emission Database Version 6.0, March 2011. Appendix B (page 25) of the CO <sub>2</sub> Baseline Database for the Indian Power Sector User Guide, accessed at:<br><a href="http://www.cea.nic.in/reports/planning/cdm_co2/user_guide_ver6.pdf">http://www.cea.nic.in/reports/planning/cdm_co2/user_guide_ver6.pdf</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |                                      |                                                     |                              |                                             |                        |                                        |                                                                                                                                                                            |
| Value applied:                                                                                              | 0.83                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |                                      |                                                     |                              |                                             |                        |                                        |                                                                                                                                                                            |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | As per tool "Tool to calculate project or leakage CO <sub>2</sub> emissions from fossil fuel combustion" the following data sources may be used if the relevant conditions apply: <table border="1"> <thead> <tr> <th>Data source</th><th>Conditions for using the data source</th></tr> </thead> <tbody> <tr> <td>a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr> <tr> <td>b) Measurements by the project participants</td><td>If a) is not available</td></tr> <tr> <td>c) Regional or national default values</td><td>If a) is not available<br/><br/>These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances).</td></tr> </tbody> </table> <p>Since (a) is not available to the PP, option (c) is opted and the value from the</p> | Data source | Conditions for using the data source | a) Values provided by the fuel supplier in invoices | This is the preferred source | b) Measurements by the project participants | If a) is not available | c) Regional or national default values | If a) is not available<br><br>These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances). |
| Data source                                                                                                 | Conditions for using the data source                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |                                      |                                                     |                              |                                             |                        |                                        |                                                                                                                                                                            |
| a) Values provided by the fuel supplier in invoices                                                         | This is the preferred source                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |                                      |                                                     |                              |                                             |                        |                                        |                                                                                                                                                                            |
| b) Measurements by the project participants                                                                 | If a) is not available                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |                                      |                                                     |                              |                                             |                        |                                        |                                                                                                                                                                            |
| c) Regional or national default values                                                                      | If a) is not available<br><br>These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |                                      |                                                     |                              |                                             |                        |                                        |                                                                                                                                                                            |

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|              |                                                                                                                                                                                                                                         |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|              | Central Electricity Authority (CEA) is used. The CEA is the statutory organisation under Ministry of Power who collects and records data concerning the generation, transmission, trading, distribution and utilization of electricity. |
| Any comment: |                                                                                                                                                                                                                                         |

|                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>                                                                                    | <b>ID. 13./ EF<sub>CO<sub>2</sub>,transport</sub></b>                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Data unit:                                                                                                  | kgCO <sub>2</sub> /km                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Description:                                                                                                | CO <sub>2</sub> emission factor from fuel use due to transportation.                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Source of data used:                                                                                        | Based on 8 km/ litre of average fuel consumption (F <sub>diesel,avg</sub> ) value determined as per contracts obtained from logistics company <sup>79</sup> .                                                                                                                                                                                                                                                                                                                            |
| Value applied:                                                                                              | 0.326                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Transport is subcontracted; value determined as per contracts obtained from logistics company <sup>80</sup> .                                                                                                                                                                                                                                                                                                                                                                            |
| Any comment:                                                                                                | $= (\text{NCV}_{\text{Diesel}} \times \rho_{\text{Diesel}} \times \text{EF}_{\text{CO}_2, \text{diesel}, y}) / F_{\text{diesel}, \text{avg}} / \text{liter} \times 1/1000 \text{ hence since:}$ $\text{NCV}_{\text{Diesel}} = \text{ID.11}$ $\rho_{\text{Diesel}} = \text{ID.12}$ $\text{EF}_{\text{CO}_2, \text{diesel}, y} = \text{ID.10}$ $F_{\text{diesel}, \text{avg}} = 8 \text{ km/liter, as per SD}_{28}.$ $\text{The result} = (42 \times 0.83 \times 74.8) / 8 / 1000 = 0.326$ |

|                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>                                                                                    | <b>ID. 14./ <math>\eta_{\text{flare}, h} = \text{FE}_y</math></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Data unit:                                                                                                  | %                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Description:                                                                                                | Flare efficiency in hour <i>h</i> based on measurements or default values.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Source of data used:                                                                                        | Default values given in the <i>Methodological Tool to determine project emissions from flaring gases containing methane</i> (Version 01).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Value applied:                                                                                              | 90%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | <p>Under the proposed project activity an enclosed flare will be installed. For enclosed flares the <i>Tool to determine project emissions from flaring gases containing methane</i> (Version 01) stipulates two options:</p> <ol style="list-style-type: none"> <li>To use a 90% default value. Continuous monitoring of compliance with manufacturer's specification of flare (temperature, flow rate of residual gas at the inlet of the flare) must be performed. If in a specific hour any of the parameters are out of the limit of manufacturer's specifications, a 50% default value for the flare efficiency should be used for the calculations for this specific hour.; or</li> <li>continuous monitoring of the methane destruction efficiency of the flare (flare efficiency).</li> </ol> <p>For determination of the flare efficiency option (a) – use of default values – has been chosen for the proposed project activity.</p> |

<sup>79</sup> Substrate Transport Quotation. Document made available to DOE.

<sup>80</sup> Substrate Transport Quotation. Document made available to DOE.



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|              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|              | <p>In case of enclosed flares and use of default values the following flare efficiency values shall be applied:</p> <ul style="list-style-type: none"> <li>• 0% if the temperature in the exhaust gas of the flare (<math>T_{\text{flare}}</math>) is below 500 °C for more than 20 minutes during the hour <math>h</math>;</li> <li>• 50%, if the temperature in the exhaust gas of the flare (<math>T_{\text{flare}}</math>) is above 500 °C for more than 40 minutes during the hour <math>h</math>, but the manufacturer's specifications on proper operation of the flare are not met at any point in time during the hour <math>h</math>;</li> <li>• 90%, if the temperature in the exhaust gas of the flare (<math>T_{\text{flare}}</math>) is above 500 °C for more than 40 minutes during the hour <math>h</math> and the manufacturer's specifications on proper operation of the flare are met continuously during the hour <math>h</math>.</li> <li>• As per paragraph 19 (b) of AMS-III.AO (Version 01) if the biogas is combusted for gainful purposes, e.g. fed to an engine, an efficiency of 100% may be applied</li> </ul> <p>Based on continuous measured <math>T_{\text{flare}}</math>, <math>\eta_{\text{flare}}</math> is determined based upon above default values.</p> |
| Any comment: | Used to calculate Project Emissions from flaring ( $PE_{\text{flare},y}$ ) as per Methodological Tool to determine project emissions from flaring gases containing methane (Version 01) (formula 15); Used to calculate Methane destructed in year $y$ ( $MD_y$ ) as per AMS-III.D (formula 18)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

|                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>                                                                                    | <b>ID.15./ <math>fv_{\text{CH}_4,\text{RG},h}</math></b>                                                                                                                                                                                                                                                                                                                                                |
| Data unit:                                                                                                  | mg/m <sup>3</sup>                                                                                                                                                                                                                                                                                                                                                                                       |
| Description:                                                                                                | Volumetric fraction of CH <sub>4</sub> in the residual gas in the hour $h$ .                                                                                                                                                                                                                                                                                                                            |
| Source of data used:                                                                                        | Page 2, 2 <sup>nd</sup> line below figure 01 of TNAU report <sup>81</sup>                                                                                                                                                                                                                                                                                                                               |
| Value applied:                                                                                              | 60%                                                                                                                                                                                                                                                                                                                                                                                                     |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Only used for ex-ante estimation of the methane content in the residual gas since PP opts to use option (a) page 3 of the "Tool to determine project emissions from flaring gases containing methane" (version 01). $fv_{\text{CH}_4,\text{RG},h}$ is only required in step 5 to calculate the ex-ante value of $TM_{\text{FG},h}$ since under step 6 PP opts to use default values and enclosed flare. |
| Any comment:                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                         |

|                                                       |                                                                                                                                                                                                                                                   |
|-------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>                              | <b>ID. 16./ <math>TDL_{j,y}</math></b>                                                                                                                                                                                                            |
| 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 | As per methodological; "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (Version 01) in case of scenario B and scenario C, case C.II, assume $TDL_{j/k,l,y} = 0$ as a simplification. In case of other |

<sup>81</sup> Department of Bioenergy, Tamil Nadu Agricultural University (Tamil Nadu), *Methane Emission Potential of Poultry Litter* (October 2011). Document made available to the DOE as SD\_04.

