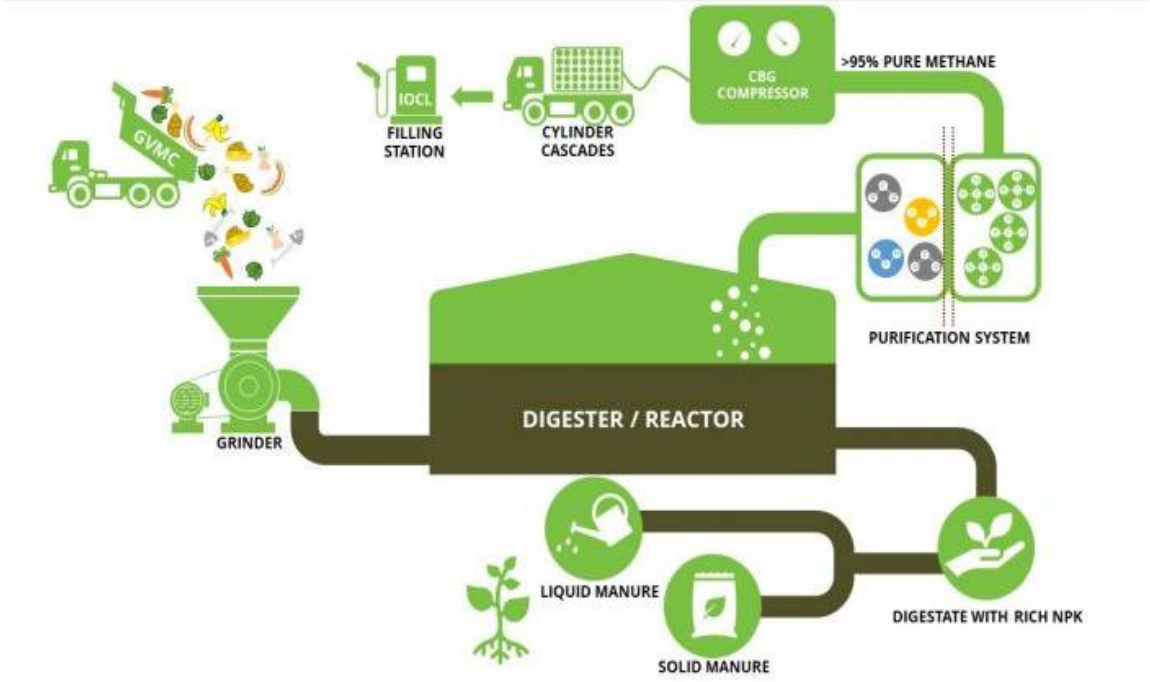
PROJECT CONCEPT NOTE

CARBON OFFSET UNIT (CoU) PROJECT



Title: Bio-CNG Project in Visakhapatnam

Version 1.0

Date 14/12/2021

First CoU Issuance Period: 2 years, 11 months

Date: 04/06/2019 to 30/11/2021

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

BASIC INFORMATION	
Title of the project activity	Bio-CNG Project in Visakhapatnam
Scale of the project activity	Small Scale
Completion date of the PCN	14/12/2021
Project participants	Urja Bio System Pvt. Ltd., Pune, Maharashtra, India
Host Party	India
Sectoral scopes	13 Waste handling and disposal 07 Transport
Applied Methodology	**AMS-III.AQ.:** ***Introduction of Bio-CNG in transportation applications, Version 2.0*** ***AMS III.AO. Methane recovery through controlled anaerobic digestion, Version 1.0***
Estimated amount of total GHG emission reductions	145229 CoUs (145229 tCO_{2eq})

SECTION A. Description of project activity

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

The project activities, **Bio-CNG Project in Visakhapatnam** are located in State: Andhra Pradesh Country: India

The details of the registered project are as follows:

Purpose of the project activity:
The **Bio-CNG Project in Visakhapatnam** comprises of a project activity using biogas technology for capturing methane from organic waste derived from municipal solid waste (MSW) and the gainful use of recovered methane gas for Bio-CNG bottling purposes for use in the transport sector. The project was commissioned on 04/06/2019.

The Vyzag Bio-Energy Fuel Pvt Ltd (VBE) project site is located in Village/Property: S.No 410/P near GVMC dumpyard, Taluka: Kapuluppada, District: Visakhapatnam, State: Andhra Pradesh, Country: India.

