PROJECT CONCEPT NOTE

CARBON OFFSET UNIT (CoU) PROJECT

Title: Small Scale Goshala Community Biogas Projects, Gujarat

Version 2.0

Date 31/10/2021

First CoU Issuance Period: 7 years, 10 months

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

Project Concept Note (PCN)
CARBON OFFSET UNIT (CoU) PROJECT

BASIC INFORMATION	
Title of the project activity	Small Scale Goshala Community Biogas Projects, Gujarat
Scale of the project activity	Small Scale
Completion date of the PCN	31/10/21
Project participants	Aryan Associates, Vadodara, Gujarat, India
Host Party	India
Applied methodologies and standardized baselines	AMS. I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User UCR Protocol Standard Baseline AMS-III.D: Methane recovery in animal manure management systems
Sectoral scopes	01 Energy industries (Renewable/NonRenewable Sources) 13 Waste handling and disposal
Estimated amount of total GHG emission reductions over the crediting period	**416928** CoUs (416928 tCO_{2eq}/yr)

SECTION A. Description of project activity

A.1. Purpose and general description of Carbon offset Unit (CoU) project activity >>

The project **<u>Small Scale Goshala Community Biogas Projects, Gujarat</u>** is located in various villages in District: Surat, Junagadh, Dhoraji, Ahmedabad, Gandhinagar, Kuttch, Banaskartha, Amreli, Tapi, Kheda, Rajkot, Navsari, Anand, Morbi, Panchmahals, Surendranagar, Bhavnagar, Nadiad, Godhra, Pavagadh, Bharuch, Karamsad, Mahisagar, Aravalli, Vadodara, Dahod, Jamnagar and Porbandar, State: Gujarat, India.

Goshala, a Sanskrit word ("Go" means cow and "Shala" means a shelter place: Go + Shala = shelter for cows), means the abode or sanctuary for cows, calves and oxen. Donations and tourist events are often important to support the activities and revenue inflows to such goshalas. The goshalas in the project activty are linked to their own ashrams or educational institutions offering yoga and music lessons, workshops and even retreats, aimed at tourists interested in spirituality, alternative medicine etc. The food cooked for tourists, residents and staff at such goshalas is from the heat derived from biogas digesters.

The details of the registered project are as follows:

Purpose of the project activity:
The **<u>Small Scale Goshala Community Biogas Projects, Gujarat</u>** is located across 50 villages within the Districts of Surat, Junagadh, Dhoraji, Ahmedabad, Gandhinagar, Kuttch, Banaskartha, Amreli, Tapi, Kheda, Rajkot, Navsari, Anand, Morbi, Panchmahals, Surendranagar, Bhavnagar, Nadiad, Godhra, Pavagadh, Bharuch, Karamsad, Mahisagar, Aravalli, Vadodara, Dahod, Jamnagar and Porbandar.

The purpose of the project activities is the set up of **93** independent biogas plants (digesters) of $15m^3$, $25m^3$, $35m^3$, $45m^3$, $60m^3$ and $85m^3$ capacity each for serving large community kitchens, staff kitchens, campus kitchens and individual households using cattle dung collected from buffaloes, cows and calves. Many of these goshalas run well equipped modern veterinary hospitals which cater to many animals and birds in distress. Each community/household/staff kitchen is directly connected to the biogas digesters and feeds cattle dung into the anaerobic digesters. The technology is tried and tested in India, and has been in use for many years. By utilizing cattle dung in a controlled anaerobic digestion and combustion system, biogas will be available for cooking energy and heat water for bath. Biogas is used on a either a single ring gas stove typically having one 4” burner or a double ring gas stove with a flame temperature of 870 ^{o} C, supplied as part of the project activity. The biogas slurry is used as bio-manure.

The digesters are installed in the following districts:

Districts			
Ahmedabad	Junagadh	Dhoraji	Gandhinagar
Kuttch	Banaskantha	Amreli	Kheda
	Rajkot	Karamsad	Tapi
Vadodara	Navsari	Porbandar	Mahisagar
Anand	Surat	Morbi	Panchmahals
Dahod	Bhavnagar	Nadiad	Surendranagar
	Pavagadh	Jamnagar	Godhra
Bharuch			Aravalli

By using biogas generated from cattle dung, the project activity replaces Non-Renewable Biomass with biogas for cooking and heating water. The baseline scenario is thermal energy from fuel wood within the domestic households in the village of which a large part of it was non-renewable for domestic cooking and water heating. The baseline scenario is also 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.

These project activities contribute strongly to sustainable development of the rural villages and households involved in the project. The larger 15m^3, 25m^3 , 35m^3, 45m^3, 60m^3 and 85m^3 capacity digesters are sufficient to provide cooking fuel to a large community based kitchen that are typically attached to such digesters and also a number of interconnected households (between 150-200 people can be served in community kitchens and each household is assumed to have four to five members per family). The larger Fuel wood scarcity has an impact directly on rural households, which are highly dependent on this fuel. Demand for fuel wood and logs from commons and forests have caused resource degradation to the extent that collection exceeds sustainable yield. The project activity will attenuate the rural thermal energy needs used for cooking and water heating. The percentage of population using fuel wood is higher in rural areas (67.3%) and 14% in urban and semi-urban areas (NSSO, 2012). uel wood is largely used by women for cooking purpose and they approximately spends more than 374 hours in a year for collecting fuel wood. The fuel wood is

Table 3: Trends of forest resources as reported in India's State of Forest Reports (IFSR)

Forest resource accounting variable	ISFR 2003	ISFR 2005	ISFR 2009	ISFR 2011	ISFR 2013	ISFR 2015	ISFR 2017	Net Change between 2003 to 2017	% change between 2003 to 2015
Forest Cover (in square kilometres)	686,767	692,027	6,90,899	6,92,027	6,97,898	7,01,673	7,08,273	20,506	3.13
Growing Stock in Forests (million cubic meters)	4781.414	4602.04	4498.7	4498.73	4173.36	4195.047	4218.38	-563.034	-11.78
Growing Stock in Forests and Tree outside forests (million cubic meters)	6413.752	6218.28	6098.2	6047.15	5658.05	5768.387	5822.377	-591.373	-9.22

