



# Monitoring Report

## CARBON OFFSET UNIT (CoU) PROJECT



**Title: Small Scale Cattle Biogas to Power Projects in Gujarat, Rajasthan, Karnataka, West Bengal, Chhattisgarh, Kerala and Haryana, India**

Version 1.0

Date 08/11/2021

First CoU Issuance Period: 3 years, 10 months

**Monitoring Period: 01/01/2018 to 31/10/2021**

Monitoring Report	
Title of the project activity	Small Scale Cattle Biogas to Power Projects in Gujarat, Rajasthan, Karnataka, West Bengal, Chhattisgarh, Kerala and Haryana, India
UCR Project Registration Number	017
Version	1
Completion date of the MR	01/11/2021
Monitoring period number and duration of this monitoring period	Monitoring Period Number: 01 Crediting Period: 01/01/2018 to 31/10/2021
Project participants	Urja Bio System Pvt. Ltd., Pune, Maharashtra, India
Host Party	India
Applied methodologies and standardized baselines	AMS.I.C. Thermal energy production with or without electricity UCR Protocol Standard Baseline AMS-III.D: Methane recovery in animal manure management systems
SDGs	SDG 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture SDG 3: Ensure healthy lives and promote well-being for all at all ages SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable SDG 13: Take urgent action to combat climate change and its impacts SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
Sectoral scopes	SECTORAL SCOPE - 01 Energy industries (Renewable/NonRenewable Sources) 13 Waste handling and disposal
Emission Reductions over the Monitoring Period each year (Year: tCO <sub>2</sub> eq)	2018: 2030 CoUs
	2019: 29918 CoUs
	2020: 46886 CoUs
	2021: 65111 CoUs
<b>Total Emission Reductions:</b>	<b>143945 CoUs (143945 tCO<sub>2</sub>eq)</b>

## SECTION A. Description of project activity

### A.1. Purpose and general description of project activity >>

#### a) Purpose of the project activity and the measures taken for GHG emission reductions >>

The project **Small Scale Cattle Biogas to Power Projects in Gujarat, Rajasthan, Karnataka, West Bengal, Chhattisgarh, Kerala and Haryana, India** is located across 9 Villages in the State of Gujarat, Rajasthan, Karnataka, West Bengal, Chhattisgarh, Kerala and Haryana, Country: India.

The details of the registered project are as follows:

#### **Purpose of the project activity:**

The **Small Scale Cattle Biogas to Power Projects in Gujarat, Rajasthan, Karnataka, West Bengal, Chhattisgarh, Kerala and Haryana, India** is located across the following Districts: Hisar, Dhanera, Palanpur, Kheda, Seekar, Hoogly, Tumkur, Trivendrum and Raipur, State: Gujarat, Rajasthan, Karnataka, West Bengal, Chhattisgarh, Kerala and Haryana, Country: India.

The small scale project activities involve the installation of 9 independent biogas digesters between the 200 m<sup>3</sup> and 2000 m<sup>3</sup> capacity range, for serving the captive electricity needs at the location of the project activities. Fresh cattle dung is fed into the anaerobic digesters.

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. The project activity recovers and utilizes biogas for producing electricity for captive use and hence displaces electricity from the grid using fossil fuels. The project activity hence avoids CH<sub>4</sub> and CO<sub>2</sub> emissions and is beneficial to the environment and community.

#### b) Brief description of the installed technology and equipment>>

The project activities involves the replacement or modification of anaerobic animal manure management systems in livestock farms to achieve methane recovery and gainful use of the recovered methane to generate captive power. The small scale project activities involve the installation of 9 independent biogas digesters between the 200 m<sup>3</sup> and 2000 m<sup>3</sup> capacity range, for serving the captive electricity needs at the location of the project activities. Fresh cattle dung is fed into the anaerobic digesters.

Name	Location Village	State	Capacity
CIRB , Sirsa Road	Hisar	Haryana	200 m3
Navsagar Dairy	Dhanera	Gujarat	300 m3
Barkat bhai prasla	Palanpur	Gujarat	2000 m3
Arco Steel	Kheda	Gujarat	400m3
Olitia Foods	Seekar	Rajasthan	200 m3
SRC Farms	Hooghly	West Bengal	400 m3
Sunvik Farms	Tumkur	Karnataka	1000 m3
Murliya Dairy	Trivendrum	Kerala	600m3
Sarda dairy	Raipur	Chhattisgarh	1200 m3

By using the biogas captured from the digesters the project activity generates power for captive use. The project activity is the controlled biological treatment of biomass or other organic matters through anaerobic digestion in closed reactors equipped with biogas recovery for electricity generation and a combustion/flaring system.

The technical specifications of the modified KVIC model bio-digesters are as follows:

Specification	Value
Total Installed Capacity	6300 m <sup>3</sup>
Mixing Proportion	(Water: Waste) 1:1
Number of units (digesters)	9
Feed Material	Cattle Dung
Biogas Power Installed Capacity	0.793 MW <sub>h</sub>
Working Days	330
Calorific Value Biogas	20 MJ/m <sup>3</sup>
Concentration of methane in the biogas	0.43008kg CH <sub>4</sub> /m <sup>3</sup> Applied an expected fraction of methane in biogas of 0.60 m <sup>3</sup> CH <sub>4</sub> /m <sup>3</sup> multiplied by the density of methane at normal conditions of 0.7168 kg/m <sup>3</sup>

The cattle dung from each dairy farm is collected from the cattle sheds within the project boundary and unloaded into the underground primary collection tank fitted with agitator to prepare homogenous slurry with a dry solid content of 20 %. The dry solid content of the homogenous slurry is measured periodically in the laboratory for ensuring the percentage of the dry solid content.

The raw slurry from the underground RCC collection tank is fitted with submersible stirrer to homogeneously mix the substrate.

c) Relevant dates for the project activity (e.g. construction, commissioning, continued operation periods, etc.)>>

UCR Project ID: 017

Start Date of 1<sup>st</sup> Crediting Period: 01/01/2018

Project Commissioned: 23/03/2018

Total Biogas Units in the monitoring period: 9

This is the 1<sup>st</sup> monitoring report for the 1<sup>st</sup> crediting period for the period 01 January 2018 to 31<sup>st</sup> October 2021.

The operational domestic biogas units are in continuous operation after installation, with minor and major repairs as and when are reported by the project owner. Since the UCR protocol for biogas systems is based on a conservative 330 days a year operation, the project activity was never non-operational for a period of 35 days or more during any year of the monitoring period.

