BIOGAS TO ELECTRICITY GENERATION GROUP PROJECT IN INDIA

Document Prepared by EKI Energy Services Limited

Project Title	Biogas to electricity generation group project in India
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1 PROJECT DETAILS

1.1 Summary Description of the Project

EKI Energy Services Ltd. is in the process of implementing grouped project based on biogas from cattle manure at different locations across various States and Union Territories in India. The primary objective of the project is to effectively demonstrate the use of anaerobic biogas digesters to generate biogas-based renewable energy connected with off grid. Thus, project will achieve an environment friendly way of managing wastes and renewable power generation by utilizing the wastes.

Project Activity:

Instance 1

M/s Bhagyalaxmi Dairy Farms Pvt Ltd, operates a large dairy farm at Sultanpur, Mancha, Taluka-Ambegaon, District- Pune, India and desires to generate off-grid electricity by using biogas generated from cattle dung and use the electricity for captive purpose. The farm is one of the leading integrated dairy farms in India. The farm has approx. 3000 cattle. Total quantity of dung generated in the farm are used to generate biogas-based power generation project.

This project has installed 250 KVA (125 KVA ×2) generator which tends to generate approx. 2,500 Kwh per day by utilizing 2100 m^3 (3 × 700 m^3) of biogas per day. The biogas project shall run 350 days per year using anaerobic digester consisting of Khadi and Village Industries Commission (KVIC) Floating Dome Type Technology. The plant converts cattle dung into biogas and fertilizer. The biogas is utilised for power generation for the captive purpose of the dairy farm. This project tends to reduce dairy farm bill by generating approximately 903 MWh of electricity per year and by displacing grid electricity.

The output from digester undergoes de-watering treatment. The separated water is recycled and used for making 50% slurry along with cow dung to produce 19,008 MT/year of organic fertilizer.

The project is expected to avoid GHG emission of methane through recovery and destruction of biogas. The project is expected to achieve an annual emission reduction of 4,877 tCO_2e and a total emission reduction of 34,139 tCO_2e during the first 7-year crediting period.

This is a grouped project and the new instances will be added as and when the biogas plants get installed across India in the future.

Location	Project Activity Instance 1
	Pune
Balloon Storage Capacity	150 m^3

More project activity instances will be included in this grouped project activity in future. These new instances will either be grid/off grid biogas renewable energy power plants or generate Biogas that will

reduce dependency on grid connected electricity and contribute to GHG emission reductions. These new project activity instances will be of small-scale project activity.

Audit Type	Period	Program	VVB Name	Number of years
Validation	(22-June-2021 to 21-June-2022)	VCS 4.4		Not Applicable
Total	7 Years			

1.2 Sectoral Scope and Project Type

The applicable scope are as follows:

Sectoral Scope – 1: Energy industries (renewable-/ non-renewable sources)

Sectoral Scope – 13: Waste Handling and Disposal

The project is a grouped project

1.3 Project Eligibility

The project is a grouped project and following are the eligibility criteria for inclusion of new project activity instances into the grouped project activity:

1. Applicability conditions: The project activity instances shall meet applicability conditions for applicable methodology (AMS III.D version 20.1 / AMS I.F version 5) whichever is applicable. Instance can apply either single methodology or any combination of the above methodologies considered in this group project activity.
2. Geographical Area: All project activity instances shall be installed in India.
3. Baseline scenario: All Project Activity Instances shall meet the baseline definition as defined in respective methodology.
4. Technology type: The project activity instances to be included in the grouped project activity will be biogas based captive power generation.
5. Additionality: The project activity instances to be added as part of the grouped project will meet additionality criteria as set out in the methodology.

The Scope of VCS Program includes

The Seven Kyoto Protocol Greenhouse gases	The project is expected to avoid two greenhouse gases[1]: 1. Methane (CH_4) emissions from the anaerobic animal manure management system in the baseline scenario, which will be captured and destroyed in the project scenario; 2. CO_2 emissions from the production of the equivalent amount of electricity replaced by the Project that would otherwise be generated by the fossil fuel fired power plants of NCPG. Thus, the project is applicable to this scope.
Ozone-depleting substances (ODS)	Not applicable, Methane and CO_2 are not Ozone-depleting substances.
Project activities supported by a methodology approved under the VCS Program through the methodology development and review process	Not applicable
Project activities supported by a methodology approved under an approved GHG program, unless explicitly exclude.	The applied methodology AMS-III.D (Version 21.0) and AMS-I.F (Version 5.0) of the project are methodologies approved under CDM Program, which is a VCS approved GHG program.
Jurisdictional REDD+ programs and nested REDD+ projects as set out in the VCS Program document Jurisdictional and Nested REDD+ (JNR) Requirements.	Not applicable

Furthermore, the project does not belong to the project activities excluded in Table 1 of VCS Standard 4.4[2].

1.4 Project Design

[1] KYOTO PROTOCOL REFERANCE MANUAL

[2] VCS Standard version 4.4

The project has been designed to be a single installation of an activity, not a grouped project.

Eligibility Criteria

The project is not a grouped project. There is no additional information needed to be provided.

1.5 Project Proponent

Organization name	EKI Energy Services Ltd.
Contact person	Arijit Das
Title	Executive
Address	Office No. 201, Plot No 48, Scheme 78, Part 2, Vijay Nagar, Indore-452010, Madhya Pradesh
Telephone	+91-9051889240
Email	registry@enkingint.org, arijit.das@enkingint.org

1.6 Other Entities Involved in the Project

Organization name	
Role in the project	
Contact person	
Title	
Address	
Telephone	
Email	

1.7 Ownership

The commissioning certificate for project activity is the supporting documents to demonstrate the project ownership which is submitted to VVB. This demonstrates the right of use according to clause 3.7.1 (3) of VCS Standard version 4.4 – Project ownership arising by virtue of a statutory,

property or contractual right in the plant, equipment or process that generates GHG emission reductions and/or removals.

1.8 Project Start Date

22-June-2021 (Commissioning Date)

1.9 Project Crediting Period

This project adopts a 7-year renewable crediting period. The first crediting period is from 22-June-2021 to 21-June-2028 (both days included).

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

The estimated annual GHG emission reductions/removals of the project are:

☒ <20,000 tCO_2e/year

☐ 20,000 – 100,000 tCO_2e/year

☐ 100,001 – 1,000,000 tCO_2e/year

☐ >1,000,000 tCO_2e/year

Project Scale	
Project	✓
Large project	

Year	Estimated GHG emission reductions or removals (tCO_2e)
Year 1	4,877
Year 2	4,877
Year 3	4,877
Year 4	4,877
Year 5	4,877
Year 6	4,877

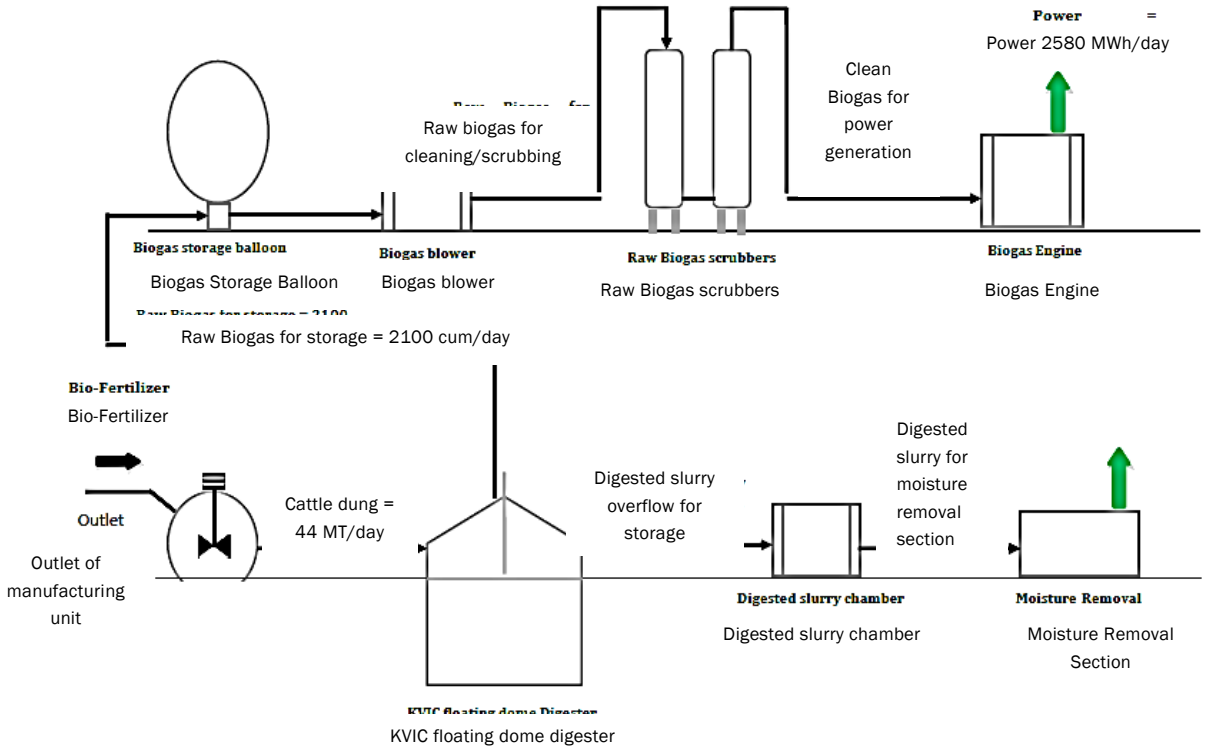
Year 7	4,877
Total estimated ERs	34,139
Total number of crediting years	7
Average annual ERs	4,877

1.11 Description of the Project Activity

The proposed project activity consists of KVIC Floating Dome Type Technology which tends to convert cattle dung into biogas and fertilizer. The project produces 903 MWh of electricity and mitigates approximately 822.114 tCO_2e annually. The final output from the digester is digested slurry which undergoes de-watering treatment. The separated water is recycled and is used for making 50% slurry along with cow-dung. The project activity is estimated to produce 19008 MT/year of organic fertilizer.

