# Monitoring Report (MR)

CARBON OFFSET UNIT (CoU) PROJECT

**Title: Bio-CNG Project AJS Fuels in Savli, Gujarat**

**UCR Project ID**: 167
**MR Version** 2.0
**Date of MR**: 31/05/2023
**2nd CoU Issuance Period**: 01 years, 0 months
**2nd Monitoring Period:** 01/01/2022 to 31/12/2022 (both dates inclusive)
**2nd Crediting Period**: 01/01/2022 to 31/12/2022 (both dates inclusive)

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

| BASIC INFORMATION | |
|---|---|
| Title of the project activity | **Bio-CNG Project AJS Fuels in Savli, Gujarat** |
| Scale of the project activity | Small Scale |
| MR # | 2.0 |
| Completion date of the MR | 31/05/2023 |
| UCR Registration ID | 167 |
| Project participants | Project Proponent: AJS Fuels Pvt. Ltd., Savli, Gujarat, India<br>Aggregator: Gram Vikas Trust<br>UCR ID:741215693 |
| Host Party | India |
| Sectoral scopes | 13 Waste handling and disposal<br>07 Transport |
| Applied Methodology | **AMS-III.AQ.:** ***Introduction of Bio-CNG in transportation applications, Version 2.0***<br>***AMS III.AO. Methane recovery through controlled anaerobic digestion, Version 1.0*** |
| Calculated amount of GHG emission reductions per year | 35784 CoUs |
| Calculated amount of GHG emission reductions over the 2nd crediting period | **35784** CoUs (**35784** $tCO_{2eq}$) |
| SDGs | SDG 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture<br>SDG 3: Ensure healthy lives and promote well-being for all at all ages<br>SDG 6: Ensure availability and sustainable management of water and sanitation for all<br>SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all<br>SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation<br>SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable<br>SDG 13: Take urgent action to combat climate change and its impacts<br>SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss |

## SECTION A. Description of project activity

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

The project activity, **Bio-CNG Project AJS Fuels in Savli, Gujarat** is located in State: Gujarat, Country: India

The details of the registered project are as follows:

**Purpose of the project activity:**
The **Bio-CNG Project AJS Fuels in Savli, Gujarat** comprises of a project activity using biogas technology for capturing methane from fresh animal dung, poultry litter and organic waste, that is fed into an anaerobic digester and the gainful use of recovered methane gas for Bio-CNG bottling purposes for use in the transport sector. The project activity avoids the methane emissions emitted from the decay of the degradable organic carbon in the biomass and other organic matter.

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

The project activity by the project proponent (PP), AJS Fuels Pvt Ltd., (AJS) is located in Village: Dhantej, Taluka: Savli, District: Vadodara, State: Gujarat, Country: India.

The purpose of the AJS project activity is the setup of an independent biogas plant of 1000 $m^3$ capacity to co-digest fresh cattle dung, poultry litter, organic waste and pressmud (press mud is used from 2022 onwards, hence is not part of this first verification period and monitoring period between 2014-2021), from farms and sugar mills outside the project boundary, which in turn generates and captures methane due to anaerobic digestion. This MR of project activity comprises of measures taken to avoid the emissions of methane to the atmosphere from **3907 tonnes of cattle dung, 252 tonnes of poultry litter and 3498 tonnes of organic agricultural waste/ crop residues (pressmud/biomass)** that would have otherwise been left to decay anaerobically **in the year 2022**.

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 also involves the gainful use of the recovered methane for replacement of fossil CNG in vehicles.

Further, the residual waste from the digestion is handled aerobically and submitted to soil application as fertilizer.

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 technical specifications of the modified KVIC model bio-digesters and resulting Bio CNG are as follows:

<table>
<tr><th>Specification</th><th>Value</th></tr>
<tr><td>Total Installed Capacity</td><td>1000 $m^3$</td></tr>
<tr><td>Mixing Proportion</td><td>(Water: Waste) 1:1</td></tr>
<tr><td>Number of units (digesters)</td><td>1</td></tr>
<tr><td>Feed Material</td><td>Cattle Dung/Organic Waste/Poultry Litter/Pressmud
<table>
<tr><th>Year</th><th>2022 (tonnes treated)</th></tr>
<tr><td>Cow Dung</td><td>3,907</td></tr>
<tr><td>Poultry Litter</td><td>252</td></tr>
<tr><td>Press Mud</td><td>2,820</td></tr>
<tr><td>Biomass</td><td>678</td></tr>
</table></td></tr>
<tr><td>Biogas Flow rate</td><td>0.9 $m^3$/hr</td></tr>
<tr><td>Calorific Value Biogas from digester</td><td>20 MJ/$m^3$</td></tr>
<tr><td>Bio CNG Calorific Value</td><td>52 MJ/kg</td></tr>
<tr><td>BioCNG capacity (Daily)</td><td>350 kg</td></tr>
<tr><td>Air-Fuel Stoichiometric Ratio by volume</td><td>23.9 : 1</td></tr>
<tr><td>Density @ 1 ATM, 15 °C (kg/m3)</td><td>0.79</td></tr>
<tr><td>Autoignition Temperature (°C )</td><td>630 - 810</td></tr>
<tr><td>Toxicity</td><td>Non toxic even at high concentration & low levels of oxygen.</td></tr>
<tr><td>Concentration of methane in the biogas</td><td>0.43008kg CH4/$m^3$<br>Applied an expected fraction of methane in biogas of 0.60 m3CH4/m3 multiplied by the density of methane at normal conditions of 0.7168 kg/m3</td></tr>
</table>

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

UCR Project ID: 167

Start Date of 1st Crediting Period: 01/01/2014
End Date of 1st Crediting Period: 31/12/2021

Start Date of 2nd Crediting Period: 01/01/2022
End Date of 2nd Crediting Period: 31/12/2022

Project Commissioned Date: 2013

Commissioning dates of digesters: 1

Total Biogas Units in this Monitoring Period: 1

This is the 2nd monitoring report for the 2nd crediting period for the duration 01/01/2022 to 31/12/2022 (both days inclusive).

