



VARANASI SMART CITY BIO- CONVERSION PROJECT



Document Prepared by EKI Energy Services

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1 PROJECT DETAILS

1.1 Summary Description of the Project

Varanasi Smart City Bio-Conversion Project (hereafter referred to as the project) is a Biogas recovery and utilization project, collects manure waste of dairy cow from surrounding livestock farms, as well as press-mud from nearby agricultural lands by building a centralized anaerobic waste treatment system and utilizes animal manure and press-mud as ferment material to produce biogas.

Gobardhan Varanasi Foundation SPV (hereafter referred to as the project proponent) has set up biogas plant in village Shahanshahpur of Varanasi district In Uttar Pradesh State of India. The project is expected to produce 90m³ biogas per day. The biogas produced is recovered and combusted in the auxiliary equipment of the project's anaerobic waste treatment system and the organic fertilizer plant. The residual waste from the CSTR digesters is used to produce organic fertilizer at the project site.

The scenario existing prior to the implementation of the project is the animal manure and press-mud waste was left to decay in anaerobic manure management system (uncovered open lagoon) at the livestock farms and methane is emitted to the atmosphere directly without any methane recovery and destruction facility. The baseline scenario is the same as the scenario existing prior to the implementation of the project activity

The project activity generates GHG emission reductions through recovery and destruction of biogas, that otherwise would be vented into the atmosphere directly thus produce financial, social and environmental benefits.

The expected total emission reduction of the Project in the first 7-year renewable crediting period (17-June-2022 to 16-June-2029) is 218,401 tCO₂e, and the annual emission reduction (17-June-2022 to 16-June-2023) is estimated to be 22,403 tCO₂e.

<u>Audit Type</u>	<u>Period</u>	<u>Program</u>	<u>VVB Name</u>	<u>Number of years</u>
Validation/ Verification	Under Development	<u>VCS</u>	<u>Under Development</u>	07 (twice renewable)

1.2 Sectoral Scope and Project Type

Sectoral Scope: 07 and 13

Project Type: Type III – Other Project Activities

Methodology for waste treatment:

AMS- III. AO, Methane recovery through controlled anaerobic digestion (Version 1.0)¹.

Methodology for CNG utilization:

AMS-III.AQ, Introduction of Bio-CNG in transportation applications Version 2².

It is not a grouped project.

1.3 Project Eligibility

The project is a biogas project, capturing Greenhouse Gases (GHGs), methane in particular, generated from animal manure and organic waste (press-mud), in anaerobic conditions and utilizing them via biogas generator units, for electricity generation, which is eligible under VCS standard 4.4.

1.4 Project Design

The project is not a grouped project, hence not applicable.

- ☒ The project includes a single location or installation only
- ☐ The project includes multiple locations or project activity instances, but is not being developed as a grouped project
- ☐ The project is a grouped project

Eligibility Criteria

The project is not a grouped project, hence not applicable.

1.5 Project Proponent

Organization name	Gobardhan Varanasi Foundation SPV
Contact person	Suman Kumar Roy
Title	Project Manager
Address	Gau Ashray Kendra, Shahansapur, Tehsil- Raja Talab, Varanasi, Uttar Pradesh- 221311
Telephone	suman@varanasismartcity.gov.in
Email	+91 9667498044

¹ https://cdm.unfccc.int/UserManagement/FileStorage/CDM_AMSU745LJQM81SDJJOJ2S4G7ID9EIKFGD

² <https://cdm.unfccc.int/methodologies/DB/TJV2WDEKTWSTLOX4KGZEMZVA7E25GC>

1.6 Other Entities Involved in the Project

Organization name	EKI Energy Services Limited
Role in the project	Project Consultant
Contact person	Krishan Kapil
Title	Senior Manager
Address	NRK Business Park, 903, B-1, 9 th floor, Scheme 54, PU4, Indore, Madhya Pradesh-452010
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Email	krishan.kapil@enkingint.org / registry@enkingint.org .

1.7 Ownership

The Project is owned by **Gobardhan Varanasi Foundation SPV**. The Project regulatory approval, and the business license of the project owner are evidence for legislative right. Besides, the contract of construction and the Bio-CNG sales contracts are the evidence for the ownership of the factory, equipment and productions.

1.8 Project Start Date

17-June-2022 (Start date is the date on which the Project begins to produce bio-CNG and the project began generating GHG emission reductions)

1.9 Project Crediting Period

The project adopts renewable crediting periods of 3*7 years.

The first crediting period is from 17-June-2022 to 16-June-2029 (the first and last days included)

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project	✓
Large project	

Year	Estimated GHG emission reductions or removals (tCO ₂ e)
17-June-2022 to 16-June -2023	23,430
17-June-2023 to 16-June -2024	27,750
17-June -2024 to 16-June -2025	30,645
17-June -2025 to 16-June -2026	32,586
17-June -2026 to 16-June -2027	33,887
17-June -2027 to 16-June -2028	34,759
17-June -2028 to 16-June -2029	35,344
Total estimated ERs	2,18,401
Total number of crediting years	7
Average annual ERs	36,400

1.11 Description of the Project Activity

As described in section 1.1., the scenario existing prior the project's implementation is the continuum of common practice for the livestock owners in the region to leave cattle manure generated at their farms to decay aerobically resulting in greenhouse gases generated from animal manure and organic waste (press-mud), methane in particular, were released directly into atmosphere.