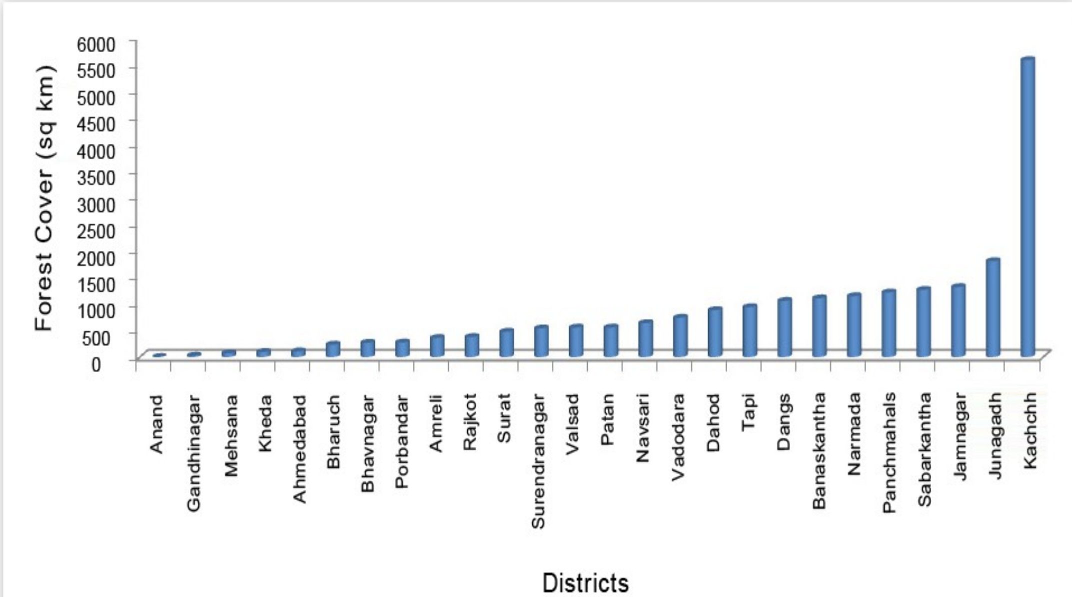
https://www.un.org/esa/forests/wp-content/uploads/2018/06/UNFF13_Background_Note_Wood_Energy_in_IndiaTERI.pdf

Source: FSI 2003; FSI, 2005; FSI 2009; FSI 2011; FSI 2013; FSI 2015; FSI 2017

collected from forests, trees grown on farm lands, homesteads and common land outside forest. The annual fuel wood consumption by 854 million people in India is 216.4 million tonnes per year (FSI, 2011). Around 27% of fuel wood is collected from Government owned forests (Public Land).

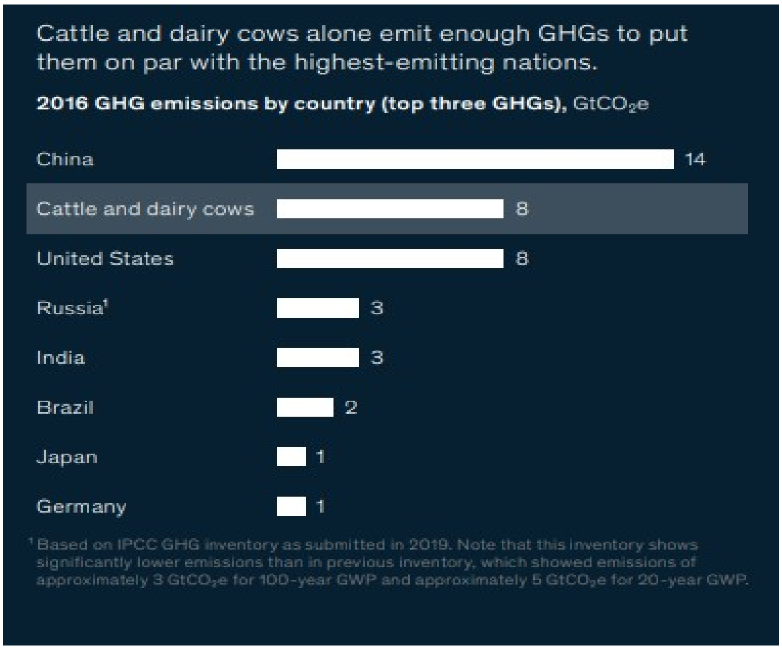
The smoke from burning such fuels causes alarming household pollution and adversely affects the health of women & children causing several respiratory diseases/ disorders. Biogas technology is a particularly useful system in the Indian rural economy, and can fulfill several end uses. The gas is useful as a fuel substitute for firewood, dung, agricultural residues, petrol, diesel, and electricity, depending on the nature of the task, and local supply conditions and constraints, thus supplying energy for cooking and lighting. Biogas systems also provide a residue organic waste after anaerobic digestion that has superior nutrient qualities over the usual organic fertilizer, cattle dung, as it is in the form of ammonia. Anaerobic digesters also function as a waste disposal system, particularly in curbing methane emissions from cattle dung which is stockpiled and untrreated in most villages.

Figure-2 : Distribution of Forest Areas over the districts of the state



source: https://forests.gujarat.gov.in/forest-area-information.htm

Livestock production can result in methane (CH_4) emissions from enteric fermentation and both CH_4 and nitrous oxide (N_2O) emissions from livestock manure management systems. Cattle are an important source of CH_4 in many countries because of their large population and high CH_4 emission rate due to their ruminant digestive system. Methane emissions from manure management tend to be smaller than enteric emissions, with the most substantial emissions associated with confined animal management operations where manure is handled in liquid-based systems. The conventional method of handling manure has been to use sufficient bedding to keep the manure relatively dry and then to move it out of the confinement area and deposit it into a manure pile for months prior to the project activity. Due to constraints associated with manure management, feeding, breeding, health and management, the Indian dairy sector is one of the most greenhouse gas (GHG) emission intensive sector in the country. The typical manure management system across India involves manure stacking in piles prior to dung cake making.