The operational domestic biogas unit is in continuous operation after installation, with minor and major repairs as and when are reported by the project owner. Since the UCR protocol for biogas systems is based on a conservative 330 days a year operation, the project activity was never non-operational for a period of 35 days or more during any year of the monitoring period. The exact quantity of waste used during 2022 is available in the ER sheet.

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

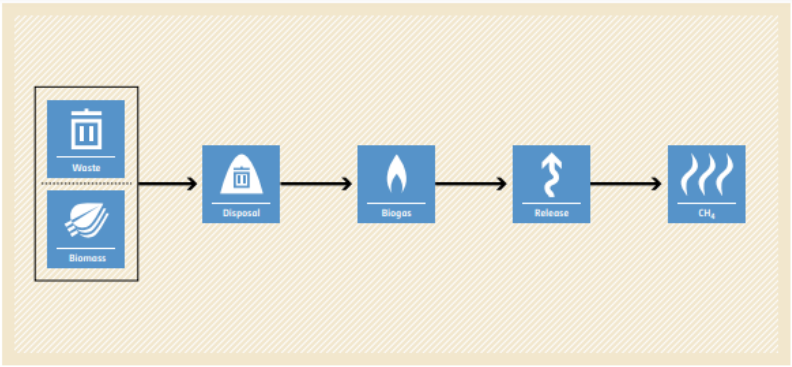
The total GHG emission reductions achieved in this monitoring period is as follows:

| **Summary of the Project Activity and ERs Generated for the Monitoring Period** | |
|---|---|
| Start date of this 2nd Monitoring Period | 01/01/2022 |
| Carbon credits claimed up to | 31/12/2022 |
| Total ERs generated ($tCO_{2eq}$) | 35784 $tCO_{2eq}$ |
| Leakage and Project Emissions | 56 $tCO_{2eq}$ |

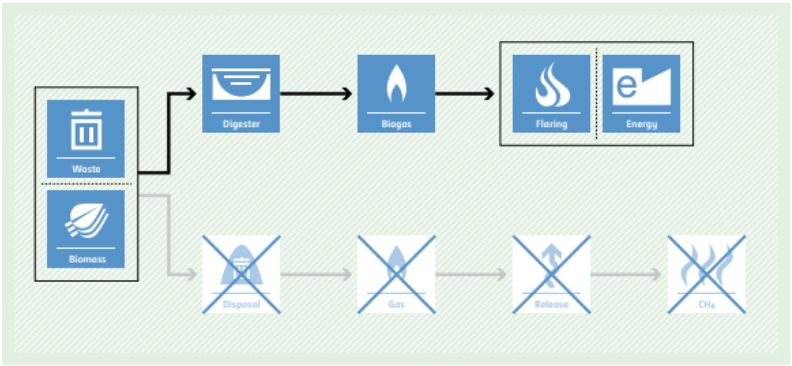
The baseline scenario identified at the MR stage of the project activity is:

- 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.

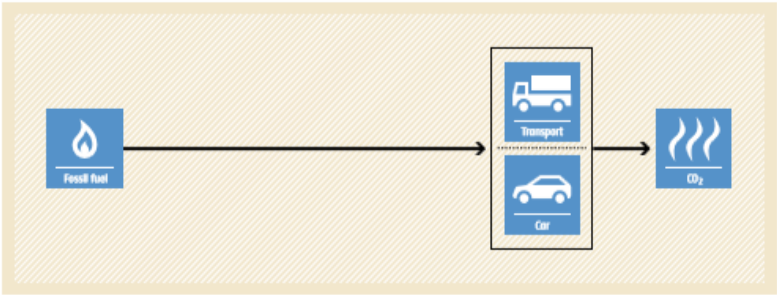
**BASELINE SCENARIO**
Biomass or other organic matter would have otherwise been left to decay anaerobically.



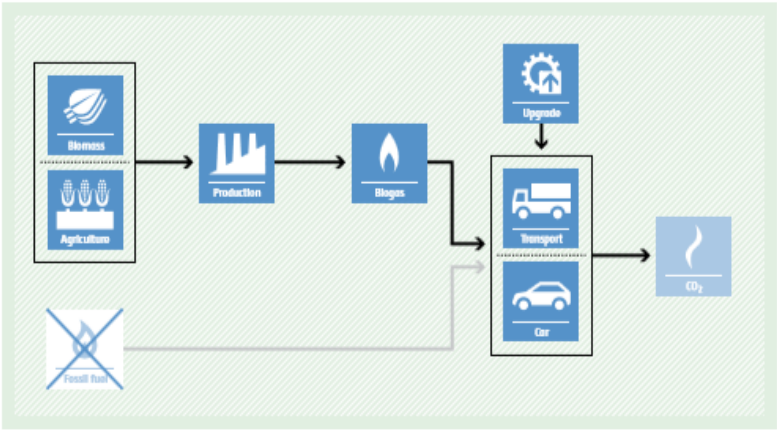

**PROJECT SCENARIO**
Biological treatment of biomass or other organic matters through anaerobic digestion in closed reactors equipped with biogas recovery and a combustion/flaring system.