The purpose of the VBE project activity is the set up of an independent biogas plant (anaerobic digester) of 2100 m^3 capacity used for generating and capturing methane from MSW which is collected from the nearby locations in the surrounding areas. The project activities comprise of measures taken to avoid the emissions of methane to the atmosphere from 30 tonnes per day (TPD) of biomass or other organic matter that would have otherwise been left to decay anaerobically in a solid waste disposal site (SWDS). The project activities also involves the installation and operation of a Bio-CNG plant that includes processing, purification and compression of the recovered biogas to obtain up-graded biogas such that methane content, its quality and the physical and chemical properties are equivalent to the fossil CNG it replaces in vehicles. The project activities hence invlove the gainful use of the recovered methane for replacement of fossil CNG in vehicles.

A vehicle's emission with the enriched biogas fuel (Bio-CNG) meets to the BS IV emission norms. There is no significant change in fuel economy of the vehicle fuelled with the enriched biogas (24.11 km/kg) as compared to base CNG (24.38 km/kg). The biogas plant such as the project activity, are significant and growing contributors to achieve world climate-neutrality by 2050.
Today, an estimated one-third of all the food produced in the world goes to waste. That's equal to about 1.3 billion tons of fruits, vegetables, meat, dairy, seafood, and grains that either never leave

the farm, get lost or spoiled during distribution, or are thrown away in hotels, grocery stores, restaurants, schools, or home kitchens. It could be enough calories to feed every undernourished person on the planet. When organic waste such as fruits and vegetables in the project activity goes to waste, we also waste all the energy and water it takes to grow, harvest, transport, and package it. And when such biomass goes to the landfill and rots, it produces methane—a greenhouse gas even more potent than carbon dioxide. About 6%-8% of all human-caused greenhouse gas emissions could be reduced if we stop wasting food and such organic waste. Decomposing organic material in anaerobic conditions — by microbes in the absence of oxygen — releases methane into the atmosphere. Anaerobic fermentation is common in landfill and open stockpiles such as manure piles. Global emissions from waste have almost doubled since 1970 and now produce 3% of anthropogenic (human origin) emissions (IPCC 2014). About half of these emissions come from the anaerobic fermentation of solid waste disposal on land.

Prior to the VBE project activity in Andhra Pradesh, the MSW was dumped at the Kapuluppada dump yard which has been operational since 2007. In December 2019, officials estimated that the 100-acre yard was home to nearly three lakh metric tonnes of solid waste (source). The city of Vizag generates about 1,100 MT of garbage a day.

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:**
- The project contributes in improving the environmental condition in the region of by hygienic treatment of MSW resulting in improvement of health standard in the city.
- The project provides employment opportunity to the locals who collect waste from surrounding areas in the city and ensure that only organic waste is treated.
- The project provides both direct and indirect employment opportunity to the people of the region.
- Reduces outdoor air pollution, thus eliminating health hazards for people in the vicinity.
- The project provides security of energy supply since it generates biogas CNG

- It leads to better waste management thus keeping the surroundings clean and reduce some of the disease causing pathogens
- Lakhs of people from the city, living in the vicinity of the former landfill site now have access to clean air from the closure of the former landfill sites that used to be the dumping ground for such MSW in the past.

