PROJECT CONCEPT NOTE

CARBON OFFSET UNIT (CoU) PROJECT

Title: Tapi Small Scale Biogas Projects, Gujarat
Version 1.0
Date 20/09/2021
First CoU Issuance Period: 7 years, 0 months
Date: 01/01/2014 to 31/12/2020

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

BASIC INFORMATION	
Title of the project activity	Tapi Small Scale Biogas Projects, Gujarat
Scale of the project activity	Small Scale
Completion date of the PCN	20/09/21
Project participants	Dharmesh Chaudhari
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
Sectoral scopes	01 Energy industries (Renewable/NonRenewable Sources)
Estimated amount of total GHG emission reductions over the crediting period	17360 CoUs /year (37 tCO_{2eq}/yr)

SECTION A. Description of project activity

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

The project **Tapi Small Scale Biogas Projects, Gujarat** is located in various villages in Taluka: Dolwan, Vyara, Songadh and Valod, District Tapi, State Gujarat, India.

The details of the registered project are as follows:

Purpose of the project activity:
The **Tapi Small Scale Biogas Projects, Gujarat** is located across 41 villages within the district of Tapi.

The purpose of the project activity is the set up of 453 independent biogas plants (digesters) of 2m^3 capacity each for serving individual households comprising of an average of 4 members each using cattle dung collected from buffaloes, cows and calves currently being housed at such households in the District of Tapi, Gujarat, India.

Each household has installed a 2 m^3 biogas plant and feeds cattle dung into the anaerobic digester. 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 single ring gas stove having one 4" burner 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 villages:

Village			
Karanj khed	Adyapor	Chikhli-Khadka	Pipalkuva
Jamaliya	Kataswan	Junwan	Ozar
Kasvav	Umarkachchh	Dhat	Shrawaniya
Panchol	Indu	Raigadh	Rampura-Kothar
Kosamkuva	Gadat	Vadpada-Tokarva	Chapawadi
Pati	Chikhalvav	Amalgundi	Ghodchit
Vazarda	Bhanawadi	Rampura-Kanadevi	Kataswan
Bamnamal	Gheriyavav	Dhamodi	Panchol
Kakdva	Dungargam	Jeshingpura	Chorwad
Vakla	Musa	Umarkui	Kelkui
Dadriya			

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.

This project contributes strongly to sustainable development of the rural households involved in the project. A biogas plant of 2 m3 capacity is sufficient to provide cooking fuel to a four household family with four to five members each. 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).

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

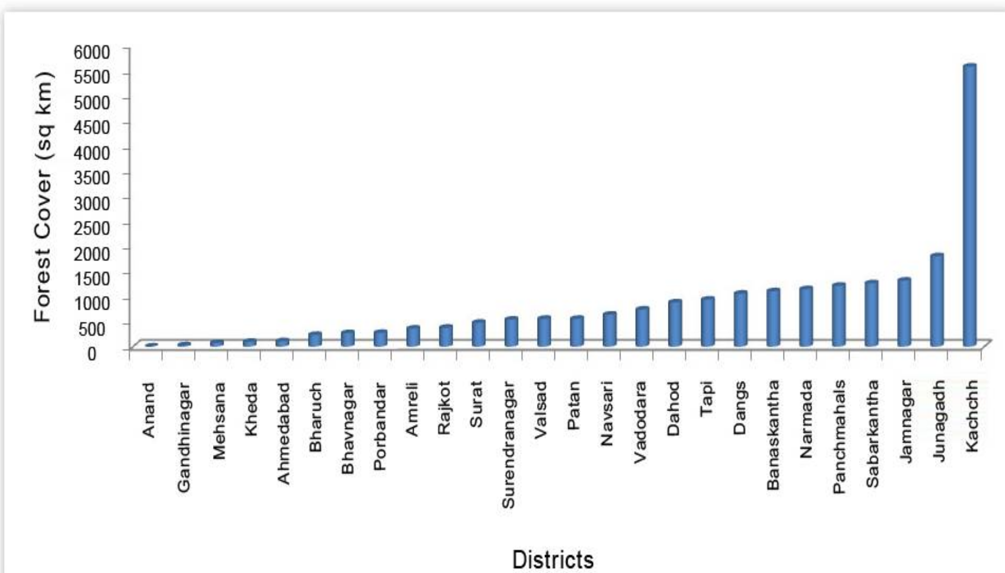
Forest resource accounting variable	ISFR 2003	ISFR 2005	ISFR 2009	ISFR 2011	ISFR 2013	ISFR 2015	ISFR 2017	Net Change between 2003 to 2017	% change between 2003 to 2015
Forest Cover (in square kilometres)	686,767	692,027	6,90,899	6,92,027	6,97,898	7,01,673	7,08,273	20,506	3.13
Growing Stock in Forests (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/2018/08/UNFF13_Background_Note_Wood_Energy_in_IndiaTERI.pdf