Emissions associated with the baseline scenario are the CH₄ emissions due to the atmospheric release of methane sourced from animal manure and organic waste (press-mud) left to decay aerobically and CO₂ emissions due to the use of diesel/petrol in transport vehicle. Through the project's implementation, the methane previously released from animal manure and press-mud left to decay aerobically will be captured via anaerobic digestion and utilized to produce CNG.

The project was commissioned on 17-June-2022 and has been in operation since then. Animal waste from the cow farm (gaushala) was allowed to decompose anaerobically in open anaerobic lagoons prior to the project's activity. Methane was released into the atmosphere by this method of managing animal manure.

The project reduces greenhouse gas emissions by capturing the methane gas produced in the animal farm and by substituting/avoiding fossil fuels like diesel and petrol with green fuel

(biogas). None of the equipment installed within the project boundary exists in the baseline scenario, because the animal manure as well as organic waste (press-mud) is allowed to decompose in exposed anaerobic lagoons without any proper treatment.

Project Major Components

Sr. No.	Major Components	Capacity/Dimension
1	Plant Civil Works consisting of the Area Development-Slurry Tank, Fertilizer preparation area, feed stock storage, Office Building, Laboratory building, Farmer training and Dormitory facility, other utilities and internal roads, etc	Slurry Tank - 17 lakh liters Raw material storage area- 55mx 60m Fertilizer Preparation Area- 40mx30m
2	GFS Digester Tank	- Diameter: 32 meters - Height: 8.5 meters - Capacity: 67 lakh liter
3	Biogas Upgradation System Package (Gas refinery system)	400 m ³ /hr, (25mx 10m shed area)
4	Biogas Compression Facility	250 barg pressure output, 250 m ³ /hr air cooled 5 Stage Compressor
5	CBG Storage (Cascade)	4500 liters capacity- 4 nos
6	Biogas Holder System consisting of two Balloon system	Raw Gas Balloon – 2,050 m ³ Purified Gas Balloon – 750 m ³
7	Agitators for Feed tank and Digester's system	173 kw through 11 nos agitators
8	Weight Bridge Package Fertilizers	50 Ton for Feed inputs and finished
9	Pumps (Mixing, slurry Transfer pumps)	11 Kw, 40 m ³ /hr slurry pumps
10	LCV Filling post with Gas Metering	Filling stations with mass flow meters
11	Gas Odorization Unit	250 liters storage with up to 1000 sm ³ /hr of gas flow dosing
12	Gas Analyzer package	CH ₄ , H ₂ S, oxygen and gas moisture analyzer
13	Online Crusher (macerator)	40 m ³ /hr, gravity flow
14	Digester Heating System Package	130 kw heating system for up to 90 TPD of feed

15	Organic Manure production Unit (Including package, etc)-	14,000 kg/ day of handing capacity
16	Liquid Fertilizer Package (Slurry, Filter press)-	45,000 lit/day of capacity

1.12 Project Location

The project is located in the village Shahanshahpur of Varanasi district, Uttar Pradesh. The central coordinates of the location is 25 ° 11' 37.39" N and 82 ° 51' 22.39" E.



1.13 Conditions Prior to Project Initiation

Before the implementation of the project activity, animal manure and organic waste (press-mud) is left to decay anaerobically within the project boundary and methane is emitted to the atmosphere. The baseline scenario is the same as the scenario existing prior to the start of the implementation of the project activity. Please refer to Section 3.4 (Baseline Scenario) for details.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The Project has received necessary approvals for development and commissioning and is in compliance to the local laws and regulations. The relevant national laws and regulations pertaining to generation of energy in India are:

- Solid waste management Rules, 2016³

Generation of Bio CNG from waste is not a legal requirement or a mandatory option. There are state and sectoral policies, framed primarily to encourage Waste Management Project. These

³ https://cpcb.nic.in/uploads/MSW/SWM_2016.pdf

policies have also been drafted realizing the extent of risks involved in the projects and to attract private investments.

The current practice in India is disposal of solid waste without any treatment and processing. Hence the rules are systematically not enforced and the non-compliance with the recommendation is widespread in the country Solid waste management Rules, 2016.

1.15 Participation under Other GHG Programs

1.15.1 Projects Registered (or seeking registration) under Other GHG Program(s)

The project has not been registered or is seeking registration under any other GHG programs.

1.15.2 Projects Rejected by Other GHG Programs

The project has not been rejected by any other GHG programs.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

The project does not reduce GHG emissions from activities that are included in an emissions trading program or any other mechanism that includes GHG allowance trading.

1.16.2 Other Forms of Environmental Credit

The project has not sought or received another form of GHG-related credit or renewable energy certificates.

1.16.3 Supply Chain (Scope 3) Emissions

Not Applicable.

1.17 Sustainable Development Contributions

The project activity is contributing towards fulfilling 3 SDG goals:

SDG 13: Anaerobic digestion is a prominent technology for treatment of organic waste materials. Since commissioning of the project, it has avoided 30,349 tonnes of greenhouse gas emissions in the atmosphere. So, the project will contribute to the sustainable development.