Technical Specification

KVIC Floating Drum	3 numbers, 16 m diameter and 7 m height
Biogas Scrubbing System	1. Water scrubbing column 2. MS absorption column 3. 50m^3 /hr 4. H_2S level: 2000 ppm to 150 ppm
Biogas Storage	1. PVC rubber made. 2. Capacity: 150 m^3 3. Diameter: 16.00m 4. Working Pressure 5 mbar 5. Expected gas flow: 300m^3/hr
Biogas Pressure Vessel	Fabricated in mild Steel of size Ø2.5m × 3 m height.
Biogas Compressor (Blower)	Blower for handling corrosive gases like H_2S, with capacity of 50 m^3/Hr and 3000 to 4000 mm water column pressure.
Biogas Engine	125 KVA × 2 No's



Picture:1- Process Flow Diagram

The 3 numbers of KVIC dome type digester are provided with water jacket to provide high solid retention without chocking, better settling characteristics of the suspended matter, faster release of the “blanket” at the gas liquid interface, better interaction between the microbes and the organic matter. The higher gas yield is partly attributable of these structures. These digesters originally operate on Anaerobic digestion process. High degree of BOD & COD reduction takes place in anaerobic digesters. Organic waste breaks into three parts viz. Biogas, Organic sludge and liquid organic overflow. Biogas generated from the anaerobic digesters will be collected in a unique dry membrane type made out of fabric reinforced with Neoprene (balloon type) biogas holder (raw). Biogas holder balloons are tensile & high tear resistant and have high bursting pressure, UV protected, rodent proof & very safe.

The generated biogas is stored in two membrane constant pressure gasholders which are designed to store biogas made from anaerobic digestion of organic waste and sludge. They are manufactured with biogas resistant polyester reinforced PVC membranes seam welded by high frequency electronic machines. The system is made with a single upper membrane, pressurized by an air fan 24 hours a day to give a pneumatic push on the inner biogas chamber, keeping the biogas chamber at a prefixed and constant positive pressure.

Each day, a portion of the digested sludge will send to slurry tank from where it is pumped to a Solid / Liquid separator where the solids are separated out and the solid matter is further processed as Organic Fertilizer; otherwise, use of the liquid slurry can also be used directly to the fields. The separated liquid is stored in lagoon from where it is recycled into the system.

1.12 Project Location

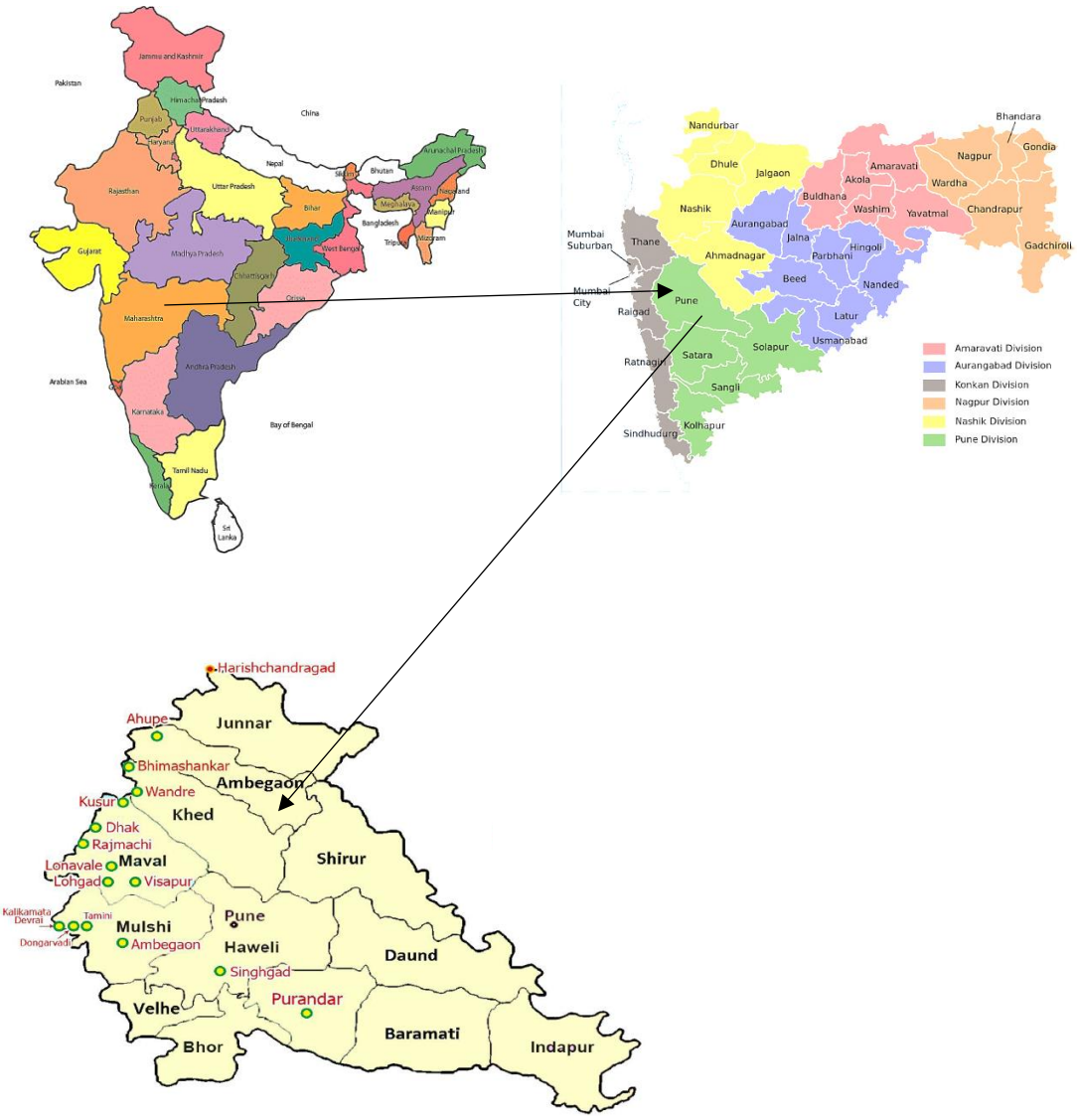
Instance-1: M/S Bhagyalaxmi Dairy Pvt. Ltd

The project is located at Sultanpur, Mancha, Taluka- Ambegaon, District- Pune, Pin code – 410503.

Coordinates of the dairy farm

Latitude: 19°01’23” N

Longitude: 73°56’18” E



1.13 Conditions Prior to Project Initiation

In the absence of this Bio-methanation and Bio-fertilizer project activity, the pre-project scenario would be the same as the baseline scenario. Please refer to Section 3.4 (Baseline Scenario) for further details.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

There is no such compliance with laws, statutes and other regulatory frameworks for animal manure handling and treatment in India. Hence this section is not applicable.

1.15 Participation under Other GHG Programs

1.15.1 Projects Registered (or seeking registration) under Other GHG Program(s)

The Project has not participated in any other GHG programs.

1.15.2 Projects Rejected by Other GHG Programs

The Project is not rejected by other GHG programs.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

Does the project reduce GHG emissions from activities that are included in an emissions trading program or any other mechanism that includes GHG allowance trading?

☐ Yes ☒ No

1.16.2 Other Forms of Environmental Credit

Has the project sought or received another form of GHG-related credit, including renewable energy certificates?

☐ Yes ☒ No

Supply Chain (Scope 3) Emissions

No transportation is used for delivering the manure which is produced within the dairy farm as the KVIL digester is placed within the dairy farm itself. Hence this section is not applicable.

Have the owner(s) or retailer(s) of the impacted goods and services3 posted a public statement saying, “VCUs may be issued for the greenhouse gas emission reductions and removals associated with [organization name(s)] [name of good or service]” since the project’s start date?

☐ Yes ☐ No

Explain your response.

Has the project proponent posted a public statement saying, “VCUs may be issued for the greenhouse gas emission reductions and removals associated with [name of good or service] [describe the region or location, including organization name(s), where practicable].”

☐ Yes ☐ No

Explain your response.

[3] Impacted goods and services are all goods and services directly impacted by the technologies and measures specified as project activities in the project description. Please see the VCS Program document *VCS Program Definitions* for additional information.

Have the producer(s) or retailer(s) of the impacted good or service been notified of the project and the potential risk of Scope 3 emissions double claiming via email?

☐ Yes ☐ No

Explain your response.

In all other cases, demonstrate that a public statement(s) by the owner(s) or retailer(s) of the impacted good*(s)* or service*(s)* or project proponent (as applicable) has been made throughout the project crediting period. Where applicable, also demonstrate that the impacted good or service's producer(s) or retailer(s) have been notified of the project and the potential risk of Scope 3 emissions double claiming via email. Evidence of the public statement(s) and email(s) must be provided in this report or attached as an appendix.

1.17 Sustainable Development Contributions

Sustainable Development Contributions Activity Description

	Description: Due to implementation of this project activity, the waste is collected which is further managed in KVIC digesters to generated Bio-Methane Gas. So, the project will contribute to the sustainable development and is fulfilling SDG 11.6.1.
	Description Anaerobic digestion is a prominent technology for treatment of organic waste materials. The project will contribute towards mitigation of 4,877 tCO_2e annually. So, the project will contribute to the sustainable development and it is fulfilling SDG 13.
	Description This project activity promotes the number of economic and will improve the level of people's life by generating potential job opportunities.

	Description This project activity contributes total generation of 903 MWh electricity annually by utilizing bio-methane gas generated from animal manure.

1.18 Additional Information Relevant to the Project

Leakage Management

Leakage emissions are considered per as tool 14[4]

Commercially Sensitive Information

No commercially sensitive information has been excluded from the public version of the project description.

Further Information

There are no information or incidents that will have bearing on the eligibility of the project, the net GHG emission reductions or removals, or the quantification of the project's net GHG emission reductions or removals.

2 SAFEGUARDS

2.1 No Net Harm

There was no harm identified form the project and hence no mitigations measures are applicable. As project is a methane avoidance project, hence there is no negative environmental and socio impact effect and the same can be summarized in the below table: -

SR. No	Indicator	Project Owner Opinion
1	Air Quality	Due to this project activity the open decomposition of animal waste will be mitigated, hence it will reduce the odour, which will make air quality much better.

[4] Tool 14

2	Water Quality	The project has no effect on water quality and quantity because it does not generate any waste water as the water is recycled to make slurry and put into digester again..
3	Biodiversity	The condition of ground vegetation will be gradually improved; No rare species has been found in the around area. The project does not create any obstruction on route of migratory bird (if any) With the implementation of Project, the greenery increases due to application of organic fertilizer in land; the biodiversity in the vicinity improves with the vegetation improvement. No negative impact envisaged.
4	Employment Generation	The project activity employed local population as skilled and unskilled workers. The personnel employed by the project activity are also provided trainings and exposed to various awareness programs therefore a positive indicator has been accepted.