A.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 drudgery to women and children who spend long hours and travel long distances to collect fuel wood.
- Reduces indoor air pollution, thus eliminating health hazards for women and children.
- The project provides security of energy supply
- It leads to better manure management thus keeping the surroundings clean and reduce some of the disease causing pathogens
- Children are able to attend school in time as food will be cooked in time.
- An important point that should be stressed upon here is the involvement of men folk in carrying the dung to the digester. Thus, this model of biogas plant reduces the efforts required to be put in by women, who in other cases are alone responsible for the operation and maintenance of collection of firewood for traditional cooking methods.

- **Environmental benefits:**
- Improves the local environment by reducing uncontrolled deforestation in the project area
- Avoids local environmental pollution through better waste management
- Leads to soil improvement by providing high quality manure
- Avoided global and local environmental pollution and environmental degradation by switching from non-renewable biomass to renewable energy, leading to reduction of GHG emissions
- Reduces deforestation, reduces indoor air pollution, and increases use of manure rather than chemical fertilizers.
- Using biogas as an energy resource contributes to clean environment. Cattle dung is transformed into high-quality enriched bio-manure/fertilizer.
- Hygienic conditions are improved through reduction of pathogens by utilizing the animal and other organic wastes in the bio-digesters.
- The high-quality manure produced will lead to improvement in soil conditions.
- A clean and particulate-free source of energy also reduces the likelihood of chronic diseases that are associated with the indoor combustion of biomass-based fuels, such as respiratory infections, ailments of the lungs; bronchitis, asthma, lung cancer, and increased severity of coronary artery disease.
- The slurry that is returned after the biogas system process is superior in terms of its nutrient content as the process of methane production serves to narrow the carbon:nitrogen ratio (C:N).

- **Economic benefits:**
- Higher productivity of members as they have adequate cooking fuel supply. Provides employment to local communities through construction and maintenance of biogas units.
- The project reduces cooking time, thus providing the people associated with the project activity to take up income generating activities like farming and other compost related sale activities.
- A regular supply of energy piped to the home/kitchen reduces, if not removes, the daily task of fuelwood gathering, which can, in areas of scarcity, be the single most time consuming task of a woman's day - taking more than three hours in some areas. Freeing up energy and time for a woman in such circumstances often allows for other activities, some of which may be income generating.

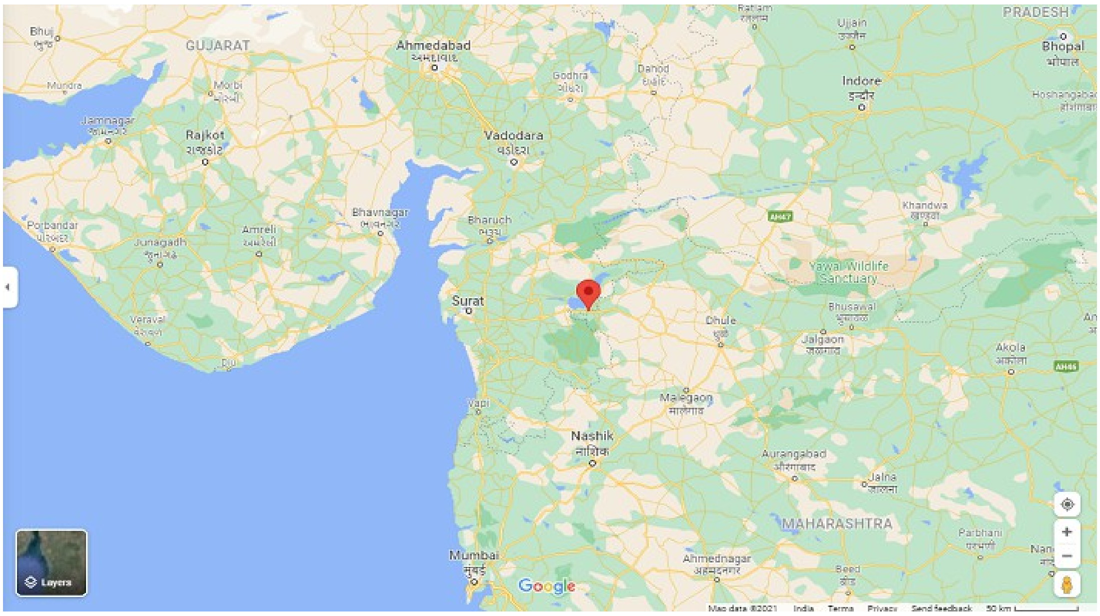
A.3. Location of project activity >>

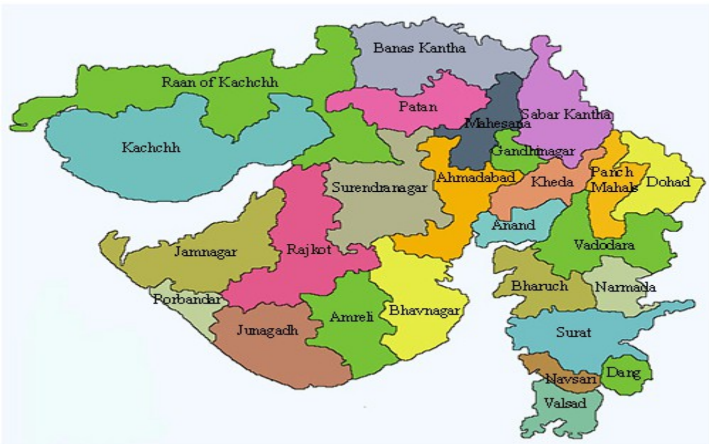
Country: India.

District: Surat, Junagadh, Dhoraji, Ahmedabad, Gandhinagar, Kuttch, Banaskartha, Amreli, Tapi, Kheda, Rajkot, Navsari, Anand, Morbi, Panchmahals, Surendranagar, Bhavnagar, Nadiad, Godhra, Pavagadh, Bharuch, Karamsad, Mahisagar, Aravalli, Vadodara, Dahod, Jamnagar and Porbandar.