SDG 8.5: The project is promoting local economic development and improving the level of people's life by proving potential job opportunities to the residents and it has employed XX number of people since commissioning and in this it is fulfilling

SDG 11.6.1: Composting is the process of producing aerobic compost through the decomposition of bio-degradable organic matter, Prior to the project activity, the solid waste collected was disposed in the existing solid waste disposal site which resulted in anaerobic decomposition of the waste leading to methane generation but the total quantity of raw waste is transported to the composting facility. So, it is also fulfilling and helping in the sustainable development.

Table 1: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	11.6.1	Proportion of solid waste collected and managed in controlled facilities out of total municipal waste generated, by cities	Implemented activities to increase	Total quantity of raw waste transported to the composting facility per annum is 27,920 tonnes/annum	Total quantity of raw waste transported to the composting facility per annum is 27,920 tonnes/annum
2)	8.5	Number of People Employed	Implemented activities to increase	The project has Employed 10 people since commissioning.	The project has Employed 10 people since commissioning.
3)	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to increase	The project has avoided emission of 22,403 tCO ₂ e in the atmosphere	The project has avoided emission of 22,403 tCO ₂ e in the atmosphere

1.18 Additional Information Relevant to the Project

Leakage Management

In accordance with the methodologies applied to the project, no leakage effects are accounted for.

Commercially Sensitive Information

No commercially sensitive information has been excluded from the public version of the project description.

2 SAFEGUARDS

2.1 No Net Harm

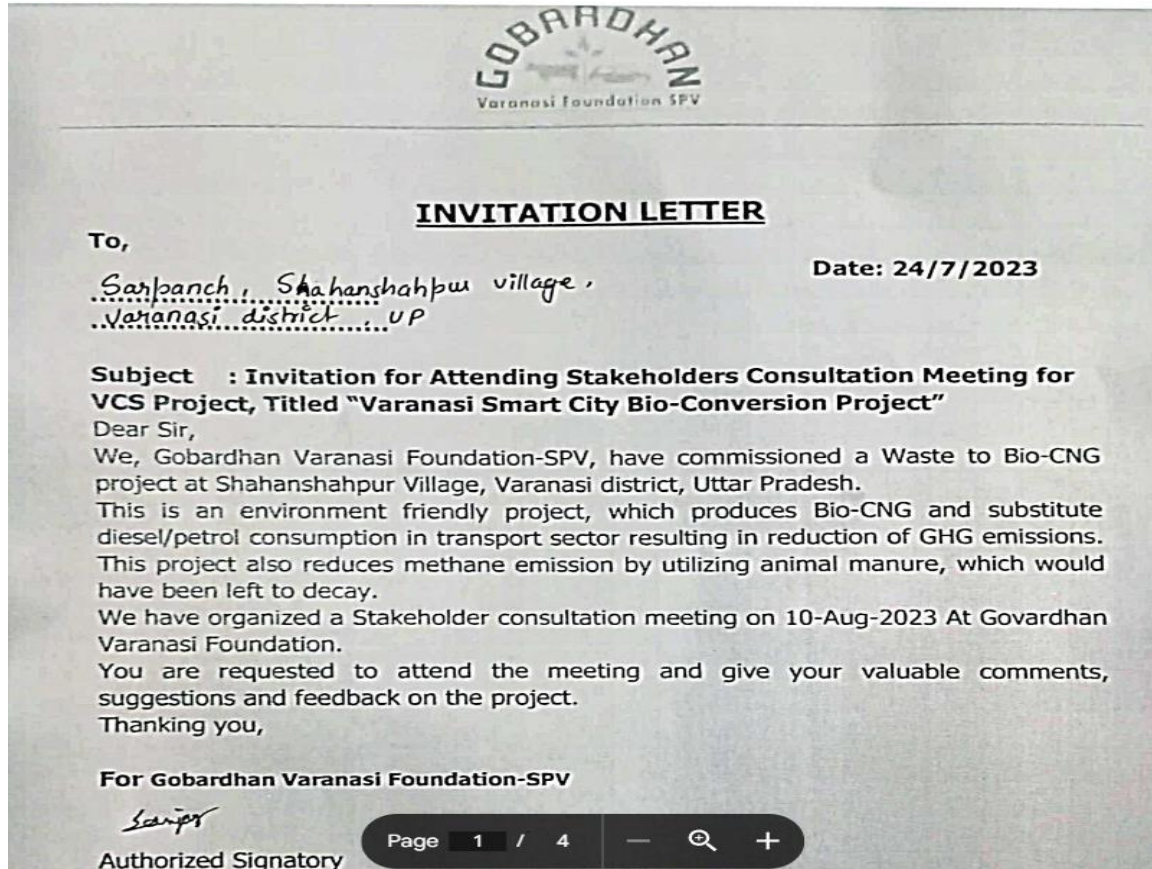
There is no harm identified from the project and hence no mitigations measures are applicable.

2.2 Local Stakeholder Consultation

The Local Stakeholder Meetings were organized at the project sites.