2.2 Local Stakeholder Consultation

The local stake-holder consultation was held at conference hall of Bhagyalaxmi Dairy farm.

Organiser	Venue	Date	Start Time	End Time
Bhagyalaxmi Dairy farms Pvt. Ltd	Conference hall	21-December-2022	11:00 am	11:45 am

The local villagers invited for the project activity stakeholder meeting.

The Minutes of Local Stakeholder meeting along with List of Attendees and other supporting's has been submitted to the VVB.

The organiser explained about the project activity and also make them understand on how does it leads to reduction of GHG gases emission. The agenda were as follows

1. Opening of the meeting
2. Explanation of the project
3. Question for clarification about project explanation
4. Closure of meeting

The stakeholders raised their concern on environmental and social impact of the project, its financial viability and marketability of compost. These concerns were appropriately addressed by the project proponent, and following table briefs the concerns raised by stakeholders and their corresponding response.

Participants Questions	Responses
Will the project provide improved health in our village?	Yes, the project will result in improved health reducing health hazards from indoor & outdoor air pollution
Will the project release any harmful pollute, hazardous toxic, or notorious substances in the air?	No, not from what we know there is no project emissions associated to project and does not have any negative impacts.
Will there be employment generation due to project activity for youth from adjoining area?	Responding about the increased possibilities for employment of local youth due to project activity, it was pointed out that the preference would be given to the locals in the employment at project site.
Will the project lead to water pollution?	No, the project does not lead to any kind of water pollution.

As a part of on-going interaction with the local stakeholders, a grievance register is placed the main gate near security cabin. The stakeholders can mention/note grievances, if any. During current monitoring period, no grievance/negative comment was received from the stakeholders.

2.3 Environmental Impact

The project activity is Waste Management which is free from any kind of anthropogenic emission. Project activity is not having any negative environmental impacts. This project rather helps having a positive impact on the environment as it leads to efficient management waste.

2.4 Public Comments

The project shall be listed for 30 days' period. In case any comments are received they shall be incorporated during the validation.

2.5 AFOLU-Specific Safeguards

As this is waste management project so it does not come under AFOLU. Hence this section is not applicable.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

Methodologies applied: -

AMS-III.D.: Methane recovery in animal manure management systems, version 21.0[5]

AMS-I.F.: Renewable electricity generation for captive use and mini-grid, version 5.0[6]

The Methodology refer to following CDM Tools: -

Tool 14: Project and leakage emissions from anaerobic digesters, version 2[7]

Tool 07: Tool to calculate the emission factor for an electricity System, Version 07.0[8]

3.2 Applicability of Methodology

Applicability of AMS-III.D		
1	a) The livestock population in the farm is managed under confined conditions;	Applicable All the livestock population in the farms within the project boundary is managed under confined conditions
	b) Manure or the streams obtained after treatment are not discharged into natural water resources (e.g. river or estuaries), otherwise "AMS-III.H Methane recovery in wastewater treatment" shall be applied;	Applicable As per the DPR, manure or the streams obtained after treatment are not discharged into natural water resources (e.g. river or estuaries)

[5] AMS-III.D, Ver-21

[6] AMS-I.F, Ver-5

[7] Tool 14, Ver-02.0

[8] Tool 7, Ver-0.7.0

	c) The annual average temperature of baseline site where anaerobic manure treatment facility is located is higher than 5°C;	The annual average temperature of baseline site where anaerobic manure treatment facility is located is higher than 5°C. The annual average temperature at the project site is 24.3°C[9].
	d) In the baseline scenario the retention time of manure waste in the anaerobic treatment system is greater than one month, and if anaerobic lagoons are used in the baseline, their depths are at least 1 m;	Applicable The retention time of manure waste in the anaerobic treatment system is greater than one month, and the depth of the lagoons is 8m.
	e) No methane recovery and destruction by flaring or combustion for gainful use takes place in the baseline scenario.	Applicable As no methane recovery and destruction by flaring or combustion for gainful use takes place in the baseline scenario.
2	a) The residual waste from the animal manure management system shall be handled aerobically, otherwise the related emissions shall be taken into account as per relevant procedures of "AMS-III.AO Methane recovery through controlled anaerobic digestion". In the case of soil application, proper conditions and procedures (not resulting in methane emissions) must be ensured;	Applicable The residual waste is handled aerobically.
	b) Technical measures shall be used (including a flare for exigencies) to ensure that all biogas produced by the digester is used or flared;	Applicable All the biogas which is produced in the biogas digester is used to generate electricity for captive purpose

[9] Climate Data

	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.	Applicable The storage time of the manure after removal is less than 45 days before it is being fed into the anaerobic digester.
3	Projects that recover methane from landfills shall use "AMS-III.G Landfill methane recovery" and projects for wastewater treatment shall use AMS-III.H. Projects for composting of animal manure shall use "AMS-III.F Avoidance of methane emissions through composting". Project activities involving co-digestion of animal manure and other organic matters shall use the methodology "AMS-III.AO Methane recovery through controlled anaerobic digestion".	Not Applicable As the project activity is using AMS-III.D. "Methane recovery in animal manure management systems"
4	Utilization of the recovered biogas in one of the options detailed in AMS-III.H is also eligible under this methodology. The respective procedures in AMS-III.H shall be followed in this regard. If the recovered biogas is used to power auxiliary equipment of the project activity, it should be taken into account accordingly, using zero as its emission factor; however, energy used for such purposes is not eligible as an SSC CDM Type I project component.	Not Applicable As no waste-water is treated hence AMS-III.H. is not used. Whereas the project activity is not using any electricity for auxiliary purpose.
5	New facilities (Greenfield projects) and project activities involving capacity additions compared to the baseline scenario are only eligible if they comply with the related and relevant	Not Applicable As there is not any capacity being added.

	requirements in the "General guidelines for SSC CDM methodologies".	
6	The requirements concerning demonstration of the remaining lifetime of the replaced equipment shall be met as described in the "General guidelines for SSC CDM methodologies".	Not Applicable As no equipment has been replaced so there is no requirement for "General guidelines for SSC CDM methodologies".
7	Measures are limited to those that result in aggregate emission reductions of less than or equal to 60 kt CO_2 equivalent annually from all Type III components of the project activity.	Applicable The project activity is estimated to generate 4,877 ktCO_2
Applicability of AMS-I.F.		
8	This methodology is applicable for project activities that: a) Install a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity (Greenfield plant); b) Involve a capacity addition, c) Involve a retrofit of (an) existing plant(s); or d) Involve a replacement of (an) existing plant(s).	Applicable As it is a biogas captive power and prior to that no any
9	a) Project supplies electricity to a national/regional grid b) 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) c) Project supplies electricity to an identified consumer facility via national/regional grid (through a	a) Not Applicable, as the project is captive power project, hence the generated power is not supplied to the national grid. b) Not Applicable, as the project is a captive power project hence the project does not import electricity from the grid c) Not Applicable, as the project is a captive power project hence it is nit

	contractual arrangement such as wheeling) d) Project supplies electricity to a mini grid system where in the baseline all generators use exclusively fuel oil and/or diesel fuel e) Project supplies electricity to household users (included in the project boundary) located in off grid areas	connected with national grid. So, the project activity is not selling electricity via national grid to any identified customer. d) Not Applicable, as the project activity is not supplying electricity to a mini-grid also the baseline of this project activity is grid connected electricity and not fuel oil of diesel oil. e) Not Applicable, as the project activity is not supplying electricity to household users located in off-grid areas. As the project activity is solely using electricity generated by using bio-methane gas for captive purpose only hence this section is not applicable.
10	In the case of project activities that involve the capacity 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.	Not Applicable No capacity addition is taking place in the project activity
11	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.	Not Applicable As no retrofit is taking place, hence this section is not applicable.
12	If the unit added 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 unit added co-fires fossil fuel, the	Not Applicable As the project activity does not have any non-Renewable component.

	capacity of the entire unit shall not exceed the limit of 15 MW.	
13	Combined heat and power (co-generation) systems are not eligible under this category.	Not Applicable As this project activity is using anaerobic digester to produce methane gas and then utilizing that biogas solely for generating Electricity for captive purpose, hence this section is not applicable.
14	Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology: a) The project activity is implemented in an existing reservoir with no change in the volume of reservoir; b) 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^2; c) 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^2	Not Applicable. As this project is not a hydro Power Project.
15	If electricity and/or steam/heat produced by the project activity is delivered to a third party, i.e., another facility or facilities within the project boundary, a contract between the supplier and consumer(s) of the energy will have to be entered that ensures that there is no double counting of emission reductions.	Not Applicable As the electricity generated is utilized in dairy premises only.

16	In the case the project activities utilize biomass, the "TOOL16: Project and leakage emissions from biomass" shall be applied to determine the relevant project emissions from the cultivation of biomass and the utilization of biomass or biomass residues.	Not Applicable As this is a bio-gas project and anaerobic digester are used to compost the waste, hence Tool-14 "Project and leakage emissions from anaerobic digesters" is used.