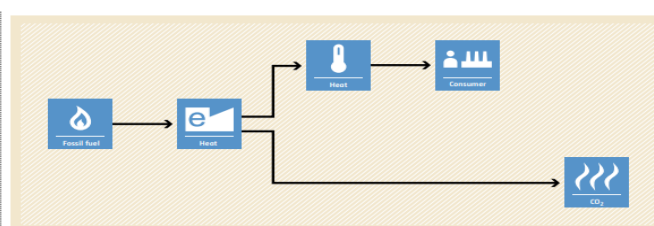
d) Total GHG emission reductions achieved or net anthropogenic GHG removals by sinks achieved in this monitoring period>>

The total GHG emission reductions achieved in this monitoring period is as follows:

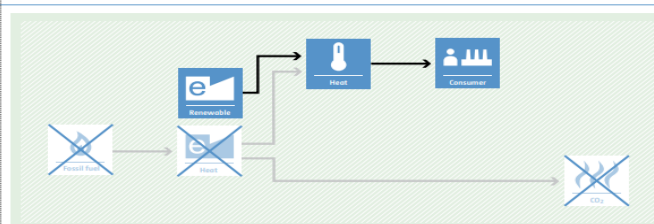
<b>Summary of the Project Activity and ERs Generated for the Monitoring Period</b>	
Start date of this Monitoring Period	01/01/2018
Carbon credits claimed up to	31/10/2021
Total ERs generated (tCO <sub>2eq</sub> )	143945 tCO <sub>2eq</sub>
Leakage	NA

The baseline scenario identified at the MR stage of the project activity is:

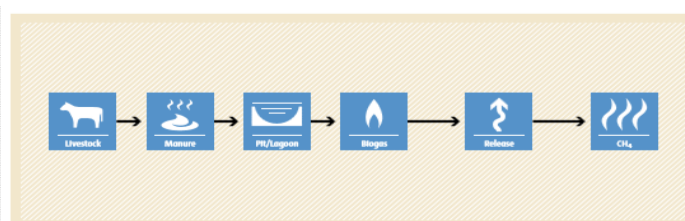
**BASILINE SCENARIO**  
Energy generation (thermal heat and / or electricity) by more-carbon-intensive technologies based on fossil fuel. In case of retrofits or capacity addition, operation of existing renewable power units without retrofit and capacity addition.



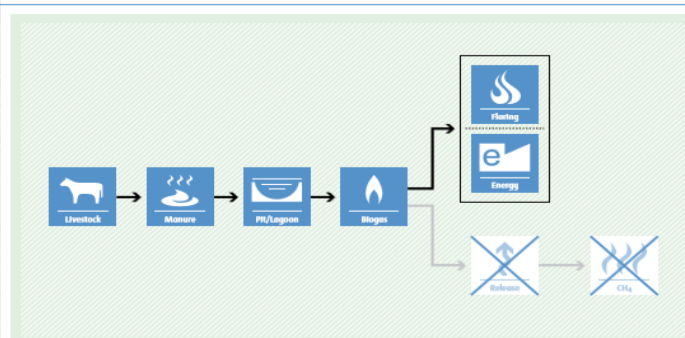
**PROJECT SCENARIO**  
Energy generation by installation of new renewable energy generation units, by retrofitting or replacement of existing renewable energy generation units as well as by switch from fossil fuel to biomass in modified existing facilities.



**BASILINE SCENARIO**  
Animal manure is left to decay anaerobically and methane is emitted into the atmosphere.



**PROJECT SCENARIO**  
Methane is recovered and destructed or gainfully used due to replacement or modification of existing anaerobic manure management systems.

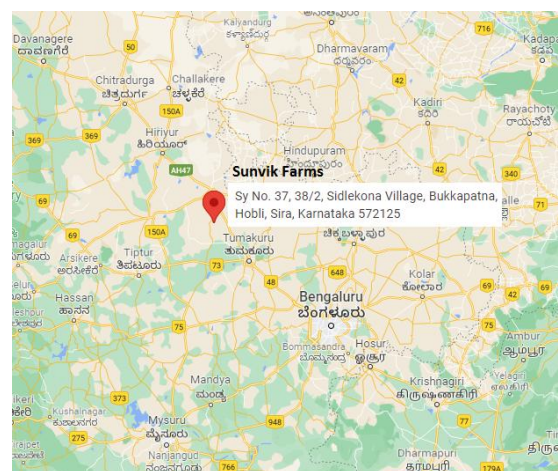
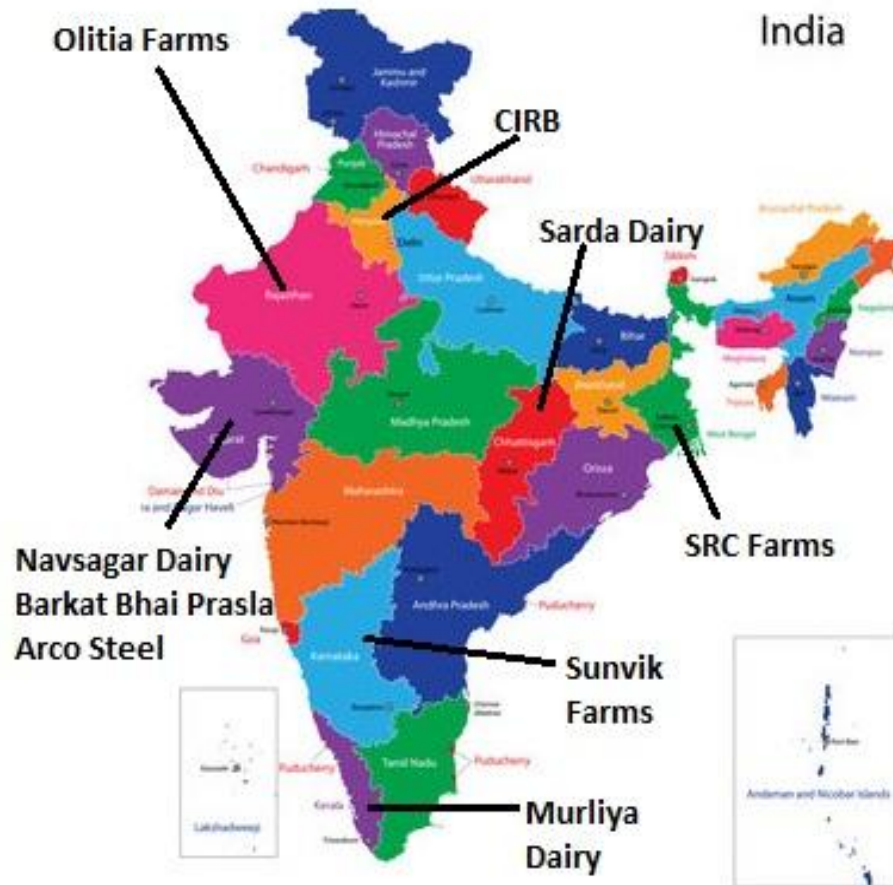