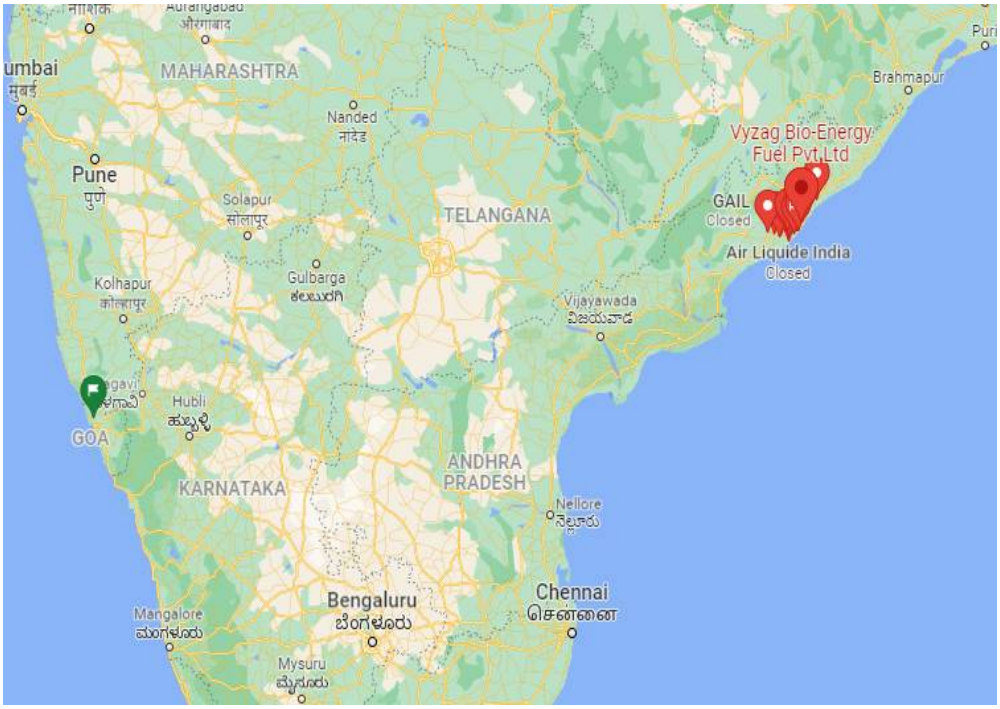
- **Environmental benefits:**
- Biogas plants not only produce energy, but also digestate, which is formed during the process of Anaerobic Digestion (AD). Digestate is a perfect biological and green fertilizer that can reduce the use of mineral fertilizers, avoiding the emissions related to their energy-intensive production.
- 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 fossil fuels to renewable energy, leading to reduction of GHG emissions
- Reduces air pollution, and increases use of manure rather than chemical fertilizers.
- Using biogas as an energy resource contributes to clean environment.
- Hygienic conditions are improved through reduction of pathogens by utilizing the animal and other organic wastes in the bio-digesters.
- Curbs methane emission as well as any leachate that would otherwise have been generated from the current practice of unscientific waste disposal.
- The land requirement used for a disposal site is removed as also is the area for dumping of equivalent amount of waste. This indirectly enables region towards a better way of land utilisation, like construction of housing, hospital etc.
- Further, by generating Bio-CNG through utilising the biogas, the project helps in replacing fossil fuel intensive fuels for transport.
- Avoids local environmental air pollution through better waste management
- Reduces outdoor air pollution, and increases use of manure rather than chemical fertilizers.
- Hygienic conditions are improved through reduction of pathogens by utilizing the organic wastes in the bio-digesters.
- Bio manure is a source of organic matter that stimulates biological activity.

- **Economic benefits:**
- The project is among the few the region than captures biogas and uses the same for the generation of Bio-CNG for use in transport.
- Organic waste is transformed into high-quality enriched bio-manure/fertilizer which is supplied to the retail marketplaces, thus providing better soil enrichment for local gardens and parks.
- Provides employment to local communities through construction and maintenance of biogas units.
- The VBE project activity is the First-of-its-kind in Andhra Pradesh that uses organic waste from municipal waste for Bio-CNG. The revenue from carbon credits will make it more attractive for the setup of similar projects across the State at scale and speed.

A.3. Location of project activity >>

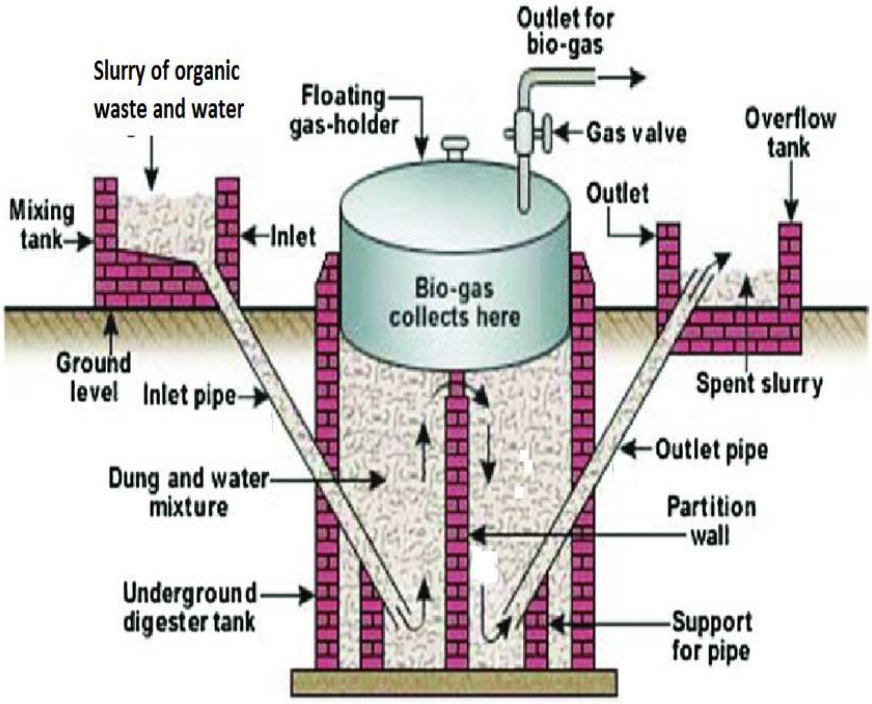
Country: India.