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



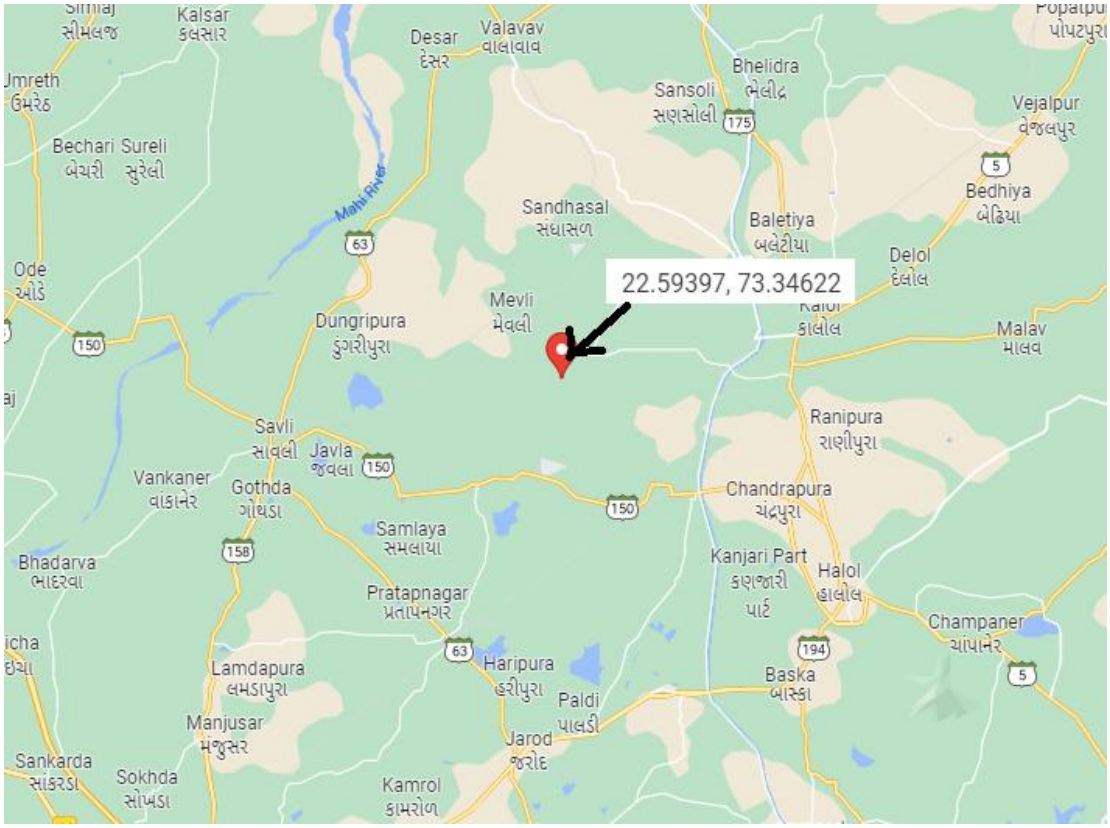

**PROJECT SCENARIO**
Only Bio-CNG are used in the project vehicles.




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

Country: India.
Plot: Survey No. 647
Village: Dhantej
Taluka: Savli

District: Vadodara,
State: Gujarat
Latitude: 22° 35' 38.2914" N
Longitude: 73° 20' 46.392" E

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

| Party (Host) | Participants |
|---|---|
| India | Project Proponent: AJS Fuels Pvt. Ltd., Savli, Gujarat, India<br>Aggregator: Gram Vikas Trust<br>UCR ID:741215693<br>Email:gvtbiogas@gmail.com |

## A.4. 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, Vers 2.0***
***AMS III.AO. Methane recovery through controlled anaerobic digestion, Ver 1.0***

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

Type: Renewable
State Date of 2nd Crediting Period: 01/01/2022
End Date of 2nd Crediting Period: 31/12/2022
Length of the crediting Period corresponding to this monitoring period: 01 years, 0 months

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

Aggregator: Gram Vikas Trust
UCR ID:741215693
Email:gvtbiogas@gmail.com

## SECTION B. Implementation of project activity

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

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

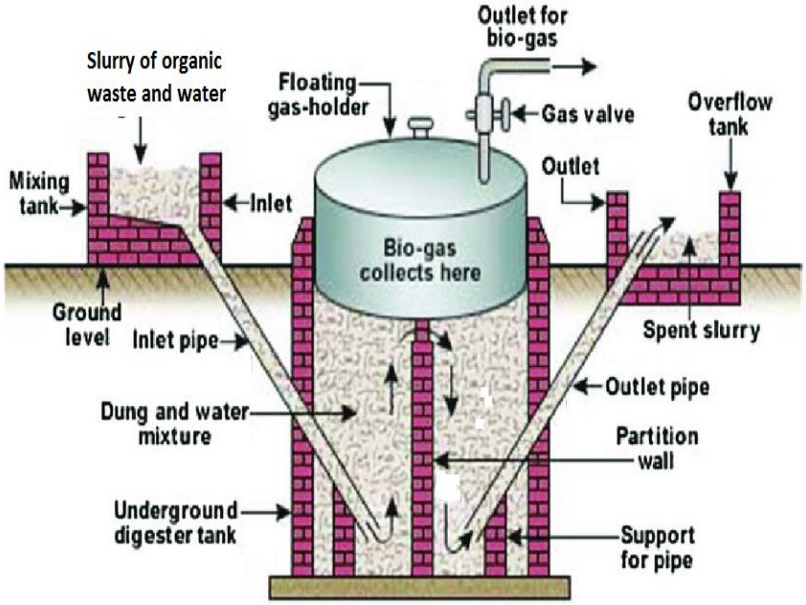
The purpose of the project activity is the set up 1 (one) independent biogas plant (digester) of 1000$m^3$ capacity for controlled biological treatment of biomass or other organic matters through anaerobic digestion in closed reactors equipped with biogas recovery. The project activity comprise of measures taken to avoid the emissions of methane to the atmosphere from 20 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).