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|                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |                                         |                    |      |     |                                         |         |    |                                         |
|-------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----------------------------------------|--------------------|------|-----|-----------------------------------------|---------|----|-----------------------------------------|
| measurement methods and procedures actually applied : | <p>scenarios (scenario A and scenario C, cases C.I and C.III), choose one of the following options;</p> <ul style="list-style-type: none"> <li>• Use recent, accurate and reliable data available within the host country;</li> <li>• Use as default values of 20% for <ul style="list-style-type: none"> <li>(a) project or leakage electricity consumption sources;</li> <li>(b) baseline electricity consumption sources if the electricity consumption by all project and leakage electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies is larger than the electricity consumption of all baseline electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies.</li> </ul> </li> <li>• Use as default values of 3% for <ul style="list-style-type: none"> <li>(a) baseline electricity consumption sources;</li> <li>(b) project and leakage electricity consumption sources if the electricity consumption by all project and leakage electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies is smaller than the electricity consumption of all baseline electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies.</li> </ul> </li> </ul> <p>In light of the options above, Project Participants have opted for the following:</p> <table border="1"> <tr> <td rowspan="2">TDL<sub>j,y</sub></td><td>Grid</td><td>20%</td><td>as per tool 2nd bullet option (a) above</td></tr> <tr> <td>Gen Set</td><td>3%</td><td>as per tool 3rd bullet option (b) above</td></tr> </table> |     |                                         | TDL <sub>j,y</sub> | Grid | 20% | as per tool 2nd bullet option (a) above | Gen Set | 3% | as per tool 3rd bullet option (b) above |
| TDL <sub>j,y</sub>                                    | Grid                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 20% | as per tool 2nd bullet option (a) above |                    |      |     |                                         |         |    |                                         |
|                                                       | Gen Set                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 3%  | as per tool 3rd bullet option (b) above |                    |      |     |                                         |         |    |                                         |
| Any comment:                                          | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |     |                                         |                    |      |     |                                         |         |    |                                         |

**B.6.3 Ex-ante calculation of emission reductions:**

&gt;&gt;

**Baseline emissions:****Baseline emissions from electricity generation (from equation 3 above)**

| Input data                            |                    |            |
|---------------------------------------|--------------------|------------|
| biogas production                     | m <sup>3</sup> /y  | 7,585,568  |
| Calorific value Biogas LHV            | kWh/m <sup>3</sup> | 6.0        |
| biogas production                     | kWh/y              | 45,354,384 |
| biogas needed for gas engine          | kWh/y              | 43,478,261 |
| gas engine PLF                        | %                  | 86%        |
| gas engine                            | kW                 | 2,400      |
| gas engine efficiency                 | %                  | 41.4       |
| Gross power production                | kWh/y              | 18,000,000 |
| Electricity auxiliary consumption     | kWh/y              | 2,602,979  |
| Electricity auxiliary consumption     | %                  | 14.5%      |
| Net power sales (EG <sub>BL,y</sub> ) | kWh/y              | 15,397,021 |

EG<sub>BL,y</sub> : 15.4 GWh/y - monitored

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 $EF_{CO_2,grid,y}$ : 865 tCO<sub>2</sub>/GWh – ex-ante
**Calculations**

$$BE_{Elec,y} = EG_{BL,y} * EF_{CO_2,grid,y} \text{ (Equation 3)}$$

**Results**

$$BE_{Elec,y} = 13,318 \text{ tCO}_2\text{e/y}$$

**Baseline emissions from poultry litter**

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

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

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  |
| $VS_{default}^{82}$              | 0.02          | kg   | IPCC    |
| days per year                    | 365           | d    | Default |
| Calculations                     |               |      |         |
| $VS_{LT,y} = VS_{default} * 365$ |               |      |         |
| Results                          |               |      |         |
| $VS_{LT,y} = 7.3 \text{ kg/y}$   |               |      |         |

| Input data   |               |                   |                                        |
|--------------|---------------|-------------------|----------------------------------------|
| Variable     | Value applied | Unit              | Source                                 |
| $GWP_{CH_4}$ | 21            | -                 | ex-ante; see parameter ID.4 in § B.6.2 |
| $D_{CH_4}$   | 0.67          | kg/m <sup>3</sup> | ex-ante; see parameter ID.5 in § B.6.2 |
| $UF_b$       | 0.94          | -                 | ex-ante; Model correction              |

<sup>82</sup> As PP doesn't use developed country VS values section 25. (b) of AMS-III.D doesn't apply. Likewise, as per section 27  $W_{site}$  doesn't have to be monitored since IPCC values of VS are not adjusted.

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|                                                                                                                                        |           |              |                                                                |
|----------------------------------------------------------------------------------------------------------------------------------------|-----------|--------------|----------------------------------------------------------------|
|                                                                                                                                        |           |              | factor to account for model uncertainties (0.94) <sup>83</sup> |
| $MCF_j$                                                                                                                                | 22.84     | %            | ex-ante; see parameter ID.6 in § B.6.2                         |
| $B_{0,LT}$                                                                                                                             | 240       | $m^3 CH_4/t$ | ex-ante; see parameter ID.7 in § B.6.2                         |
| $N_{LT,y}$                                                                                                                             | 2,500,000 | birds        | Calculated                                                     |
| $VS_{LT,y}$                                                                                                                            | 7.3       | kg/y         | Calculated above                                               |
| $MS\%_{Bl,u}$                                                                                                                          | 100%      |              | ex-ante; see parameter ID.9 in § B.6.2                         |
| <b>Calculations</b>                                                                                                                    |           |              |                                                                |
| $BE_{manure,y} = GWP_{CH_4} * D_{CH_4} * UF_b * \sum_{j,LT} MCF_j * B_{0,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{Bl,j}$ <p>(Equation 8)</p> |           |              |                                                                |
| <b>Results</b>                                                                                                                         |           |              |                                                                |
| $BE_{manure,y} = 13,231 \text{ tCO}_2\text{e/y}$                                                                                       |           |              |                                                                |

Hence baseline emissions are:

|                                                  |  |  |  |
|--------------------------------------------------|--|--|--|
| <b>Input data</b>                                |  |  |  |
| $BE_{Elec,y} = 13,318 \text{ tCO}_2\text{e/y}$   |  |  |  |
| $BE_{manure,y} = 13,231 \text{ tCO}_2\text{e/y}$ |  |  |  |
| <b>Calculations</b>                              |  |  |  |
| $BE_y = BE_{Elec,y} + BE_{manure,y}$             |  |  |  |
| <b>Results</b>                                   |  |  |  |
| $BE_y = 26,549 \text{ tCO}_2\text{e/y}$          |  |  |  |

**Project emissions:****Emissions due to transportation ( $PE_{transp,y}$ )**

Calculate parameter  $EF_{CO_2}$

|                      |                      |             |                              |
|----------------------|----------------------|-------------|------------------------------|
| <b>Input data</b>    |                      |             |                              |
| <b>Variable</b>      | <b>Value applied</b> | <b>Unit</b> | <b>Source</b>                |
| $NCV_{Diesel}$       | 43.3                 | GJ/t        | ex-ante; see parameter ID.11 |
| $\rho_{Diesel}$      | 0.83                 | $t/m^3$     | ex-ante; see parameter ID.12 |
| $EF_{CO_2,diesel,y}$ | 74.8                 | $tCO_2/TJ$  | ex-ante; see parameter ID.10 |

<sup>83</sup> Reference: FCCC/SBSTA/2003/10/Add.2, page 25.

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|                                                                                                                                       |   |      |                                    |
|---------------------------------------------------------------------------------------------------------------------------------------|---|------|------------------------------------|
| $F_{\text{diesel,avg}}$                                                                                                               | 8 | km/l | ex-ante; see under parameter ID.13 |
| <b>Calculations</b>                                                                                                                   |   |      |                                    |
| $EF_{\text{CO}_2} = ((NCV_{\text{Diesel}} * \rho_{\text{Diesel}} * EF_{\text{CO}_2,\text{diesel},y}) / F_{\text{diesel,avg}}) / 1000$ |   |      |                                    |
| <b>Results</b>                                                                                                                        |   |      |                                    |
| $EF_{\text{CO}_2} = 0.336 \text{ kgCO}_2/\text{km}$                                                                                   |   |      |                                    |

Calculate parameter  $PE_{\text{transp},y}$

| <b>Input data</b>                                                                                                                                                                                                     |               |         |           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------|-----------|
| Variable                                                                                                                                                                                                              | Value applied | Unit    | Source    |
| $Q_y$                                                                                                                                                                                                                 | 96,825        | t/y     | monitored |
| $CT_y$                                                                                                                                                                                                                | 8             | t/truck | monitored |
| $DAF_w$                                                                                                                                                                                                               | 25            | km      | monitored |
| $Q_{\text{res waste},y}$                                                                                                                                                                                              | 22,706        | t/y     | monitored |
| $CT_{\text{res waste},y}$                                                                                                                                                                                             | 8             | t/truck | monitored |
| $DAF_{\text{res waste}}$                                                                                                                                                                                              | 50            | km      | monitored |
| <b>Calculations</b>                                                                                                                                                                                                   |               |         |           |
| (Equation 11):<br>$PE_{\text{transp},y} = (Q_y / CT_y) * DAF_w * EF_{\text{CO}_2,\text{transport}} + (Q_{\text{res waste},y} / CT_{\text{res waste},y}) * DAF_{\text{res waste}} * EF_{\text{CO}_2,\text{transport}}$ |               |         |           |
| <b>Results</b>                                                                                                                                                                                                        |               |         |           |
| $PE_{\text{transp},y} = PE_{y,\text{transp},\text{litter}} + PE_{y,\text{transp},\text{treatment}} = 149.36 \text{ tCO}_2\text{e/y}$                                                                                  |               |         |           |