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

Fuel 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 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

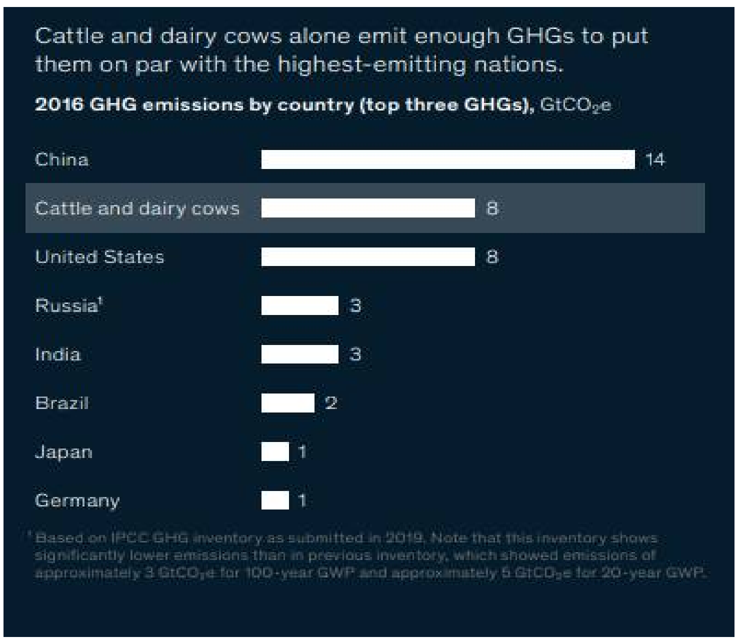
Figure-2 : Distribution of Forest Areas over the districts of the state



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

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.
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 su□cient 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.

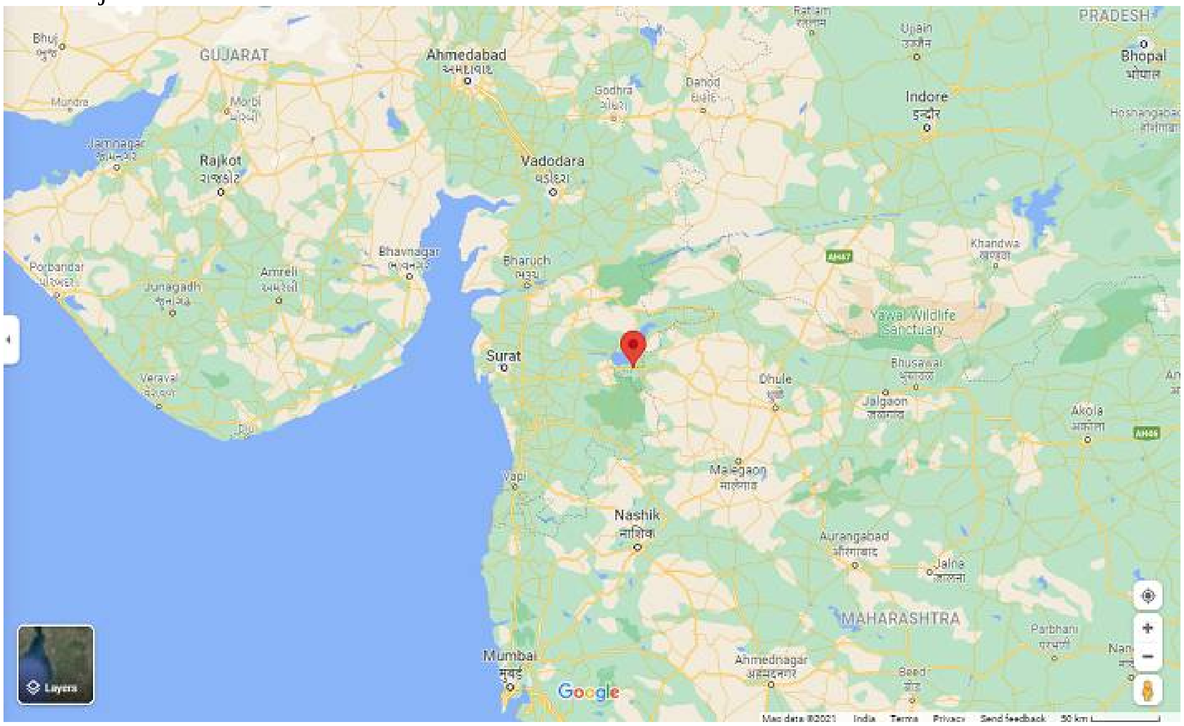
- Reduces indoor air pollution, thus eliminating health hazards for women and children.
- The project provides security of energy supply
- It leads to better manure management thus keeping the surroundings clean and reduce some of the disease causing pathogens
- Children are able to attend school in 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.

