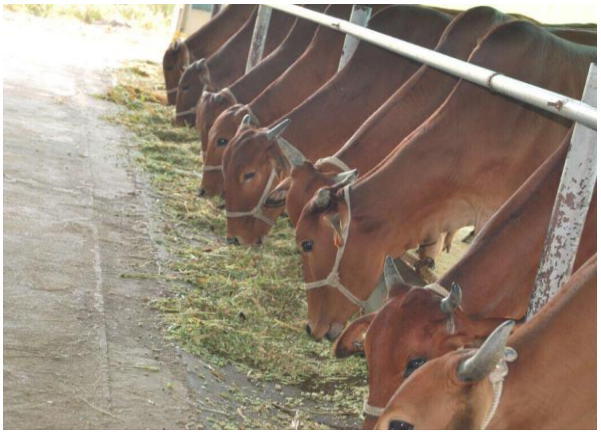
Monitoring Report

CARBON OFFSET UNIT (CoU) PROJECT



Title: PoA Cattle Dung Biogas to Power, Maharashtra (UCR ID#015)

Version 1.0

Date 01/11/2021

First CoU Issuance Period: 7 years, 10 months

Date: 01/01/2014 to 31/10/2021

Monitoring Report (MR)
CARBON OFFSET UNIT (CoU) PROJECT

Monitoring Report	
Title of the project activity	PoA Cattle Dung Biogas to Power, Maharashtra
UCR Project Registration Number	015
Version	1
Completion date of the MR	01/11/2021
Monitoring period number and duration of this monitoring period	Monitoring Period Number: 1 Crediting Period: 01/01/2014 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
Sectoral scopes	SECTORAL SCOPE - 01 Energy industries (Renewable/NonRenewable Sources) 13 Waste handling and disposal
	2014: 5583 CoUs
	2015: 6268 CoUs
	2016: 19134 CoUs
	2017: 25458 CoUs
	2018: 27420 CoUs
	2019: 27412 CoUs
	2020: 40735 CoUs
	2020: 48346 CoUs
Total:	**200356 CoUs (200356 tCO_{2eq})**

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 **PoA Cattle Dung Biogas to Power, Maharashtra** is located across 13 Villages in the State of Maharashtra, India.

The details of the registered project are as follows:

Purpose of the project activity:

The **PoA Cattle Dung Biogas to Power, Maharashtra** is located across the following Districts: Marathwada, Nashik, Pune, Raigad and Osmanabad, State: Maharashtra, Country: India. The project activity qualifies under the programme of activities (PoAs) and involves the installation of 13 independent biogas digesters beginning 15/06/2009. The purpose of the PoA is the set up independent biogas plants (digesters) between the 50 m^3 , 100 m^3 (2nos), 200m^3 (4nos), 300 m^3 (2nos), 500 m^3, 800 m^3 and 1000 m^3 (2nos) capacity range, for serving the captive electricity needs at the location of the PoA. Fresh cattle dung is fed into the anaerobic digesters.

In the absence of the PoA, animal manure is left to decay anaerobically within the project boundary and methane is emitted to the atmosphere. The PoA recovers and utilizes biogas for producing electricity for captive use and hence displaces electricity from the grid using fossil fuels. The PoA hence avoids CH_4 and CO_2 emissions and is beneficial to the environment and community.

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

The purpose of the PoA is the set up independent biogas plants (digesters) between the 50 m^3 , 100 m^3 (2nos), 200m^3 (4nos), 300 m^3 (2nos), 500 m^3, 800 m^3 and 1000 m^3 (2nos) capacity range, for serving the captive electricity needs at the location of the PoA. Fresh cattle dung is fed into the anaerobic digesters.