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

| <b>Input data</b>                                                                                             |               |                      |                                             |
|---------------------------------------------------------------------------------------------------------------|---------------|----------------------|---------------------------------------------|
| Variable                                                                                                      | Value applied | Unit                 | Source                                      |
| $PE_{\text{power own gen}}$                                                                                   | 0             | tCO <sub>2</sub> e/y | own generation is renewable energy, hence 0 |
| $PE_{\text{power elec}}$                                                                                      | 0             | tCO <sub>2</sub> e/y | Monitored                                   |
| $PE_{\text{power DG}}$                                                                                        | 0             | tCO <sub>2</sub> e/y | Monitored                                   |
| <b>Calculations</b>                                                                                           |               |                      |                                             |
| $PE_{\text{power}} = PE_{\text{power own gen}} + PE_{\text{power elec}} + PE_{\text{power DG}}$ (Equation 12) |               |                      |                                             |
| <b>Results</b>                                                                                                |               |                      |                                             |
| $PE_{\text{power},y} = 0 \text{ tCO}_2\text{e/y}$                                                             |               |                      |                                             |

Since Project Participant expects to use 100% of the auxiliary power from its own Power Units, if diesel and/ or electricity from the grid are used during operations, then these will be monitored and the actual emissions will be calculated at the project site after implementation of the project activity).

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

|                   |
|-------------------|
| <b>Input data</b> |
|-------------------|

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| Variable                                                         | Value applied | Unit              | Source                                             |
|------------------------------------------------------------------|---------------|-------------------|----------------------------------------------------|
| Biogas                                                           | 7,984,808     | m <sup>3</sup> /y | BG <sub>flared,y</sub> + BG <sub>combusted,y</sub> |
| biogas leaked/ m <sup>3</sup> biogas                             | 0.05          | m <sup>3</sup> /y | as per AMS-III.AO                                  |
| biogas leaked                                                    | 399,240       | m <sup>3</sup> /y | Calculated                                         |
| W <sub>CH<sub>4</sub></sub>                                      | 60%           |                   | Monitored                                          |
| methane leaked                                                   | 239,544       | m <sup>3</sup> /y | Calculated                                         |
| ρ <sub>CH<sub>4</sub>,n</sub>                                    | 0.67          | kg/m <sup>3</sup> | IPCC ex-ante see parameter ID.5 in § B.6.2         |
| methane leaked                                                   | 160.49        | t/y               | Calculated                                         |
| GWP <sub>CH<sub>4</sub></sub>                                    | 21            |                   | IPCC ex-ante; see parameter ID.4 in § B.6.2        |
| <b>Calculations</b>                                              |               |                   |                                                    |
| $PE_{phy\ leakage,y} = \text{methane leaked (t/y)} * GWP_{CH_4}$ |               |                   |                                                    |
| <b>Results</b>                                                   |               |                   |                                                    |
| $PE_{phy\ leakage,y} = 3,370 \text{ tCO}_2\text{e/y}$            |               |                   |                                                    |

Project Emissions due to flaring (PE<sub>flare,y</sub>)

| <b>Input data</b>                                                                |               |                   |                                        |
|----------------------------------------------------------------------------------|---------------|-------------------|----------------------------------------|
| Variable                                                                         | Value applied | Unit              | Source                                 |
| FV <sub>RG,h</sub>                                                               | 912           | m <sup>3</sup> /h | Monitored                              |
| fV <sub>CH<sub>4</sub>,RG,h</sub>                                                | 60%           | -                 | ex-ante                                |
| ρ <sub>CH<sub>4</sub>,n</sub>                                                    | 0.67          | kg/m <sup>3</sup> | ex-ante; see parameter ID.5 in § B.6.2 |
| <b>Calculations</b>                                                              |               |                   |                                        |
| $TM_{RG,h} = FV_{RG,h} \times fV_{CH_4,RG,h} \times \rho_{CH_4,n}$ (Equation 16) |               |                   |                                        |
| <b>Results</b>                                                                   |               |                   |                                        |
| $TM_{RG,h} = 366 \text{ kg/h}$                                                   |               |                   |                                        |

| <b>Input data</b>             |               |      |                                                                                                                                         |
|-------------------------------|---------------|------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Variable                      | Value applied | Unit | Source                                                                                                                                  |
| TM <sub>RG,h</sub>            | 366           | kg/h | calculated above                                                                                                                        |
| η <sub>flare,h</sub>          | 90%           |      | ex-ante; see parameter ID.14 in § B.6.2                                                                                                 |
| GWP <sub>CH<sub>4</sub></sub> | 21            |      | ex-ante; see parameter ID.4 in § B.6.2                                                                                                  |
| time flare is burning         | 876           | h    | ex-ante assumption (10%); actual operating hours are determined through monitoring of ID. 17./ η <sub>flare,h</sub> = FE <sub>v</sub> . |
| <b>Calculations</b>           |               |      |                                                                                                                                         |

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$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} \times (1 - \eta_{flare,h}) \times \frac{GWP_{CH_4}}{1000}$$

(Equation 17)

**Results**

$$PE_{flare,y} = 674.08 \text{ tCO}_2\text{e/y}$$

**Project Emissions due to storage ( $PE_{res \text{ waste},y}$ )**

As per methodology AMS-III.AO version 01 paragraph 16, the methane emissions from anaerobic storage and/or disposal in a landfill of the residual waste from the digestion ( $PE_{res \text{ waste},y}$ ) are to be calculated as per the latest version of the tool “Emissions from solid waste disposal sites” (version 06.0.1). As detailed in table 4, application condition 5, no residual waste will be stored, hence:

$$PE_{res \text{ waste},y} = 0$$

**Leakage:**

$$LE_y = 0 \text{ tCO}_2\text{e}$$

**Emission reductions:**

$$ER_y = BE_y - PE_y - LE_y = 26,549 - 4,189 - 0 = 22,355 \text{ tCO}_2\text{e}$$

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

&gt;&gt;

| Year                            | Estimation of project activity emissions (tCO <sub>2</sub> e) | Estimation of baseline emissions (tCO <sub>2</sub> e) | Estimation of leakage (tCO <sub>2</sub> e) | Estimation of overall emission reductions (tCO <sub>2</sub> e) |
|---------------------------------|---------------------------------------------------------------|-------------------------------------------------------|--------------------------------------------|----------------------------------------------------------------|
| 2013                            | 4,194                                                         | 26,549                                                | 0                                          | 22,355                                                         |
| 2014                            | 4,194                                                         | 26,549                                                | 0                                          | 22,355                                                         |
| 2015                            | 4,194                                                         | 26,549                                                | 0                                          | 22,355                                                         |
| 2016                            | 4,194                                                         | 26,549                                                | 0                                          | 22,355                                                         |
| 2017                            | 4,194                                                         | 26,549                                                | 0                                          | 22,355                                                         |
| 2018                            | 4,194                                                         | 26,549                                                | 0                                          | 22,355                                                         |
| 2019                            | 4,194                                                         | 26,549                                                | 0                                          | 22,355                                                         |
| 2020                            | 4,194                                                         | 26,549                                                | 0                                          | 22,355                                                         |
| 2021                            | 4,194                                                         | 26,549                                                | 0                                          | 22,355                                                         |
| 2022                            | 4,194                                                         | 26,549                                                | 0                                          | 22,355                                                         |
| <b>Total (tCO<sub>2</sub>e)</b> | <b>41,938</b>                                                 | <b>265,494</b>                                        | <b>0</b>                                   | <b>223,550</b>                                                 |

**B.7 Application of a monitoring methodology and description of the monitoring plan:****B.7.1 Data and parameters monitored:**

|                          |                                                          |
|--------------------------|----------------------------------------------------------|
| <b>Data / Parameter:</b> | <b>ID. 18./ EG<sub>gross,y</sub></b>                     |
| Data unit:               | GWh/y                                                    |
| Description:             | The gross electricity generated by the project activity. |
| Source of data to be     | Energy meter.                                            |