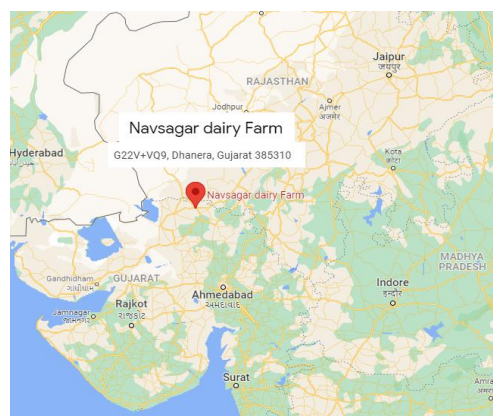
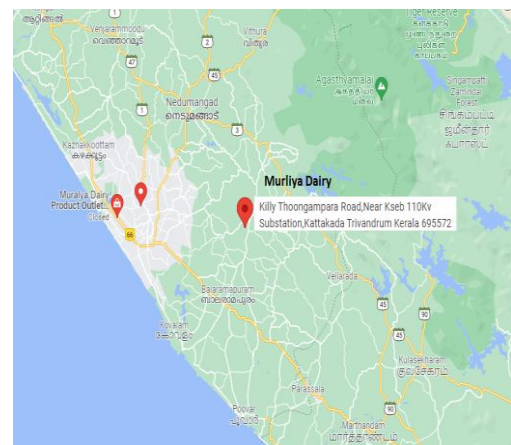
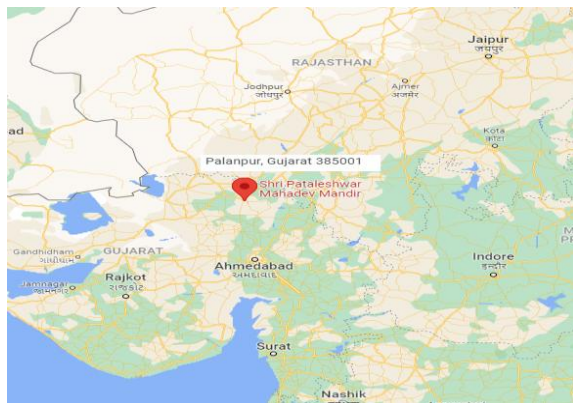
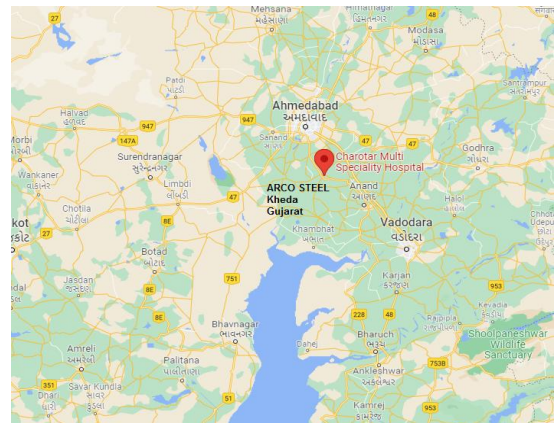
- where, in the absence of the project activity, animal manure is left to decay anaerobically within the project boundary and methane is emitted to the atmosphere.
- the fuel consumption of the technologies that would have been used in the absence of the project activity, times an emission factor for the fossil fuel displaced. Hence the baseline scenario is also electricity imported from a grid in the absence of the project activity.



## A.2. Location of project activity>>

Districts: Hisar, Dhanera, Palanpur, Kheda, Seekar, Hoogly, Tumkur, Trivendrum and Raipur,  
State: Gujarat, Rajasthan, Karnataka, West Bengal, Chhattisgarh, Kerala and Haryana,  
Country: India.







### A.3. Parties and project participants >>

Party (Host)	Participants
India	Urja Bio System Pvt. Ltd., Pune, Maharashtra, India

### A.4. References to methodologies and standardized baselines >>

**SECTORAL SCOPE** - 01 Energy industries (Renewable/Non-renewable sources)  
13 Waste handling and disposal

**TYPE I** - Renewable Energy Projects

**CATEGORY-** *AMS-I.C.: Thermal energy production with or without electricity*

This methodology comprises renewable energy technologies that supply users i.e. residential, industrial or commercial facilities with thermal energy that displaces fossil fuel use. These units include technologies such as energy derived from renewable biomass and other technologies that provide thermal energy that displaces fossil fuel.

#### ***AMS-III.D: Methane recovery in animal manure management systems***

Replacement or modification of existing anaerobic manure management systems in livestock farms, or treatment of manure collected from several farms in a centralized plant to achieve methane recovery and destruction by flaring/combustion or energetic use of the recovered methane.

### A.5. Crediting period of project activity >>

Type: Renewable

State date: 01-01-2018

**1<sup>st</sup> CoU Issuance Period: 3 years, 10 months – 01/01/2018 to 31/10/2021**

**1<sup>st</sup> Crediting Period: 3 years, 10 months – 01/01/2018 to 31/10/2021**

### A.6. Contact information of responsible persons/entities >>

M/S Gram Vikas Trust , Gujarat,

UCR Seller #741215693

Email: gvtbiogas@gmail.com



## SECTION B. Implementation of project activity

### B.1. Description of implemented registered project activity >>

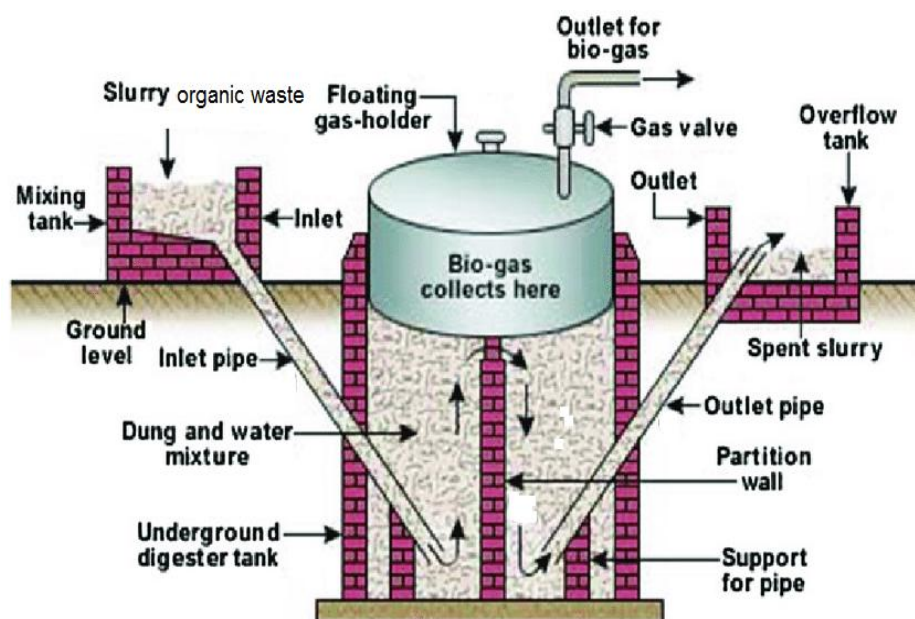
a) Provide information on the implementation status of the project activity during this monitoring period in accordance with UCR PCN>>

The small scale project activities involve the installation of 9 independent biogas digesters between the 200 m<sup>3</sup> and 2000 m<sup>3</sup> capacity range, for serving the captive electricity needs at the location of the project activities. The high rate digester treats cattle dung under anaerobic condition and converts 50 % of organic carbon to produce Biogas.