Sr no	Name of client	location	State	Use of biogas	Commissioning Date
1	MGM college	Aurangabad	Maharashtra	Power 25kW	15/06/2009
2	Surendra Girme	Pune	Maharashtra	Power , 36 KW	22/12/2013
3	Amey Balasaheb Patil	Osmanabad	Maharashtra	Power , 36 KW	27/04/2014
4	Modern Dairy	Nashik	Maharashtra	Power , 24 KW	30/05/2015
5	Sarda Dairy	Nashik	Maharashtra	Power , 120 KW	07/02/2016
6	Parbhani Agro tech	Jalna	Maharashtra	Power , 50 KW	21/09/2016
7	Govind Baug	Baramati	Maharashtra	Power , 12 KW	21/12/2016
8	BAIF	Pune	Maharashtra	Power , 10 KW	30/01/2017
9	Deepak kargal	Shirur	Maharashtra	Power , 12 KW	23/08/2017
10	Sandeep Ghojge	Talegaon , Pune	Maharashtra	Power , 24 KW	08/05/2019
11	Novosera Raut Serum	Pune	Maharashtra	Power , 100 KW	28/09/2019
12	Aba Sutar	Chale, Pune	Maharashtra	Power , 24 KW	25/04/2020
13	KVK	Baramati	Maharashtra	Power 100kw	27/10/2021

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	4950 m^3
Mixing Proportion	(Water: Waste) 1:1
Number of units (digesters)	13
Feed Material	Cattle Dung
Biogas Power Installed Capacity	0.573 MW_h
Working Days	330
Calorific Value Biogas	20 MJ/m^3
Concentration of methane in the biogas	0.43008kg $CH4/m^3$ Applied an expected fraction of methane in biogas of 0.60 m3CH4/m3 multiplied by the density of methane at normal conditions of 0.7168 kg/m3

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.

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

Date of UCR Project Authorization: ___29/10/ 2021_

Start Date of Crediting Period: 01/01/2014

Project Commissioned: 15/06/2009

Total Biogas Units in the monitoring period: 13

This is the first monitoring report for the first crediting period for the period 01 January 2014 to 31st October 2021.

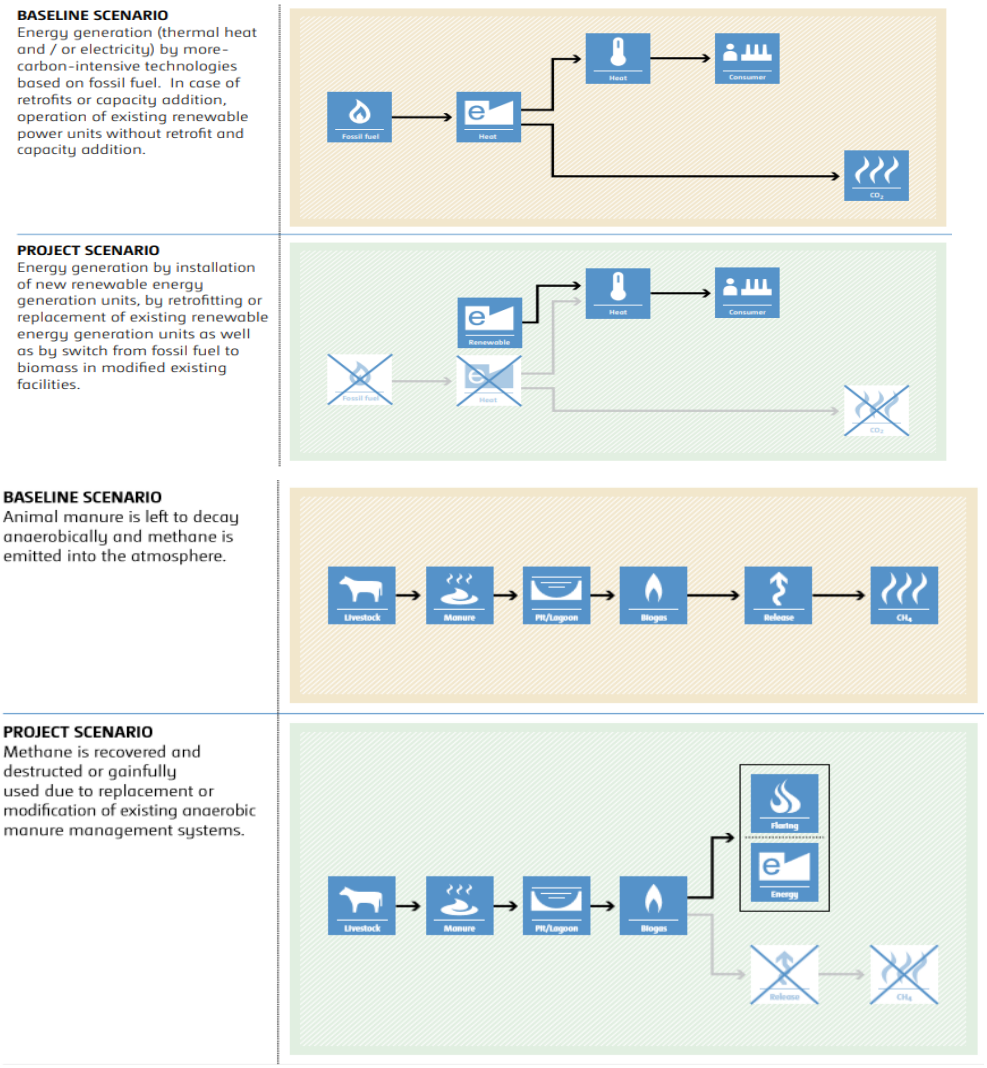
The operational domestic biogas units are in continuous operation after installation, with minor and major repairs as and when are reported by the project owner. Since the UCR protocol for biogas systems is based on a conservative 330 days a year operation, the project activity was never non-operational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