Taluka: Mundra, Lakhpat, Padara, Anand, Fatepura, Chottaudaipur, Junagadh, Deesa, Wankaner, Karjan, Navasari, Kamrej, Choryasi, Surat, Sihor, Mangrol, Ahemdabad, Mahuva, Visavadar, Godhra, Maliya Hatina, Kimadi, Suvarkundla, Mandvi, Bharuch, Doraji, Karmsad, Gariyadhar, Morbi, Savarkundla, Nadiyad, Jamodhpur, netrang, Nandod, Gandhinagar, Kheda, Valod, Santrampur, Marwa, Jalod, Meghraj, Bhachau, Dholka, Anjar, Goghamba, Sanjeli, Zagadiya, Daskroi and Bardoli.

State: Gujarat





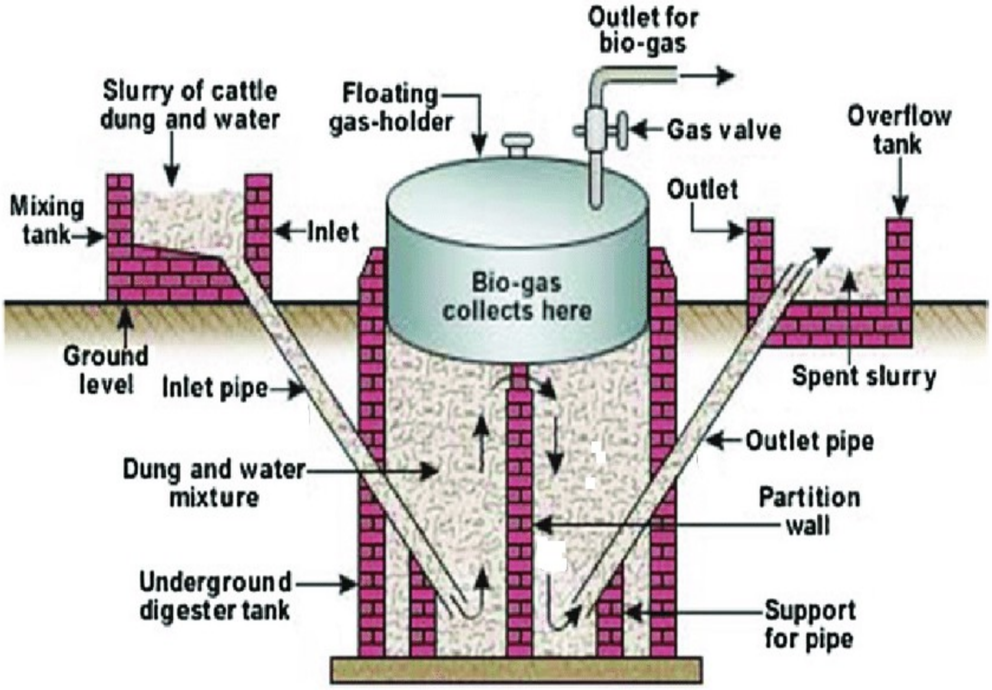
A.4. Technologies/measures >>

A total of 93 biogas digesters have been installed between 2002 and 2021, having capacities as follows:

Sr.No	Date	Project Title	Location	Capacity (M^3)	No of Plants	Total M^3
2	31.03.2003	Shree kutch Mundra Panjarapole & Gaushala	Kuttch	45	1	45
3	31.03.2003	Shree Kutch Narayan Sarovar Gaushala Panjarapole	Kuttch	85	1	85
4	17.03.2005	Shree Vallabh Foundation Trust Sanchalit, Vallabh Gaushala	Vadodara	35	1	35
6	30.03.2005	Anand agricultural university	Anand	60	1	60
7	15.01.2006	Community Bio Gas Plant	Dahod	85	1	85
	15.01.2006			60	2	120
8	25.03.2006	Community Bio Gas Plant	Vadodara	85	2	170
9	29.03.2006	Vallabh Gaushala	Junagadh	85	1	85
10	03.01.2007	Cattle Breeding Farm	Banaskantha	45	1	45
11	15.02.2007	Gayatri Parivar Trust	Rajkot	15	1	15
12	25.06.2007	Community Bio Gas Plant	Vadodara	60	1	60
13	24.10.2007	Navsari Agri.University	Navsari	45	1	45
14	22.04.2008	Amar Dham Lal Gebi Ashram	Ahmedabad	85	3	255
15	24.12.2008	Shree Surat panjarapole Sanchalit Vrajbhoomi Shakha	Surat	85	4	340
16	14.12.2009	Lok Bharti Gaushala	Bhavnagar	45	1	45
17	14.12.2009	Central Cattle breeding farm	Surat	60	2	120
	14.12.2009			35	1	35
18	14.12.2009	Shree Swaminarayan Gurukul Jivhitavah Trust gaushala	Ahmedabad	85	1	85
19	29.12.2009	Cattle Breeding Farm, Junagadh agri.Univ	Junagadh	85	3	255
20	22.01.2010	Garden Restaurant	Ahmedabad	35	1	35
21	06.02.2010	Kailash Gaushala	Bhavnagar	45	1	45
22	08.02.2010	Adesh Ashram Gaushala	Pavagadh	85	1	85
23	30.11.2010			85	1	85
24	30.11.2010	Amar Dham Lal Gebi Ashram	Kuttch	85	2	170
25	30.11.2010	Chirkut dham Trust Gaushala	Bhavnagar	35	1	35
26	30.11.2010	Shree rameshwar Gaushala	Junagadh	60	1	60
27	04.12.2010	Shree Madhav Vidhyapith	Bharuch	25	1	25
28	04.12.2010	Vaishnav haveli - Asarva baithak	Ahmedabad	85	2	170
29	20.12.2010	Gujarat Fire & Safety Academy	Godhra	85	1	85
30	23.12.2010	Bhutnath Mahadev Mandir Gaushala	Gir (Junagadh)	85	1	85
31	23.12.2010	Pashu Arogya Trust	Junagadh	85	1	85
32	23.12.2010	Prabhav Hem Kamdhenu Girivihar Trust	Bhavnagar	85	1	85
33	23.12.2010	Life Mision- Raj Rajeswari Dham	Surendranagar	85	1	85
34	23.12.2010	Shri Bhojal Bhagwati Seva Trust	Amreli	35	1	35