3.3 Project Boundary

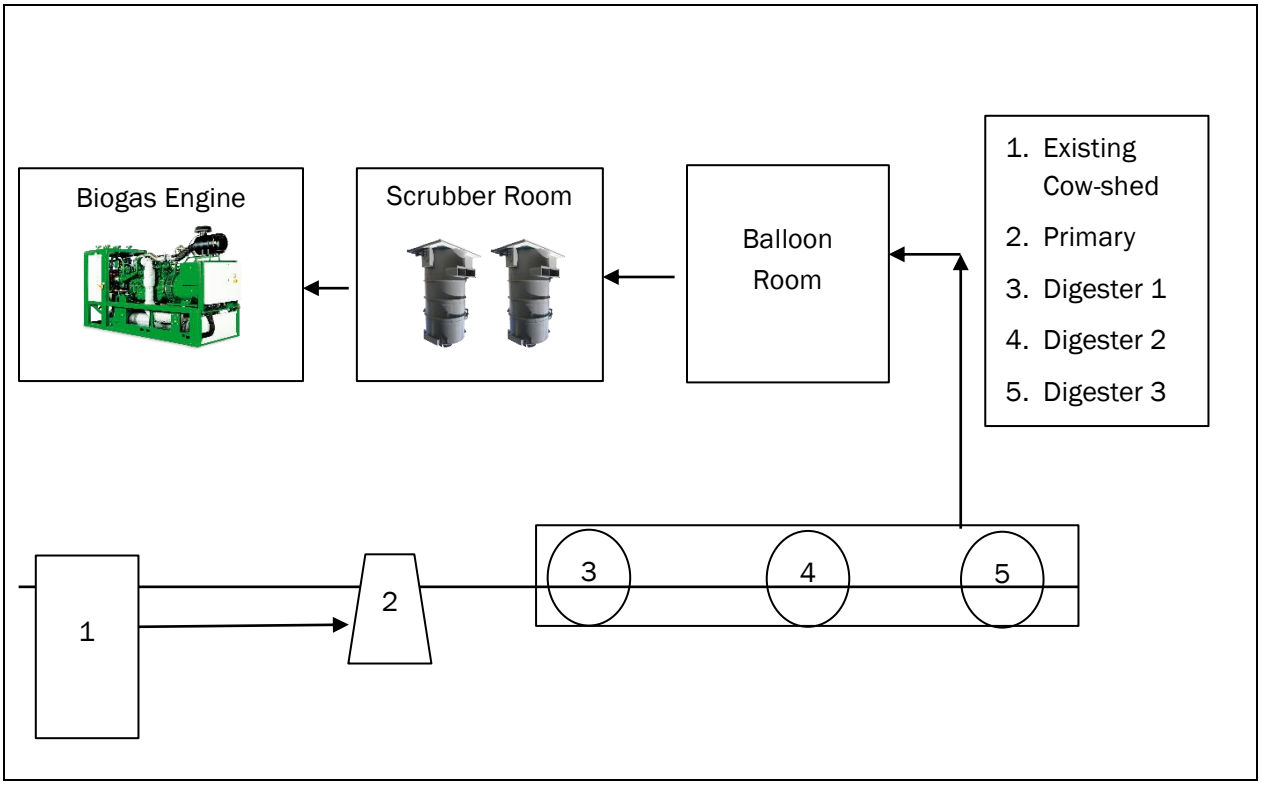


Figure – Project Boundary

The boundary for the project is as follows

Source		Gas	Included?	Justification/Explanation
Baseline	Direct emissions from the manure treatment processes	CO_2	No	CO_2 emission are not accounted from decomposition
		CH_4	Yes	The major source of emissions in the baseline
		N_2O	No	N_2O emission are less than compare to CH_4

Source		Gas	Included?	Justification/Explanation
	Emission from Electricity consumption/Generation	CO_2	Yes	The main source of emission due to grid emission factor
		CH_4	Yes	CH_4 emission are not accounted from decomposition
		N_2O	No	N_2O emission are not accounted from decomposition
	Physical leakage of biogas in the manure management systems	CO_2	No	Excluded for simplification
		CH_4	Yes	Main emission source
		N_2O		Excluded for simplification

3.4 Baseline Scenario

As per para. 17 of AMS-III.D, the baseline scenario is the situation where, in the absence of the project activity, animal manure is left to decay anaerobically within the project boundary and methane is emitted to the atmosphere.

As per as para. 20 of AMS.I.F, the baseline scenario is the situation where, in the absence of the project activity, the facility would draw electricity from grid which have grid emission factor.

Hence, the baseline scenario of the project is the animal manure waste was left to decay in anaerobic manure management system (lagoon) at the livestock farms and methane is emitted to the atmosphere directly without any methane recovery and destruction facility; equivalent amount of electricity was drawn from the grid connected fossil fuel fired power plants.

3.5 Additionality

As per para. 15-16 of applied methodology AMS-III.D, project activities may demonstrate the additionality by showing that there is no regulation in the host country, applicable to the project site, that requires the collection and destruction of methane from livestock manure. If so, it is not required to apply the “Guidelines on the demonstration of additionality of small-scale project activities”. This additionality condition also applies to Greenfield project activities. Furthermore, for project activities applying this methodology in combination with a Type I methodology, that has an energy component whose installed capacity is less than 5 MW, this procedure for additionality demonstration also applies to that component.

In line with AMS-III.D, the project recovers biogas to generate electricity with a total installed capacity of 250 KVA, which is lower than 5MW.

There is no such regulation in India regarding collection and destruction of methane.

3.6 Methodology Deviations

There is no such methodology deviation identified.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

According to the methodology AMS-III.D and AMS-I.F, baseline emissions are determined according to equation (1) and comprise the following sources:

$BE_y = BE_{ch4} + BE_{Electricity,y}$

BE_y = Baseline emissions in year y (tCO_2e/yr).

BE_{CH4} = Baseline emissions from the manure treatment processes in year y (tCO_2e/yr).

$BE_{Electricity,y}$ = Baseline emissions associated with electricity generation in year y (tCO_2e/yr).

1. Baseline emissions from the manure treatment processes in year y (tCO_2e/yr), BE_{CH4}.

   (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 number 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 applies option (a) to calculate baseline emissions from the manure management (BE_y), and baseline emissions are determined as follows:

$$BE_y = GWP_{CH_4} \times D_{CH_4} \times UF_B \times \sum_{j,LT} MCF_j \times B_{O,L,T} \times N_{LT,y} \times VS_{LT,y} \times MS\%_{BL,j}$$

GWP_{CH4}	=	Global warming potential of CH_4 applicable to the crediting period (tCO_2e/tCH_4)
D_{CH4}	=	CH_4 density (0.67kg/m^3 at room temperature (20°C) and 1 atm pressure)
UF_b	=	Model correction factor to account for model uncertainties (0.94).
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
$B_{O,LT}$	=	Maximum methane producing potential of the volatile solid generated for animal type LT (m^3CH_4/kg-dm)
$N_{LT,y}$	=	Annual average number of animals of type LT in year y (numbers)
$VS_{LT,y}$	=	Volatile solids production/excretion per animal of livestock LT in year y (on a dry matter weight basis, kg-dm/animal/year)
$MS\%_{BI,j}$	=	Fraction of manure handled in baseline animal manure management system j.

a. The maximum methane-producing capacity of the manure ($Bo_{,LT}$) varies by species and diet. The preferred method to obtain $Bo_{,LT}$ measurement values is to use data from country-specific published sources, measured with a standardised method ($Bo_{,LT}$ 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 Bo 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[10] can be used, provided that the project participants assess the suitability of those data to the specific situation of the treatment site.

b. 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.

   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;

c. $Bo_{,LT}$ values or VS values applicable to developed countries can be used provided the following four conditions are satisfied:

[10] EMISSIONS FROM LIVESTOCK AND MANURE MANAGEMENT

i. The genetic source of the livestock originates from an Annex I Party;

ii. The farm uses formulated feed rations (FFR) which are optimized for the various animal(s), stage of growth, category, weight gain/productivity and/or genetics;

iii. The use of FFR can be validated (through on-farm record keeping, feed supplier, etc.);

iv. The project specific animal weights are more similar to developed country IPCC default values.

d. Methane Conversion Factors (MCF) values are determined for a specific manure management system and represent the degree to which Bo is achieved. Where available country-specific MCF values that reflect the specific management systems used in particular countries or regions shall be used. Alternatively, the IPCC default values provided in table 10.17 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 10 can be used. The site annual average temperature is taken from official data at the nearest meteorological station, or from data available from historical on site observations.

e. The annual average number of animals (NLT,y) is determined as follows:

$$N_{LT,y} = N_{da,y} \times \frac{N_{p,y}}{365}$$

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)

2. Baseline emissions from the manure treatment processes in year y (tCO_2e/yr), $BE_{Electricity,y}$.

As per paragraph 20 of AMS-I.F. version 05.0, the baseline emissions for other systems are the product of amount electricity displaced with the electricity produced by the renewable generating unit and an emission factor.

$BE_{Electrical,y} = EG_{BL,y} \times EF_{grid,y}$

Where,

$EG_{BL,y}$	=	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the project activity in year y (MWh/yr)
$EF_{CO2,y}$	=	Emission factor (tCO2/MWh)

Emission factor of a grid shall be calculated as per the procedures provided in AMS-I.F:

As per methodology, combined grid emission factor as per the "Tool 07: Tool to calculate the emission factor for an electricity system" version 07 is calculated as below.

$EG_{BL,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the project activity in year y (MWh/yr)

CO_2 Baseline Database for the Indian Power Sector, Version 18, December, 2022[11] published by Central Electricity Authority (CEA), Government of India has been used for the calculation of emission reduction.

As per Methodological tool: Tool 07 - Tool to calculate the emission factor for an electricity system (Version 7.0, EB 100, Annex 4), following six steps have been followed:

a. Step 1: Identify the relevant electricity systems;
b. Step 2: Choose whether to include off-grid power plants in the project electricity system (optional);
c. Step 3: Select a method to determine the operating margin (OM);
d. Step 4: Calculate the operating margin emission factor according to the selected method;
e. Step 5: Calculate the build margin (BM) emission factor;
f. Step 6: Calculate the combined margin (CM) emission factor.

Step 1: Identify the relevant electricity systems

As described in tool "For determining the electricity emission factors, identify the relevant project electricity system. Similarly, identify any connected electricity systems". It also states that "If the DNA of the host country has published a delineation of the project electricity system and connected electricity systems, these delineations should be used". Keeping this into consideration, the Central Electricity Authority (CEA), Government of India have Indian grid.

However, since August 2006, however, all regional grids except the Southern Grid had been integrated and were operating in synchronous mode, i.e. at same frequency. Consequently, the Northern, Eastern, Western and North-Eastern grids were treated as a single grid named as NEWNE grid from FY 2007-08 onwards for the purpose of this CO2 Baseline Database. As of 31 December 2013, the Southern grid has also been synchronized with the NEWNE grid, hence forming one unified Indian Grid. Since the project supplies electricity to the Indian grid, emissions generated due to the electricity generated by the Indian grid as per CM calculations will serve as the baseline for this project.

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

The project proponent may choose between the following two options to calculate the operating margin and build margin emission factor:

[11] CDM-CO_2 Baseline Data Base, Version-18

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.

The project proponent has chosen only grid power plants in the calculation.

Step 3: Select a method to determine the operating margin (OM)

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods, which are described under Step 4:

(a) Simple OM; or

(b) Simple adjusted OM; or

(c) Dispatch data analysis OM; or

(d) Average OM.