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|                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| used:                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 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:                                 | <p>The data is monitored continuously. The Operator reports the readings on a monthly basis. Based on the logged data, a monthly report is prepared by Manager-in-Charge and is forwarded to CDM Coordinator through email on monthly basis. The data used is reviewed by conducting an inter department review meeting once in 6 months. The Coordinator CDM will discuss the data (received from respective departments) with the operators of the concerned departments. Accuracy class is 0.2S class as per IEC62053-22.</p> <p>Once the data is compiled and checked, it will be handed over to Verifier for verification. The measuring equipment used for monitoring data is calibrated as per manufacturers specifications, but at least once in three years as per § 17.c of the general guidelines to SSC CDM methodologies (version 17).</p> |
| 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

|                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>                                         | <b>ID. 19./EG<sub>BL,v</sub></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Data unit:                                                       | GWh/y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Description:                                                     | Net electricity supplied by the project activity to the grid.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Source of data to be used:                                       | TANGEDCO (Tamil Nadu Generation and Distribution Corporation) report based on this which PP will raise the invoice to TANGEDCO along with duly signed report.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Value of data:                                                   | 15.26                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Description of measurement methods and procedures to be applied: | The energy meter operates continuously. TANGEDCO official will check the energy meter (primary) once per month and the reading will be recorded in the log books. The TANGEDCO official will issue a monthly consumption statement, which will be used as source of data. Based on this statement PP will raise the invoice to TANGEDCO along with the monthly consumption statement.                                                                                                                                                                                                                                                                                                                                                                                                                                |
| QA/QC procedures to be applied:                                  | <p>If primary energy meter fails to read then TANGEDCO will refer the secondary energy meter.</p> <p>If both energy meters fails then source of data will be used from the previous last 3 months reports mutually agreed by PP &amp; TANGEDCO.</p> <p>Based on the logged data, a report is prepared by Manager-in-Charge and is forwarded to CDM Coordinator through email on monthly basis. The data used is reviewed by conducting an inter department review meeting once in 6 months. The Coordinator CDM will discuss the data (received from respective departments) with the operators of the concerned departments.</p> <p>Once the data is compiled and checked, it will be handed over to Verifier for verification.</p> <p>The metering arrangements with facilities to record export and import of</p> |



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|              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|              | 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 <sup>84</sup> The energy meters healthiness will be checked by TANGEDCO at regular intervals will be decided by TANGEDCO on time to time basis. The measuring equipment used for monitoring data is calibrated as per manufacturers specifications, but at least once in three years as per § 17.c of the general guidelines to SSC CDM methodologies (version 17). |
| Any comment: | The above methodology is accepted by PP in EPA signed with TANGEDCO.<br><br>The data will be archived electronically until two years after the end of crediting period or the last issuance of CERs for this project activity, whichever occurs later as per § 17.a of the general guidelines to SSC CDM methodologies (version 17).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

|                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>                                         | <b>ID. 20./ EC<sub>PJ,y</sub></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Data unit:                                                       | GWh/y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Description:                                                     | Net electricity imported from the grid in case the Power units are not operating.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Source of data to be used:                                       | TANGEDCO (Tamil Nadu Generation and Distribution Corporation) report based on this which PP will raise the invoice to TANGEDCO along with duly signed report.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Value of data:                                                   | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Description of measurement methods and procedures to be applied: | The energy meter operates continuously. TANGEDCO official will check the energy meter (primary) once per month and the reading will be recorded in the logbooks. The TANGEDCO official will issue a monthly consumption statement, which will be used as source of data. Based on this statement TANGEDCO will raise an invoice along with duly signed report if the Net electricity supplied by the project activity to the grid minus the net electricity imported is negative over the reporting period (if more electricity is imported than supplied).                                                                                                                                                         |
| QA/QC procedures to be applied:                                  | If primary energy meter fails to read then TANGEDCO will refer the secondary energy meter.<br><br>If both energy meters fail then source of data will be used from the previous last 3 months reports mutually agreed by PP & TANGEDCO.<br><br>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, |

<sup>84</sup> Biomass Energy Purchase Agreement. Document made available to DOE.

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|              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|              | calibration etc., will be governed by the Regulations issued by the Central Electricity Authority / Commission <sup>85</sup> The energy meters healthiness will be checked by TANGEDCO at regular intervals will be decided by TANGEDCO on time to time basis. The measuring equipment used for monitoring data is calibrated as per manufacturers specifications, but at least once in three years as per § 17.c of the general guidelines to SSC CDM methodologies (version 17). |
| 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.                                                                                                                                                                                                                                                                                                                        |

|                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>                                         | <b>ID. 21./ <math>Q_{i,v}</math></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Data unit:                                                       | t/y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Description:                                                     | Amount of waste type <i>i</i> (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<br>58,000 Agricultural biomass residue<br>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 onsite weighbridge. The delta in weight between the empty truck and the loaded truck is taken as the weight of the poultry litter.                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| QA/QC procedures to be applied:                                  | Each weigh instance is monitored and logged in the log book by the Operator. Based on the logged data, a monthly report is prepared by Manager-in-Charge and is forwarded to CDM Coordinator through email on monthly basis. Once the data is compiled and checked, it will be handed over to Verifier for verification. The measuring equipment (electronic weigh bridge) is designed as per IS: 9281 manufacturing standard specifications (+/- 0.025% of FS) <sup>86</sup> . The measuring equipment used for monitoring data is calibrated as per manufacturers specifications, but at least once in three years as per § 17.c of the general guidelines to SSC CDM methodologies (version 17).. |
| 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

|                                                                  |                                                                                                                                                                                                                                                                                                                 |
|------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>                                         | <b>ID. 22./ <math>Q_{res\ waste,v}</math></b>                                                                                                                                                                                                                                                                   |
| 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. |

<sup>85</sup> Biomass Energy Purchase Agreement; Document made available to DOE.

<sup>86</sup> SD\_76 Weigh bridge data sheet provided to the DOE

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|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| QA/QC procedures to be applied: | Each weigh instance is monitored and logged in the log book on a daily basis by the Operator. Based on the logged data, a monthly report is prepared by the Manager-in-Charge and is forwarded to the CDM Coordinator through email on monthly basis. Once the data is compiled and checked, it will be handed over to the Verifier for verification. The measuring equipment (electronic weigh bridge) is designed as per IS:9281 manufacturing standard specifications (+/- 0.025% of FS). The measuring equipment used for monitoring data is calibrated as per manufacturers specifications, but at least once in three years as per § 17.c of the general guidelines to SSC CDM methodologies (version 17). |
| 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

|                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>                                         | <b>ID.23./ <math>w_{CH4}</math></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Data unit:                                                       | %                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Description:                                                     | Methane content in the biogas (dry).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Source of data to be used:                                       | Gas analyser.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Value of data:                                                   | 60%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Description of measurement methods and procedures to be applied: | Data is monitored continuously. Values are logged every half hour. The CH <sub>4</sub> content is analysed by NDIR (non-dispersive infrared sensor) and is hence measured directly and the measurement point is close to the biogas flow rate measurement point (ID.24).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| QA/QC procedures to be applied:                                  | <p>The 30 minutes interval assures a confidence/ precision level higher than the 90/10 level required (see appendix 4 regarding the required sample size).</p> <p>Based on the logged data, a monthly report is prepared by Manager-in-Charge which is forwarded to the CDM Coordinator. The data used is reviewed by conducting a inter department review meeting once in 6 months. Once the data is compiled and checked, it will be handed over to the Verifier for verification. The measuring equipment (Gas analyser) is designed as per ANSI/API RP 555-2001 manufacturing standard specifications. The measuring equipment used for monitoring data is calibrated as per manufacturers specifications, but at least once in three years as per § 17.c of the general guidelines to SSC CDM methodologies (version 17).</p> |
| 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 as per § 17.a of the general guidelines to SSC CDM methodologies (version 17). Value is used in equation 23.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

|                                    |                                                                                                              |
|------------------------------------|--------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>           | <b>ID. 24./<math>FV_{RG,h}</math></b>                                                                        |
| Data unit:                         | m <sup>3</sup> /h                                                                                            |
| Description:                       | Volumetric flow rate of the residual gas in dry basis at normal conditions in hour <i>h</i> .                |
| Source of data to be used:         | Measurements by project participants using a Thermal mass flow meter.                                        |
| Value of data:                     | 912 (sourced from SD_16 CDM financial analysis, on the tab-sheet “CER”; SD_16 made available to DOE).        |
| Description of measurement methods | Will be continuously measuring the gas flow rate and the value will be logged in PLC on a half hourly basis. |

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|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| and procedures to be applied:   | Accuracy measurement: $\pm 1.8\%$ of reading + 0.1% full scale <sup>87</sup> .<br>PP will ensure that the same basis (dry) is considered for this measurement.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| QA/QC procedures to be applied: | Data is monitored continuously. Values are logged every half hour. Based on the logged data, a monthly report is prepared by Manager-in-Charge which is forwarded to CDM Coordinator. The measuring equipment is designed using IS/ANSI manufacturing standard specifications. The measuring equipment used for monitoring data is calibrated as per manufacturers specifications, but at least once in three years as per § 17.c of the general guidelines to SSC CDM methodologies (version 17).                                                                                                                                                                                                                                                                                                                                         |
| 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 as per § 17.a of the general guidelines to SSC CDM methodologies (version 17).<br><br>In § III of the “Tool to determine project emissions from flaring gases containing methane” (version 01) in the parameter box for $FV_{RG,h}$ under “Measurement procedures” the following sentence is included (“[...] and the measurement of volumetric fraction of all components in the residual gas ( $f_{v,i,h}$ ) when the residual gas temperature exceeds 60 °C]. Since PP opts to use option (a) page 3 of the “Tool to determine project emissions from flaring gases containing methane” (version 01), this part of the sentence is not relevant and has hence been left out. |

|                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>                                         | <b>ID.25./ <math>BG_{combusted,v}</math></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Data unit:                                                       | $m^3/y$ (normalized)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Description:                                                     | The amount of the biogas combusted, measured on a dry basis.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Source of data to be used:                                       | Flow meter.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Value of data:                                                   | 7,186,328 (sourced from SD_16 CDM financial analysis, on the tab-sheet ‘Energy & Mass Balance’; SD_16 made available to DOE).                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Description of measurement methods and procedures to be applied: | The quantity of biogas generated is measured using a calibrated flow meter. The flow meter values are logged in the system. The accuracy class of the flow meter for is +0.1% of full scale.                                                                                                                                                                                                                                                                                                                                                                                                      |
| QA/QC procedures to be applied:                                  | Data is monitored continuously. Values are logged every half hour. Based on the logged data, a monthly report is prepared by Manager-in-Charge which is forwarded to CDM Coordinator. The data used is reviewed by conducting a inter department review meeting once in 6 months. Once the data is compiled and checked, it will be handed over to Verifier for verification. The measuring equipment used for monitoring data is calibrated as per manufacturers specifications, but at least once in three years as per § 17.c of the general guidelines to SSC CDM methodologies (version 17). |
| 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.                                                                                                                                                                                                                                                                                                                                                                                                                                       |

|                          |                                                                         |
|--------------------------|-------------------------------------------------------------------------|
| <b>Data / Parameter:</b> | <b>ID.26./ <math>BG_{flared,v}</math></b>                               |
| Data unit:               | $m^3/y$ (normalized)                                                    |
| Description:             | The amount of biogas generated that is flared, measured on a dry basis. |