Pressmud is an industrial waste available from the sugar mills. For every 100 tonnes of sugarcane crushed about 3 tonnes of pressmud cake is left behind as by-product. Press or mill mud contains all solid impurities from converting sugarcane juice to raw sugar under elevated temperature, including residual soil, phosphate precipitates, calcium oxalate/aconitate, sucrose, fiber, and protein. Consequently, pressmud is a good substrate for the production of biogas.

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. Yearly 144 tonnes of bottled Bio-CNG is generated from the project activity.

| | |
|---|---|
| Digester # 1 Capacity | 1000$m^3$ |
| Organic Waste Treated | **Year** / **2022 (tonnes treated)**<br>**Cow Dung** 3,907<br>**Poultry Litter** 252<br>**Press Mud** 2,820<br>**Biomass** 678 |
| Bio-CNG | 144 TPY |

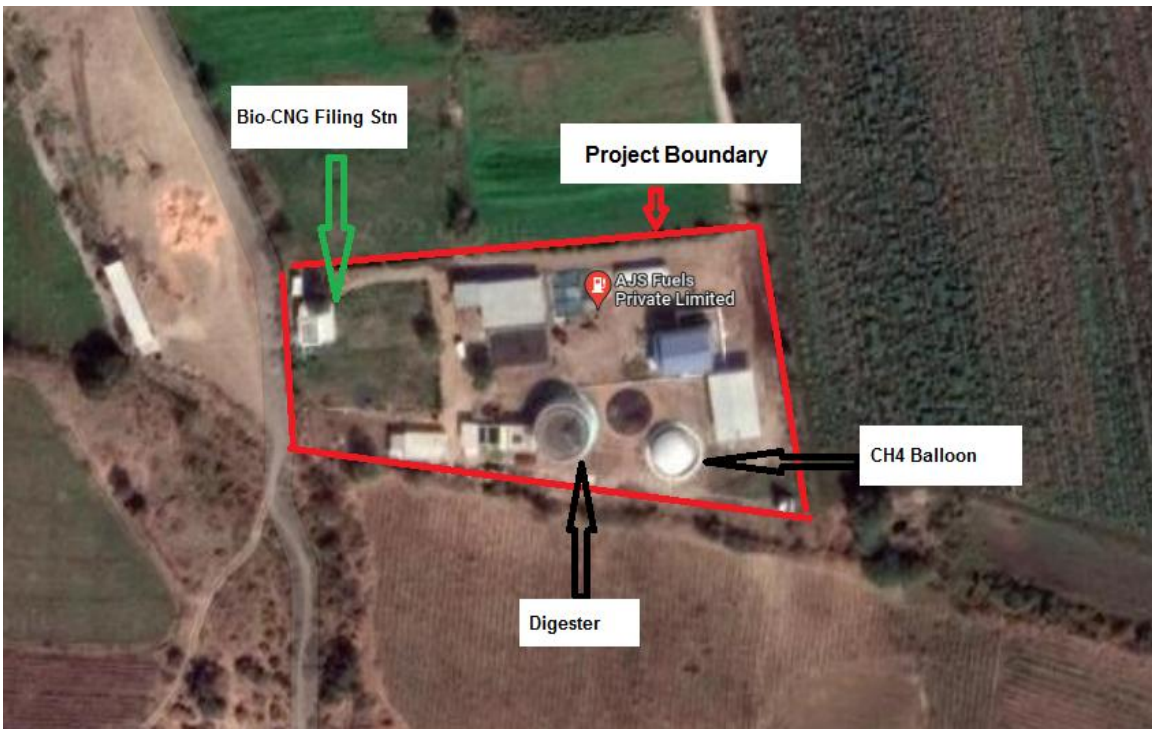
b) For the description of the installed technology(ies), technical process and equipment, include diagrams, where appropriate>>

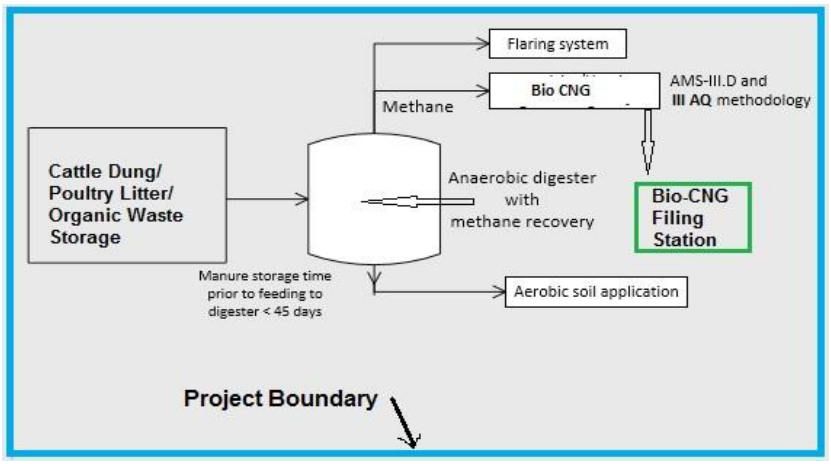



Bio-methanation is a process by which organic waste is microbiologically converted under anaerobic conditions to biogas. It is the most energy efficient and eco-friendly method for treatment of poultry litter. With bio-methanation the project activity converts poultry litter to Bio-CNG and also good quality organic manure. AJS has set up a 1000 $m^3$ biogas digester which treats approximately 20 TPD of organic waste including cattle dung/poultry litter at the site in Gujarat where around 200-350 kg Bio-CNG is bottled in cylinders and sold at the filling station within the project boundary.