The data required to calculate Simple adjusted OM and Dispatch data analysis OM is not possible due to lack of availability of data to project developers. The choice of other two options for calculating operating margin emission factor depends on generation of electricity from low-cost/ must-run sources. In the context of the methodology low cost/must run resources typically include hydro, geothermal, solar, low-cost biomass, nuclear and solar generation.

Share of Must-Run (Hydro/Nuclear) (% of Net Generation)

2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
14.6%	14.3%	14.5%	17.0%	16.5%	15.8%

Data Source: Central Electricity Authority (CEA) database Version 18, December 2022[12]

The above data clearly shows that the percentage of total grid generation by low-cost/ must-run plants (on the basis of average of five most recent years) for the Indian grid is less than 50 % of the total generation. Thus, the Average OM method cannot be applied, as low cost/must run resources constitute less than 50% of total grid generation.

The simple OM emission factor is calculated as the generation-weighted average CO2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units.

For the simple OM, the simple adjusted OM and the average OM, the emissions factor can be calculated using either of the two following data vintages:

(a) Ex-ante option: if the ex-ante option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required.

[12] CDM-CO_2 Database, Version 18.0

OR

(b) Ex-post option: if the ex-post option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring.

Project Proponent has chosen ex-ante option for calculation of Simple OM emission factor using a 3-year generation-weighted average, based on the most recent data available at the time of submission of the PD to the DOE for validation.

OM determined at validation stage will be the same throughout the crediting period. There will be no requirement to monitor and recalculate the emission factor during the crediting period.

Step 4: Calculate the operating margin emission factor (EF_{grid}, $OM_{Simple, y}$) according to the selected method

The operating margin emission factor has been calculated using a 3-year data vintage:

Net Generation in Operating Margin (GWH) (incl. Imports)		
2019-20	2020-21	2021-22
965,009	958,218	1,035,672

Simple Operating Margin		
2019-20	2020-21	2021-22
0.96	0.96	

Weighted Generation operating Margin	
2021-22	0.9519

Step 5: Calculate the build margin (BM) emission factor ($EF_{grid, BM, y}$)

As per Methodological tool: "Tool 07: Tool to calculate the emission factor for an electricity system" (Version 7.0, EB 100, Annex 4) para 72:

In terms of vintage of data, the project proponent can choose between one of the following two options:

(a) Option 1 - 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 PD submission to the DOE for validation. For the second crediting period, the build

margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

(b) Option 2 - For the first crediting period, the build margin emission factor shall be updated annually, ex post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated ex ante, as described in Option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

Option 1 as described above is chosen by Project proponent to calculate the build margin emission factor for the project activity. BM is calculated ex-ante based on the most recent information available at the time of submission of PD and is fixed for the entire crediting period.

Build Margin	
2021-22	0.869

Step 6: Calculate the combined margin (CM) emission factor ($EF_{grid, CM, y}$)

As per Methodological tool: "Tool 07: Tool to calculate the emission factor for an electricity system" (Version 7.0, EB 100, Annex 4) para 81:

The calculation of the combined margin (CM) emission factor ($EF_{grid, CM, y}$) is based on one of the following methods:

(a) Weighted average CM; or

(b) Simplified CM.

Project proponent has chosen option (a) i.e., weighted average CM to calculate the combined margin emission factor for the project activity.

The combined margin emissions factor is calculated as follows:

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

where:

$EF_{grid, BM, y}$ = Build margin CO_2 emission factor in year y (tCO_2e/MWh)

$EF_{grid, OM, y}$ = Operating margin CO_2 emission factor in year y (tCO_2e/MWh)

W_{OM} = Weighting of operating margin emissions factor (%)

W_{BM} = Weighting of build margin emissions factor (%)

The following default values should be used for W_{OM} and W_{BM}:

For solar project activities: W_{OM} = 0.5 and W_{BM} = 0.5 (owing to their intermittent and non-dispatchable nature) for the second crediting period and for subsequent crediting periods. Since project activity is of power generation by using biogas methane, the above weightage has been considered for OM and BM.

Therefore, $EF_{grid, CM, y}$ = 0.869×0.5 + 0.9519×0.5

= 0.9104 tCO_2e/MWh

Therefore, referring to the applied methodology AMS.I.F. Version 5.0, the EFCO2, y for grid connected and mini grid project instances would be $EF_{grid, CM, y}$ i.e., 0.9305 tCO_2e/MWh. The baseline emission factor is ex- ante parameter and will remain constant throughout the crediting period.

BE_y = 903 × 0.9104 = 822.114 tCO2e (estimated value for first year of operation)

4.2 Project Emissions

According to the methodology AMS-III.D,

$$PE_{CH_4,y} = PE_{transportation,y} + PE_{power,y} + PE_{storage,y} + PE_{PLy} + PE_{flare,y}$$

a. $PE_{transportation,y}$ = Emission from incremental transportation in the year y, tCO_2e.

b. $PE_{Power,y}$ = Emission from electricity or fossil fuel consumption, tCO_2e.

c. $PE_{storage,y}$ = Emission from the storage of manure, tCO_2e.

d. $PE_{PL,y}$ = Emissions due to physical leakage of biogas in year y, tCO_2e.

e. $PE_{flare,y}$ = Emissions from flaring or combustion of the biogas stream in the year y, tCO_2e.

For $PE_{transportation}$:

As the digester is only at 10m distance from the cow shed hence they use scraper to move dung from the shed to the digester.

Hence $PE_{transportation}$ = 0 tCO2e.

For PE_{power}:

As there is no fossil fuel consumption and quantity of electricity is ex-post and determine as 0 in the PD and will be monitored during verification period.

Hence PE_{Power} = 0 tCO2e.

For $PE_{Storage}$:

Project emissions on account of storage of manure before being fed into the anaerobic digester shall be accounted for if both condition (a) and condition (b) below are satisfied:

a) The storage time of the manure after removal from the animal barns, including transportation, exceeds 24 hours before being fed into the anaerobic digester;

b) The dry matter content of the manure when removed from the animal barns is less than 20%.

The storage time of the manure after removal from the animal barns, including transportation, is

5~7 hours, within 24 hours before being fed into the anaerobic digester, hence emissions from the storage of manure is not accounted for,

Hence $PE_{storage,y}$ = 0 tCO2e.

For $PE_{PL,y}$

Project emissions due to physical leakage of biogas from the animal manure management systems used to produce, collect and transport the biogas to the point of flaring or gainful use is taken 0, but will be monitored during verification process.

For PE_{Flare}

As the biogas is stored in balloon and during maintenance process, instead of flaring, biogas is not released and is kept in balloon itself. Hence project activity due to flaring is nil.

Hence PE_{Flare} = 0

According to the methodology AMS-I.F,

As per the approved consolidated Methodology AMS.I.F. Version 5.0 “For most renewable energy power generation project activities, PE_y = 0. However, some project activities may involve project emissions that can be significant. These emissions shall be accounted for as project emissions by using the following equation:

$$PE_{Electricity,y} = PE_{FF,y} + PE_{GP,y} + PE_{HP,y}$$

$PE_{FF,y}$ = Project emissions from fossil fuel consumption in year y (tCO_2e/yr)

$PE_{GP,Y}$ = Project emissions from the operation of dry, flash steam or binary geothermal power plants in year y (tCO_2e/yr)

$PE_{HP,Y}$ = Project emissions from water reservoirs of hydro power plants in year y (tCO_2e/yr)

As the project activity is the installation of biogas captive power plant and does not involve any project emissions from fossil fuel, operation of dry, flash steam or binary geothermal power plants, and from water reservoirs of hydro power plants. Therefore $P_{EFF,\,y}$, $PE_{GP,\,y}$, $PE_{HP,\,y}$ is equal to zero and thus, $PE_y = 0$.

4.3 Leakage

The leakage1 emissions associated with the anaerobic digester ($LE_{AD,y}$) depend on how the digestate is managed. They include emissions associated with storage and composting of the digestate and are determined as follows:

$LE_{AD,y} = LE_{storage} + LE_{comp,y}$

$LE_{AD,y}$ = Leakage emissions associated with the anaerobic digester in year y (t CO_2e).

$LE_{storage}$ = Leakage emissions associated with storage of digestate in year y (t CO_2e).

$LE_{Comp,y}$ = Leakage emissions associated with composting digestate in year y (t CO_2e).

= 429 tCO_2e

Step-1: Procedure using a default value

$LE_{storage} = F_{SD,CH4,default} \times Q_{CH4} \times GWP_{CH4}$

$LE_{storage,y}$ = Leakage emissions associated with storage of digestate in year y (t CO_2e).

$F_{SD,CH4,default}$ = Default factor representing the remaining methane production capacity of Solid digestate (fraction)

Q_{CH4} = Quantity of methane produced in the digester in year y (t CH_4).

GWP_{CH4} = Global warming potential of CH_4 (tCO_2/t CH_4).

= 429 tCO_2e

Step-2: Finding Q_{CH4}

$Q_{CH4} = Q_{biogas} \times f_{CH4default} \times \rho_{CH_4}$

Q_{biogas} = Quantity of biogas

$F_{CH4default}$ = Default value for the fraction of methane in the biogas

ρ_{CH_4} = CH_4 density at room temperature (20°C) and 1 atm pressure.