<sup>87</sup> SD\_69\_Flow\_meter\_spec\_sheet

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|                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Source of data to be used:                                       | Project participants will monitor which will provide the actual value with flow meter.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Value of data:                                                   | 798,481 (sourced from SD_16 CDM financial analysis, on the tab-sheet “CER”; SD_16 made available to DOE).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Description of measurement methods and procedures to be applied: | The quantity of biogas flared is measured using a calibrated flow meter. The flow meter values are logged in the system. The accuracy class of the flow meter for is $\pm 0.1\%$ of full scale.                                                                                                                                                                                                                                                                                                                                                                                                    |
| QA/QC procedures to be applied:                                  | Data is monitored continuously. Values are logged every half hour.. Based on the logged data, a monthly report is prepared by Manager-in-Charge which is forwarded to CDM Coordinator. The data used is reviewed by conducting a inter department review meeting once in 6 months. Once the data is compiled and checked, it will be handed over to Verifier for verification. The measuring equipment used for monitoring data is calibrated as per manufacturers specifications, but at least once in three years as per § 17.c of the general guidelines to SSC CDM methodologies (version 17). |
| 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.                                                                                                                                                                                                                                                                                                                                                                                                                                        |

|                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>                                         | <b>ID. 27./ Frequency of tilling</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Data unit:                                                       | Number                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Description:                                                     | Number of times each batch is tilled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Source of data to be used:                                       | Plant records (Log book maintained at drying yard).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Value of data:                                                   | Once per day                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Description of measurement methods and procedures to be applied: | The digester sludge output will be separated in a common separation system. The solid phase will be solar dried in a dedicated fertilizer yard. The piles are regularly turned (once or twice in a day) to improve porosity and oxygen content of the piles, thus ensuring that the solids are aerobically handled. Each batch is dried for approximately 12 - 13 days.                                                                                                                                                                                                                                                                                 |
| QA/QC procedures to be applied:                                  | The Operator reports the readings at each tilling in the plant records, as well as when the sludge is removed. Based on the logged data, a monthly report is prepared by the Manager-in-Charge and is forwarded to the CDM Coordinator. The data used is reviewed by conducting a inter department review meeting once in 6 months. Once the data is compiled and checked, it will be handed over to the Verifier for verification. The measuring equipment used for monitoring data is calibrated as per manufacturers specifications, but at least once in three years as per § 17.c of the general guidelines to SSC CDM methodologies (version 17). |
| 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

|                            |                                                                                               |
|----------------------------|-----------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>   | <b>ID. 28./FC<sub>Diesel</sub></b>                                                            |
| 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:             | Zero.                                                                                         |
| Description of             | Monthly stock balance shall be used for calculating quantity of diesel                        |

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|                                                   |                                                                                                                                                             |
|---------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| measurement methods and procedures to be applied: | 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. |

|                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>                                         | <b>ID. 29./ <math>T_{\text{flare}}</math></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Data unit:                                                       | °C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Description:                                                     | Temperature in the exhaust gas of the flare.                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Source of data to be used:                                       | Measurements by project participants.                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Value of data:                                                   | > 500°C.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 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 °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 monitored continuously. Values are logged every half hour. Based on the logged data, a monthly report is prepared by the Accounts Manager in hard or soft copy and is forwarded to the CDM Coordinator through email on monthly basis. Once the data is compiled and checked, it will be handed over to the Verifier for verification. The thermocouples are manufactured as per ANSI standard specifications. Thermocouples are replaced or calibrated every year as per the manufacturer recommendations. |
| Any comment:                                                     | An excessively high temperature at the sampling point (above 700 °C) may be an indication that the flare is not being adequately operated or that its capacity is not adequate to the actual flow. The data will be archived until two years after the end of crediting period or the last issuance of CERs for this project activity, whichever occurs later.                                                                                                                                                      |

|                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>                                         | <b>ID. 30./ <math>N_{LT,y}</math></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Data unit:                                                       | Individual bird.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Description:                                                     | Livestock population.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Source of data to be used:                                       | Based on back-calculation of poultry litter requirement of the plant (i.e. design capacity) and average generation data (i.e. 40 g / head / day)                                                                                                                                                                                                                                                                                                                                                            |
| Value 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 <sup>88</sup> . The value $N_{LT,y}$ is determined through back-calculation of the poultry litter requirement of the plant on an annual basis.<br><br>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. |

<sup>88</sup> Department of Bioenergy, Tamil Nadu Agricultural University (Tamil Nadu), *Methane Emission Potential of Poultry Litter* (October 2011). Document made available to the DOE as SD\_04.

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|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 livestock population will be explained.                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Any comment:                   | <p>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.</p> <p>For 100% of the population the used value is then based on the following back calculation: <math>\sim 2.5</math> million heads * <math>\sim 40</math> grams per head per day * 365 operational days <math>\approx 37,000</math> tonne of poultry litter per year.</p> <p>As the animal manure is not treated in different treatment systems, the parameter <math>MS\%_{i,y}</math> doesn't have to be monitored as is defined in section 26 no. 15 of AMS-III.D version 18.</p> |

|                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>                                        | <b>ID. 31./DAF<sub>w,i</sub></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Data unit:                                                      | km/truck                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Description:                                                    | Average incremental distance for waste type <i>i</i> (poultry litter, agri waste and cow dung) transportation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Source of data to be used:                                      | Records (TRIPSHEETS) showing from which location the waste originates.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Value of data:                                                  | 25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Description of measurement methods and procedures to be applied | The “average incremental distance” of 25 km is taken as a conservative average. This is as per SD_03, Detailed Project Report, pages 53 through 63 and also based on TIDE Technocrat report; Since PP cannot calculate the baseline distance; PP has opted to monitor (sample) the distances and use the sampled values without subtracting the baseline (original) distance. Hence the “average incremental distance was determined based on all the distances provided in pages 53 through 63 of the DPR, which are based on SD_02 Tide Technocrats Report. The average distance is less, which is below 25 km. PP considering a conservative value of 25 KM, and therefore; the proposed project activity complies with this requirement. |
| QA/QC procedures to be applied                                  | Records (TRIPSHEETS) showing from which location the waste originates. Through statistically sound sampling the distance between those locations and the project (plant) site is determined and verified.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Any comment:                                                    | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

|                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>                                        | <b>ID. 32./ DAF<sub>res waste</sub></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Data unit:                                                      | km/truck                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Description:                                                    | Average incremental distance for compost transportation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Source of data to be used:                                      | Records i.e. TRIPSHEETS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Value of data:                                                  | 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Description of measurement methods and procedures to be applied | <p>50 km is taken as a conservative average. The parameter will be determined through sampling (see Annex 4 sampling plan). For determining the ex-ante value: this was based on SD_02 Tide Technocrats Report: the survey conducted for compost sales. The area covered for 50 kms radius distance from project site, the compost can be sold to farmers for agricultural purpose.</p> <p>Page 25 table 10 of the Tide Technocrats Private Limited (Bangalore), <i>Assessment Report of feedstock availability and market for biomethanation solids</i> (April 2011). Document made available to the DOE</p> |