Summary of the Project Activity and ERs Generated for the Monitoring Period	
Start date of this Monitoring Period	01/01/14
Carbon credits claimed up to	31/10/21
Total ERs generated (tCO_{2eq})	200356 tCO_{2eq}
Leakage	NA

The baseline scenario identified at the MR stage 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.

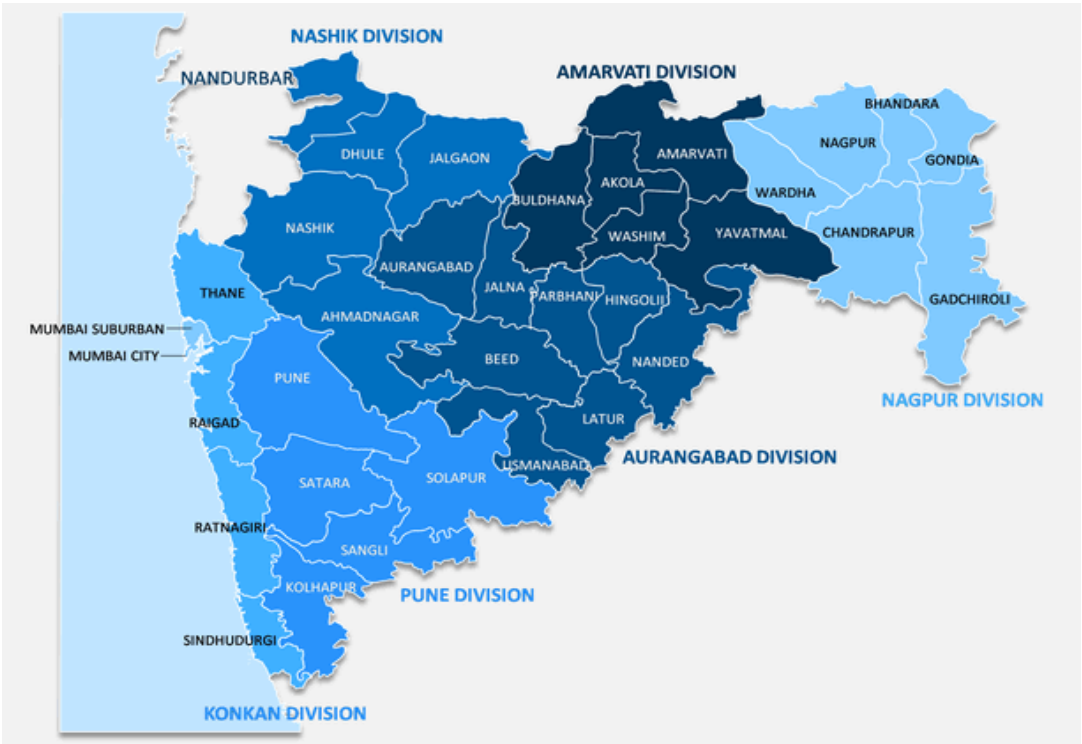
A.2. Location of project activity>>

Country: India

Districts: Marathwada, Nashik, Pune, Raigad and Osmanabad

Taluka: Jalna, Nashik, Pune, Baramati, Osmanabad, Aurangabad, Shirur, Chale, and Talegaon

State: Maharashtra



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: 01-01-2014
First Issuance Period: 7 years, 10 months – 01/01/2014 to 31/10/2021

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

Nutan P.,
Chief Executive, Gram Vikas Trust, Vadodara, Gujarat, India.
Email: gvtbiogas@gmail.com

SECTION B. Implementation of project activity

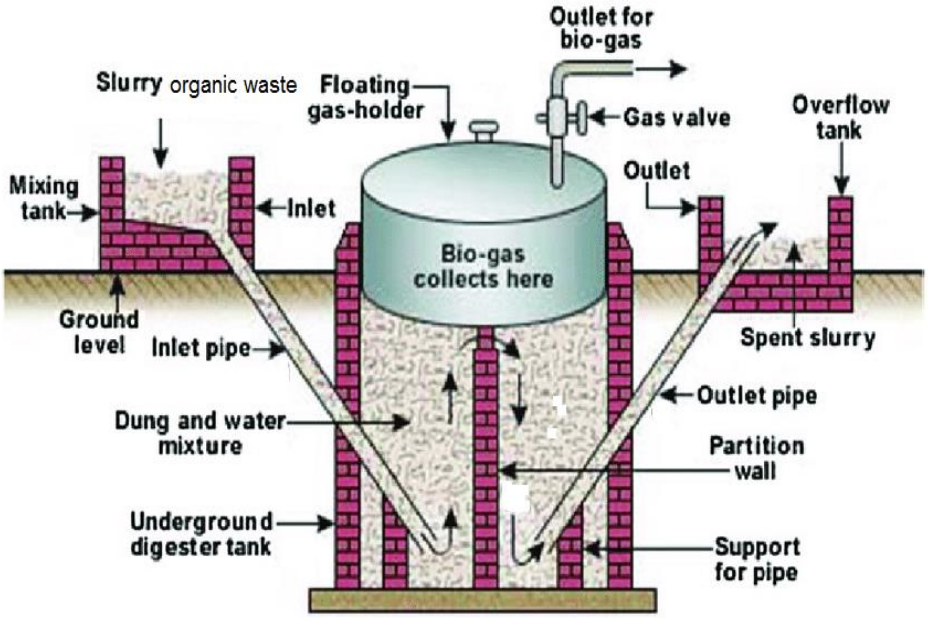
B.1. Description of implemented registered project activity >>

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

The PoA has a total of 13 independent biogas digesters between the 50 m^3 and 1000 m^3 in capacity with arrangements of continuous stirring. The high rate digester treats cattle dung under anaerobic condition and converts 50 % of organic carbon to produce Biogas.

Sr no	Name of client	location	Use of biogas	Capacity m3
1	MGM college	Aurangabad	Power 25kW	**200**
2	Surendra Girme	Pune	Power , 36 KW	**300**
3	Amey Balasaheb Patil	Osmanabad	Power , 36 KW	**300**
4	Modern Dairy	Nashik	Power , 24 KW	**200**
5	Sarda Dairy	Nashik	Power , 120 KW	**1000**
6	Parbhani Agro tech	Jalna	Power , 50 KW	**500**
7	Govind Baug	Baramati	Power , 12 KW	50
8	BAIF	Pune	Power , 10 KW	100
9	Deepak kargal	Shirur	Power , 12 KW	100
10	Sandeep Ghojge	Talegaon , Pune	Power , 24 KW	200
11	Novosera Raut Serum	Pune	Power , 100 KW	1000
12	Aba Sutar	Chale, Pune	Power , 24 KW	200
13	KVK	Baramati	Power 100kw	800

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.