SPV Name	Plant	Invitation Notice Dates	LSHM Meetings Dates
Gobardhan Varanasi Foundation SPV	Varanasi Smart City Bio-Conversion Project	24-July-2023	10-August-2023

Since the local communities are the predominant stakeholders for the meeting, Hence the invitation letters were sent to Gram Pradhan & Govt officials. Minutes of Meeting of conducted LSC has been enclosed as Annexure 1 of this report.



Furthermore, Questionnaires were distributed to collect comments from local villages. The following questions were asked in the feedback by tick mark:

1. This project turns waste into useful product.
2. The project creates job to the local people.
3. The project do not harm to the environment.
4. This project reduce Methane and Carbon di Oxide emission to the atmosphere.
5. Due to this project income of local people has increased.
6. The project reduce dependency on diesel & petrol consumption in transport
10. The project contributes to the national clean mission.

11. The project helps in overall development of the society.

FEEDBACK FORM

VCC Project : Varanasi Smart City Bio-Conversion Project
Project Owner : Gobardhan Varanasi Foundation-SPV
Project Location : Shahanshahpur Village, Varanasi district, Uttar Pradesh

A. Please give your feedback by tick mark in the box.

Sl. No.	Description	Feedback	
1.	This project turns waste into useful product.	Yes ☒	No ☐
2.	The project creates job to the local people.	Yes ☒	No ☐
3.	The project do not harm environment.	Yes ☒	No ☐
4.	This project reduces Methane and Carbon di Oxide emission to the atmosphere.	Yes ☒	No ☐
5.	Due to this project income of local people has increased	Yes ☒	No ☐
6.	The project reduce dependency on diesel & petrol consumption in transport sector.	Yes ☒	No ☐
7.	The project contributes to the national clean mission.	Yes ☒	No ☐
8.	The project helps in overall development of the society.	Yes ☒	No ☐

B. Comments/Suggestions: Chemical free project

Submitted by:

Name: Mohit Singh

Place: Sihora

Date: 10-Aug-2023

All stakeholders interviewed are supportive to the implementation of the project, believing that the Project will help improve the community environment and promote local economic development.

All comments raised during local stakeholder consultation have been considered in the report and corresponding precaution measures and corrective actions (if any) have been proposed to ensure all issues during construction and operation of the project are properly addressed.



2.3 Environmental Impact

The approval by the Uttar Pradesh Pollution Control Board, clearly demonstrates that there is no environmental net harm linked to the project. The Uttar Pradesh Pollution Control Board is a statutory body tasked with carrying out environmental laws and regulations within the purview of the Indian state of Uttar Pradesh, India.

2.4 Public Comments

The project shall be listed for 30 days' period. In case any comments are received they shall be incorporated during the validation.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

The project uses the following approved baseline and monitoring methodology-

Methodology for waste treatment:

AMS-III.AO. Methane recovery through controlled anaerobic digestion (Ver 1.0)⁴.

Methodology for CNG utilization:

AMS-III.AQ, Introduction of Bio-CNG in transportation applications Version 2⁵.

The methodologies refer to following CDM tools:

- Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion⁸, Version 3.0, EB 96, Annex 4
- Emissions from solid waste disposal sites, Version 08.0, EB 94, Annex 7
- Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation⁹, Version 03.0, EB 96, Annex 5
- Project and leakage emissions from composting, Version 2.0, EB 96, Annex 6
- Demonstration of additionality of small-scale project activities – Version 13.1
- Project and leakage emissions from anaerobic digesters (Version 2.0)
- Combined tool to identify the baseline scenario and demonstrate additionality

3.2 Applicability of Methodology

AMS-III. A.O. – v1.0 is applicable to the methane recovery component of the project activities as following:

Applicability of AMS-III. A.O. – v1.0		
	Application Criteria	Applicability
The methodology is applicable under the following conditions:		
1.	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), or in an animal waste management system (AWMS), or in a wastewater treatment system (WWTS). In	The project activity avoids emissions of methane to the atmosphere from waste biomass (press mud and animal manure) that would have been left to decay anaerobically. In the proposed project activity, controlled biological treatment of animal manure is introduced through

⁴ https://cdm.unfccc.int/UserManagement/FileStorage/CDM_AMSU745LJQM81SDJJOJ2S4G7ID9EIKFGD