VBE Project Site	Village/Property: S.No 410/P near GVMC dumpyard, Taluka: Kapuluppada, District: Visakhapatnam, State: Andhra Pradesh

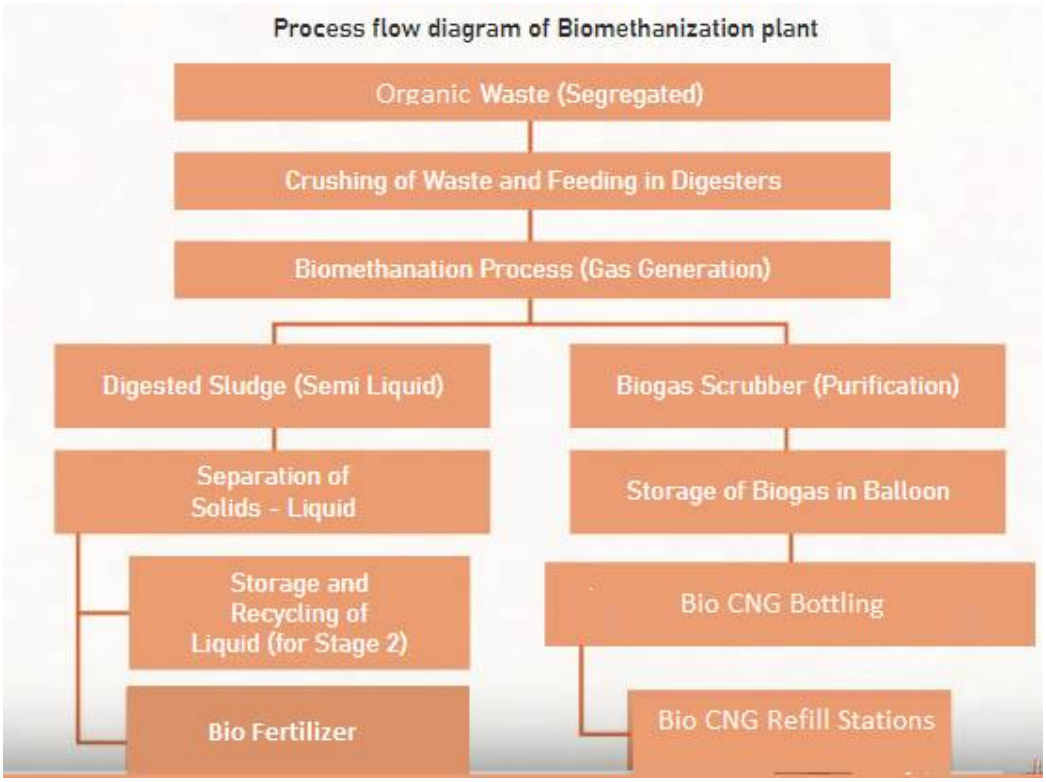


A.4. Technologies/measures >>

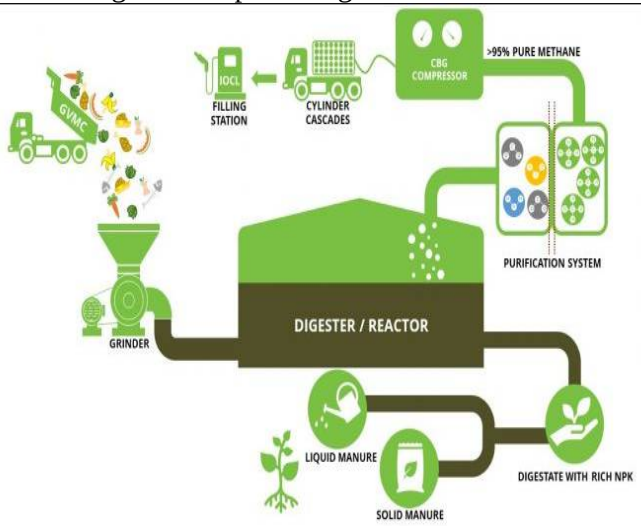
Bio-methanation is a process by which organic waste is microbiologically converted under anaerobic conditions to biogas. It is the most energy efficient and eco-friendly method for treatment of wet organic waste. With bio-methanation the project activity converts wet organic waste in to Bio-CNG and also good quality organic manure. The VBE Project involves the set up a 2100 m^3 biogas digester which treats approximately 30 TPD of organic waste at the site in Andhra Pradesh and around 850 kg Bio-CNG is bottled per day.



Biogas is a product from the process of degradation of organic matter by anaerobic bacteria. The biogas generation process consists of four subsequent chemical and biochemical reactions i.e. Hydrolysis reaction, Acidogenesis reaction, Acetogenesis reaction and Methanogenesis reaction.