= 102.24 tCH_4

4.4 Net GHG Emission Reductions and Removals

According to para 27 of AMS-III.D, the emission reductions achieved by the project activity will be determined ex post through direct measurement of the amount of methane fueled, 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 are limited to the ex post calculated baseline emissions minus the project emissions using the actual monitored data for the project activity (i.e. $NL_{T,y}$, MS% i,y, $MS\%_l$, AI_l, as well as $VS_{LT,y}$ in cases where adjusted values for animal weight are used). The emission reductions achieved in any year are the lowest value of the following:

$$ER_{y,ex\ post} = min[(BE_{y,ex\ post} - PE_{y,ex\ post}), (MD_y - PE_{power,y,ex\ post})$$

Where,

$ER_{y,ex\ post}$	=	Emission reductions achieved by the project activity based on monitored values for year y (tCO_2e)
$BE_{y,ex\ post}$	=	Baseline emissions calculated using equation 1 (for projects using option using ex post monitored values of $NL_{T,y}$ and if applicable $VS_{LT,y}$. For projects using option in paragraph 17(b), the ex post monitored values for $Q_{manure,j,LT,y}$ and $SVS_{j,LT,y}$ are used.
$PE_{y,\ ex\ pos}$	=	Project emissions calculated using equation 6 using ex post monitored values of NLT,y,$MS_{\%\ i,y}$, $MS\%_{\ l}$, AI_l, $Q_{res\ waste,y}$ and if applicable $VSLT,_y$
MD_y	=	Methane captured and destroyed or used gainfully by the project activity in year y ($t\ CO_2e$)
$PE_{power,y,ex\ post}$	=	Emissions from the use of fossil fuel or electricity for the operation of the installed facilities based on monitored values in the year y ($t\ CO_2e$)

Data and Parameters Taken

Data	Parameters	Unit	Data Input	Description	Reference
Region			Indian Subcontinent		
Annual Average number of animals in Year y	$N_{LT,y}$	Numbers	1615	Annual Average number of animals of LT type in year y	Calculated
Average number of milking Cow at the site	$N_{LT_{milk\ Cow}}$	Numbers	1363	Annual Average number of animals of LT type in year y	Average Number of Animals
Average number of dry Cow at the site	$N_{LT_{dry\ Cow}}$	Numbers	252		DPR
Average Weight of Cows	$W_{default}$	Kg	275	Default average animal weight of a defined population, this data is sourced from IPCC 2006	Table 10A.3, DATA FOR ESTIMATING TIER 1 ENTERIC FERMENTATION CH4 EMISSION FACTORS FOR BUFFALO, P-10.75
Milking Cow	W_{site}	Kg	500		DPR, P-6
	For Milking Cow				
Dry Cow	W_{site}	Kg	600		DPR, P-6
	For Dry Cow				
Total Weight of Milking Cow		Kg	681500		Calculated
Total Weight of Dry Cow		Kg	151200		Calculated
Type of Treatment Plant					
UASB Digester				3 × 2500 cum capacity, size - Ø 20m × 8m depth	DPR, page - 30
Methane Conversion Factor	MCF_j		0.71	Annual Methane conversion factor (MCF) for the baseline animal manure management system j	IPCC default value, Volume4, Chapter10, table 10.17, cattle and swine bedding

Max Methane Producing Capacity	$B_{0,LT}$		0.13	Maximum methane producing potential of the volatile solid generated for animal type LT	IPCC default value, Volume4, Chapter10, table 10.A-4
Volatile Solid Producing Potential	$VS_{LT,y}$	Kg-dm/animal/year		Volatile solids production/excretion per animal of livestock LT in year y (on a dry matter weight basis, kg-dm/animal/year)	AMS-III.D, ver-7, P-7
Volatile solid Excretion rate per day	$VS_{default}$	Kg-dm/animal/year	2.6	Default value for the volatile solid excretion rate per day on a dry-matter basis for a defined livestock population	Table 10A-4, Chapter 10: Emissions from Livestock and Manure Management, IPCC- 2006, P-10.17
Fraction of Manure handle	$MS\%_{BL,j}$	%	100%	Fraction of manuare handled animal manure management system j	AMS-III.D, ver-7, P-7
	Assume all the manure is collected and treated				
Model Correction factor	UF_b		0.94	Model correction factor to account for model uncertainities (0.94)	AMS-III.D, ver-7, P-7
Methane Density	D_{CH_4}	t/m^3	0.00067	CH_4 density at room temperature (20°C) and 1 atm pressure	AMS-III.D, ver-7, P-7
Operational Day	nd_y	Days	350		DPR, page - 35
$FE_{SD,CH_4,default}$		Fraction	0.15	Default factor for the methane generation capacity of solid digestate (for two phase)	Project and leakage emissions from anaerobic digesters
GWP			28		AR5 Synthesis Report -

					Climate Change 2014
$f_{CH_4,default}$		m^3CH_4/CH_4	0.6	Default value for the fraction of methane in the biogas	Project and leakage emissions from anaerobic digesters, P-11

1. Calculation for baseline emission

<u>According to AMS-III.D,</u>

$$BE_y = GWP_{CH_4} \times D_{CH_4} \times UF_B \times \sum_{j,LT} MCF_j \times B_{O,L,T} \times N_{LT,y} \times VS_{LT,y} \times MS\%_{BL,j}$$

Calculation

$VS_{LT,y} = \frac{W_{site}}{W_{default}} \times VS_{default} \times nd_y$ Kg/-dm/animal/year

For Milking Cows = 1655 Kg-dm/animal/year

For Dry Cows = 1985 Kg-dm/animal/year

Now

$MCF_j \times B_{O,L,T} \times N_{LT,y} \times VS_{LT,y} \times MS\%_{BL,j}$

For Milking Cows = 208,150 Tons/year

For Dry Cows = 46,181 Tons/year

BE_{CH4} = 4,484

For 7 years

BE_{CH4}	tCO_2e
Year 1	4,484
Year 2	4,484
Year 3	4,484
Year 4	4,484
Year 5	4,484
Year 6	4,484
Year 7	4,484

According to AMS-I.F

Actual Installed Capacity	Number of operating Days	Number of Hours	Plant Load Factor	Net Estimated Generated Power	Estimated CO2 Reduced
250 KVA	350 Days	8400 Hours	43%	903 MWh	822.114 tCO_2

For 7 Years

$BE_{Electricity,y}$	tCO_2e
Year 1	822.114
Year 2	822.114
Year 3	822.114
Year 4	822.114
Year 5	822.114
Year 6	822.114
Year 7	822.114

Total Baseline emission

BE_y	tCO_2e	tCO_2e	tCO_2e
Year 1	4,484	822.114	5306.11
Year 2	4,484	822.114	5306.11
Year 3	4,484	822.114	5306.11
Year 4	4,484	822.114	5306.11
Year 5	4,484	822.114	5306.11
Year 6	4,484	822.114	5306.11
Year 7	4,484	822.114	5306.11

Now Total emission reduction

$ER_y = BE_y - PE_y - LE_y$

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
22-June-2021 to 21-June-2022	5306.11	0	429	4877.11
22-June-2022 to 21-June-2023	5306.11	0	429	4877.11
22-June-2023 to 21-June-2024	5306.11	0	429	4877.11
22-June-2024 to 21-June-2025	5306.11	0	429	4877.11
22-June-2025 to 21-June-2026	5306.11	0	429	4877.11
22-June-2026 to 21-June-2027	5306.11	0	429	4877.11
22-June-2027 to 21-June-2028	5306.11	0	429	4877.11
Total	37,142	0	3,003	34,139 (Round down value)

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	GWP_{CH4}
Data unit	tCO_2e/tCH_4
Description	Global Warming Potential (GWP) of CH_4 applicable to the crediting period.

Source of data	IPCC
Value applied	28
Justification of choice of data or description of measurement methods and procedures applied	Default value of 28 from IPCC Fifth Assessment Report (AR5). Shall be updated according to any future revision to VCS standard by VERRA.
Purpose of Data	Calculation of baseline emissions and leakage emission.
Comments	-

Data / Parameter	D_{CH4}
Data unit	t/m^3
Description	CH_4 Density
Source of data	AMS-III.D
Value applied	0.00067 (CH_4 density at room temperature 20°C and 1 atm pressure)
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline emissions and leakage emission.
Comments	-

Data / Parameter	UF_b
Data unit	-
Description	Model Correction factor to account model uncertainties.
Source of data	AMS-III.D
Value applied	0.94
Justification of choice of data or description of measurement methods and procedures applied	-

Purpose of Data	Calculation of baseline emissions and leakage emission.
Comments	-

Data / Parameter	MCF_j
Data unit	-
Description	Annual methane conversion factor (MCF) for the baseline animal manure management system j
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied	0.71
Justification of choice of data or description of measurement methods and procedures applied	No country or regional specific value is available. Default value from table 10.17 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 10 is applied.
Purpose of Data	Calculation of baseline emissions and leakage emission.
Comments	-

Data / Parameter	$B_{O,LT}$
Data unit	$m^3CH_4/kg\text{-}VS$
Description	Maximum methane producing potential of the volatile solid generated for animal type LT
Source of data	Table 10A-4 of Volume 4 Chapter 10 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories.
Value applied	0.13
Justification of choice of data or description of measurement methods and procedures applied	No country or regional specific value is 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 are applied.
Purpose of Data	Calculation of baseline emissions and leakage emission.
Comments	-

Data / Parameter	$MS\%_{BL,j}$
Data unit	-
Description	Fraction of manure handled in baseline animal manure management system j
Source of data	AMS-III.D
Value applied	100%
Justification of choice of data or description of measurement methods and procedures applied	–
Purpose of Data	Calculation of baseline emissions and leakage emission.
Comments	-

Data / Parameter	$N_{da,y}$
Data unit	Day
Description	Number of days animal is alive in the farm in the year y
Source of data	Project Proponent
Value applied	365
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline emissions and leakage emission.
Comments	-

Data / Parameter	W_{site}
Data unit	Kg
Description	Default average animal weight of a defined population
Source of data	IPCC 2006

Value applied	275
Justification of choice of data or description of measurement methods and procedures applied	Data is taken from Table 10A.I, IPCC 2006, Volume 4, of chapter 10. Default value of Indian Subcontinent is taken into account.
Purpose of Data	Calculation of $VS_{LT,y}$
Comments	-

Data / Parameter	$EF_{grid,OM,y}$
Data unit	tCO_2e/MWh
Description	Operating margin CO_2 emission factor in year y
Source of data	Central Electricity Authority: CO_2 Database
Value applied	0.9519
Justification of choice of data or description of measurement methods and procedures applied	Official and authoritative statistic data
Purpose of Data	Calculation of baseline emissions and leakage emission.
Comments	According to section 4.1, the ex ante option is selected to calculate $EF_{grid,OM,y}$ and fixed in the crediting period.

Data / Parameter	$EF_{grid,BM,y}$
Data unit	tCO_2e/MWh
Description	Build margin CO_2 emission factor in year y
Source of data	Central Electricity Authority: CO_2 Database
Value applied	0.869

Justification of choice of data or description of measurement methods and procedures applied	Official and authoritative statistic data
Purpose of Data	Calculation of baseline emissions and leakage emission.
Comments	According to section 4.1, the ex-ante option is selected to calculate $EFg_{rid,BM,y}$ and fixed in the crediting period.