⁵ <https://cdm.unfccc.int/methodologies/DB/TJV2WDEKTWSTLOX4KGZEMZVA7E25GC>

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. The following conditions apply : (a) Digestion of biomass or other matter(excluding animal manure and sludge generated in the wastewater treatment works) as a single source of substrate is included; (b) 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; (c) If for one or more sources of substrates, it cannot be demonstrated that the organic matter would otherwise been left to decay anaerobically, baseline emissions related to such organic matter shall be accounted for as zero, whereas project emissions shall be calculated according to the procedures presented in this methodology for all co-digested substrates; (d) Project participants shall apply the procedures related to the “competing use for the biomass” according to the latest “General guidance on leakage in biomass project activities”; (e) Project activities treating animal manure as single source substrate shall apply AMS-III.D “Methane recovery in animal manure management systems”, similarly	anaerobic digestion equipped with biogas recovery system. Thus, the required conditions are as follows: a) Not applicable: There are more than one substrate for digestion; b) Applicable: It’s co-digestion of animal manure and press mud of sugarcane processing industry; c) Both the animal manure and press mud of sugarcane processing industry are demonstrated that in the absence of the project activity, the substrates would have been left to decay anaerobically and hence baseline emission have been taken. d) Cow manure and press mud will not lead to the competing use for the biomass. e) The project will treat more than one substrate, so AMS-III.D and AMS III.H is not applicable; f) The project does not include recovery or combustion of landfill gas; also it does not include activities pertaining to waste water treatment. Hence not applicable.
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	projects only treating wastewater and/or sludge generated in the wastewater treatment works shall apply AMS-III.H “Methane recovery in wastewater treatment”; (f) The project activity does not recover or combust landfill gas from the disposal site (unlike AMS-III.G “Landfill methane recovery”), and does not undertake controlled combustion of the waste that is not treated biologically in a first step (unlike AMS-III.E “Avoidance of methane production from decay of biomass through controlled combustion, gasification or mechanical/thermal treatment”). Project activities that recover biogas from wastewater treatment shall use methodology AMS-III.H.	
2.	Measures are limited to those that result in emission reductions of less than or equal to 60 kt CO ₂ equivalent annually.	The applicability of particular baseline scenarios using this methodology is limited to the measures with emission reduction less than 60 kt CO ₂ e annually
3.	The location and characteristics of the disposal site of the biomass used for digestion in the baseline condition shall be known, in such a way as to allow the estimation of its methane emissions. Guidelines in AMS-III.G, AMS-III.D, AMS-III.E (concerning stockpiles) and AMS-III.H (as the case may be) shall be followed in this regard. Project activities for co-digestion of animal manure shall also meet the requirements under paragraphs 1 and 2(c) of AMS-III.D. The following requirement shall be checked ex ante at the beginning of each crediting period: a) Establish that identified landfill(s)/stockpile(s) can be expected to accommodate the waste to be used for the project	Recovering biogas from manure follows Paragraph 1 and 2(c) of AMS-III.D, which are described in the animal manure management component. Recovering biogas from press mud follows Paragraph 1 and 2(c) of AMS-III.H, which are described in the waste water treatment component. The Project doesn’t involve the waste disposed in solid waste disposal site. Criteria (a) and (b) do not apply as the project activity does not use the solid waste disposal site.

	activity for the duration of the crediting period; or b) Establish that it is common practice in the region to dispose off the waste in solid waste disposal site (landfill/stockpile).	
4.	The project participants shall clearly define the geographical boundary of the region referred to in 3(b), and document it in the CDM-PDD. In defining the geographical boundary of the region, project participants should take into account the source of waste, i.e. if waste is transported up to 50 km, the region may cover a radius of 50 km around the project activity. In addition, it should also consider the distances to which the final product after digestion will be transported. In either case, the region should cover a reasonable radius around the project activity that can be justified with reference to the project circumstances but in no case it shall be more than 200 km. Once defined, the boundary should not be changed during the crediting period(s).	The project doesn't involve the waste disposed in solid waste disposal site
5.	In case residual waste from the digestion is handled aerobically and submitted to soil application, the proper conditions and procedures (not resulting in methane emissions) for storage and transportation and soil application must be ensured.	The residual from the bio-refinery is identified as bio-manure, which will be submitted for soil application. Therefore, the proper conditions and procedures for storage and transportation and soil application shall be ensured by PP such that it does not lead to any methane emissions.
6.	In case residual waste from the digestion is treated thermally/mechanically, the provisions in AMS-III.E related to thermal/mechanical treatment shall be applied	Not applicable, as the bio-residual is submitted to soil application
7.	In case residual waste from the digestion is stored under anaerobic conditions and/or delivered to a landfill, emissions from the residual waste shall to be taken into account and calculated as per the latest	Not applicable as the bio-residual shall be submitted to soil application. Hence the

	version of the .Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site.	residual waste shall not be stored under any anaerobic condition.
8.	In case the outflow from the digestion is discharged to a subsequent wastewater treatment system or to the natural water receiving body, relevant procedure in AMS-III.H shall be followed to estimate the resultant project emissions.	Not applicable as the bio-residual shall be submitted to soil application. Hence the residual waste shall not be stored under any anaerobic condition.
9.	Technical measures shall be used to ensure that all biogas captured from the digester is combusted/flared.	The recovered biogas in the Project will be upgraded and used as Bio-CNG for vehicles. There is no flaring involved.
10.	All the applications to utilize the recovered biogas detailed in paragraph 3 of AMS-III.H are eligible for use under this methodology. The relevant procedure in AMS-III.H shall be followed in this regard.	The recovered biogas in the Project will be upgraded and used as Bio-CNG for vehicles which cover under Paragraph 3(e) of AMSIII.H. As per paragraph 11of AMS-III.H, this component is calculated followed AMS-III.AQ.