Hydrolysis reaction decomposes organic molecule such as carbohydrates, proteins and fats into glucose, amino acids and fatty acids, respectively. Acidogenesis converts those generated small organic molecules to volatile organic acids with help from bacteria. During the Acetogenesis process, bacteria in the acetic group digests volatile organic acids and releases acetic acid. Lastly, anaerobic bacteria in the methanogenic producing bacteria group will complete the Methanogenesis process by converting acetic acid to methane gas and other gases like carbon dioxide and hydrogen sulfide. Hydrogen sulfide is a corrosive gas. Presence of carbon-dioxide in the bio-gas reduces its calorific value. Hence the bio-gas needs to be purified. The raw Biogas is purified for methane enrichment by removal of other gases and purified gas have methane content of more than 93%.



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 modified KVIC model bio-digester and resulting Bio CNG are as follows:

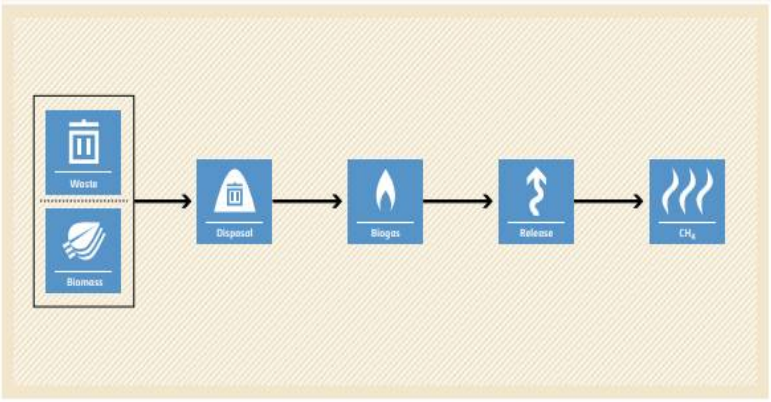
Specification	Value
Total Installed Capacity	2100 m^3
Mixing Proportion	(Water: Organic Waste) 1:1
Number of units (digesters)	1
Feed Material	MSW/Organic Waste/Food Waste
Biogas Flow rate	0.9 m^3/hr
Calorific Value Biogas from digester	20 MJ/m^3
Quantity of Organic Waste Treated	30 TPD
Bio CNG Calorific Value	52 MJ/kg
Air-Fuel Stoichiometric Ratio by volume	23.9 : 1
Density @ 1 ATM, 15 °C (kg/m3)	0.79
Autoignition Temperature (°C)	630 - 810
Toxicity	Non toxic even at high concentration & low levels of oxygen.
Mileage per unit	24.11 km/kg

A.5. Parties and project participants >>

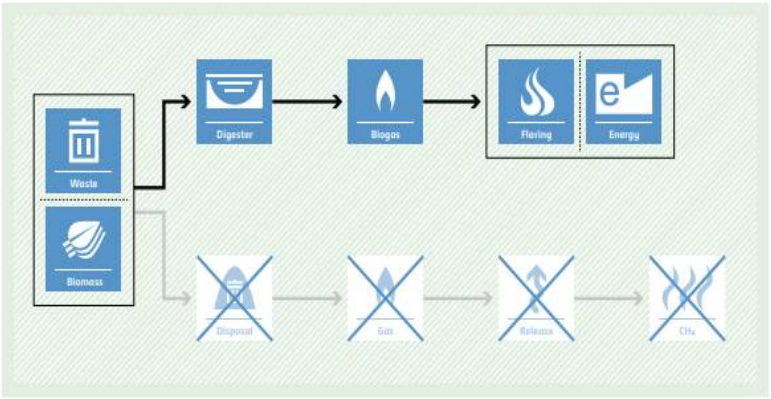
Party (Host)	Participants
India	Project Proponent: Urja Bio System Pvt. Ltd., Pune, Maharashtra, India Aggregator: Gram Vikas Trust UCR ID:741215693 Email:gvtbiogas@gmail.com

A.6. Baseline Emissions>>

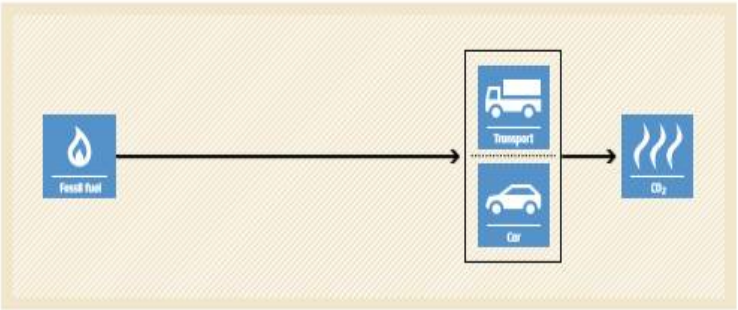
BASELINE SCENARIO
Biomass or other organic matter would have otherwise been left to decay anaerobically.