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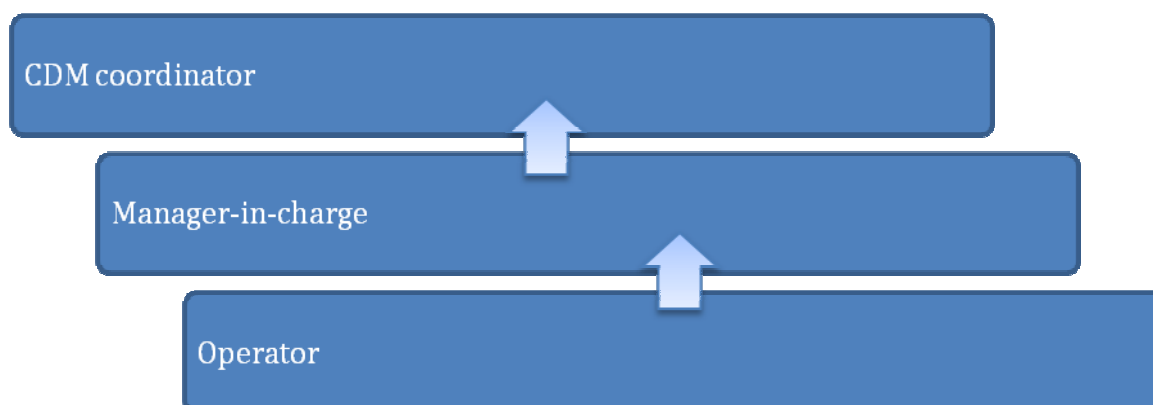
|                                |                                                                                                                                                                                                                                                                                        |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| QA/QC procedures to be applied | The location of each batch of compost sold will be registered and documented via sales records and TRIPSHEETS. The distances from the project (plant) site to these sample soil application locations of the compost are averaged and cross-referenced with the compost sales records. |
| Any comment:                   | -                                                                                                                                                                                                                                                                                      |

|                                                                 |                                                                                                                                                                                                                                                                                                                               |
|-----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter:</b>                                        | <b>ID. 33./ APP<sub>comp</sub></b>                                                                                                                                                                                                                                                                                            |
| Data unit:                                                      | %-age                                                                                                                                                                                                                                                                                                                         |
| Description:                                                    | Proper application of compost                                                                                                                                                                                                                                                                                                 |
| Source of data to be used:                                      | An external local expert shall execute the sampling.                                                                                                                                                                                                                                                                          |
| Value of data:                                                  | 100%                                                                                                                                                                                                                                                                                                                          |
| Description of measurement methods and procedures to be applied | The soil application should be monitored to ensure that there is proper application of compost. A sample of 20 hectares of land per annum to check on proper application of compost and condition during application which does not lead to any further emissions. Final crop for which compost is used should be recorded.   |
| QA/QC procedures to be applied                                  | The location of each batch of compost sold will be registered and documented via sales records and TRIPSHEETS. A statistically sound test sample land area totalling 20 hectares is determined from locations where soil application of the compost takes place (as per SD_32 Tide Compost Report made available to the DOE). |
| 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 as per § 17.a of the general guidelines to SSC CDM methodologies (version 17).                                                                                     |

**B.7.2 Description of the monitoring plan:**

&gt;&gt;

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



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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, whichever 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 participant. This would be done at a frequency of less than 3 years in line with the guidance.

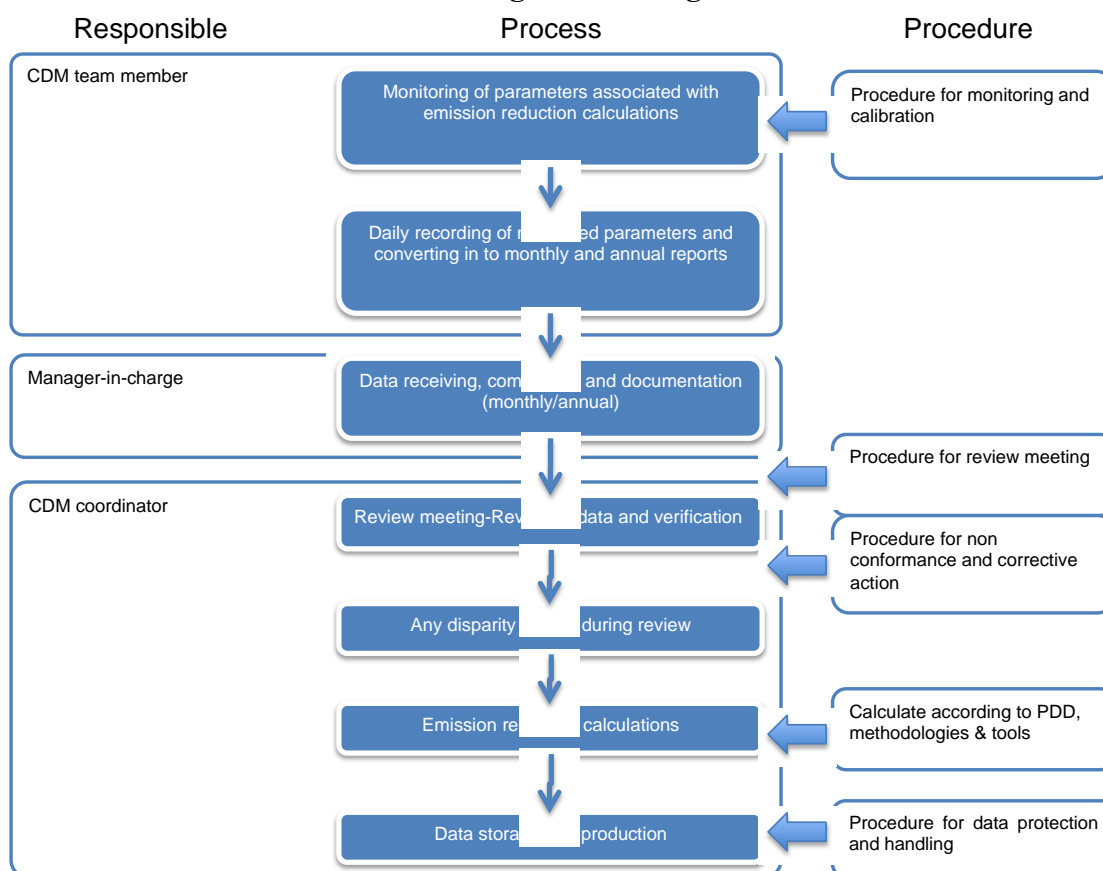
- (d) *The measured data with high levels of uncertainty or without adequate calibration should be compared with location/national data and commercial data to ensure consistency;*

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.

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**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:

$$ER_{y,ex\ post} = \min \left[ (BE_{y,ex\ post} - PE_{y,ex\ post} - LE_{y,ex\ post}), (MD_y - PE_{y,power,ex\ post} - PE_{y,transp,ex\ post} - PE_{y,res\ waste,ex\ post} - PE_{y,phy\ leakage,ex\ post} - LE_{y,ex\ post}) \right] \quad (\text{Equation 19})$$

Where:

$ER_{y,ex\ post}$

Emission reductions achieved by the project activity based on monitored values for year y (tCO<sub>2</sub>e)

$BE_{y,ex\ post}$

Baseline emissions calculated using equation 6 using *ex post* monitored values (e.g.  $Q_y$ ) (tCO<sub>2</sub>e)

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|                                |                                                                                                                                                                                                                                                                                                       |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $PE_{y,ex\ post}$              | Project emissions calculated using equation (10) using <i>ex post</i> 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 <sub>2</sub> e) |
| $LE_{y,ex\ post}$              | Leakage emissions calculated using <i>ex post</i> monitored values (tCO <sub>2</sub> e)                                                                                                                                                                                                               |
| $MD_y$                         | Methane captured and destroyed or used gainfully by the project activity in year y (tCO <sub>2</sub> e)                                                                                                                                                                                               |
| $PE_{y,transp,ex\ post}$       | Emissions from incremental transportation based on monitored values in the year y (tCO <sub>2</sub> e)                                                                                                                                                                                                |
| $PE_{y,power,ex\ post}$        | 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 <sub>2</sub> e)                                                                                                                                       |
| $PE_{y,res\ waste,ex\ post}$   | Methane emissions from the anaerobic decay/treatment of the residual waste/products based on monitored values in the year y (tCO <sub>2</sub> e)                                                                                                                                                      |
| $PE_{y,phy\ leakage,ex\ post}$ | Methane emissions from physical leakages of the anaerobic digester based on monitored values in year y (tCO <sub>2</sub> e)                                                                                                                                                                           |

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

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

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

$PE_{power,y}$

### Monitoring parameters to determine ex-post methane capture & destroyed ( $MD_y$ )

**According to paragraph 19 (b) of AMS-III.AO (Version 01):** flaring/ combustion  $MD_y$  will be measured using the conditions of the flaring process:

$$MD_y = BG_{burnt,y} * w_{CH_4,y} * D_{CH_4} * FE * GWP_{CH_4} \quad (\text{Equation 20})$$

Where:

|                |                                                                                                                                                                               |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $BG_{burnt,y}$ | Biogas <sup>89</sup> flared/combusted in year y (m <sup>3</sup> )                                                                                                             |
| $w_{CH_4,y}$   | Methane content in the biogas in the year y (volume fraction)                                                                                                                 |
| $D_{CH_4}$     | Density of methane at normal conditions (20°C at 1 atmosphere) (tonnes/m <sup>3</sup> )                                                                                       |
| $FE$           | Flare efficiency in the year y (fraction). If the biogas is combusted for gainful purposes, e.g. fed to an engine, an efficiency of 100% may be applied (see parameter ID.14) |

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

*The method for integration of the terms to calculate  $MD_y$  to obtain the results for one year of measurements within the confidence level, as well as the methods and instruments used for*

<sup>89</sup> Biogas and methane content measurements shall be on the same basis (dry).