Co-digestion in the project activity is the simultaneous digestion of a homogenous mixture of two or more substrates from different sources, e.g. co-digestion of organic waste, animal manure and/or pressmud. The situation in the project activity is where cattle dung is used as a major amount of the primary basic substrate (e.g. manure) which is mixed and digested together with minor amounts of other substrates.

The project activity comprises of measures taken to avoid the emissions of methane to the atmosphere from **3907 tonnes of cattle (cow) dung, 252 tonnes of poultry litter and 3498 tonnes of organic agricultural waste/ crop residues (pressmud/biomass)** that would have otherwise been left to decay anaerobically outside the project boundary in 2022.




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

This biogas project activity is uniquely positioned to help achieve eight of the SDGs – perhaps more than any other sector. Anaerobic digestion (AD) is a natural process in which microbes digest organic material in sealed containers, producing biogas, which in the case of the project activity, is upgraded and used for vehicle fossil fuel replacement.

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

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

the disease causing pathogens

- Biogas CNG projects allow farms in the vicinity of the project activity to become self-sufficient and monetise their waste.

- **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
- Avoids 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.
- Further, by generating Bio-CNG through utilising the biogas, the project helps in replacing fossil fuel intensive fuels for transport.
- Recycling of the biogas slurry ensures that water is recycled into the biomethanation process thus resulting in water savings.
- 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.
- Poultry litter and cattle dung is transformed into high-quality enriched bio-manure/fertilizer which is supplied to the retail marketplace, thus providing better soil enrichment for local gardens and parks.
- Provides employment to local communities through construction and maintenance of biogas units.
- The revenue from carbon credits will make it more attractive for the setup of similar projects across the State at scale and speed. Finance is another hurdle for setup of such biogas plants. A biogas plant is a large investment. However, revenue from the sale of carbon credits will force green entrepreneurs to give it a second thought under the UCR Program and will enable scaling up of such project activities.

## B.3. Baseline Emissions>>

The baseline scenario identified at this MR 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.

| SDG | Impact |
|---|---|
|  Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture | • Restoring soils through the recycling of nutrients, organic matter, and carbon<br>• Increasing crop yields through use of nutrient-rich digestate biofertiliser<br>• Recirculating phosphorus, which is essential for the growth of plants but limited in supply |
|  Goal 3: Ensure healthy lives and promote well-being for all at all ages | • Reducing air pollution by substituting fossil fuel with biogas<br>• • Treating and recycling sewage and organic wastes to reduce odours and the spread of diseases |
|  Goal 6: Ensure availability and sustainable management of water and sanitation for all | • Providing decentralised, local treatment of bio-solids in remote and rural communities to reduce odours and the spread of disease<br>• Stabilising and recycling biosolids through AD to allow them to be applied back to land<br>• • Reducing the carbon loading of wastewater to reduce impact on water bodies |
|  Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all | • Reducing dependence on fossil-fuel-based energy sources by replacing with biogas<br>• Utilising locally produced wastes and crops to generate energy for rural and remote communities. The project activity treats **10 tonnes per day (TPD) of cattle dung, 3 TPD of poultry litter and 7 TPD of organic agricultural waste/ crop residues (biomass)** that would have otherwise been left to decay anaerobically<br>• • Storing biogas to produce energy when required<br>• Methane, constituting about 55–60% of landfill gas, is utilized to increase the share of renewable energy in the global energy mix |
|  Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation | • Improving the self-sufficiency and sustainability of industries by extracting the energy from local waste and effluents and using it for the generation of renewable clean fuels.<br>• Collaboration between industries and agriculture for mutual benefit<br>• • Generating short-term construction employment and long-term equipment manufacturing and maintenance employment. |

| | |
|---|---|
|  <br>Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable | • Preventing spread of diseases through collection and proper management of organic cattle waste<br>• Improving sanitation and hygiene through decentralised and local treatment of biosolids<br>• Improving urban air quality by substituting fossil fuel with biomethane in vehicles<br>• • Reducing greenhouse gas emissions by using biogas-based renewable energy in the transportation industry |
|  <br>Goal 13: Take urgent action to combat climate change and its impacts | • Reducing carbon dioxide emissions by replacing fossil-fuel-based energy sources with biogas and commercial fertilisers with digestate biofertiliser<br>• Reduction of methane and nitrous oxide emissions from livestock manures<br>• Reduction of methane and generation of renewable energy from other organic wastes<br>• Capturing emissions from landfills |
|  <br>Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss | • Recirculating nutrients and organic matter in organic wastes through AD and returning them to the soil in the form of digestate biofertiliser |

## B.4. Debundling>>

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

## SECTION C Application of methodologies and standardized baselines

### C.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.
Co-digestion of multiple sources of biomass substrates, e.g. MSW, organic waste, animal manure, wastewater, where those organic matters would otherwise have been treated in an anaerobic treatment system without biogas recovery is also eligible under this methodology.

### C.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:<br>• (a) Anaerobic digester(s) to produce and recover biogas;<br>• (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;<br>• (c) Filling stations, storage and transportation. |
| 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 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 using both methodologies. |

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

The biogas unit along with the meters is constructed within the project boundary and has a unique ID, which is visible on the biogas unit and log books. The control room has all the details and specifications of the equipment installed at the project site. The project activity is not registered under any GHG program since being commissioned other than UCR.