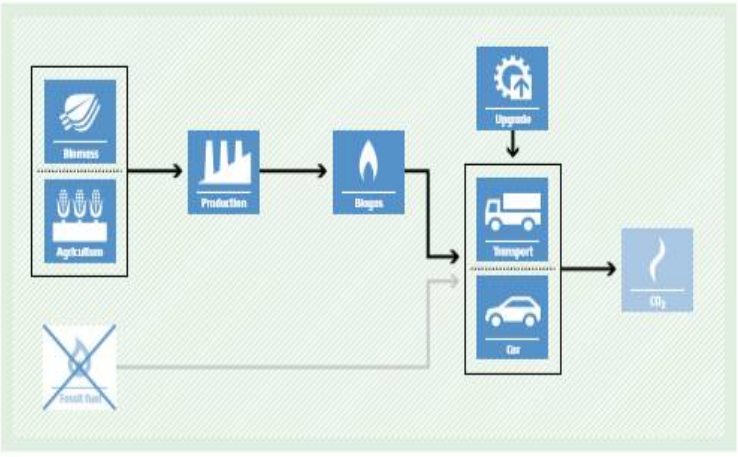
PROJECT SCENARIO
Biological treatment of biomass or other organic matters through anaerobic digestion in closed reactors equipped with biogas recovery and a combustion/flaring system.



BASELINE SCENARIO
Gasoline or CNG are used in the baseline vehicles.



PROJECT SCENARIO
Only Bio-CNG are used in the project vehicles.



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

- the amount of Bio-CNG produced and distributed to replace fossil produced fuel,
- the situation where, in the absence of the project activity, biomass and other organic matter are left to decay within the project boundary and methane is emitted to the atmosphere. The baseline emissions are the amount of methane emitted from the decay of the degradable organic carbon in the biomass and other organic matter.

A.7. Debundling>>

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

SECTION B. Application of methodologies and standardized baselines

B.1. References to methodologies and standardized baselines >>

SECTORAL SCOPE - 07 Transport
13 Waste handling and disposal

TYPE I - Renewable Energy Projects. Displacement of more-GHG-intensive fossil fuel used in vehicles.
TYPE III-Other Project Activities

CATEGORY- ***AMS-III.AQ.: Introduction of Bio-CNG in transportation applications, Version 2.0***

This methodology comprises activities for production of Biogenic Compressed Natural Gas (Bio-CNG) from biomass including biomass residues to be used in transportation applications. The project activity involves installation and operation of Bio-CNG plant that includes:

(a) Anaerobic digester(s) to produce and recover biogas;
(b) Biogas treatment system that includes processing and purification of the biogas to obtain up-graded biogas such that methane content, its quality and the physical and chemical properties are equivalent to the CNG;
(c) Filling stations, storage and transportation.

This methodology covers the use of Bio-CNG in various types of transportation applications such as Compressed Natural Gas (CNG) vehicles, modified vehicles. Examples include buses, trucks, three-wheeler, cars, jeeps, etc.

AMS III.AO. Methane recovery through controlled anaerobic digestion, Version 1.0

This methodology comprises measures to avoid the emissions of methane to the atmosphere from biomass or other organic matter that would have otherwise been left to decay anaerobically in a solid waste disposal site (SWDS). In the project activity, controlled biological treatment of biomass or other organic matters is introduced through anaerobic digestion in closed reactors equipped with biogas recovery and combustion/flaring system.

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

The project activity comprises measures to avoid the emissions of methane to the atmosphere from biomass or other organic matter that would have otherwise been left to decay anaerobically in a solid waste disposal site (SWDS). The project activity also involves installation and operation of Bio-CNG plant that includes: • (a) Anaerobic digester(s) to produce and recover biogas; • (b) Biogas treatment system that includes processing, purification of the biogas to obtain up-graded biogas such that methane content, its quality and the physical and chemical properties are equivalent to the CNG; • (c) Filling stations, storage and transportation.
Biogas produced by the two digesters are used or flared.
The annual average temperature of the biogas site is located is higher than 5°C
The digested residue waste leaving the reactor is handled aerobically and sold to local clients who submit residue to soil application in gardens and parks.The storage time of the agricultural waste does not exceed 45 days before being fed into the digesters.
The project activity does not recover or combust landfill gas from the disposal site, does not undertake controlled