AMS-III.AQ (Version 02) is applicable to the Bio-CNG transportation component of the project activity as following:

Applicability of AMS-III.AQ. – V 02		
	Application Criteria	Applicability
The methodology is applicable under the following conditions:		
1.	This methodology comprises activities for production of Biogenic Compressed Natural Gas (Bio-CNG) from biomass including biomass residues and cultivated biomass to be used in transportation applications. Biomass cultivated for production of the Bio-CNG should be sourced from dedicated plantations.	The Project will produce Bio-CNG from animal manure and biomass residues to be used in transportation applications. The organic matters used in the Project do not include crops.
2	The project activity involves installation and operation of Bio-CNG plant that includes: a) Anaerobic digester(s) to produce and recover biogas; b) (b) Biogas treatment system that includes processing, purification and compression of the biogas to obtain up-graded biogas such that methane content, its	The Project involves installation and operation of Bio-CNG plant that includes (a), (b) and (c)

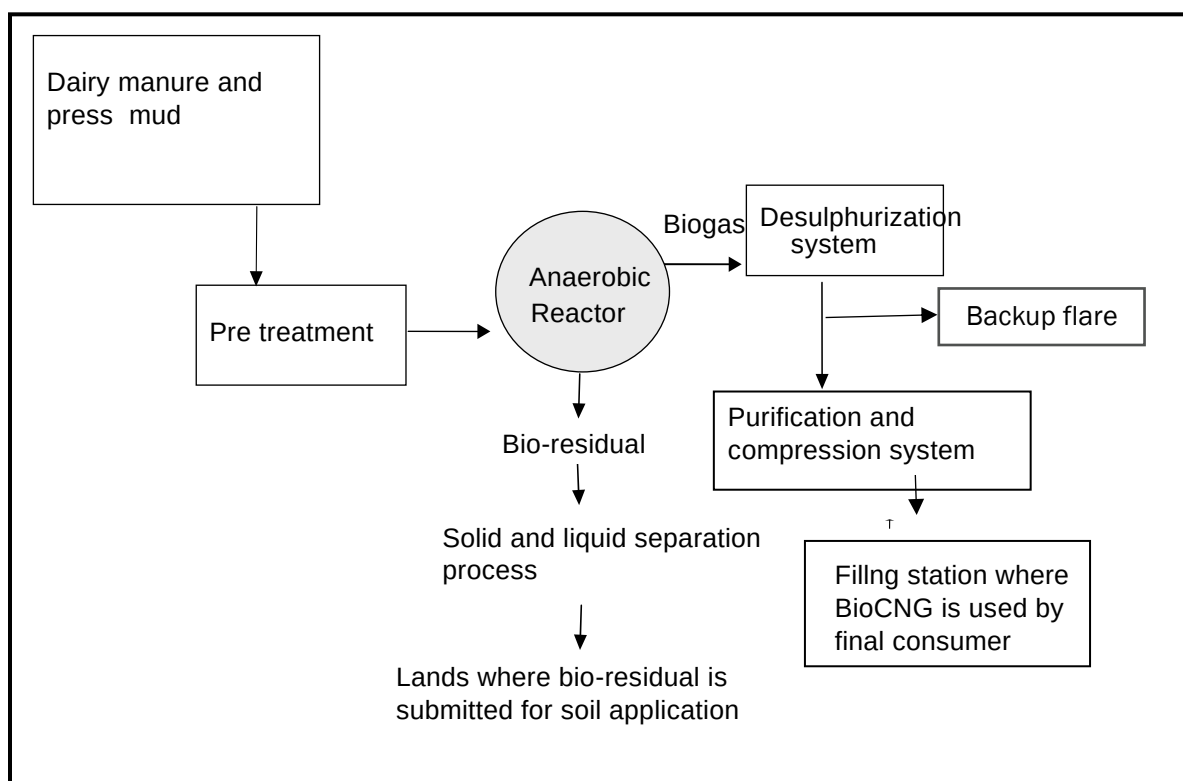
	quality and the physical and chemical properties are equivalent to the CNG; c) Filling stations, storage and transportation	
3	This methodology covers the use of Bio-CNG in various types of transportation applications such as Compressed Natural Gas (CNG) vehicles, modified vehicles. Examples include buses, trucks, three-wheeler, cars, jeeps, etc.	The Bio-CNG is used for CNG vehicles
4	If the part of the recovered biogas is injected into a natural gas distribution grid, emission reduction for that component of the project activity can be claimed following the provisions in annex 1 of “AMS-III.H: Methane recovery in wastewater treatment”	The Bio-CNG is used for CNG vehicles.
5	This methodology is applicable if the methane content of the upgraded biogas is in accordance with relevant national regulations and in their absence a minimum of 96 per cent (by volume).	The methane content in upgraded gas will be in line with applicable regulations in host country.
6	If the project activity utilizes biomass sourced from dedicated plantations, the applicability conditions prescribed in the methodological tool “project emissions from cultivation of biomass” shall apply.	There is no renewable biomass cultivated at dedicated plantations in the feedstock for production of Bio- CNG.
7	The retailers, final users (where applicable) and the producer of the Bio- CNG are bound by a contract that states that the final consumers and retailers shall not claim emission reductions resulting from its consumption. Only the producer of the Bio-CNG can claim emission reductions under this methodology.	Contract would be signed to ensure that the final consumers and retailers shall not claim emission reductions resulting from its consumption and only the producer of Bio-CNG, claims emission reductions
8	The export of Bio-CNG produced under this methodology is not allowed.	There is no export of Bio-CNG.
9	The digested residue waste leaving the reactor shall be handled aerobically and submitted to soil application, the proper procedures and conditions not resulting in the methane emissions shall be ensured; otherwise the emissions shall be taken into	The bio-residual will be used for soil application. The proper conditions and procedures for storage and transportation and soil application include: the bio-residual will be placed in the tank whose depth is less than 1m and immediately

	account as per relevant procedures of “AMSIII.AO: Methane recovery through controlled anaerobic digestion”.	transported to land by trucks.
4.	Measures are limited to those that result in emission reduction of less than or equal to 60 kt CO ₂ equivalent annually. Where applicable the sum of the emission reductions from all Type III components of a project activity should comply with 60 kt CO ₂ equivalent annually.	The emission reduction from the bio- CNG component is 6,002 tCO ₂ e; which is less than 60 kt CO ₂ e.