Year Capacity Installed m3	2018	2019	2020	2021
	200	2900	4500	6300

Name	Power Capacity Kwh
C IRB	24
Navsagar Dairy	50
Barkat bhai prasla	250
Arco Steel	50
Olitia Foods	24
SRC Farms	50
Sunvik Farms	120
Murliya Dairy	75
Sarda dairy	150
<b>Total</b>	<b>793</b>

b) For the description of the installed technology(ies), technical process and equipment, include diagrams, where appropriate>>



The cattle dung from each dairy farm is collected from the cattle sheds within the project boundary and unloaded into the underground primary collection tank fitted with agitator to prepare homogenous slurry with a dry solid content of 20 %. The dry solid content of the homogenous slurry is measured periodically in the laboratory for ensuring the percentage of the dry solid content.

The raw slurry from the underground RCC collection tank is fitted with submersible stirrer to homogenously mix the substrate.

The retention time of slurry in the digester is 25 days with an operating temperature of 55°C. The methanization digesters are fitted with stirrers that ensure dry solid control within the digester to an average value of 15%.

The technical specifications of the modified KVIC model bio-digesters are as follows:

Specification	Value
Total Installed Capacity	6300 m <sup>3</sup>
Mixing Proportion	(Water: Waste) 1:1
Number of units (digesters)	9
Feed Material	Cattle Dung
Biogas Power Installed Capacity	0.793 MW <sub>h</sub>
Working Days	330
Calorific Value Biogas	20 MJ/m <sup>3</sup>
Concentration of methane in the biogas	0.43008kg CH <sub>4</sub> /m <sup>3</sup> Applied an expected fraction of methane in biogas of 0.60 m <sup>3</sup> CH <sub>4</sub> /m <sup>3</sup> multiplied by the density of methane at normal conditions of 0.7168 kg/m <sup>3</sup>

The dairy farm owners in the project activity can be classified as small to medium-level farmers who are feeding a combination of green fodder and crop residues. Feed intake is typically measured

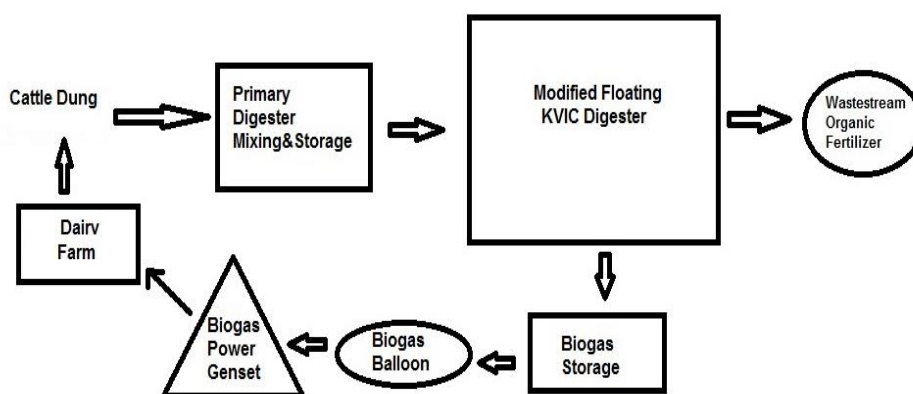
in terms of gross energy (eg., megajoules (MJ) per day) or dry matter (eg. kilograms (kg) per day).

Type of waste	Digester Capacity Installed (total)
Cattle dung based	6300 m <sup>3</sup>

Type of waste	Estimated TPD treated in the digesters
Cattle dung	126 TPD

**Processing of Treated Slurry:** The treated slurry is dewatered and the dry cake is used as high quality organic fertilizer.

**Biogas Storage System:** The biogas from all the digesters are collected in a gas storage facility and then sent to balloon holding chamber with a cumulative storage capacity of 6300m<sup>3</sup> in this project activity.



**Scrubbing System:** From the ballons, the raw biogas is sent to scrubbing containers that remove CO<sub>2</sub> and H<sub>2</sub>S gases and provide the raw biogas with a methane content of approximately 60%. This purified CH<sub>4</sub> is then typically stored in another ballon chamber for further usage.

**Power Generation:** The scrubbed biogas is then sent to biogas generators which is typically a spark ignition inter-cooler engine generator. The genset capacities in the project sites ranges between 24 kwh to 250 kwh with a total number of 9 generators installed within the project activities. The electrical efficiency is about 38% of each generator.

## B.2 Do no harm or Impact test of the project activity>>

There are social, environmental, economic and technological benefits which contribute to sustainable development.

### • Social benefits:


- Reduces outdoor air pollution, thus eliminating health hazards for people in the vicinity.
- The project provides security of energy supply since it generates biogas based electricity
- It leads to better waste management thus keeping the surroundings clean and reduce some of the disease causing pathogens
- Biogas allowed farms in the project activities to become self-sufficient in power and monetise their waste.

- **Environmental benefits:**






- While carbon dioxide remains in the atmosphere for hundreds to thousands of years, it takes only about a decade for methane to break down. So, reducing methane emissions now would have an impact in the near term and is critical for helping keep the world on a path to 1.5°C.
- Further, by generating electricity through utilising the biogas, the project helps in replacing fossil fuel intensive power generation from the local grid.
- Biogas is environmentally friendly and does not release as many greenhouse gases when burned compared to other fuels
- Leads to soil improvement by providing high quality manure to farmers from waste stream.
- Reduces outdoor air pollution, and increases use of manure rather than chemical fertilizers.
- Methane is the primary contributor to the formation of ground-level ozone, a hazardous air pollutant and greenhouse gas, exposure to which causes 1 million premature deaths every year worldwide.