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

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

- Where the treatment of biomass or other organic matters through anaerobic digestion takes place;
- Where the residual waste from biological treatment or products from those treatments, like slurry, are handled, disposed, submitted to soil application, or treated thermally/mechanically;
- Where biogas is burned/flared or gainfully used, including biogas sale points, if applicable;
- The Bio-CNG plant and sale points are located within the Project Boundary;

| | Source | GHG | Included? | Justification/Explanation |
|---|---|---|---|---|
| Baseline | $CO_2$ emissions from CNG from fossil origin<br><br>$CH_4$ 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<br><br>$CH_4$ 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.

The waste transported to the project site is not more than 200 km, hence project emissions on account of transport has been neglected.

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

*As per **AMS-III. A.O methodology,** since* the project activity treats animal manure as a substrate, the relevant sub methodology applicable is ***AMS-III.D Methane recovery in animal manure management systems***, has been applied.

The baseline scenario is

- *the situation where, in the absence of the project activity, biomass and other organic matter (including manure where applicable) 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 baseline scenario under AMS III. D 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 under AMS III.D ($BE_{y1}$) are calculated by using the following option:

> *(b) 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 (SVS) content.*

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.

**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. Methane emissions due to physical leakages from the digester and recovery system ( leakagey phy PE , ) 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"($tCO_2e$).

$PE_{transport,y}$ = Nil. The biomass and animal manure is transported to the project activity site within a radius of 200 km of the project boundary. Hence incremental emissions on account of transport is neglected.

**Estimated Annual Emission Reductions**: $BE_y = BE_{y1} + BE_{y2} + BE_{y3} - PE_{phy,leakagey} - PE_{flare,y}$

$BE_y$ = Total Baseline Emissions in a year.

$BE_{y2}$ = 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.

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

| | |
|---|---|
| $FS_{BIO\text{-}CNG,Y}$ | Amount of Bio-CNG distributed 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) |

$$BE_{y1} = GWP_{CH4} \times D_{CH4} \times UF_b \times \sum_{j,LT} MCF_j \times B_{0,LT} \times Q_{manure,j,LT,y} \times SVS_{j,LT,y}$$

Where:

$Q_{manure,j,LT,y}$ = Quantity of manure treated from livestock type LT and animal manure management system j (tonnes/year, dry basis)

$SVS_{j\ LT\ y}$ = Specific volatile solids content of animal manure from livestock type LT and animal manure management system j in year y (tonnes/tonnes, dry basis)

$MCF_j$ = Annual methane conversion factor (MCF) for the baseline animal manure management system j

$B_{0,LT}$ = Maximum methane producing potential of the volatile solid generated for animal type LT ($m^3$ CH4/kg dm),

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

$BE_{y1}$ = 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

$VS_{default\_cattle/poultr}$ = Volatile solids of livestock LT entering the animal manure management system in

| | |
|---|---|
| y | year y as per IPCC default for poultry/cattle in India |
| $UF_b$ | = Model correction factor to account for model uncertainties (0.94) Default |
| $VS_{jLTy}$ | = Specific volatile solids content of animal manure from livestock type LT and animal manure management system j in year y (tonnes/tonnes, dry basis) (Poultry=0.02) (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 (Poultry=2%), solid storage, (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 (Poultry =0.24). IPCC 2006 - IPCC Default Value taken for Indian Subcontinent. (Cow =0.13). IPCC 2006 - IPCC Default Value taken for Indian Subcontinent |
| VS | = Volatile Solids<br><br>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.<br><br>$VS_{Default,\ poultry}$ 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) = 0.01<br><br>The feed digestibility in the range of 50 to 60% has been considered as appropriate for this project activity. 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 :<br><br>DMI = BM0.75 x[{[(0.0119xNEma 2 )+0.1938]}/NEma] where:<br><br>DMI = Dry Matter Intake;<br>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).<br><br>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 $kg^{-1}$<br><br>$VS_{Default,\ Cow}$ 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 $CH_4$) selected as conservative. |

***$BE_{y3} = BE_{swds,y}$*** = The baseline scenario under AMS III.AO is the situation where, in the absence of the project activity, biomass/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.

| | | |
|---|---|---|
| $BE_{swds,y}$ | = | 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. |
| $GWP_{CH4}$ | = | 21 is the default IPCC conservative value of $CH_4$ applicable to the crediting period ($tCO_{2e}/t\ CH_4$) |

Press mud from sugar factory typically contains 71% moisture, 9% ash and 20% volatile solids, with 74-75% organic matter on solids. Sugar molasses has methane potential (i.e. CH4 per ton of raw material) of 230 m3 . Typical composition of press-mud is given below in the table:

Composition of press-mud

| COMPOUND | PERCENTAGE |
|---|---|
| Cellulose | 11.4 |
| Hemi cellulose | 10.0 |
| Lignin | 9.3 |
| Protein | 15.5 |
| Wax | 8.4 |
| Sugar | 5.7 |
| Na | 0.22 |

Characteristics of press-mud

| PARAMETER | AVERAGE VALUE (%) |
|---|---|
| Moisture | 76.3 |
| Volatile matter | 76.6 |
| Sugars | 6.4 |
| Wax | 7.2 |
| C/N ratio | 14 |

The advantage of using press mud is that the sludge coming out from the digester is a good fertilizer and press mud used with cattle dung increases the efficiency of the process to produce biogas.
(*source: IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) ISSN: 2278-1684, PP: 37-41, Biogas From Pressmud Karan M. Agrawal , B. R. Barve , Shareena S. Khan (Mechanical department, Dr J J Magdum College of engineering / Shivaji University, India)*