Modified KVIC Floating Methanization Digesters: The PoA has a total of 13 independent biogas digesters between the 50 m^3 and 1000 m^3 in capacity with arrangements of continuous stirring. The high rate digester treats cattle dung under anaerobic condition and converts 50 % of organic carbon to produce Biogas.

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%.

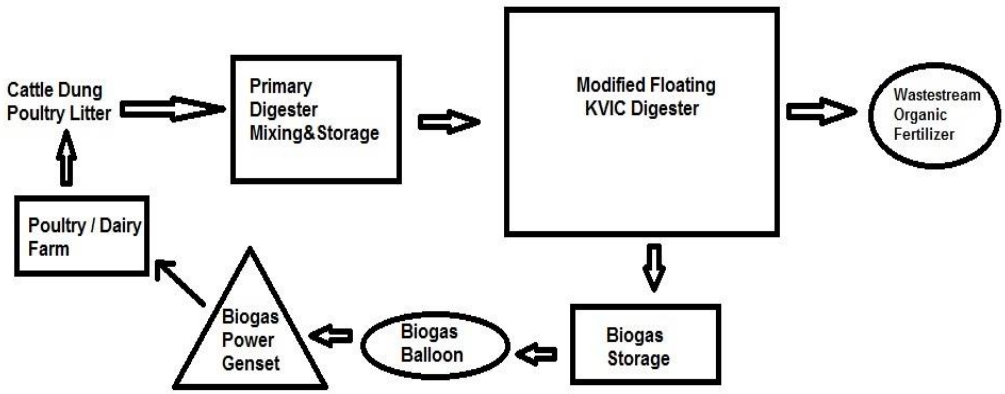
The technical specifications of the modified KVIC model bio-digesters are as follows:

Specification	Value
Total Installed Capacity	4950 m^3
Mixing Proportion	(Water: Waste) 1:1
Number of units (digesters)	8
Feed Material	Cattle Dung
Biogas Power Installed Capacity	0.573 MW_h
Working Days	330
Calorific Value Biogas	20 MJ/m^3
Concentration of methane in the biogas	0.43008kg $CH4/m^3$ Applied an expected fraction of methane in biogas of 0.60 m3CH4/m3 multiplied by the density of methane at normal conditions of 0.7168 kg/m3
Calculated biogas production rates	Biogas per day (m3 /day) generation capacity
Cattle Dung 1TPD	50 m3

The dairy farm owners in the PoA 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).

Number Annually within PoA	2014	2015	2016	2017	2018	2019	2020	2021
Cattle	1070	1370	2703	3569	3835	3835	5700	6766

Type of waste	Estimated TPD treated in the PoA
Cattle dung	99-100 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 4950m^3 in this PoA.

Scrubbing System: From the ballons, the raw biogas is sent to scrubbing containers that remove CO_2 and H_2S gases and provide the raw biogas with a methane content of approximately 60%. This purified CH4 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 PoA genset capacity ranges between 10 kwh to 120 kwh with a total number of 13 generators installed within the PoA. 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 PoA 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.
- Using biogas as an energy resource contributes to clean environment.
- 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 PoA.
- The revenue from carbon credits will showcase such efforts undertaken to curb CH_4 emissons 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.

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 PoA 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 PoA 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 CO2 equivalent annually from all Type III components of the project activity.
This is a small scale project with total electricity capacity of 0.573 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 not exceed 15 MW.