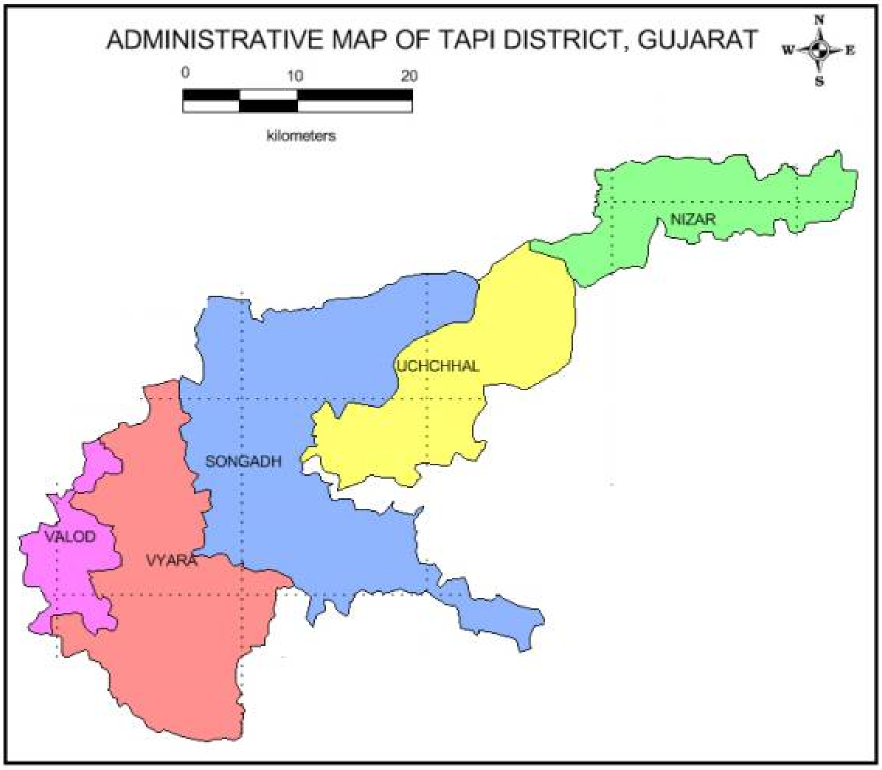
- **Environmental benefits:**
- Improves the local environment by reducing uncontrolled deforestation in the project area
- Avoids local environmental pollution through better waste management
- Leads to soil improvement by providing high quality manure
- Avoided global and local environmental pollution 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 family 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 three households to take up income generating activities like farming and other compost related sale activities.
- A regular supply of energy piped to the home 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: Tapi
Taluka: Dolwan, Vyara, Songadh and Valod
State: Gujarat