35	07.01.2011	Shri Maa Annapurna Charitable Trust	Kuttch	60	1	60
36	07.01.2011	Shri brahmdharmeshwar Charitable Trust Sanchalit Gaushala	Bharuch	35	3	105
37	07.01.2011	Hotel Nyay Mandir	Bharuch	85	1	85
38	04.02.2011	Central Cattle Breeding Farm	Surat	60	2	120
	04.02.2011			35	1	35
39	25.11.2011	Gujarat Pradesh Salagn Vidyabharti	Dhoraji	25	1	25
40	25.11.2011	Santram Mandir Gaushala	Karamsad	35	1	35
41	27.12.2011	Bhartiya Sanskrutik Samvardhak Trust	Porbandar	85	1	85
42	27.12.2011	Shri Valaramji Manavseva sansthan Trust & Bal Hanuman gaushala	Bhavnagar	25	1	25
43	27.12.2011	Society For The Training And Vocational Rehabilitation of The Disabled-Seva-Tirth	Vadodara	45	1	45
44	28.11.2011	Shri Kabirdham Charitable Trust	Morbi	25	1	25
45	13.01.2012	Shree Bhojal Bhagwati Seva Trust Gaushala	Amreli	85	1	85
46	16.03.2013	Karunamani Mangal Seva Trust Sanchalit Gaushala	Nadiad	35	1	35
47	22.07.2013	Shree Umiya Parivar Education Trust	Jamnagar	85	1	85
48	22.07.2013	Shree Nurapir Nana Ashram	Amreli	25	1	25
49	22.09.2013	Shree Kuttch Narayan Sarovar Gaushala & Panrapole	Kuttch	85	1	85
50	16.12.2013	Shram Mandir Trust	Vadodara	35	1	35
51	10.02.2014	Shri Jangli Maharaj Gaushala Charitable Trust	Bhavnagar	35	1	35
52	10.02.2014	Gram Nirman Kelvani Mandal	Bharuch	45	1	45
53	27.04.2015	Muktidham Sector-30	Gandhinagar	85	1	85
54	28.04.2015	Amin Sons Marketing Pvt Ltd	Kheda	85	1	85
55	02.05.2015	Shree Swaraj Ashram	Tapi	25	1	25
56	02.06.2015	Babrol Ashramshala	Mahisagar	25	1	25
57	02.06.2015	Mora Ashramshala	Panchmahals	25	1	25
58	01.06.2015	Mahila Adhyapan Mandir	Dahod	25	1	25
59	13.10.2015	Vasundhara Gir Gay Gaushala	Morbi	45	1	45
60	13.10.2015	Seva Mandal	Aravalli	25	1	25
61	13.10.2015	Baroda Public School(St Stephens Foundation Trust)	Vadodara	25	1	25
62	28.1.2016	Shree Leuva Patidar Boarding(Bhachau)	Kuttch	85	1	85
63	01.03.2016	Shri Swaminarayan Mandir gaushala Trust	Dholka	45	1	45
64	21.03.2016	Welspun Foundation For Health & Knowledge	Kuttch	60	1	60
65	29.08.2016	Shri Swaminarayan Gaushala	Surat	85	1	85
66	28.02.2017	Shri Thakkar Bapa Ashram Shala	Pamchmahals	25	1	25
67	28.02.2017	Shri Itadi Ashram Shala	Dahod	25	1	25
68	16.06.2017	Shree Gamandev Mandir Trust	Bharuch	85	1	85
69	23.10.2017	Shree nageshwar Kalyan shaktidham	Ahmedabad	25	1	25
70	19.02.2018	BAPS Gaushala Trust	Surat	25	1	25
71	19.03.2020	Gaumangal Gau Seva Charitable Trust Sanchalit Nand bava Gaushala	Junagadh	25	1	25
72	19.03.2020	International Society For Krishna Consciousness	Vadodara	25	1	25
73	19.03.2020	Shree junagadh Panjarapole Gaushala	Junagadh	25	1	25
74	30.12.2020	Cattle Breeding Farm Junagadh Agri.univ	Junagadh	85	3	255
75	06.01.2021	Shri Santram SamadhiSthan	Nadiad	45	1	45
Total					93	**5430**

All households and communities attached to the digesters within the project activity possess cattle or other bovine animals.The animal stalls are within the project activity boundary. The animals are allowed to graze in the free pastures of the village or in some cases fed in the stall itself. One cow produces around 13-14 kg cow dung per day. Before the establishment of many of these the biogas plants, this cow dung used to be dried and processed into dung cakes which were then used to fuel gobar chullas or sold annually to external contractors.



Biogas is a mixture of methane and carbon dioxide. It also has traces of hydrogen sulphide (3%), ammonia, oxygen, hydrogen, water vapour etc., depending upon feed materials and other conditions.

Biogas is generated by fermentation of cellulose rich organic matter under anaerobic conditions. In anaerobic conditions, the methane-producing bacteria become more active. Thus, the gas produced becomes rich in methane. The optimum utilization depends upon the successful physical installations, which in turn depend upon plant design and its selection.

The basic conversion principle is that when a non-ligneous biomass is kept in a closed chamber for a few days, it ferments and produces an inflammable gas. The anaerobic digestion consists of three stages: I Hydrolysis; II Acid formation and III Methane fermentation. The processes are carried out by two sets of bacteria namely acid forming bacteria and methane formers. The acidogenic phase I is the combined hydrolysis and acid formation stages in which the organic wastes are converted mainly into acetate, and phase II is the methanogenic phase in which methane and carbon dioxide are formed. The better the three stages merge with each other, the shorter the digestion process.