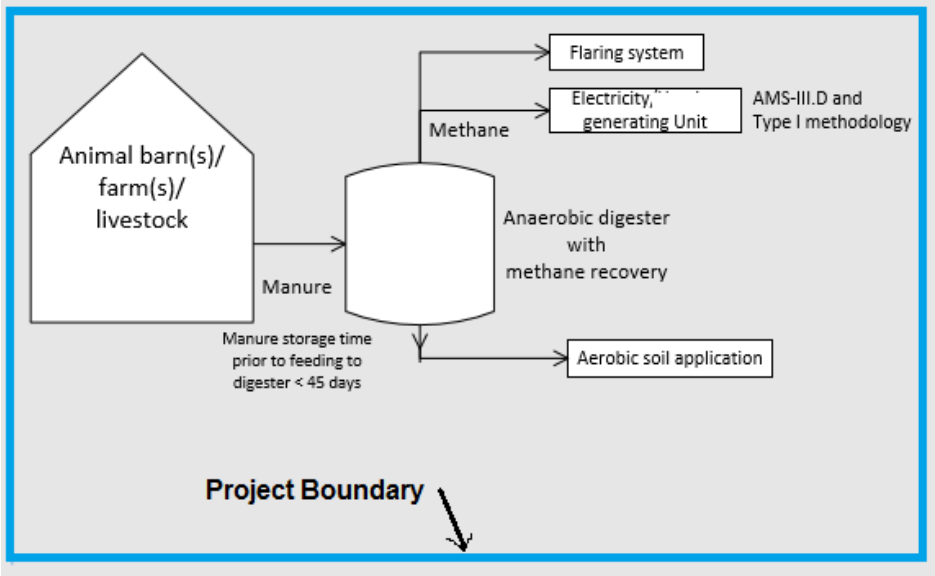
C.3. Applicability of double counting emission reductions >>

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_2**	**Included**	Major source of emission
		CH_4	**Included**	Major source of emission
	Emissions from electricity generated using fossil fuels	N_2O	Excluded	Excluded for simplification. This is conservative
Project Activity	Co_2 Emissions from on-site electricity use	CO_2	Excluded	Electricity is generated from collected biogas, hence these emissions are not accounted for.
	CH_4 Emissions from flaring of the biogas	**CH_4**	**Included**	Included in project emissions
	CH_4 Emissions associated with anerobic digesters	N_2O	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_{y1}) 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: $BE_y = BE_{y1} + Be_{generated,y} - PE_{flare} - PE_{AD,y}$

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 CO2e)
$EG_{y,grid}$	=	Amount of grid electricity displaced by project in year y (MWh)
$EF_{y,grid}$	=	Emission factor of the grid (t CO2e/MWh) = 0.9 (UCR Standard)

$$BE_{y1} = GWP_{CH4} \times D_{CH4} \times UF_b \times \Sigma MCF_j \times B_{0,LT} \times N_{LT,y} \times VS_{LT,y} \times MS\%_{Bl,j}$$

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

BE_{y1}	= 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

$VS_{default\_cattle}$ = 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_{CH4} = CH_4 density (0.00067 t/m^3 at room temperature (20 ºC) 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^3 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 = BM0.75 x[{[(0.0119xNEma 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^{-1}

$VS_{Default, Cow}$ 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_{CH4} = 21 is the default IPCC value of CH_4 applicable to the crediting period (tCO_{2e}/t CH_4)

Project Emissions:

$PE_{flare,y}$ = Emissions from flaring of the biogas stream in the year y (tCO_{2e})

$$PE_{flare,y} = GWP_{CH4} \times \Sigma TM_{RG,h} \times (1 - \eta_{flare,h}) \times 0.001$$

$PE_{AD,y}$ = Project Emissions associated with anerobic digesters in year y (tCO_{2e})

$PE_{leakage}$ = Nil
$PE_{transport}$ = Nil

Emissions from incremental transportation in the year y (t CO2e), and physical leakage is

negligible since the dung is generated within the project boundary of all the sites in the PoA.

PE $_{power, y}$ = Nil.

No fossil fuel is used for power generation within the PoA. 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.