combustion of the waste that is not treated biologically in a first step and does not recover biogas from wastewater treatment.
The storage time of the organic waste does not exceed 45 days before being fed into the digesters.
The activities for production of Biogenic Compressed Natural Gas (Bio-CNG) are from biomass including biomass residues from municipal solid waste.
Methane content of the upgraded biogas is in accordance with relevant national regulations and over the minimum volume specified for India.
Only the producer of the Bio-CNG is claiming emission reductions under this methodology.
Biogas treatment system that includes processing, purification of the biogas to obtain up-graded biogas such that methane content, its quality and the physical and chemical properties are equivalent to the CNG;
Measures are limited to those that result in emission reductions of less than or equal to 60 kt CO2 equivalent annually

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

The biogas unit is constructed within the project boundary and has a unique ID, which is visible on the biogas unit and log books. The Monitoring Report has the details of the same and the Unique ID. The project activity is not registered under any GHG program since being commissioned.

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

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

- The Bio-CNG plant;
- Biogas digesters;
- Transportation Bio-CNG from biogas plant to filling stations where it is used by final consumers;

	Source	GHG	Included?	Justification/Explanation
Baseline	CO_2 emissions from CNG from fossil origin CH_4 Emissions from biomass decay	CO_2	**Included**	Major source of emission
		CH_4	**Included**	Major source of emission
		N_2O	Excluded	Excluded for simplification. This is conservative
Project Activity	CH_4 Emissions from anaerobic digester CH_4 Emissions from flaring of the biogas	CO_2	Excluded	There is no incremental emissions related to transport of waste to project site as compared to the disposal site.
		CH_4	**Included**	Methane emissions due to physical leakages from the digester / recovery system and flaring per year
		N_2O	Excluded	Excluded for simplification. This is conservative

Leakage Emissions under AMS III.AO is not applicable as the project technology is not transferred from another activity and neither is the existing equipment being transferred to another activity.
Leakage Emissions under AM III.AQ related to the substitution of Bio-CNG for CNG from fossil origin reduces indirect ("upstream") emissions associated with the production of fossil CNG and is treated as negative leakage, hence is not considered and is conservative in the approach to calculate baseline emissions.

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

The baseline scenario under AMS III.AO is the situation where, in the absence of the project activity, biomass and other organic matter are left to decay within the project boundary and methane is emitted to the atmosphere. The baseline emissions are the amount of methane emitted from the decay of the degradable organic carbon in the biomass and other organic matter. The yearly baseline emissions are the amount of methane that would have been emitted from the decay of the cumulative quantity of the waste diverted or removed from the disposal site, to date, by the project activity, calculated as the methane generation potential using the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site." The project proponent was not bound to incur this investment as it was not mandatory by national and sectoral policies.

The baseline emissions under AMS III.AQ are calculated based on the amount of Bio-CNG produced and distributed, and it is applicable to project activities that use Bio-CNG in modified diesel vehicles and modified gasoline vehicles when such vehicles are not included in the boundary. All vehicles have been assumed to converted to run on natural gas, which is then considered being the baseline fuel.

Estimated Annual Emission Reductions: $BE_y = BE_{y1} + BE_{y2} - PE_{phy,leakage y} - PE_{flare,y}$

BE_y = Total Baseline Emissions in a year.

$BE_{y2} = FS_{BIO\text{-}CNG,\,Y} \times NCV_{BIO\text{-}CNG} \times EF_{CO2,\,BIO\text{-}CNG}$

$FS_{BIO\text{-}CNG,\,Y}$	Amount of Bio-CNG distributed/sold directly to retailers, filling stations by the project activity in year y (tonnes)
$EF_{CO2,\,BIO\text{-}CNG}$	CO2 emission factor of CNG (tCO2e/GJ), determined using reliable local or national data (0.053 TCO2/GJ)
$NCV_{BIO\text{-}CNG}$	Net calorific value of Bio-CNG (GJ/tonne). For NCV of CNG, reliable local or national data shall the used. (43.5 GJ/T IPCC Default)

$BE_{y1} = BE_{swds,y} + BE_{manure,y} + BE_{WW,y} - MD_{reg,,y} \times GWP_{CH4}$

BE_{y1} = Baseline emissions from biomass and other organic matter left to decay within the project boundary and methane is emitted to the atmosphere

$BE_{swds,y}$ = Baseline emission determination of digested waste that would otherwise have been disposed in stockpiles shall follow relevant procedures in AMS-III.E. This is equal to the yearly methane generation potential of the SWDS at the year y, considering all the wastes deposited in it since its beginning of operation, and without considering any removal of wastes by the project activity.