Approximate biogas production rates of different waste	Biogas per day (m3 /day) generation capacity
Cattle dung 1 TPD	50 m3

Annual head count	2014	2015	2016	2017	2018	2019	2020	2021
Cattle	5640	6240	6494	6707	6470	6740	7240	7240

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 project activity has a total of 93 independent biogas digesters of $15m^3$, $25m^3$, $35m^3$, $45m^3$, $60m^3$ and $85m^3$ capacities 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 treated slurry is dewatered and the dry cake is used as high quality organic fertilizer. The biogas from all the digesters are collected in a gas storage facility and then sent to a holding chamber with a cumulative storage capacity of $5430m^3$ in this project activity. From the holding chamber, 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 CH_4 is then supplied to the community kitchens for cooking and heating purposes.

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

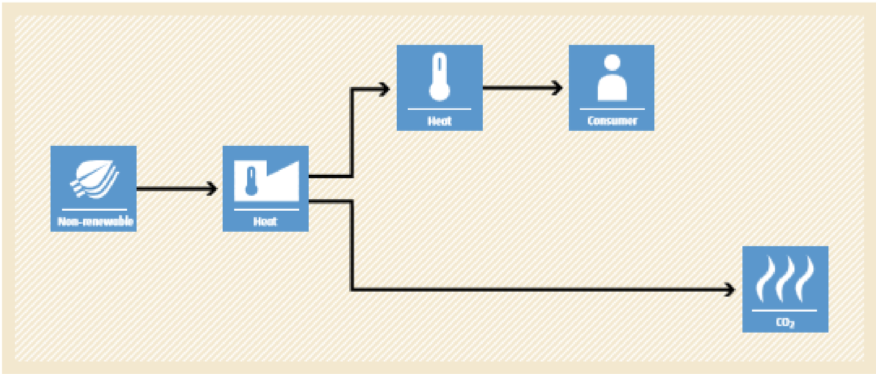
Specification	Value
Total Installed Capacity	5430 m^3
Mixing Proportion	(Water: Dung) 1:1
Number of units (digesters)	93
Feed Material	Cattle Dung
Biogas Flow rate	0.9 m^3/hr
Number of Stoves	1-2 per household/kitchen
Unit Conversion rate MJ -> kWh	0.28
Efficiency of Burners	60.00%
Calorific Value Biogas	20 MJ/m^3
Rated Capacity (thermal) MW	16.42 MW_{th}

A.5. Parties and project participants >>

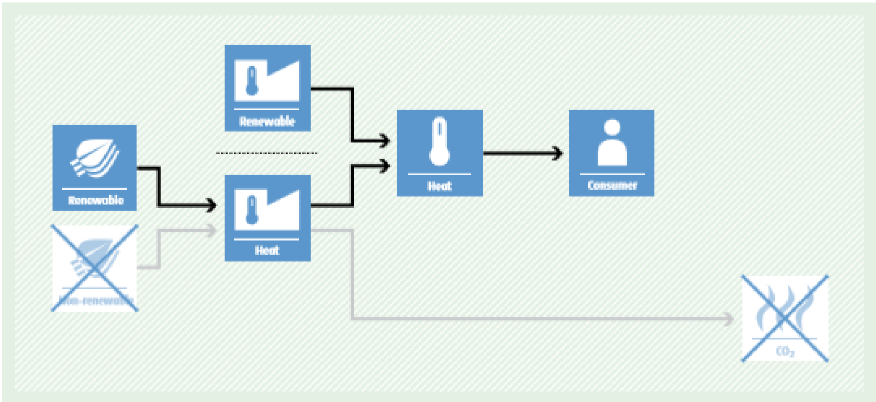
Party (Host)	Participants
India	Aryan Associates, Vadodara, Gujarat

A.6. Baseline Emissions>>

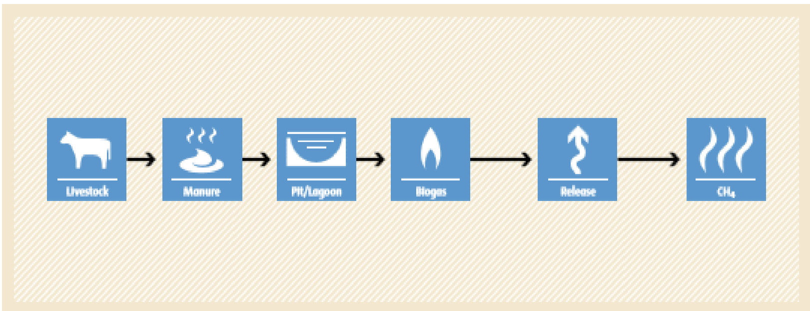
BASELINE SCENARIO
Thermal energy would be produced by more-GHG-intensive means based on the use of non-renewable biomass.



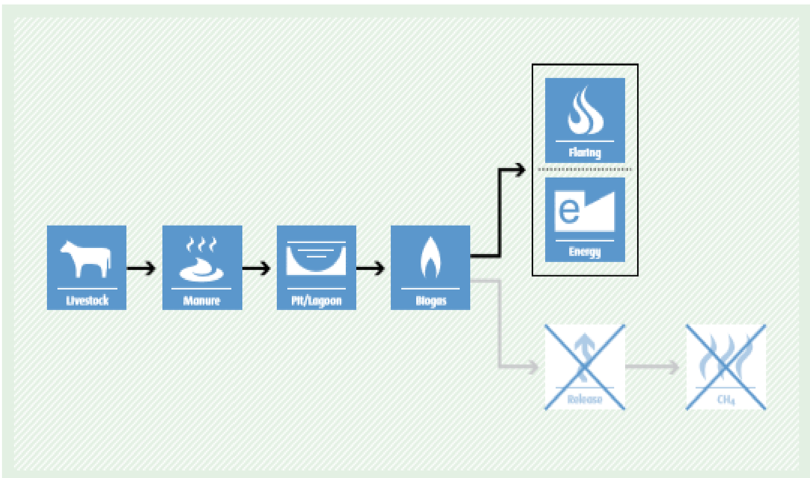
PROJECT SCENARIO
Use of renewable energy technologies for thermal energy generation, displacing non-renewable biomass use.



BASELINE 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.



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

- thermal energy from more GHG intensive means based on the use of non-renewable biomass for domestic cooking and water heating.
- 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.

Thus, all these biogas digesters within the project activity is a voluntary investment which replaced equivalent amount of thermal energy from renewable source, the biogas. The project proponents are 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 thermal energy from fuel wood and fight the impacts of climate change.