- **Economic and Technological benefits:**

- The project is among the few in the region than captures biogas and uses the same for the generation of electricity for captive uses at the project site.
- Cattle dung is transformed into high-quality enriched bio-manure/fertilizer which provides better soil enrichment in the areas surrounding the project activities.
- The revenue from carbon credits will showcase such efforts undertaken to curb CH<sub>4</sub> emissions as being highly profitable and will encourage larger capacity installations and additions across all livestock farms and make the Indian dairy and livestock sector environmentally sustainable.
- Finance is another hurdle for setup of such biogas plants. A biogas plant is a large investment. However, revenue from the sale of carbon credits will force green entrepreneurs to give it a second thought under the UCR Program. [India's biogas potential from cattle dung is estimated at 1000 MTA from 300 million cows & buffaloes.](#)

SDG	Impact
 <p>Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture</p>	<ul style="list-style-type: none"> <li>• Restoring soils through the recycling of nutrients, organic matter, and carbon</li> <li>• Increasing crop yields through use of nutrient-rich digestate biofertiliser</li> <li>• Recirculating phosphorus, which is essential for the growth of plants but limited in supply</li> </ul>



 <p>Goal 3: Ensure healthy lives and promote well-being for all at all ages</p>	<ul style="list-style-type: none"> <li>• Reducing air pollution by substituting fossil fuel with biogas</li> <li>• Treating and recycling sewage and organic wastes to reduce odours and the spread of diseases</li> </ul>
 <p>Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all</p>	<ul style="list-style-type: none"> <li>• Reducing dependence on fossil-fuel-based energy sources by replacing with biogas</li> <li>• Utilising locally produced wastes and crops to generate energy for rural and remote communities. The project activity treats <b>126 tonnes per day (TPD) of cattle dung</b> that would have otherwise been left to decay anaerobically</li> <li>• Storing biogas to produce energy when required</li> <li>• Methane, constituting about 55–60% of landfill gas, is utilized to increase the share of renewable energy in the global energy mix</li> </ul>
 <p>Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation</p>	<ul style="list-style-type: none"> <li>• Improving the self-sufficiency and sustainability of industries by extracting the energy from local waste and effluents and using it for the generation of renewable clean fuels.</li> <li>• Collaboration between industries and agriculture for mutual benefit</li> <li>• Generating short-term construction employment and long-term equipment manufacturing and maintenance employment.</li> </ul>
 <p>Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable</p>	<ul style="list-style-type: none"> <li>• Preventing spread of diseases through collection and proper management of organic cattle waste</li> <li>• Improving sanitation and hygiene through decentralised and local treatment of biosolids</li> <li>• Improving urban air quality by substituting fossil fuel with biomethane in vehicles</li> <li>• Reducing greenhouse gas emissions by using biogas-based renewable energy in the transportation industry</li> </ul>
 <p>Goal 13: Take urgent action to combat climate change and its impacts</p>	<ul style="list-style-type: none"> <li>• Reducing carbon dioxide emissions by replacing fossil-fuel-based energy sources with biogas and commercial fertilisers with digestate biofertiliser</li> <li>• Reduction of methane and nitrous oxide emissions from livestock manures</li> <li>• Reduction of methane and generation of renewable energy from other organic wastes</li> <li>• Capturing emissions from landfills</li> </ul>

 <p>Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss</p>	<ul style="list-style-type: none"> <li>Recirculating nutrients and organic matter in organic wastes through AD and returning them to the soil in the form of digestate biofertiliser</li> </ul>
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### B.3. Baseline Emissions>>

The baseline scenario identified of the project activity is:

- 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.
- the fuel consumption of the technologies that would have been used in the absence of the project activity, times an emission factor for the fossil fuel displaced. Hence the baseline scenario is also electricity imported from a grid in the absence of the project activity.

### B.4. Debundling>>

This project activity is not a debundled component of a larger registered carbon project activity.

## SECTION C Application of methodologies and standardized baselines

### C.1. References to methodologies and standardized baselines >>

**SECTORAL SCOPE** - 01 Energy industries (Renewable/Non-renewable sources)  
13 Waste handling and disposal

**TYPE I** - Renewable Energy Projects

**CATEGORY-** *AMS-I.C.: Thermal energy production with or without electricity*

This methodology comprises renewable energy technologies that supply users i.e. residential, industrial or commercial facilities with thermal energy that displaces fossil fuel use. These units include technologies such as energy derived from renewable biomass and other technologies that provide thermal energy that displaces fossil fuel.

#### ***AMS-III.D: Methane recovery in animal manure management systems***

Replacement or modification of existing anaerobic manure management systems in livestock farms, or treatment of manure collected from several farms in a centralized plant to achieve methane recovery and destruction by flaring/combustion or energetic use of the recovered methane.

### • C.2. Applicability of methodologies and standardized baselines >>

This project activity comprises measures to avoid the emissions of methane to the atmosphere from cattle dung within the project boundary.
No methane recovery and destruction by flaring or combustion for gainful use takes place in the baseline scenario.
The livestock population in the farm is managed under confined conditions
Manure or the streams obtained after treatment are not discharged into natural water resources (e.g. river or estuaries);
Biogas is used for renewable power generation for captive use.
The project activity is biogas power plant and is not a co-generation project.
In the baseline scenario the retention time of manure waste in the anaerobic treatment system is greater than one month
Residual waste from the digestion is handled aerobically
The storage time of the manure after removal from the animal barns, including transportation, does not exceed 45 days before being fed into the anaerobic digester
Measures are limited to those that result in aggregate emission reductions of less than or equal to 60 kt CO <sub>2</sub> equivalent annually from all Type III components of the project activity.
This is a small scale project with total electricity capacity of 0.793 MW which is not greater than small scale thresholds defined by the applied methodology I.C. under Type I – renewable energy project activity, i.e. the total installed electrical energy generation capacity of the project equipment does not exceed 15 MW.

### C.3. Applicability of double counting emission reductions >>

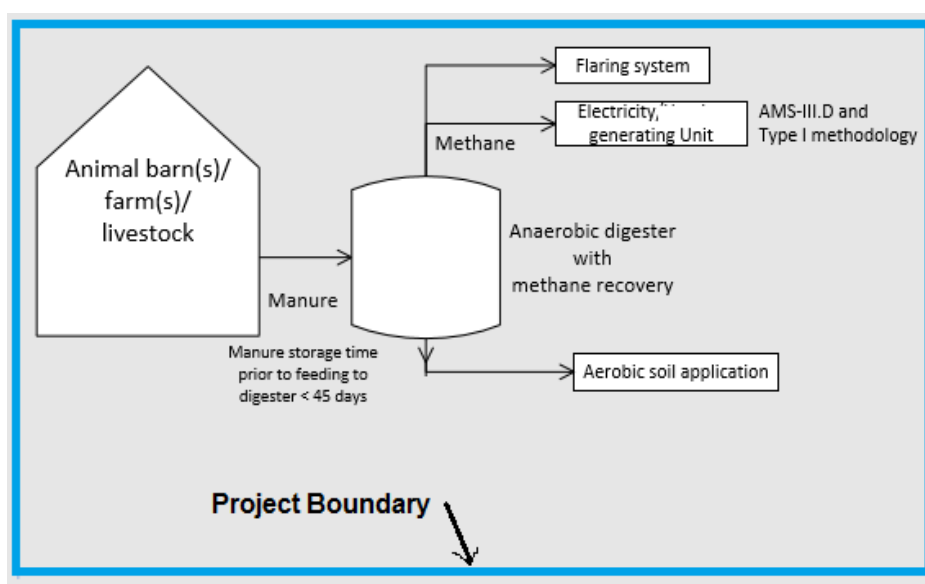
Each of the biogas unit is constructed within the project boundary. Each biogas unit has a unique ID, which is visible on the biogas unit and each power generator set has a unique ID and metering system. The details of the end user's name and the location i.e. District, Mandal, village in which it

is constructed along with the Unique ID will be provided to the UCR verifier during verification.