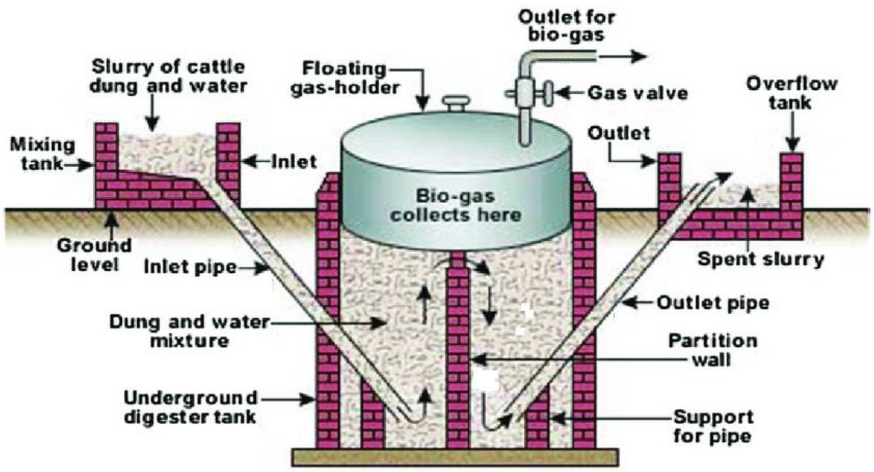



ADMINISTRATIVE MAP OF TAPI DISTRICT, GUJARAT
N
W
E
S
0
10
20
kilometers
NIZAR
UCHCHHAL
SONGADH
VALOD
VYARA

A.4. Technologies/measures >>

Sr. No	Village Name	Taluka	District	Plant Size	Number of Plant	Install Years
1	Karanj khed	Dolwan	Tapi	2	25	2012-13
3	Jamaliya	Dolwan	Tapi	2	1	
4	kasvav	Vyara	Tapi	2	1	
5	Panchol	Dolwan	Tapi	2	11	
6	Kosamkuva	Dolwan	Tapi	2	11	
7	Pati	Dolwan	Tapi	2	30	
8	Panchol	Dolwan	Tapi	2	11	
9	Vazarda	Songadh	Tapi	2	5	
10	Bamnamal	Dolwan	Tapi	2	15	
11	Kakdva	Dolwan	Tapi	2	5	
12	kasvav	Vyara	Tapi	2	2	
13	Dadriya	Valod	Tapi	2	2	
14	Adyapor	Valod	Tapi	2	1	2013-14
15	Kataswan	Vyara	Tapi	2	25	
16	Adyapor	Valod	Tapi	2	8	2014-15
17	Umarkachchh	Dolwan	Tapi	2	7	
18	Kasvav	Vyara	Tapi	2	3	
19	Gadat	Dolwan	Tapi	2	2	
20	Chikhalvav	Vyara	Tapi	2	9	
21	Kataswan	Vyara	Tapi	2	32	
22	Bhanawadi	Vyara	Tapi	2	3	
23	Gheriyavav	Vyara	Tapi	2	13	
24	Dungargam	Vyara	Tapi	2	23	
25	Musa	Vyara	Tapi	2	2	
26	kelkui	Vyara	Tapi	2	1	
27	Indu	Vyara	Tapi	4	1	
28	Vakla	Dolwan	Tapi	2	1	
29	Pati	Dolwan	Tapi	2	40	2015-16
30	Chikhli-Khadka	Songadh	Tapi	2	23	
31	Junwan	Songadh	Tapi	2	5	
32						
33	Pati	Dolwan	Tapi	2	21	2016-17
34	Dhat	Vyara	Tapi	2	1	
35	Raigadh	Dolwan	Tapi	2	10	
36	Vadpada-Tokarva	Songadh	Tapi	2	6	
37	Amalgundi	Songadh	Tapi	2	7	
38	Ghodchit	Songadh	Tapi	2	11	
39	Rampura-Kanadevi	Songadh	Tapi	2	11	
40	Dhamodi	Songadh	Tapi	2	11	
41	kasvav	Vyara	Tapi	2	4	
42	Umarkachchh	Vyara	Tapi	2	1	
43	Jeshingpura	Vyara	Tapi	2	1	
44	Chorwad	Songadh	Tapi	2	2	2017-18
45	Umarkui	Vyara	Tapi	2	4	
46	Pipalkuva	Songadh	Tapi	2	17	
47	Ozar	Songadh	Tapi	2	16	
48	Shrawaniya	Songadh	Tapi	2	4	
49	Rampura-Kothar	Songadh	Tapi	2	5	
50	Chapawadi	Songadh	Tapi	2	3	

A total of 453 biogas digesters have been installed between 2012 and 2018, having capacity of $2m^3$ each. All households within the project activity possess cattle or other bovine animals, the number of cattle at each household ranges from 2-6.



The animal stalls are in the front yard/backyard/porch of the household in most of the cases. 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 10-12 kg cow dung per day. Before the establishment of the biogas plant, 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.

Idea of the biogas plant was triggered in order to have a proper disposal system for the cow dung. Before the establishment of biogas plants, the dung would be collected in households, streets, empty spaces and left there itself till it was sold to some external contractor. The contractor would collect the dung once in a year which resulted in dung being piled up in large quantities. This was an unhygienic practice and raised health concerns.