$BE_{manure,y}$	=	Baseline emissions from the manure co-digested by the project activities = 0
$BE_{WW,y}$	=	Baseline emissions from the wastewater co-digested = 0
$MD_{reg,,y}$	=	Amount of methane that would have to be captured and combusted in the year y to comply with the prevailing regulations (tonne) = 0
GWP_{CH4}	=	21 is the default IPCC value of CH_4 applicable to the crediting period ($tCO_{2e}/t\ CH_4$)

Project Activity Emissions

1. Project activity emissions consist of:
   (a) Methane emissions from physical leakages of the anaerobic digester;
   (b) Methane emissions due to flare inefficiency;

$PE_{phy,leakagey}$ = Methane emissions due to physical leakages from the digester and recovery system shall be estimated using a default factor of 0.05 m³ biogas leaked/m³ biogas produced.

$PE_{flare,y}$ = Methane emissions due to incomplete flaring in year *y* as per the "Tool to determine project emissions from flaring gases containing methane"(tCO_2e).

Year	2019	2020	2021
Emission Reductions (tCO2e)	30979	57184	57184

Estimated baseline emission reductions (BE_y) = 145229 CoUs (145229 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 CoU Issuance Period: 2 years, 11 months
Crediting Date: 04/06/2019 to 30/11/2021

B.8. Monitoring plan>>

Relevant parameters shall be monitored as indicated in the below.

No.	Parameter	Description	Unit	Monitoring/recording Frequency	Measurement Methods and Procedures
1	Q_y,	Quantity of solid waste	tons	Monthly	On-site data sheets recorded monthly using weigh bridge. Weighbridge will be subject to periodic calibration (in accordance with stipulation of the weighbridge supplier)
2	$w_{CH4,y}$	Methane content in biogas in the year *y*	%		As per the relevant procedure in AMS-III.H
4	T	Temperature of the biogas	^{o}C		As per the relevant procedure in AMS-III.H
5	P	Pressure of the biogas	Pa		As per the relevant procedure in AMS-III.H
6	FE	The flare efficiency	%		As per the "Tool to determine project emissions from flaring gases containing Methane". Regular maintenance shall be carried out to ensure optimal operation of flares

Data/Parameter	Date of commissioning of biogas unit
Data unit	Date.
Description	Actual date of commissioning of the project device
Source of data Value(s) applied	Monitoring Report As and when commissioned
Measurement methods and procedures	The construction processes are maintained from its initiation to completion dates for the biogas unit. Thus the start date of each of the unit installed is recorded in the monitoring report.
Monitoring frequency	As and when commissioned and fixed and recorded in the monitoring report
Purpose of data	To estimate baseline emissions

Data / Parameter:	NCV_i
Data unit:	GJ/t
Description:	Methane content in biogas in the year *yNet calorific value of gasoline/blended gasoline that was used by project vehicle k*
Source of data:	Measured according to relevant national/international standards
Measurement procedures (if any):	NA
Monitoring frequency:	At verification and annually during the crediting period
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$w_{CH4,y}$
Data unit:	%
Description:	*Methane content in the Bio-CNG*
Source of data:	-
Measurement procedures (if any):	The fraction of methane in the gas is to be measured with a continuous analyzer or, alternatively, with periodical measurements at a 90/10 sampling confidence/precision level. It shall be measured using equipment that can directly measure methane content in the biogas.
Monitoring frequency:	Continuous/periodic
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$NCV_{Bio\text{-}CNG}$
Data unit:	GJ/t
Description:	*Net calorific value of Bio-CNG*
Source of data:	-
Measurement procedures (if any):	Measured according to relevant national/international standards through sampling
Monitoring frequency:	Monthly or as prescribed by the applied national/international standard
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$FP_{Bio\text{-}CNG,y}$
Data unit:	t
Description:	Quantity of the Bio-CNG produced by the project activity in the year y
Source of data:	-
Measurement procedures (if any):	Measurements are undertaken using calibrated meters at the outlet of the biogas upgrading section of the Bio-CNG production site
Monitoring frequency:	Continuously
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$FS_{Bio\text{-}CNG,y}$
Data unit:	t
Description:	*Amount of Bio-CNG distributed/sold directly to retailers, filling stations by the project activity in year y*
Source of data:	Measurements of the amount of Bio-CNG distributed/sold to retailers/filling stations are undertaken using calibrated meters at the delivery section of Bio-CNG production site. Measurements results shall be cross checked with records for sold amount (e.g. invoices/receipts) and with the amount of biogas produced
Measurement procedures (if any):	Continuously or in batches
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-