**Project Activity and Leakage Emissions**

**$PE_y$ = <u>56 $tCO_{2eq}$/year</u>**

| Year | 2022 |
|---|---|
| Baseline emissions on account of organic waste **BE $_{y3}$** | 3655 |
| Baseline emissions on account of poultry litter and cow dung waste **BE $_{y1}$** | 31879 |
| Baseline emissions on account of bottling BIO-CNG **BE $_{y2}$** | 306 |
| Project Emissions due to Digester Leakage and flaring **PE** $_{y}$ | 56 |
| **ER (tCO2)** | **35784** |

**Calculated Total Emission Reductions (ERs) over the 2nd crediting period = 35784 CoUs**

**B.6. Prior History>>**

The project activity has not applied to any other GHG program for generation or issuance of carbon offsets or credits in the past or for the current crediting period.

**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>>**

2nd Issuance Period: 01 years, 0 months
2nd Crediting Period – 01/01/2022 to 31/12/2022
Monitoring Period: 02
Duration: 01 years, 0 months

**B.8. Monitoring plan>>**

Relevant parameters are monitored as indicated below.

- Amount of poultry litter manure used at the plant (**$Q_{poultry\ litter}$**) each day
- Amount of cow dung used at the plant (**$Q_{cow\ dung}$**) each day
- Amount of organic waste/biomass/pressmud used at the plant (**$Q_{biomass}$**) each day
- Amount of biogas generated per day (**BG $_{fuelled,\ y}$**)
- Mass flow of methane in the residual gas in the minute m (kg) (**$FCH_{4,RG,m}$**)
- Annual average ambient temperature at a weather station nearby project site. **$T_{region}$**

- Methane content in biogas $\mathbf{W_{CH4,\,y}}$
- Pressure of biogas at flow measurement site **P**
- Temperature of biogas at flow measurement site **T (26 Deg C)**
- Fraction of Manure handled in the digester. **MS% (100%)**
- Annual operational days of the digesters $\mathbf{n_{dy}}$
- Amount of organic manure disposed from the project boundary on a daily basis.$\mathbf{Q_{Organic\ \ manure}}$
- Volumetric component of component i in the residual gas in the hour h where I is $\mathbf{CH_{4\ fv\ i,h}}$

| No. | Parameter | Description | Unit | Monitoring/recording Frequency | Measurement Methods and Procedures |
|---|---|---|---|---|---|
| 1 | $Q_y$, | Quantity of solid waste | tonnes per year | Daily | On-site data sheets recorded monthly using weigh bridge. Weighbridge is subject to periodic calibration (in accordance with stipulation of the weighbridge supplier) |
| 2 | $w_{CH4,y}$ | Methane content in biogas in the year *y* | 60% | *Monthly* | As per the relevant procedure in AMS-III.H |
| 3 | *FE* | The flare efficiency | 10% | Yearly | As per the "Tool to determine project emissions from flaring gases containing Methane". Regular maintenance is carried out to ensure optimal operation of flares. O&M is available in the log sheets. |

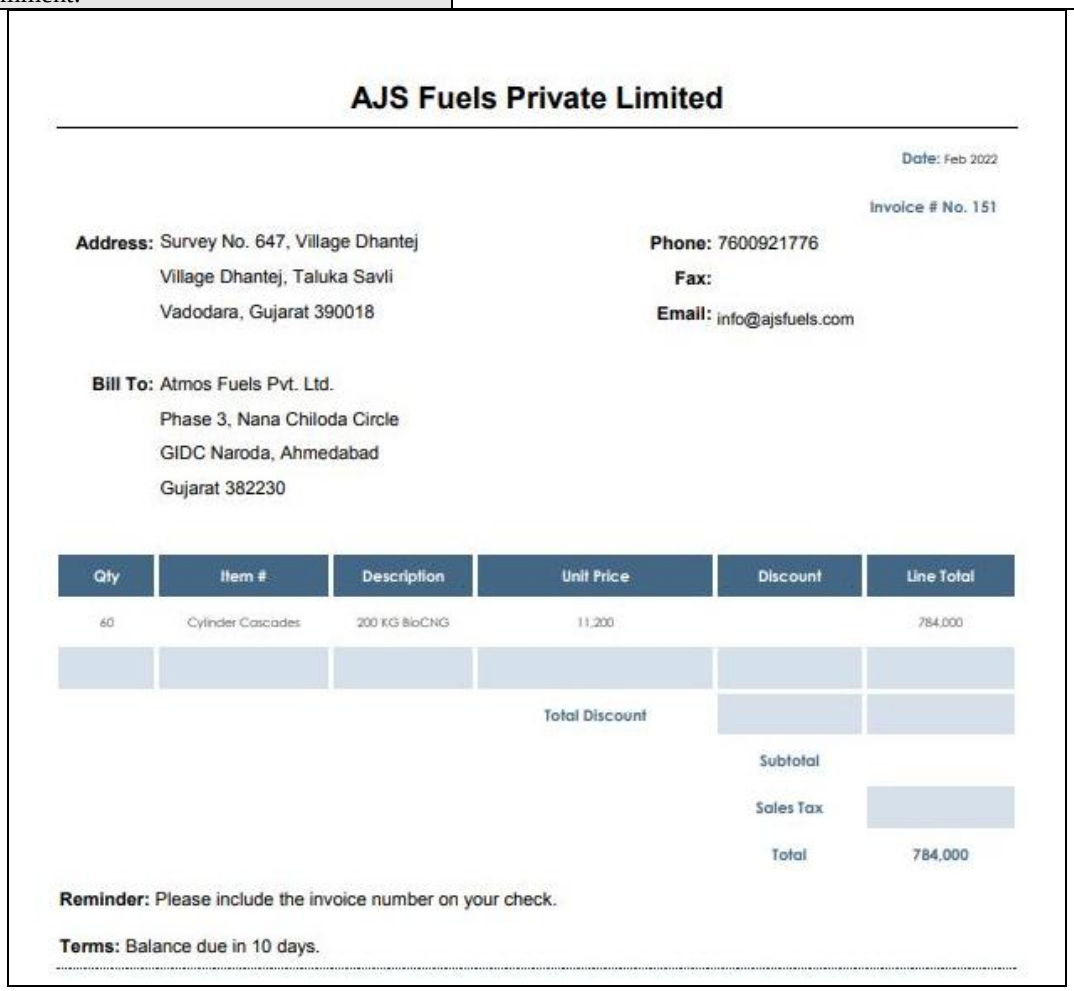
| Data/Parameter | Date of commissioning of biogas unit |
|---|---|
| Data unit | 2013 |
| Description | Actual date of commissioning of the project |
| Source of data<br>Value(s) applied | Monitoring Report<br>As and when commissioned |
| Measurement methods and procedures | The construction processes 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:** | **$w_{CH4,y}$** |
|---|---|
| Data unit: | 95.00% |
| 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: | 43.5 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:** | **$FS_{Bio\text{-}CNG,y}$** |
|---|---|
| Data unit: | QUANTITY PER cascade: 200 kg; Number of cascades per month: 60; Months: 12 |
| 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. Records for sold amount (e.g. invoices/receipts) and with the amount of biogas produced is kept on file. |
| Measurement procedures (if any): | Continuously or in batches |
| Monitoring frequency: | - |
| QA/QC procedures: | - |
| Any comment: | - |