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.

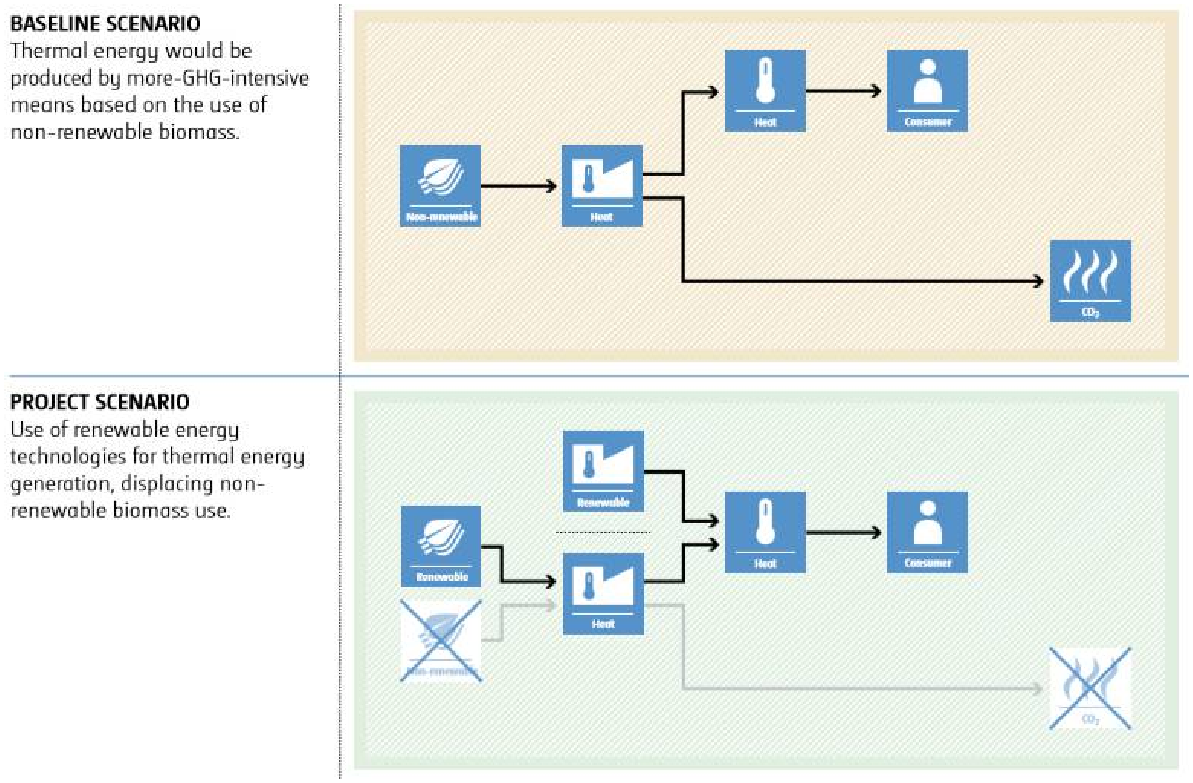
The technical specifications of the KVIC model bio-digesters are as follows:

Specification	Value
Capacity per unit	2 m^3
Mixing Proportion	(Water: Dung) 1:1
Number of units (digesters) Feed Material	453 Cattle Dung
Biogas Flow rate	0.9 m^3/hr
Number of Stoves	1 per household
Unit Conversion rate MJ -> kWh Efficiency of Burners	0.28 60.00%
Calorific Value Biogas	20 MJ/m^3
Rated Capacity (thermal) MW	1.36 MW_{th}

A.5. Parties and project participants >>

Party (Host)	Participants
India	Dharmesh Chaudhari, A-25/26, Ambika Nagar, Kakrapar Road, Tadkuva, Vyara, District – Tapi - 394650

A.6. Baseline Emissions>>



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.

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 Proponents hopes that carbon revenues from 2014-2020 accumulated as a result of carbon credits generated will help repay the loans and in the continued maintenance of this project activity. 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 micro scale project is not a debundled component of a larger 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)

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.