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*metering, recording and processing the data obtained, shall be described in the project design document and monitored during the crediting period;*

The methods and instruments used for metering, recording and processing are described in the relevant parameter boxes for  $BG_{\text{flared},y}$ ,  $BG_{\text{combusted},y}$ ,  $w_{\text{CH}_4}$ ,  $D_{\text{CH}_4}$  and FE. The monitored parameters are  $w_{\text{CH}_4}$  (ID.23)  $BG_{\text{combusted},y}$  (ID.24),  $BG_{\text{flared},y}$  (ID.25) and  $T_{\text{flare}}$  (ID.28).

| ID |                           | Description                                   | Measurement point | How monitored                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----|---------------------------|-----------------------------------------------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 23 | $w_{\text{CH}_4}$         | Methane content in the biogas                 | Control room      | Values are logged every half hour. This results in 17520 measurement points (365 days * 24 hours * 2 measurements per hour) values. These values are then exported using a CSV file into Excel.                                                                                                                                                                                                                                                                        |
| 24 | $BG_{\text{combusted},y}$ | The total amount of the biogas combusted      | Control room      | Values are logged every half hour. This results in 17520 measurement points (365 days * 24 hours * 2 measurements per hour) values. These values are then exported using a CSV file into Excel.                                                                                                                                                                                                                                                                        |
| 25 | $BG_{\text{flared},y}$    | The amount of biogas generated that is flared | Control room      | Values are logged every half hour. This results in 17520 measurement points (365 days * 24 hours * 2 measurements per hour) values. These values are then exported using a CSV file into Excel.                                                                                                                                                                                                                                                                        |
| 28 | $T_{\text{flare}}$        | Temperature in the exhaust gas of the flare.  | Flare             | Using a Type N thermocouple the temperature is monitored continuously; the average value is logged every half hour by the system. This results in 17520 measurement points (365 days * 24 hours * 2 measurements per hour) values. These values are then exported using a CSV file into Excel. Here the project participant checks if they should be taken into account (see parameter box ID.14 FE <sub>y</sub> ) and then averages all values into one annual value. |

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

| Time interval       | $BG_{\text{flared}}$ | $BG_{\text{combusted}}$ | $T_{\text{flare}}$ | $w_{\text{CH}_4}$ | FE                                | MD                                             |
|---------------------|----------------------|-------------------------|--------------------|-------------------|-----------------------------------|------------------------------------------------|
|                     | Monitored            | Monitored               | Monitored          | Monitored         | Default (see parameter box ID.14) | Calculated (See equation 23)                   |
| 00:30:00            | m <sup>3</sup>       | m <sup>3</sup>          | °C                 | %                 | 100%; 90%; 50%; 0%                | tCO <sub>2</sub> e                             |
| 01:00:00            | m <sup>3</sup>       | m <sup>3</sup>          | °C                 | %                 | 100%; 90%; 50%; 0%                | tCO <sub>2</sub> e                             |
| Etc.                |                      |                         |                    |                   |                                   |                                                |
| ...                 |                      |                         |                    |                   |                                   |                                                |
| <b>Annual Total</b> |                      |                         |                    |                   |                                   | <b>TOTAL tCO<sub>2</sub>e/y (sum of above)</b> |

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

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

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

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

Hence:

$$BG_{\text{burnt},y} = BG_{\text{combusted},y} + BG_{\text{flared},y} \quad \text{(Equation 21)}$$

Hence equation (18) is rewritten:

$$MD_y = (BG_{\text{flared},y} * w_{CH_4,y} * D_{CH_4} * FE * GWP_{CH_4}) + (BG_{\text{combusted},y} * w_{CH_4,y} * D_{CH_4} * GWP_{CH_4}) \quad \text{(Equation 22)}$$

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

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

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

|        |                           |              |                   |
|--------|---------------------------|--------------|-------------------|
| ID. 23 | $w_{CH_4}$                | gas analyser | see parameter box |
| ID. 24 | $FV_{RG,h}$               | flow meter   | see parameter box |
| ID. 25 | $BG_{\text{combusted},y}$ | flow meter   | see parameter box |
| ID. 26 | $BG_{\text{flared},y}$    | flow meter   | see parameter box |

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

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

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

#### **Monitoring requirement for verification of proper soil application**

As per AMS-III.F paragraph 25 the project participant will archive all sales records for the treated residue (compost). The conditions for proper soil application ensuring aerobic conditions have been established by a local expert<sup>90</sup>.

<sup>90</sup> Tide Technocrats Private Limited, Bangalore, Assessment report of feedstock availability and market for Biomethanation Solids, April 2011 - - Made available to the DOE

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

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

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

Based on the mass balance (supporting document SD\_14) the  $MD_y$  of the gas will be  $7.5 \text{ mln m}^3 \cdot \text{density} \cdot \text{methane content} \cdot 21 \sim 65,000 \text{ CERs}$ . Equation (6) would result in  $\sim 13,200 \text{ CERs}$  claimed ( $BE_{y,expost}$ ), in which case ER would equal  $\text{MIN}(BE_{y,expost}, MD_y) = 13,200 \text{ CERs}$ .

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

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

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

**Apportioning Procedure**

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

To determine electricity consumed on site:

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

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

The draft of this baseline section has been completed on 20/05/2012 by Mr G.J. Eenhoorn and Mr Lucas Koolschijn.

**Entity Name Address:**

Do-inc. business B.V.  
G.J. Eenhoorn

<sup>91</sup> Assuming that the performance would not suffer from a mono-waste stream, which in practice it will as is shown in the PDD.

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[Do-it@do-inc.net](mailto:Do-it@do-inc.net)

+31 20 846 36 50

Mauritskade 55-D

1092AD Amsterdam

Do-inc. business B.V. is not a project participant.

## **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:**

>>

22/07/2011

#### **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

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**SECTION D. Environmental impacts**

&gt;&gt;

**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<sup>92</sup>. 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<sub>2</sub> 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 18<sup>th</sup> of March 2011 at the plant site in the village Pudhuchatram. Invitations were given to local villagers, direct stakeholders and government

<sup>92</sup> <http://moef.nic.in/legis/eia/so1533.pdf>



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officials. The invitation was pasted at the village panchayat notice board on 10<sup>th</sup> March 2011, and an advertisement was printed in the local and national newspaper on 16<sup>th</sup> 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 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.

|                                               |
|-----------------------------------------------|
| <b>E.2. Summary of the comments received:</b> |
|-----------------------------------------------|

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 1 by 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.

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Question 3 by 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 Limited officials explained how the project will augment the power supplied to the grid through a local substation 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.

|                                                                           |
|---------------------------------------------------------------------------|
| <b>E.3. Report on how due account was taken of any comments received:</b> |
|---------------------------------------------------------------------------|

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.

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**Annex 1****CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY.**

|                  |                                                                                    |
|------------------|------------------------------------------------------------------------------------|
| Organization:    | IOT Mabagas Limited (IML)                                                          |
| Street/P.O.Box:  | 103                                                                                |
| Building:        | Spectra, Hiranandani Business Park, Powai,                                         |
| City:            | MUMBAI                                                                             |
| State/Region:    | MAHARASTRA                                                                         |
| Postfix/ZIP:     | 400 076                                                                            |
| Country:         | INDIA                                                                              |
| Telephone:       | +91 22 66772700                                                                    |
| FAX:             | +91 22 66919599/ +91 22 2570685                                                    |
| E-Mail:          | <a href="mailto:marketing.india@oiltanking.com">marketing.india@oiltanking.com</a> |
| URL:             | <a href="http://www.iotinfracenergy.com">www.iotinfracenergy.com</a>               |
| Represented by:  |                                                                                    |
| Title:           | Chief Operating Officer                                                            |
| Salutation:      | Mr                                                                                 |
| Last Name:       | Ali                                                                                |
| Middle Name:     |                                                                                    |
| First Name:      | Beer                                                                               |
| Department:      | Energy                                                                             |
| Mobile:          | 09930493856                                                                        |
| Direct FAX:      |                                                                                    |
| Direct tel:      |                                                                                    |
| Personal E-Mail: | <a href="mailto:beer.ali@oiltanking.com">beer.ali@oiltanking.com</a>               |

|                 |                                                                                      |
|-----------------|--------------------------------------------------------------------------------------|
| Organization:   | Mabanaft Carbon B.V.                                                                 |
| Street/P.O.Box: | Wilhelminakade 101                                                                   |
| Building:       | Maastoren                                                                            |
| City:           | Rotterdam                                                                            |
| State/Region:   | Zuid-Holland                                                                         |
| Postfix/ZIP:    | 3072AD                                                                               |
| Country:        | The Netherlands                                                                      |
| Telephone:      | +31 10 290 69 43                                                                     |
| FAX:            | +31 10 411 07 53                                                                     |
| E-Mail:         | <a href="mailto:alexander.savelkoul@mabanaft.nl">alexander.savelkoul@mabanaft.nl</a> |
| URL:            | <a href="http://www.mabanaft.nl">www.mabanaft.nl</a>                                 |
| Represented by: |                                                                                      |
| Title:          | Senior Trader                                                                        |
| Salutation:     | Mr.                                                                                  |
| Last Name:      | Savelkoul                                                                            |
| Middle Name:    |                                                                                      |
| First Name:     | Alexander                                                                            |
| Department:     | Mabanaft Carbon Trading                                                              |
|                 |                                                                                      |