#### C.4. Project boundary, sources and greenhouse gases (GHGs)>>

The project boundary includes the physical, geographical site(s) of:

- (a) The livestock;
- (b) Animal manure management systems (including centralised manure treatment plant where applicable);
- (c) Facilities which recover and use methane for power generation.



	Source	GHG	Included?	Justification/Explanation
Baseline	Methane Emissions from manure decay	CO <sub>2</sub>	<b>Included</b>	Major source of emission
		CH <sub>4</sub>	<b>Included</b>	Major source of emission
	Emissions from electricity generated using fossil fuels	N <sub>2</sub> O	Excluded	Excluded for simplification. This is conservative
Project Activity	CO <sub>2</sub> Emissions from on-site electricity use	CO <sub>2</sub>	Excluded	Electricity is generated from collected biogas, hence these emissions are not accounted for.
	CH <sub>4</sub> Emissions from flaring of the biogas	CH <sub>4</sub>	<b>Included</b>	Included in project emissions
	CH <sub>4</sub> Emissions associated with anerobic digesters	N <sub>2</sub> O	Excluded	Excluded for simplification. This is conservative

The project activity recovers and utilizes biogas for producing electricity and applies AMS IC



methodology in addition to using a Type III component of a SSC methodology, hence any incremental carbon emissions occurring due to the implementation of the project activity is neglected.

## C5. Establishment and description of baseline scenario (UCR Protocol) >>

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.

Baseline emissions ( $BE_{yI}$ ) are calculated by using the following option: 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 ( $Bo$ ).

For renewable energy technologies that displace technologies using fossil fuels, the simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity, times an emission factor for the fossil fuel displaced. Hence the baseline scenario is also electricity is imported from a grid.

The project proponent was not bound to incur this investment as it was not mandatory by national and sectoral policies. Thus, the continued operation of the project activity would continue to replace fossil fuel derived grid electricity.

**Estimated Annual Emission Reductions:**  $BE_y = BE_{yI} + BE_{generated,y} - PE_{flare} - PE_{AD,y}$

$BE_y$  = Total Baseline Emissions in a year.

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

$BE_{grid}$  = Baseline emissions for the grid electricity displaced by the project in year y (t CO<sub>2</sub>e)

$EG_{y,grid}$  = Amount of grid electricity displaced by project in year y (MWh)

$EF_{y,grid}$  = Emission factor of the grid (t CO<sub>2</sub>e/MWh) = 0.9 (UCR Standard)

$$BE_{yI} = GWP_{CH4} \times D_{CH4} \times UF_b \times \sum MCF_j \times B_{0,LT} \times N_{LT,y} \times VS_{LT,y} \times MS\%_{Bl,j}$$

$$VS_{LT,y} = (W_{site}/W_{default}) \times VS_{default} \times nd_y$$

$BE_{yI}$  = 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 (VS) content

$N_{LT,y}$  = Average number of animals of type LT in a year

$W_{site}$  = 275 kg Avg. Wt. at Site (cow) in kg

$W_{default}$  = 275 kg Avg. Default Wt. of (cow) as per IPCC for Dairy Cow in India.

$nd_y$	= Number of days in year y where the treatment was operational
$VS_{\text{default\_cattle}}$	= Volatile solids of livestock LT entering the animal manure management system in year y as per IPCC default for cattle in India
$UF_b$	= Model correction factor to account for model uncertainties (0.94) Default
$VS_{jLTy}$	= Specific volatile solids content of animal manure from livestock type LT and animal manure management system j in year y (tonnes/tonnes, dry basis) (Cow=2.6). As per IPCC guidelines
$D_{CH_4}$	= $CH_4$ density (0.00067 t/m <sup>3</sup> at room temperature (20 °C) and 1 atm pressure)
$MCF_j$	= Annual methane conversion factor (MCF) for the baseline animal manure management system j (Dairy Cow = 5%), solid storage.
$B_{O,LT}$	= Maximum methane producing potential of the volatile solid generated for animal type LT (m <sup>3</sup> $CH_4$ /kg dm) in Indian Subcontinent (Cow =0.13). IPCC 2006 - IPCC Default Value taken for Indian Subcontinent
VS	= Volatile Solids

The feed digestibility in the range of 50 to 60% has been considered as appropriate for this PoA. The production of volatile solids is very much dependent on the feed digestibility levels. Corresponding to the feed intake levels, the estimated dietary net energy concentration of diet of 5.5 MJ/kg (Nema) has been found appropriate considering the default Values for Moderate Quality Forage taken from IPCC 2006, Ch. 10, Vol. 4, Table 10.8 Page 10.23. Based on the above value, at 50 to 60% feed digestibility levels, the Dry Matter Intake comes around 49 kg/day for a 295kg cattle head as per the equation (Equation 10.18a in IPCC 2006 chapter 10, volume 4, Page 10.22) as follows :

$DMI = BM^{0.75} \times \{[(0.0119 \times Nema^2) + 0.1938]\} / Nema$  where:

DMI = Dry Matter Intake;

BM = Live Body Weight = Default Value of 275 Kg (as given in IPCC 2006 table 10.A.6, chapter 10, volume 4, Page 10.77 considered).