3.3 Project Boundary

The Project is to recover the biogas from the anaerobic treatment process and use them as vehicle fuel displacing fuel CNG.

The project boundary includes the anaerobic digesters in the poultry litter, two-stage anaerobic reactors, the Bio-CNG generation process places, lands where bio-residual is submitted for soil application, the Bio-CNG plant and the transportation of animal manure, and bio-residual as well as the transportation from the Bio-CNG plant to filling station.



The table below provides an overview of the emissions sources included or excluded from the project boundary for determination of baseline and project emissions

Source		Gas	Included?	Justification/Explanation
Baseline	Animal manure treatment process	CO ₂	No	Excluded for simplification. This is conservative.
		CH ₄	Yes	The major source of emissions in the baseline from uncovered anaerobic digester
		N ₂ O	Yes	Excluded for simplification. This is conservative.
	Diesel used for transport process	CO ₂	No	Excluded for simplification. This is conservative.
		CH ₄	Yes	The major source of emissions in the baseline from uncovered anaerobic digester
		N ₂ O	Yes	Excluded for simplification. This is conservative.
Project	Emissions from use of fossil fuels or electricity	CO ₂	Yes	Electricity consumption for operation of the equipment of the project is taken into account.
		CH ₄	No.	Excluded for simplification. This is conservative.
		N ₂ O	Yes	Excluded for simplification. This is conservative.
	Emissions from biogas and Bio-CNG processing, upgrading, purification, compression, storage and transportation	CO ₂	No	Excluded for simplification. This is conservative.
		CH ₄	Yes	Methane emissions from physical leakages of the upgrading and compression installation
		N ₂ O	No	Excluded for simplification. This emission source is assumed to be very small.

3.4 Baseline Scenario

AMS-III.AO. (Methane recovery through controlled anaerobic digestion)

The baseline scenario is the situation where, in the absence of the project activity, animal manure as well as press mud is left to decay anaerobically within the project boundary and methane is emitted to the atmosphere.

AMS-III.AQ (Introduction of Bio-CNG in transportation applications)

According to the methodology AMS-III.AQ, the baseline scenario is Case1: in the absence of the project activity, CNG from fossil origin would be used in transportation applications.

Therefore, the baseline scenario for the Project is that in the absence of the Project, the animal manures are left to decay within the project boundary and methane is emitted to the atmosphere; and CNG from fossil origin would be used in transportation applications.

3.5 Additionality

Additionality of the proposed project will be demonstrated in this section based on the requirement of Attachment A of the Appendix B of the Simplified Modalities and Procedures for Small-scale CDM Project Activities which lists various barriers, such as investment barrier, technological barrier, barrier due to prevailing practice, and other barriers. The main barrier identified by the project participants for the proposed project activity is investment barrier.

Investment Barrier Analysis

There are three analysis methods for the investment barrier analysis namely simple cost analysis (Option I), investment comparison analysis (Option II) and benchmark analysis (Option III). The analysis will be conducted through benchmark analysis or investment comparison analysis.

Simple cost analysis, does not apply as the project generates economic returns through the sales of bio-CNG. Investment comparison analysis (Option II) is selected for the additionality demonstration of the Project.

NPV (Net Present Value) analysis is used for demonstrating the additionality of the project. If the NPV (Net Present Value) of the project is lower than “0”, the project is not an economically attractive.

Discount rate for the project is applied as **9.77%** which is the default Value for India as per **Tool 27: Investment analysis Version 12.0**⁶. The project NPV was calculated as -112.26 Million INR. The detail financial parameter is shown below

Basic parameters for calculation of financial indicators

Annual Revenue		
Amount of Bio-CNG Produced (TPA)	1095	Detailed Project Report (DPR)
Selling rate for Bio-CNG (Rs/kg)	67.00	Bio-CNG Sale Agreement
Annual Revenue (INR MN)	73.37	Calculated
Annual Operation Cost		
Cow dung requirement (TPD)	90	Detailed Project Report (DPR)
Annual Cow dung Requirement (TPA)	32850	Calculated
Cow Dung Purchase Price (Rs/kg)	1	Detailed Project Report (DPR)
Annual Cow Dung Expense (INR MN)	32.85	Calculated
Press Mud requirement (TPD)	30	Detailed Project Report (DPR)
Annual Press Mud Requirement (TPA)	10950	Calculated