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

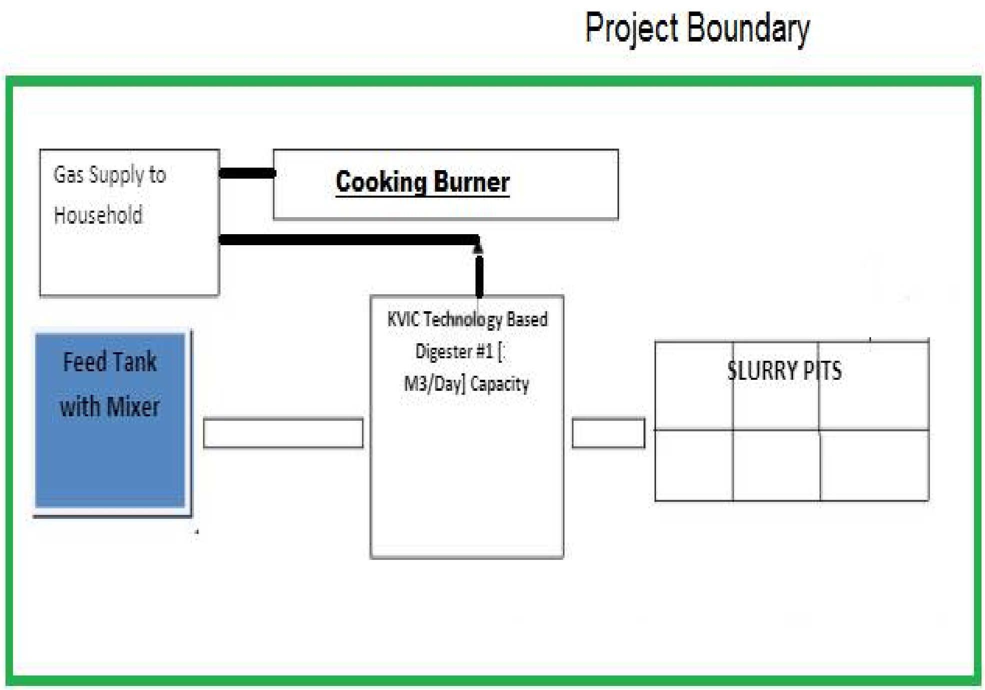
The project activity is biogas cook stove for households and provides thermal energy from cattle dung that is renewable. It replaced the baseline technology mud/clay, three-stone traditional cook stove that used non-renewable biomass at the household level. The biogas produced is also used for captive power generation. All biogas units are of $2m^3$ capacity and 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.
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).
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 1.36 Mw_{th} which is not greater than the small scale thresholds defined by the applied methodology I.E. the limit of 45 MWth 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

	Source	GHG	Included?	Justification/Explanation
Baseline	Emissions from burning non-renewable wood Emissions from animal manure stored on site	CO_2	Included	Major source of emission
		CH_4	Excluded	Excluded for simplification. This is conservative
		N_2O	Excluded	Excluded for simplification. This is conservative
Project Activity	Emissions from residue from anaerobic digester	CO_2	Excluded	Heat is generated from collected biogas, hence these emissions are not accounted for. CO2 emissions from the decomposition of organic waste are not accounted
		CH_4	Excluded	Excluded for simplification. This is conservative
		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.

B.5. Establishment and description of baseline scenario (UCR Protocol) >>

The baseline scenario is thermal energy from more GHG intensive means based on the use of non-renewable biomass for domestic cooking and water heating. Thus, this project activity was a voluntary investment which replaced equivalent amount of thermal energy from renewable source, the biogas. The baseline emission boundary is site of the anaerobic digester in the case of project activity that recovers and utilizes biogas for producing thermal energy and applies this methodology on a standalone basis, i.e. without using a Type III component of a SSC methodology.

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: $BE_y = HG_{ythermal} \times EF_{FF, CO2}$

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 a $2m^3$ digester.

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

NCV_{CH4}= NCV of methane (MJ/Nm^3) (default value: 35.9 MJ/Nm^3)
$NCV_{biomass}$ = Net calorific value of the non-renewable biomass as per UCR Standard (0.015 TJ/tonne)

Year	2014	2015	2016	2017	2018	2019	2020
Cumulative Installed m3	290	502	638	806	908	908	908
Baselime Emission Reductions (tCO2eq)	**1015**	**1757**	**2233**	**2821**	**3178**	**3178**	**3178**
Total (CoUs)	**17360**						

Estimated total baseline emission reductions (*BE_y*) = 17360 CoUs (17360 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, 0 months – 01/01/2014 to 31/12/2020

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 Monitoring frequency	The repair and maintenence sheets are maintained from its initiation to completion dates for the biogas unit. As per sample survey
Purpose of data	To estimate 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