Nema = estimated dietary net energy concentration of diet (Default Values for Moderate Quality Forage taken from IPCC 2006, Ch. 10, Vol. 4, Table 10.8 Page 10.23 = 5.5 MJ kg<sup>-1</sup>

$VS_{\text{Default, Cow}}$  is the value for the volatile solid excretion rate per day on a dry-matter basis for a defined livestock population (kg dm/animal/day) = 2.6

$GWP_{CH_4}$  = 21 is the default IPCC value of  $CH_4$  applicable to the crediting period (tCO<sub>2e</sub>/t  $CH_4$ )

### Project Emissions:

$PE_{\text{flare},y}$  = Emissions from flaring of the biogas stream in the year y (tCO<sub>2e</sub>)

$$PE_{\text{flare},y} = GWP_{CH_4} \times \sum TM_{RG,h} \times (1 - \eta_{\text{flare},h}) \times 0.001$$

$PE_{AD,y}$  = Project Emissions associated with anaerobic digesters in year y (tCO<sub>2e</sub>)

$PE_{\text{leakage}} = \text{Nil}$

$PE_{\text{transport}} = \text{Nil}$

Emissions from incremental transportation in the year  $y$  (t CO<sub>2</sub>e), and physical leakage is negligible since the dung is generated within the project boundary of all the sites in the PoA.

$PE_{\text{power}, y} = \text{Nil}$ .

No fossil fuel is used for power generation within the project boundary. The electricity generated for captive use. The use of the recovered biogas is within the project boundary and its output is monitored in order to ensure that the recovered biogas is actually destroyed. Project emissions on account of storage of cattle dung before being fed into the anaerobic digester is not accounted since the storage time of the dung after removal from the cattle shed, including transportation, does not exceed 24 hours before being fed into the anaerobic digester.

**Estimated yearly baseline emission reductions ( $BE$ ) =**

Year	Emission Reductions Type I	Emission Reductions Type I (tCO <sub>2</sub> )
2018	124.416	124
2019	2309.472	2309
2020	4048.704	4048
2021	5138.64	5138

Parameter	Unit	2018	2019	2020	2021
<b>Emission Reductions</b> $ER_y = (BE_y - PE_y - LE_y)_{AMS\ III.D} + (ER_y)_{AMS\ IC}$		<b>1,906.00</b>	<b>27,609.00</b>	<b>42,838.00</b>	<b>59,973.00</b>
<b>Baseline Emissions</b> $BE_y = GWP_{CH_4} \times D_{CH_4} \times UF_b \times \sum MCF_j \times B_{0,LT} \times N_{LT,y} \times VS_{LT,y} \times MS\%$		<b>1,969.40</b>	<b>28,523.10</b>	<b>44,256.17</b>	<b>61,958.64</b>
<b>Project Emissions</b> $PE_y = PE_{PL,y} + PE_{flare,y} + PE_{power} + PE_{transport,y} + PE_{storage} + PE_{AD,y}$		<b>63.01</b>	<b>913.67</b>	<b>1,417.77</b>	<b>1,984.88</b>

Year	Emission Reductions
2018	2030
2019	29918
2020	46886
2021	65111
Total	143945

## C.6. Prior History>>

The project activity has not applied to any other GHG program for generation or issuance of carbon offsets or credits.

## C.7. Monitoring period number and duration>>

First CoU Issuance Period: 3 years, 10 months

Monitoring Date: 01/01/2018 to 31/10/2021

## C.8. Changes to start date of crediting period >>

Start date of the project activity: 23/03/2018

There is no change in the start date of crediting period.

## C.9. Permanent changes from PCN monitoring plan, applied methodology or applied standardized baseline >>

There are no permanent changes from registered PCN, monitoring plan and applied methodology

## C.10. Monitoring plan>>

The project activity applies the monitoring methodology AMS-IC., for monitoring of emission reduction and AMS-III.D.

The data required to be monitored include:

- ☐ Quantity of gross electricity generation by the project plant/unit in year y ( $EG_{gross,y}$ )
- ☐ Amount of cattle dung used at the plants ( $Q_{cattle\ dung}$ )
- ☐ Amount of biogas generated per day from the poultry litter. ( $BG_{fuelled,y}$ )
- ☐ Mass flow of methane in the residual gas in the minute m (kg) ( $FCH_{4,RG,m}$ )
- ☐ Annual average ambient temperature at a weather station nearby project site.  $T_{region}$
- ☐ Methane content in biogas  $W_{CH_4,y}$
- ☐ Number of days cattle is alive in the farm in the year y  $N_{da,y}$
- ☐ Site average animal weight of the defined livestock population  $W_{site}$
- ☐ Number of animals produced annually of type LT for the year y  $N_{p,y}$
- ☐ Pressure of biogas at flow measurement site  $P$
- ☐ Temperature of biogas at flow measurement site  $T$  (26 Deg C)
- ☐ Annual average interval between manure collection and delivery for treatment at a given storage device
- ☐ Fraction of Manure handled in the digester.  $MS\%$  (100%)
- ☐ Annual operational days of the digesters  $n_{dy}$
- ☐ Amount of organic manure disposed from the project boundary on a daily basis.  $Q_{Organic\ manure}$
- ☐ Volumetric component of component i in the residual gas in the hour h where I is  $CH_4$   $f_{v\ i,h}$

Data/Parameter	$N_L$										
Data unit	<table><tr><th>Year</th><th>Cattle Count</th></tr><tr><td>2018</td><td>1070</td></tr><tr><td>2019</td><td>1370</td></tr><tr><td>2020</td><td>2703</td></tr><tr><td>2021</td><td>3569</td></tr></table>	Year	Cattle Count	2018	1070	2019	1370	2020	2703	2021	3569
Year	Cattle Count										
2018	1070										
2019	1370										
2020	2703										
2021	3569										
Description	Number of head of cattle										
Source of data	Head count of cattle whose dung is used for generating biogas										
Value(s) applied											
Measurement methods and procedures	Based on back-calculation of cattle dung requirement of the										



Monitoring frequency	plant. Cow average generation data (i.e. 15kg / head / day).
Purpose of data	Fixed (conservative estimate)
	To estimate baseline emissions

<b>Data / Parameter:</b>	<b>MCF</b>
Data unit:	5.00%
Description:	Annual methane conversion factor. The MCF indicates the extent to which, under certain conditions, the degradable substances will actually be converted into methane.
Source of data:	-IPCC Guidelines
Measurement procedures (if any):	Default values provided in 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10. The project proponent has used the IPCC default values to estimate the baseline emissions. It also ensures that the baseline emissions are calculated in a conservative manner.
Monitoring frequency:	Fixed
QA/QC procedures:	-
Any comment:	-Baseline emissions are calculated in a conservative manner.