**AJS Fuels Private Limited**

Date: Feb 2022

Invoice # No. 151

**Address:** Survey No. 647, Village Dhantej
Village Dhantej, Taluka Savli
Vadodara, Gujarat 390018

**Phone:** 7600921776
**Fax:**
**Email:** info@ajsfuels.com

**Bill To:** Atmos Fuels Pvt. Ltd.
Phase 3, Nana Chiloda Circle
GIDC Naroda, Ahmedabad
Gujarat 382230

| Qty | Item # | Description | Unit Price | Discount | Line Total |
|---|---|---|---|---|---|
| 60 | Cylinder Cascades | 200 KG BioCNG | 11,200 | | 784,000 |
| | | | | | |
| | | | Total Discount | | |
| | | | | Subtotal | |
| | | | | Sales Tax | |
| | | | | Total | 784,000 |

**Reminder:** Please include the invoice number on your check.

**Terms:** Balance due in 10 days.

**Sample of Bio CNG bottling invoice**

| Data / Parameter: | $fv_{i,h}$ |
|---|---|
| Data Unit | Fraction Description Volumetric component of component i in the residual gas in the hour h where I is $CH_4$ |
| Source of data | Continuous Gas Analyser - Applied an expected fraction of methane in biogas of 0.60 $m^3CH_4/m^3$ multiplied by the density of methane at normal conditions of 0.7168 $kg/m^3$. |
| Value(s) applied | 0.43 |
| Measurement methods and procedures | The same basis (dry or wet) is considered for this measurement and the measurement of the volumetric flow rate of the residual gas (FVRG,H) when the residual gas temperature exceed 60°C. |
| Monitoring frequency | Continuously. Values shall be averaged hourly. |
| QA/QC procedures | Analysers shall be periodically calibrated as per manufacturer's recommendation |
| Purpose of data | To ensure the applicability of Flare Efficiency of 90% |
| Additional comment | All gas volumes other than CH4 is considered as N2 for simplification |

| Data / Parameter | **T** |
|---|---|
| Data Unit | °C |
| Description | Temperature of biogas at flow measurement site |
| Source of data: | Monitored through thermometer |
| Value(s) applied | 38 °C<br>Measured regularly as per the technical guidance issued by the manufacturer for the installed equipment. Measurement methods and procedures . |
| Monitoring: | The temperature of the biogas will be monitored regularly and 12 measurements (one measurement per month) shall be taken each year. (As per Box 4 – Non-binding Best Practices in the methodology) |
| Data Type: | Temperature of the biogas is °C |
| Recording: | The data shall be recorded monthly. |
| Archiving Policy: | All the electronic and paper monitoring documents will be archived during the crediting period and two years thereafter. |
| Monitoring frequency | The value will be monitored regularly and 12 measurements (one measurement per month) shall be recorded. |
| QA/QC procedures | The parameter is monitored regularly and the measurements are logged in the log book. All measurement devices shall be procured from reputed manufacturers. The instruments used for monitoring are calibrated once a year. |
| Purpose of data | To calculate the baseline emissions |
| Additional comment | NA |

| Data / Parameter | **P** |
|---|---|
| Data Unit | Pa |
| Description | Pressure of biogas at flow measurement site |

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

| Year | 2022 (tonnes treated) |
|---|---|
| Cow Dung | 3,907 |
| Poultry Litter | 252 |
| Press Mud | 2,820 |
| Biomass | 678 |

| **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): | Poultry=0.02 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:** | **$N_y$** |
|---|---|
| Data unit: | Number of operational days in a year |
| Description: | Measured |
| Value(s) applied | 365 |
| 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: | -Baseline Emissions |