Parameter	Unit	2014	2015	2016	2017	2,018	2,019	2,020	2,021
Emission Reductions $ER_y = (BE_y - PEy - LE)_{y\,AMS\,III.D} + (ER)_{y\,AMS\,ID}$		5,583.00	6,268.00	19,134.00	25,458.00	27,420.00	27,412.00	40,735.00	48,346.00
Baseline Emissions $BE_y = GWP_{CH4} \times D_{CH4} \times UF_b \times \sum MCF_j \times B_{0,LT} \times N_{LT,y} \times VS_{LT,y} \times MS\%$		5,835.56	6,583.66	19,937.41	26,325.05	28,287.07	28,287.07	42,043.36	49,906.21
Project Emissions $PE_y = PE_{PL,y} + PE_{flare,y} + PE_{power} + PE_{transport,y} + PE_{storage} + PE_{AD,y}$		252.05	315.06	803.40	866.42	866.42	874.73	1,307.50	1,559.55

Estimated yearly baseline emission reductions (*BE*) =

Year	Emission Reductions
2014	5583
2015	6268
2016	19134
2017	25458
2018	27420
2019	27412*
2020	40735
2021	48346
Total	172944

*Mid year capacity additions have not been considered for the year/s in which they were commissioned in order to be conservative, however project emissions have been considered in the total emission reductions for the commissioned years in order to be conservative (example year 2019, 2021).

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 Issuance Period: 7 years, 10 months – **1/01/2014 to 31/10/2021**

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

Start Date of the PoA: 15/06/2009
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-I.D., 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 (EGgross,y)
- Amount of cattle dung used at the plants (**$Q_{cattle\ dung}$**)
- Amount of biogas generated per day from the polutry 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 **$W_{CH4,\ y}$**
- 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 **$CH_{4\ fv\ i,h}$**

Data/Parameter	N_L
Data unit	

Year	Cattle Count
2014	1070
2015	1370
2016	2703
2017	3569
2018	3835
2019	3835
2020	5700
2021	6766

Description	Number of head of cattle
Source of data Value(s) applied	Head count of cattle whose dung is used for generating biogas
Measurement methods and procedures	Based on back-calculation of cattle dung requirement of the plant. Cow average generation data (i.e. 15kg / head / day).
Monitoring frequency	Fixed (conservative estimate)
Purpose of data	To estimate baseline emissions

Data / Parameter:	MCF
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	Default values provided in 2006 IPCC Guidelines for National

procedures (if any):	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.

Data / Parameter:	$EG_{grenerated,y}$
Data unit:	kWh
Description:	

Year	kwh Generated
2014	568032
2015	624360
2016	1908720
2017	2478960
2018	2574000
2019	2574000
2020	3556080
2021	3746160

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

Data / Parameter:	$EF_{grid,y}$
Data unit:	t CO_2e/MWh
Description:	CO_2 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

Data / Parameter:	**VS**
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	$B_{0,LT}$
Data unit	0.13 m^3 CH_4/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 , chapte r 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_{waste}
Data unit:	
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

Year	TPD Treated
2014	16
2015	20
2016	51
2017	55
2018	55
2019	79
2020	83
2021	99

Data/Parameter	N_y
Data unit	<table><tr><th>Year</th><th>Days of Operation</th></tr><tr><td>2014</td><td>244</td></tr><tr><td>2015</td><td>215</td></tr><tr><td>2016</td><td>330</td></tr><tr><td>2017</td><td>330</td></tr><tr><td>2018</td><td>330</td></tr><tr><td>2019</td><td>330</td></tr><tr><td>2020</td><td>330</td></tr><tr><td>2021</td><td>330</td></tr></table>
Description	Number of working days of the biogas units in each year
Source of data Value(s) applied	Conservative estimate to offset repair and maintenance activities at the site
Measurement methods and procedures	Recorded in log books
Monitoring frequency	Recorded in log books
Purpose of data	To estimate baseline emissions

Data / Parameter:	$fv_{i,h}$
Data Unit	Fraction Description Volumetric component of component i in the residual gas in the hour h where I is CH_4
Source of data	Continuous Gas Analyser - Applied an expected fraction of methane in biogas of 0.60 m^3CH_4/m^3 multiplied by the density of methane at normal conditions of 0.7168 kg/m^3.
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 CH4 is considered as N2 for simplification

Data / Parameter	**T**
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