Data / Parameter	$EF_{grid,CM,y}$
Data unit	tCO_2e/MWh
Description	Combined margin CO_2 emission factor in year y
Source of data	Central Electricity Authority: CO_2 Database
Value applied	0.9311
Justification of choice of data or description of measurement methods and procedures applied	Official and authoritative statistic data
Purpose of Data	Calculation of baseline emissions and leakage emission.
Comments	According to section 4.1, the ex-ante option is selected to calculate $EF_{grid,CM,y}$ and fixed in the crediting period.

5.2 Data and Parameters Monitored

Data / Parameter	$MS\%_{,y}$
Data unit	-
Description	Fraction of manure handled in system i in year y
Source of data	Project proponents
Description of measurement methods and procedures to be applied	All manure would be handled in the project, 100% is applied for $MS\%_y$, in ex-ante estimation. This parameter will be monitored during verification period.
Frequency of monitoring/recording	-

Value applied	100%
Monitoring equipment	A register will be maintain describing fraction of manure handled with dully signed by plant manager.
QA/QC procedures to be applied	-
Purpose of data	Calculation of baseline emissions and project emissions
Calculation method	-
Comments	-

Data / Parameter	$N_{p,y}$
Data unit	Number
Description	Number of animals produced annually of type LT for the year y
Source of data	Project proponents
Description of measurement methods and procedures to be applied	The number of Dairy cows produced in the farm will be recorded manually in the plant registered with plant's manager dully signed.
Frequency of monitoring/recording	Annually, based on monthly records
Value applied	Milk Cow: 1363 Dry Cow: 252
Monitoring equipment	Sale purchase agreement/Daily farm registered.
QA/QC procedures to be applied	The values will be crossed check from sale/purchase agreement.
Purpose of data	To calculate the annual average numbers of animals ($N_{LT,y}$)

Calculation method	-
Comments	-

Data / Parameter	$VS_{LT,y}$
Data unit	kg/hd/day
Description	Default value for the volatile solid excretion rate per day on a dry-matter basis for a defined livestock population
Source of data	Default value for the volatile solid excretion rate per day on a dry-matter basis for a defined livestock population
Description of measurement methods and procedures to be applied	According to animals' genetic region and type, Default values from tables 10 A-4 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10 are applied. The genetic source for all types of Dairy cows is from Indian Subcontinent, the average weight of Dairy cow is 500 kg and Dry Cow is 600 Kg, is taken. Thus, VS value from IPCC default value can be used, which is 2.60kg/hd/day and it is conservative. The animal purchase contract, Feed Purchase Contract and on-farm record keeping will be monitored in verification period.
Frequency of monitoring/recording	Annually
Value applied	2.6
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of baseline emissions and project emissions
Calculation method	-
Comments	-

Data / Parameter	W_{site}
Data unit	Kg

Description	Average animal weight of a defined livestock population of the project site.
Source of data	-
Description of measurement methods and procedures to be applied	Stratified sampling will be used to determine animal weight by using sampling procedure mentioned in "Standard for sampling and surveys for CDM project activities and Programs of Activities"
Frequency of monitoring/recording	Annually
Value applied	<table><tr><td>Milking Cow</td><td>500</td></tr><tr><td>Dry Cow</td><td>600</td></tr></table> These values are used for the calculation of VS_{LT} on Ex-ante basis. Actual values will be monitored during verification process.
Monitoring equipment	Weighing Scale
QA/QC procedures to be applied	The weight of animals will be maintained in plant registered in sample basis with plant manager's duly signed.
Purpose of data	Calculation of emissions reduction
Calculation method	-
Comments	The weighing scale which will be used for measuring animal weight will be calibrated according to manufacturer's specification.

Data / Parameter	EG_y
Data unit	MWh
Description	Total electricity generated from the recovered biogas in year y
Source of data	Electricity meter
Description of measurement methods and procedures to be applied	Registered will be maintained of continuous generation with pant manager dully signed
Frequency of monitoring/recording	Continuous monitored and monthly recorded
Value applied	903 (Ex-Ante estimation)

Monitoring equipment	Electricity meter
QA/QC procedures to be applied	The data will be maintained in plant registered with plant managers duly signed. The metering instruments with accuracy no less than 0.5s will be calibrated.
Purpose of data	Calculation of emissions reduction
Calculation method	-
Comments	-

5.3 Monitoring Plan

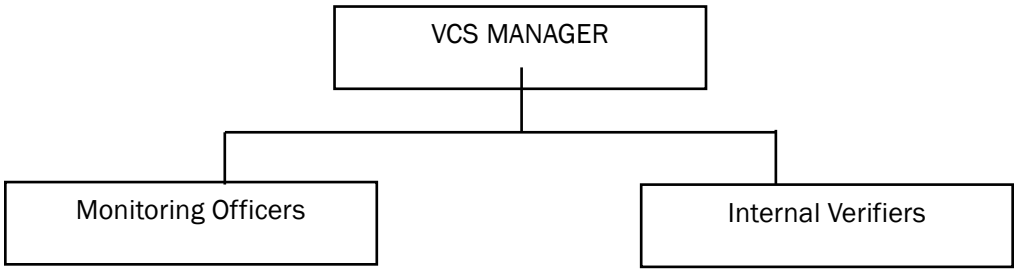
The monitoring plan presented in this PD assures that real, measurable, long-term GHG emission reductions can be monitored, recorded and reported. It is a crucial procedure to identify the final

Project Description: VCS Version 4.2

VCUs of the project. This monitoring plan will be implemented by the project owner during the project operation. The details of the monitoring plan are specified as follows:

(A) Monitoring structure

The Project owner organizes a specific VCS team in project development department to be responsible for data collection, supervision and witness the whole process of data measuring and recording. A VCS manager is appointed to take full responsibility for the overall monitoring of the project. The monitoring and measurement are to be carried out by designated monitoring officers. In addition, the Project developer appoints internal verifiers who is responsible for internal check of the measurement, collection of relevant receipts and invoices, and the calculation of the emission reductions. A monitoring and management manual of the project that identifies detailed duties and responsibilities of the relevant parties is developed and served as the basis of the project monitoring. Below figure shows the operation and management structure of the Project.

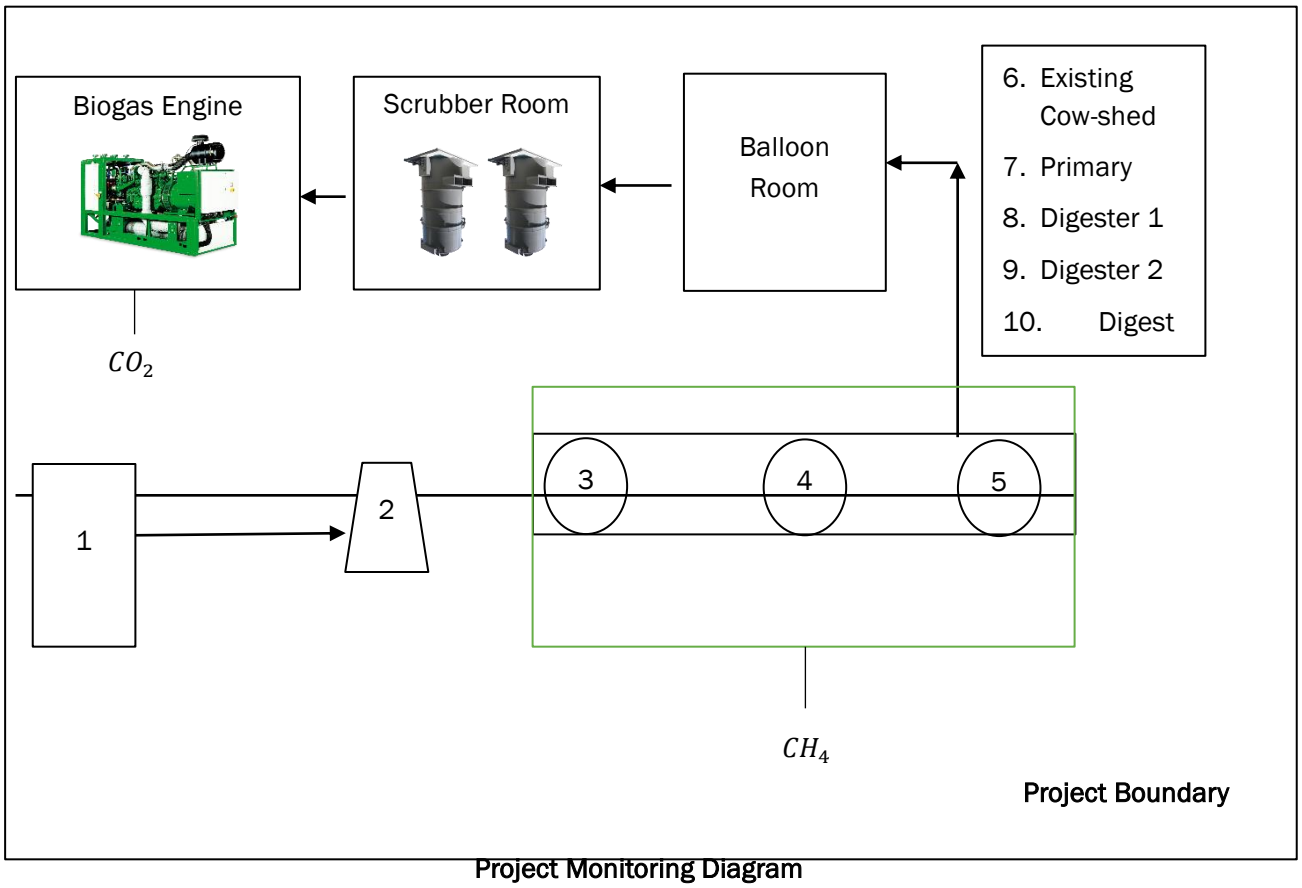


(B) Data and parameters to be monitored

Data and parameters to be monitored are listed below. Below figure showing the positions of the monitoring instruments and Table 5-1 lists the corresponding parameters monitored:

Table-5.1: Data and parameters to be monitored

Parameters to be monitored	Description
$MS\%_{,y}$	A register will be maintaining describing fraction of manure handled with dully signed by plant manager.
W_{site}	1. Stratified sampling will be used to determine animal weight by using sampling procedure mentioned in "Standard for sampling and surveys for CDM project activities and Programs of Activities" 2. The weight of animals will be maintained in plant registered in sample basis with plant managers duly signed. 3. The weighing scale which will be used for measuring animal weight will be calibrated according to manufacturer's specification.
$N_{p,y}$	Sale purchase agreement/Daily farm registered.
EG_y	1. Registered will be maintained of continuous generation with pant manager dully signed 2. The data will be maintained in plant registered with plant managers duly signed. The metering instruments with accuracy no less than 0.5s will be calibrated.