The Project Proponent hopes that carbon revenues from 2014-2020 accumulated as a result of carbon credits generated will help repay the loans, contributions from villagers and in the continued maintenance of this project activity including the possibility of capacity increase and also pay for the upkeep of cattle and cow dung management facilities. The rural households across India are primarily dependent on fuel wood for cooking and heating water. Further, when complications have arisen in the functioning of plants, a common complaint articulated is that there is a lack of available technical support. In this way, plants are allowed to fall into disrepair, when their functioning depends upon adequate maintenance skills, which should be available in every village. There is a danger that biogas may come to be thought of as a useless and inappropriate initiative.

Fuel usage correlates with income levels and lower income households tend to use more fuelwood as cost is still a barrier for use of LPG in rural areas. All the households were still using fuelwood as the dominant fuel for cooking and heating water for bath on inefficient mud/clay wood stoves that do not have chimney and grate.
Majority of the firewood users believe that cooking with this fuel improved their financial wellbeing because selling firewood generated income, whilst collecting the fuel gave them an opportunity to socialise and is a tradition they would like to continue. They viewed LPG as a financial burden that gave food an undesirable taste and feared a fatal canister explosion. This shows that though LPG has been provided with subsidy to the rural communities, the refill is very expensive and rural households are still using traditional stove for cooking. Easy availability of biomass, affordability and concerns of safety issues deter households from adopting LPG and continue using fuelwood. The region is scarce of biomass and non-renewable biomass is part of the biomass used for cooking and heating water.

A.7. Debundling>>

This small scale project is not a debundled component of a larger carbon offset project activity.

SECTION B. Application of methodologies and standardized baselines

B.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.E. Switch from Non-Renewable Biomass for Thermal Applications by the User***

This methodology comprises of activities to displace the use of non-renewable biomass by introducing renewable energy technologies to households, communities, and/or institutions such as schools, prisons or hospitals (hereinafter referred as end-users). Examples of these technologies include, but are not limited to : Biogas stoves.

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.

B.2. Applicability of methodologies and standardized baselines >>

The project activity is biogas cook stove for households and provides thermal energy from cattle dung that is renewable. It replaced the baseline technology mud/clay, three-stone traditional cook stove that used non-renewable biomass at the household level. The biogas produced is used for heating and cooking purposes. All biogas units are distinct from each other.
Biogas produced by the digesters are used or flared.
The annual average temperature of the biogas site is located is higher than 5°C
The storage time of the manure after removal from the animal barns, including transportation, does not exceed 45 days before being fed into the digesters.
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.
The residual waste from the animal manure management system is handled aerobically.
The communities across India are using non-renewable biomass since 31st December 1989. This is based on using published literature, official reports and statistics.
The project activity does not use renewable biomass. The renewable source is cattle dung.
The project activity is biogas cook stove and is not electric cook stoves.
There is a technology switch from traditional stove to biogas stove.
This is a small scale project with total thermal capacity of 16.42 Mw_{th} which is not greater than the small scale thresholds defined by the applied methodology I.E. the “limit of 45 MW_{th} is the installed/rated capacity of the thermal application equipment or device/s (e.g. biogas stoves)”.

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

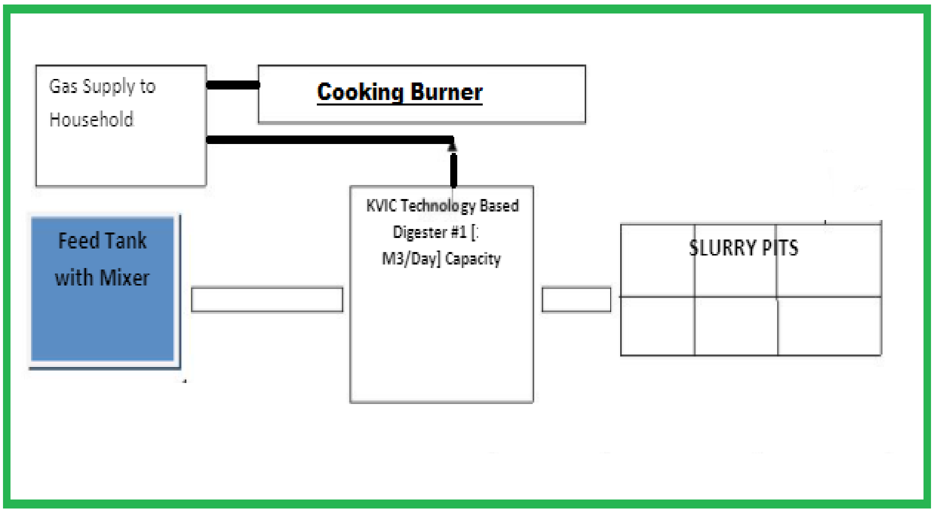
Each of the biogas unit is constructed by the PP close to the household. Each biogas unit has a unique ID, which is visible on the biogas unit. The Monitoring Report has the details of the end user’s name and the location i.e. District, Mandal, village in which it is constructed along with the Unique ID.

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

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

- Biogas digesters;
- Households using biogas for heating and cooking
- The livestock;

Project Boundary



	Source	GHG	Included?	Justification/Explanation
Baseline	CO2 Emissions from burning non-renewable wood	CO_2	**Included**	Major source of emission
		CH_4	**Included**	Major source of emission
	Methane Emissions from manure decay	N_2O	Excluded	Excluded for simplification. This is conservative
Project Activity	CH_4 Emissions from flaring of the biogas	CO_2	Excluded	Heat is generated from collected biogas, hence these emissions are not accounted.
	CH_4 Emissions associated with anerobic digesters	CH_4	**Included**	Major source of project emission
		N_2O	Excluded	Excluded for simplification. This is conservative

Leakage Emissions is not applicable as the project cook stove is not switching to charcoal or processed renewable biomass. The project activity recovers and utilizes biogas for producing heat and applies AMS IC methodology in addition to using a Type III component of a SSC methodology, hence any incremental emissions occurring due to the implementation of the project activity is neglected.