<b>Data / Parameter:</b>	<b><math>EG_{generated,y}</math></b>										
Data unit:	kWh										
Description:	<table border="1"> <thead> <tr> <th>Year</th><th>kwh Generated</th></tr> </thead> <tbody> <tr> <td>2018</td><td>138240</td></tr> <tr> <td>2019</td><td>2566080</td></tr> <tr> <td>2020</td><td>4498560</td></tr> <tr> <td>2021</td><td>5709600</td></tr> </tbody> </table>	Year	kwh Generated	2018	138240	2019	2566080	2020	4498560	2021	5709600
Year	kwh Generated										
2018	138240										
2019	2566080										
2020	4498560										
2021	5709600										
Source of data	Plant records/Meter records										
Measurement procedures (if any):	Measured using calibrated meters. Calibration shall be as per the relevant methodologies.										
Monitoring frequency:	Continuous monitoring, integrated hourly and at least monthly recording										
QA/QC procedure	-										
Any comment:	The parameter need to be monitored for project activities which displaces grid electricity										

<b>Data / Parameter:</b>	<b><math>EF_{grid,y}</math></b>
Data unit:	t CO <sub>2</sub> e/MWh
Description:	CO <sub>2</sub> emission factor for the grid electricity in year y
Source of data	-As described in UCR Standard
Measurement procedures (if any):	0.9
Monitoring frequency:	NA
QA/QC procedure	-
Any comment:	The parameter need to be monitored for project activities which displaces grid electricity

<b>Data / Parameter:</b>	<b>VS</b>
Data unit:	2.6 kg/head/day

Description:	Volatile Solids production per head
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories under the volume 'Agriculture, Forestry and other Land use' for 'Emissions from Livestock and Manure Management' -
Measurement procedures (if any):	Fixed Default
Monitoring frequency:	NA
QA/QC procedure	The project proponent has used a combination of the field values and the IPCC default values to estimate the baseline emissions and an assessment on its suitability has been provided. It also ensures that the baseline emissions are calculated in a conservative manner
Any comment:	Baseline Emissions

Data/Parameter	B <sub>0,LT</sub>
Data unit	0.13 m <sup>3</sup> CH <sub>4</sub> /kg dm
Description	Maximum methane producing potential of the volatile solids generated for animal type LT
Source of data Value(s) applied	IPCC 2006 table 10.A.6 , chapitre 10, volume 4, Value taken for India
Measurement methods and procedures	The selected default value is appropriate as it reflects the feed intake levels at the site. The option as per AMS III D Para 18 (c), Page 8, is utilised to adjust the default IPCC values for VS for a site-specific animal weight .The methane producing potential is utilised to calculate the volatile solids generated.
Monitoring frequency	Fixed
Purpose of data	To estimate baseline emissions

Data / Parameter:	Q <sub>waste</sub>										
Data unit:	<table border="1"> <thead> <tr> <th>Year</th><th>TPD Treated</th></tr> </thead> <tbody> <tr> <td>2018</td><td>4</td></tr> <tr> <td>2019</td><td>58</td></tr> <tr> <td>2020</td><td>90</td></tr> <tr> <td>2021</td><td>126</td></tr> </tbody> </table>	Year	TPD Treated	2018	4	2019	58	2020	90	2021	126
Year	TPD Treated										
2018	4										
2019	58										
2020	90										
2021	126										
Description:	Quantity of cattle dung used in the biogas digesters each year.										
Source of data:	Measured										
Measurement procedures (if any):	On-site data sheets recorded monthly and daily using weigh bridge										
Monitoring frequency:	Monthly-										
QA/QC procedures:	Weighbridge is subject to periodic calibration (in accordance with stipulation of the weighbridge supplier)										
Any comment:	Log of data entry is provided to UCR verifier										

Data/Parameter	$N_y$										
Data unit	<table border="1"> <thead> <tr> <th>Year</th><th>Days of Operation</th></tr> </thead> <tbody> <tr> <td>2018</td><td>240</td></tr> <tr> <td>2019</td><td>330</td></tr> <tr> <td>2020</td><td>330</td></tr> <tr> <td>2021</td><td>300</td></tr> </tbody> </table>	Year	Days of Operation	2018	240	2019	330	2020	330	2021	300
Year	Days of Operation										
2018	240										
2019	330										
2020	330										
2021	300										
Description	Number of working days of the biogas units in each year										
Source of data	Conservative estimate to offset repair and maintenance activities at the site										
Value(s) applied											
Measurement methods and procedures	Recorded in log books										
Monitoring frequency	Recorded in log books										
Purpose of data	To estimate baseline emissions										

Data / Parameter:	$f_{v\ i,h}$
Data Unit	Fraction Description Volumetric component of component i in the residual gas in the hour h where I is CH <sub>4</sub>
Source of data	Continuous Gas Analyser - Applied an expected fraction of methane in biogas of 0.60 m <sup>3</sup> CH <sub>4</sub> /m <sup>3</sup> multiplied by the density of methane at normal conditions of 0.7168 kg/m <sup>3</sup> .
Value(s) applied	0.43
Measurement methods and procedures	The same basis (dry or wet) is considered for this measurement and the measurement of the volumetric flow rate of the residual gas (FVRG,H) when the residual gas temperature exceed 60°C.
Monitoring frequency	Continuously. Values shall be averaged hourly.
QA/QC procedures	Analysers shall be periodically calibrated as per manufacturer's recommendation
Purpose of data	To ensure the applicability of Flare Efficiency of 90%
Additional comment	All gas volumes other than CH <sub>4</sub> is considered as N <sub>2</sub> for simplification

Data / Parameter	<b>T</b>
Data Unit	°C
Description	Temperature of biogas at flow measurement site
Source of data:	Monitored through thermometer
Value(s) applied	38 °C Measured regularly as per the technical guidance issued by the manufacturer for the installed equipment. Measurement methods and procedures .
Monitoring:	The temperature of the biogas will be monitored regularly and 12 measurements (one measurement per month) shall be taken each year. (As per Box 4 – Non-binding Best Practices in the methodology)

Data Type:	Temperature of the biogas is °C
Recording:	The data shall be recorded monthly.
Archiving Policy:	All the electronic and paper monitoring documents will be archived during the crediting period and two years thereafter.
Monitoring frequency	The value will be monitored regularly and 12 measurements (one measurement per month) shall be recorded.
QA/QC procedures	The parameter is monitored regularly and the measurements are logged in the log book. All measurement devices shall be procured from reputed manufacturers. The instruments used for monitoring are calibrated once a year.
Purpose of data	To calculate the baseline emissions
Additional comment	NA

Data / Parameter	P
Data Unit	Pa
Description	Pressure of biogas at flow measurement site
Source of data:	Monitored through pressure meter
Value(s) applied	100 mmWC
Data Type:	Pressure of the biogas is mbar or MMWC
Recording:	The data shall be recorded monthly.
Archiving Policy:	All the electronic and paper monitoring documents will be archived during the crediting period and two years thereafter.
Monitoring frequency	The value will be monitored regularly and 12 measurements (one measurement per month) shall be recorded.
QA/QC procedures	The parameter is monitored regularly and the measurements are logged in the log book. All measurement devices shall be procured from reputed manufacturers. The instruments used for monitoring are calibrated once a year.
Purpose of data	To calculate the baseline emissions
Additional comment	NA