Project Monitoring Diagram

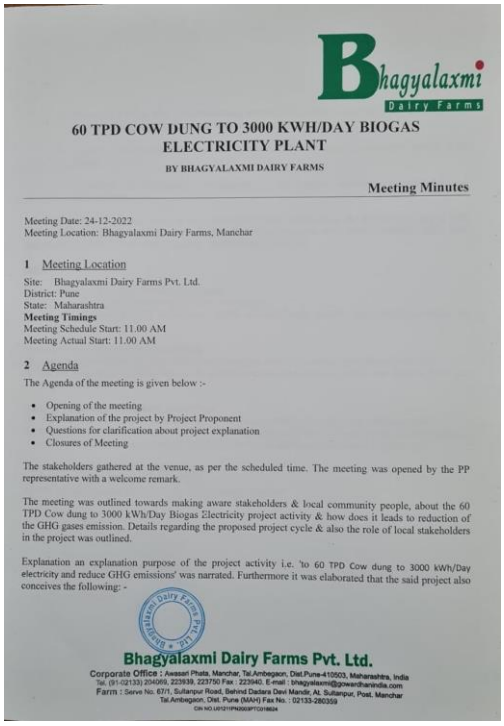
(C) Data collection

Monitoring officers are responsible for data collection. Designated teams will read and collect the monitored data regularly. The computer system will automatically monitor and record relevant meter data. Automatic records will serve as the main data source for emission reductions calculation. All data files, relevant receipts will be collected by a designated monitoring officer, who will prepare backup in time and archive all documents properly.

(D) Quality assurance

All metering equipment for monitoring will be chosen in accordance with VCS requirements and will be calibrated regularly for accuracy by qualified party according to the national regulations.

APPENDIX-1: LOCAL STAKE-HOLDER DOCUMENTS



Bhagyalaxmi Dairy Farms

60 TPD COW DUNG TO 3000 KWH/DAY BIOGAS ELECTRICITY PLANT

BY BHAGYALAXMI DAIRY FARMS

Meeting Minutes

Meeting Date: 24-12-2022
Meeting Location: Bhagyalaxmi Dairy Farms, Manchar

1 Meeting Location

Site: Bhagyalaxmi Dairy Farms Pvt. Ltd.
District: Pune
State: Maharashtra
Meeting Timings
Meeting Schedule Start: 11.00 AM
Meeting Actual Start: 11.00 AM

2 Agenda

The Agenda of the meeting is given below :-

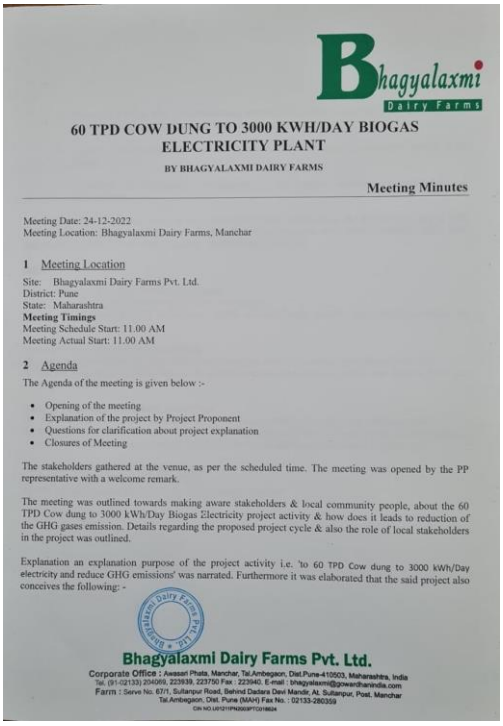
- Opening of the meeting
- Explanation of the project by Project Proponent
- Questions for clarification about project explanation
- Closures of Meeting

The stakeholders gathered at the venue, as per the scheduled time. The meeting was opened by the PP representative with a welcome remark.

The meeting was outlined towards making aware stakeholders & local community people, about the 60 TPD Cow dung to 3000 kWh/Day Biogas Electricity project activity & how does it leads to reduction of the GHG gases emission. Details regarding the proposed project cycle & also the role of local stakeholders in the project was outlined.

Explanation an explanation purpose of the project activity i.e. 'to 60 TPD Cow dung to 3000 kWh/Day electricity and reduce GHG emissions' was narrated. Furthermore it was elaborated that the said project also conceives the following: -

Bhagyalaxmi Dairy Farms Pvt. Ltd.
Corporate Office : Awasari Phata, Manchar, Tal.Ambegaon, Dist.Pune-410503, Maharashtra, India
Tel. (91-02133) 254069, 223939, 223750 Fax : 223940. E-mail : bhagyalaxmi@gowardhanindia.com
Farm : Serve No. 67/1, Sultanpur Road, Behind Dadara Devi Mandir, At. Sultanpur, Post. Manchar
Tal.Ambegaon, Dist. Pune (MAH) Fax No. : 02133-280359



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Tal.Ambegaon, Dist. Pune (MAH) Fax No. : 02133-280359

Bhagyalaxmi Dairy Farms

Public Notice

Date: 15.12.2022

Subject: Invitation for Local Stakeholder meeting of the Project Activity titled "60 TPD Cow dung to 3000 kWh/Day electricity Plant by Bhagyalaxmi Dairy Farms."

Respected Stakeholder,

We, Bhagyalaxmi Dairy Farms Pvt. Ltd. are the investor for the project activity titled "60 TPD Cow dung to 3000 kWh/Day electricity Plant by Bhagyalaxmi Dairy Farms."

For this project activity, Bhagyalaxmi Dairy Farms have invited you for a **Local Stakeholder meeting of the Biogas to Electricity Project Activity.**

Being a part of the same project activity, Local Stake Holder is invited to give their feedback and comments about the project activity. We are conducting the Local Stakeholder meeting and in this regard, any kind of comments or views from your side are welcome and we are pleased to invite you for the same.

The details of the meeting are, as :-

Organizer:-	Bhagyalaxmi Dairy Farms Pvt. Ltd.		
Venue:-	Conference Hall, Bhagyalaxmi Dairy Farms.	Date:-	24.12.2022
District:-	Pune	Start Time:-	Hrs. 11.00 AM
State:-	Maharashtra	End Time:-	Hrs. 11.45 AM

For Bhagyalaxmi Dairy Farms, PP representative,

Authorised Signatory

Bhagyalaxmi Dairy Farms Pvt. Ltd.
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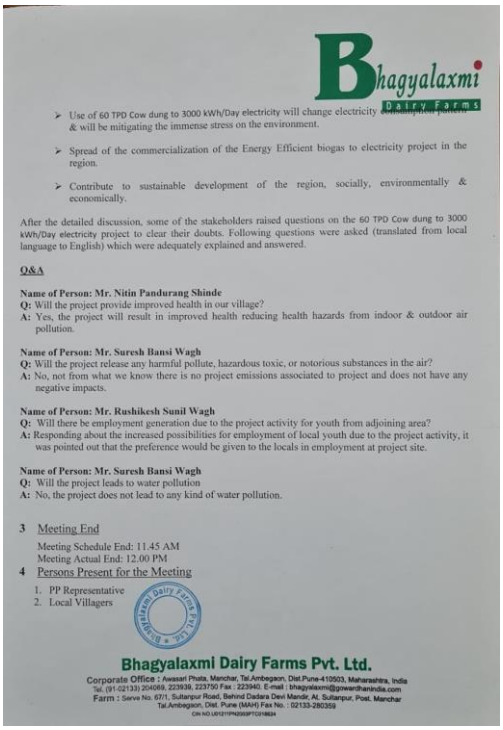

Bhagyalaxmi Dairy Farms

- Use of 60 TPD Cow dung to 3000 kWh/Day electricity will change electricity [illegible] & will be mitigating the immense stress on the environment.
- Spread of the commercialization of the Energy Efficient biogas to electricity project in the region.
- Contribute to sustainable development of the region, socially, environmentally & economically.

After the detailed discussion, some of the stakeholders raised questions on the 60 TPD Cow dung to 3000 kWh/Day electricity project to clear their doubts. Following questions were asked (translated from local language to English) which were adequately explained and answered.

Q&A

Name of Person: Mr. Nitin Pandurang Shinde
Q: Will the project provide improved health in our village?
A: Yes, the project will result in improved health reducing health hazards from indoor & outdoor air pollution.

Name of Person: Mr. Suresh Bansi Wagh
Q: Will the project release any harmful pollute, hazardous toxic, or notorious substances in the air?
A: No, not from what we know there is no project emissions associated to project and does not have any negative impacts.

Name of Person: Mr. Rushikesh Sunil Wagh
Q: Will there be employment generation due to the project activity for youth from adjoining area?
A: Responding about the increased possibilities for employment of local youth due to the project activity, it was pointed out that the preference would be given to the locals in employment at project site.

Name of Person: Mr. Suresh Bansi Wagh
Q: Will the project leads to water pollution
A: No, the project does not lead to any kind of water pollution.

3 Meeting End

Meeting Schedule End: 11.45 AM
Meeting Actual End: 12.00 PM

4 Persons Present for the Meeting

1. PP Representative
2. Local Villagers

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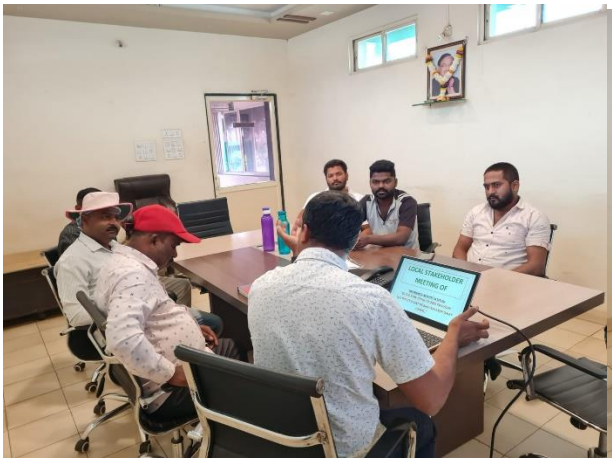
LOCAL STAKEHOLDER
MEETING OF


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MEETING OF


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