B.5. 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 from fuel wood displaced within the domestic households in the village of which a large part of it was non-renewable for domestic cooking and water heating as per the applicable factors in the UCR Standard.

The project proponent was not bound to incur this investment as it was not mandatory by national and sectoral policies.

Year	2003-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Capacity Additions m3	4150	80	450	190	160	25	0	375	0

The project proponents are 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 thermal energy from fuel wood.

The CoUs or emission reductions for small-scale biogas units are based on approved fossil fuel emission displacement rates established by the UCR Standard. These rates have taken into account the size of the biogas unit, fossil fuel displaced and size of a household.

1-2 cubic meter	3 cubic meter	4 cubic meter	5 cubic meter	>5 cubic meter
3.5 CoUs/year	4.5 CoUs/year	5.3 CoUs/year	5.5 CoUs/year	Biogas units that have a capacity above 5 cubic meters that follow this UCR Protocol will be credited at the 5 cubic meters rate

Estimated Annual Emission Reductions Type I: $BE_1 = HG_{ythermal} \times EF_{FF, CO2}$

BE_y = Emission reductions from the use of non-renewable biomass as per the UCR protocol in a year y.

where:

$HG_{y, thermal}$ = Total thermal capacity of the number of digesters in year y

$EF_{FF, CO2}$ = CO_2 emission factor of the fossil fuel displaced in the baseline as determined by the UCR Standard based on the various capacities of digesters.

GWP_{CH4} = 21 is the default IPCC value of CH_4 applicable to the crediting period (tCO_{2e}/t CH_4)

$NCV_{biomass}$ = Net calorific value of the non-renewable biomass as per UCR Standard (0.015 TJ/tonne)

Year	2014	2015	2016	2017	2018	2019	2020	2021
Total Capacity Digesters >5m3	4230	4680	4870	5030	5055	5055	5430	5430
TCO2eq	4843	5148	5357	5533	5560.5	5820.5	5973	5973
Total Baseline Reductions TYPE1 (tCO2eq/yr)	4843	5148	5357	5533	5560	5820	5973	5973
B.E Monitoring Period (tCO2eq)	38234							

Estimated total baseline emission reductions (BE_1) TYPE I = 38234 CoUs (38234 tCO_{2eq})

Estimated Annual Emission Reductions: $BE_3 = BE_{y1} - PE_{flare} - PE_{AD,y}$

BE_3 = Total Baseline Emissions in a year for **TYPE III.**

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

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

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}	=	Avg. Wt. at Site (Taken for Cow) in kg
$W_{default}$	=	Avg. Default Wt. of (Cow) as per IPCC for India in kg
nd_y	=	Number of days in year y where the treatment was operational
$VS_{default\_cattle/poultry}$	=	Volatile solids of livestock LT entering the animal manure management system in year y as per IPCC default for poultry and cattle for 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) (Cattle= 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 (Cattle=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 project boundary. 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 manure before being fed into the anaerobic digester is not accounted since the storage time of the manure after removal from the animal barns, including transportation, does not exceed 24 hours before being fed into the anaerobic digester.

Year	TYPE III Emission Reductions TCO2eq
2014	40268
2015	44551
2016	46365
2017	47886
2018	48121
2019	48121
2020	51691
2021	51691
Total	378694

Total baseline emission reductions (*BE*) in the crediting period (TYPE I+III) = 416928 CoUs (416928 tCO_{2eq})

B.6. Prior History>>

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

B.7. Changes to start date of crediting period >>

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

B.8. 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

B.9. Monitoring period number and duration>>

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

B.8. Monitoring plan>>

Data / Parameter:	f_{nrb}
Data unit:	Fraction of woody biomass saved by the project activity in year y that can be established as non-renewable biomass
Description:	Determination of the share of NonRenewable woody biomass
Source of data:	UCR Standard

Measurement procedures (if any):	Fixed
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

Data/Parameter	Number of Functional digesters
Data unit	N
Description	Number of functional digesters in households in the project activity in year y
Source of data Value(s) applied	Monitoring Report As and when commissioned
Measurement methods and procedures	The repair and maintenence sheets are maintained from its initiation to completion dates for the biogas unit.
Monitoring frequency	As per sample survey
Purpose of data	To estimate baseline emissions

Data/Parameter	N_L
Data unit	Number
Description	Number of head of cattle
Source of data Value(s) applied	Head count of cattle whose waste is used for generating biogas
Measurement methods and procedures	Based on back-calculation of poultry litter requirement of the plant. Poultry average generation data - Cattle average generation data (15kg/head/day)
Monitoring frequency	As and when commissioned and fixed and recorded in the monitoring report
Purpose of data	To estimate baseline emissions

Data / Parameter:	Q_{waste}
Data unit:	tons
Description:	Quantity of solid waste or residual waste handled by each digester based on capacity monthly.
Source of data:	Measured
Measurement procedures (if any):	On-site data sheets recorded monthly using weigh bridge
Monitoring frequency:	Monthly-
QA/QC procedures:	Weighbridge will be subject to periodic calibration (in accordance with stipulation of the weighbridge supplier)
Any comment:	-

Data / Parameter:	N_y
Data unit:	Number of operational days in a year
Description:	Measured
Source of data:	-
Measurement procedures (if any):	Records kept in the log book.
Monitoring frequency:	Annually, based on monthly records
QA/QC procedures:	-

Any comment:	-

Data / Parameter:	MCF
Data unit:	%
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):	AMS-III.D provides three options for obtaining the manure production and methane production potential. These include: • Data from nationally published sources; • Estimated from actual feed intake levels, via the enhanced characterisation method (tier 2) • 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:	Annually, based on monthly records
QA/QC procedures:	-
Any comment:	-Baseline emissions are calculated in a conservative manner.

Data / Parameter:	**VS**
Data unit:	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):	Cattle= 2.6
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_y
Data unit	tonnes/household/year
Description	Average annual consumption of woody biomass per household in the project before the project activity.
of data Value(s) applied	UCR Standard Protocol As per Standard
Measurement methods and procedures	Fixed
Monitoring frequency	NA
Purpose of data	To estimate baseline emissions