**Annex 2****INFORMATION REGARDING PUBLIC FUNDING**

**The IOT Mabagas Limited power plant, Pudhuchatram project does not make use of public funding from Parties included in Annex 1, hence no public funding results in a diversion of official development assistance and is separate from and is not counted towards the financial obligations of those Parties (EB 41, Annex 12, Part II).**

**Annex 3****BASELINE INFORMATION**

The baseline data are taken from the CO2 Emission Database Version 6.0, March 2011 by CEA<sup>93</sup> (CEA Database). The data can be accessed through the following link:  
[http://www.cea.nic.in/reports/planning/cdm\\_co2/cdm\\_co2.htm](http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm)

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<sup>93</sup>[http://www.cea.nic.in/reports/planning/cdm\\_co2/cdm\\_co2.htm](http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm) (accessed November 18 2011)

**Annex 4****MONITORING INFORMATION**

Please refer to Section B.7.2. for all monitoring information other than the sampling plan below.

**Sampling Plan**

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

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

**(a) Sampling design****(i) Objectives and Reliability Requirements**

objective of determining the:

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

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

**(ii) Target Population**

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

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

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

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

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*(iii) Sampling Method*

| Parameter                               | Sampling Method            | Comment                                                                                                           |
|-----------------------------------------|----------------------------|-------------------------------------------------------------------------------------------------------------------|
| DAF <sub>w,i</sub>                      | Stratified Random Sampling | The average incremental distance is expected to be different for each strata (but homogeneous within the strata). |
| DAF <sub>w, poultry</sub>               | Stratum                    |                                                                                                                   |
| DAF <sub>w, cow dung</sub>              | Stratum                    |                                                                                                                   |
| DAF <sub>w, agri</sub>                  | Stratum                    |                                                                                                                   |
| DAF <sub>res, waste</sub>               | Simple Random Sampling     | The average incremental distance is expected to be homogeneous within sample group.                               |
| APP <sub>comp</sub> Compost application | Simple Random Sampling     | The application is expected to be homogeneous within sample group.                                                |

*(iv) Sample Size*

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

| Parameter                                                                                                     | sampling type   | N (population)       | p (expected proportion)                              | z @ 90% conf. interval | mean | SD   | Sample size                           |
|---------------------------------------------------------------------------------------------------------------|-----------------|----------------------|------------------------------------------------------|------------------------|------|------|---------------------------------------|
| Average incremental distance for poultry litter, agri waste and cow dung transportation (DAF <sub>w,i</sub> ) |                 |                      |                                                      |                        |      |      |                                       |
| DAF <sub>w, poultry</sub>                                                                                     | numerical data  | 4900 truck movements |                                                      | 1.645                  | 15km | 5km  | 30 truck movements (rounded-up to 32) |
| DAF <sub>w, cow dung</sub>                                                                                    | numerical data  | 280 truck movements  |                                                      | 1.645                  | 15km | 5km  | 28 truck movements (rounded-up to 30) |
| DAF <sub>w, agri</sub>                                                                                        | numerical data  | 7250 truck movements |                                                      | 1.645                  | 46km | 12km | 19 truck movements (rounded-up to 20) |
| DAF <sub>res, waste</sub>                                                                                     | percentage data | 3000 truck movements | 0.95 (expected proportion of the sites within 50 km) | 1.645                  |      |      | 13 truck movements (rounded-up to 20) |

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|                     |                 |                  |           |       |  |  |                                             |
|---------------------|-----------------|------------------|-----------|-------|--|--|---------------------------------------------|
|                     |                 |                  | distance) |       |  |  |                                             |
| APP <sub>comp</sub> | percentage data | 110.000 hectares | 0.95      | 1.645 |  |  | 20 ha (see Tide compost application report) |

*(v) Sampling Frame*

| Parameter                  | Sampling Frame                                                        |
|----------------------------|-----------------------------------------------------------------------|
| DAF <sub>w</sub>           |                                                                       |
| DAF <sub>w, poultry</sub>  | records of all incoming trucks from poultry farms (Trip sheet)        |
| DAF <sub>w, cow dung</sub> | records of all incoming trucks from dairy farms (Trip sheet)          |
| DAF <sub>w, agri</sub>     | records of all incoming trucks from agri waste factories (Trip sheet) |
| DAF <sub>res, waste</sub>  | records of outgoing trucks carrying compost (Trip sheet)              |
| APP <sub>comp</sub>        | records of outgoing trucks carrying compost (Trip sheet)              |

*(b) Data**(i) Field measurements*

| Parameter                  | Field measurements                                                                                                                                                                                                             |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DAF <sub>w</sub>           |                                                                                                                                                                                                                                |
| DAF <sub>w, poultry</sub>  | the samples will be selected randomly from the sample frame. The travelled distance will be determined based on GPS/ Google Maps directions or similar of the shortest route between the respective poultry farm and the site. |
| DAF <sub>w, cow dung</sub> | the samples will be selected randomly from the sample frame. The travelled distance will be determined based on GPS/ Google Maps directions or similar of the shortest route between the respective poultry farm and the site. |
| DAF <sub>w, agri</sub>     | the samples will be selected randomly from the sample frame. The travelled distance will be determined based on GPS/ Google Maps directions or similar of the shortest route between the respective factory and the site.      |
| DAF <sub>res, waste</sub>  | During operations the samples will be selected randomly from the sample frame. The distance will be measured/ recorded. To derive the incremental distance                                                                     |
| APP <sub>comp</sub>        | See Tide report [source] for data form.                                                                                                                                                                                        |

*(ii) Quality Assurance/Quality Control:*

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

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

**Table 9: QA/QC**

| Parameter to be sampled | Quality Assurance/Quality Control |
|-------------------------|-----------------------------------|
|-------------------------|-----------------------------------|



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

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

| Parameter to be sampled   | How data will be used                                                                      |
|---------------------------|--------------------------------------------------------------------------------------------|
| DAF <sub>w,i</sub>        | The average value calculated from the sample size will be used as DAF <sub>w,i</sub> value |
| DAF <sub>res, waste</sub> | Data will be used to verify the assumed average value of 50km incremental distance.        |
| APP <sub>comp</sub>       | Data will be used to conclude that soil is properly applied.                               |

**(c) Implementation**

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

**Verification**

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

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## Sample size numerical data

$$n = \frac{1.645^2 N \left( \frac{SD}{mean} \right)^2}{(N-1) \times 0.1^2 + 1.645^2 \left( \frac{SD}{mean} \right)^2}$$

## Qpoultry litter

|      |       |                 |
|------|-------|-----------------|
| N    | 4630  | truck movements |
| z    | 1.645 |                 |
| SD   | 5     | km              |
| mean | 15    | km              |

29.8793631 samples

**30 sample size (rounded up to the nearest interger)**

## Qcow dung

|      |       |                 |
|------|-------|-----------------|
| N    | 280   | truck movements |
| z    | 1.645 |                 |
| SD   | 5     | km              |
| mean | 15    | km              |

27.2392263 samples

**28 sample size (rounded up to the nearest interger)**

## Qagri waste

|      |       |                 |
|------|-------|-----------------|
| N    | 7250  | truck movements |
| z    | 1.645 |                 |
| SD   | 12    | km              |
| mean | 46    | km              |

18.3711635 samples

**19 sample size (rounded up to the nearest interger)**

## Sample size (percentage)

## Compost distance

$$n \geq \frac{1.645^2 N p (1-p)}{0.1^2 (N-1) + 1.645^2 p (1-p)}$$

|   |    |       |                                                                                                                        |
|---|----|-------|------------------------------------------------------------------------------------------------------------------------|
| N | km | 3000  |                                                                                                                        |
| z |    | 1.645 | is the value belonging to the 90% probability i                                                                        |
| p |    | 0.95  | x?qid=20070815181914AATob1F<br><a href="http://en.wikipedia.org/wiki/P-value">http://en.wikipedia.org/wiki/P-value</a> |

12.8522338 sample size

**13 sample size (rounded up to the nearest interger)**

## Compost application

$$n \geq \frac{1.645^2 N p (1-p)}{0.1^2 (N-1) + 1.645^2 p (1-p)}$$

|   |    |        |                                                                                                                        |
|---|----|--------|------------------------------------------------------------------------------------------------------------------------|
| N | ha | 110000 |                                                                                                                        |
| z |    | 1.645  | is the value belonging to the 90% probability i                                                                        |
| p |    | 0.95   | x?qid=20070815181914AATob1F<br><a href="http://en.wikipedia.org/wiki/P-value">http://en.wikipedia.org/wiki/P-value</a> |

12.8522338 sample size

**13 sample size (rounded up to the nearest interger)**

-----