⁶ <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-27-v12.pdf>

Press Mud Purchase Price (Rs/T)	2500	Detailed Project Report (DPR)
Annual Press mud Expense (INR MN)	27.38	Calculated
Daily Electricity requirement (KWh)	4518	Detailed Project Report (DPR)
Annual Electricity requirement (KWh)	1649070	Calculated
Power Tariff (Rs/Kwh)	7	
Annual Electricity Expense (INR MN)	11.54	Calculated
Annual Manpower Expenses	4.78	Calculated
No of Trip	80	Detailed Project Report (DPR)
KM Travelled per trip	10	Detailed Project Report (DPR)
Total KM	800	Calculated
Fuel Expenses (Rs/km)	18	Detailed Project Report (DPR)
Annual Transport Expense (INR MN)	5.26	Calculated
Annual Operation Expenses (INR MN)	81.80	

Net Present Value (NPV)	-112.26 Million INR
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Considering the uncertainties of the financial analysis, sensitivity analysis was conducted by altering the following variables (+10% & -10%) as follows;

1. Bio-CNG Produced (TPA)
2. O&M
3. Selling rate for Bio-CNG

The result of sensitivity analysis is shown in the table below.

Sensitivity Analysis	NPV		
Variation %	-10%	Normal	10%
Bio-CNG Produced (TPA)	-209.89	-112.26	-14.62
O&M	-3.40	-112.26	-221.11
Selling rate for Bio-CNG	-209.89	-112.26	-14.62

As a result of analysis, the result is lower than '0'. Therefore, Varanasi Smart City Bio-Conversion Project is regarded as an activity having significant investment barrier. Consequently, the project is not economically attractive

3.6 Methodology Deviations

No methodology deviation is applied in the project.

4 IMPLEMENTATION STATUS

4.1 Implementation Status of the Project Activity

The project was commissioned on 17-June-2022 & has been in continuous operation since then. Also, during this monitoring period, no events has occurred which may impact the GHG emission reductions or removals and monitoring. The technical specification of major installed equipment's are as follows:

Unit / Equipments	Dimensions / Capacity
GFS Digester Tank	67,00,000 liters
Slurry Tank	17,00,000 liters
Biogas Compression Facility	250 bar/g pressure output, 250 m ³ /hr air cooled at 5-stage Compressor
Biogas Upgradation System Package (Gas refinery system)	400 m ³ /hr
Biogas Holder System consisting of two Balloon system	Raw Gas Balloon – 2,050 m ³ Purified Gas Balloon – 750 m ³
Agitators for Feed tank and Digester's system	173 kw through 11 nos agitators
CBG Storage (Cascade)	4,500 liters capacity- 4 nos
Weight Bridge Unit	50 Ton for Feed inputs and Finished Fertilizers
Pumps (Mixing, slurry Transfer pumps)	11 Kw, 40 m ³ /hr slurry pumps
Gas Odorization Unit	250 litres storage with up to 1000 sm ³ /hr of gas flow dosing
Online Crusher (macerator)	40 m ³ /hr
Digester Heating System Unit	130 kw heating system for up to 90 TPD of feed
Organic Manure production Unit	14,000 kg / day
Liquid Fertilizer Unit	45,000 litres / day
LCV Filling post with Gas Metering	Filling stations with mass flow meters

5 ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

The equation for baseline emissions is:

$$BE_y = BE_{bio,y} + BE_{fuel,Bio-CNG,y}$$

Where

BE_y : Baseline emissions in year y (tCO₂e)

$BE_{bio,y}$: Baseline emissions from methane recovery component in year y (tCO₂e)

$BE_{fuel,Bio-CNG,y}$: Baseline emissions from Bio-CNG component in year y (tCO₂e)

The following section shows the process of calculation for $BE_{bio,y}$ and $BE_{fuel,Bio-CNG,y}$ separately.

Step 1.1. Baseline Emissions due to Methane Recovery Component ($BE_{bio,y}$)

According to the AMS-III.AO (Version 1.0), the baseline scenario for the proposed project activity is the case 1(b): Co-digestion of organic matters in closed reactors equipped with biogas recovery and combustion/flared system. The baseline emissions are calculated as:

Equation (1)-

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

Where:

$BE_{bio,y}$ = Total baseline emissions from methane recovery component in year y (tCO₂e)

$BE_{swds,y}$ = Where applicable, yearly methane generation potential of the solid waste anaerobically digested by the project activity during the years “x” from the beginning of the project activity (x=1) up to the year y estimated as per “Emissions from solid waste disposal sites (Version 06.0.0)” (tCO₂e).

$BE_{ww,y}$ = Where applicable, baseline emissions from the wastewater co-digested, calculated as per the procedures of AMS-III.H. For simplification, baseline emissions of human faeces in the Project are considered to be zero.

$BE_{manure,y}$ = Where applicable, baseline emissions from the manure co-digested by the project activities, calculated as per the relevant procedures of AMS-III.D.

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). There is no biogas that would have to be captured and combusted to comply with the prevailing regulations in the baseline scenario, so this term is 0

GWP_{CH4} = GWP for CH₄ (value of 28 is used)

Therefore, the formula used to calculate baseline emissions is simplified to be:

$$BE_{bio,y} = BE_{manure,y}$$

According to paragraph 18 of AMS-III.D, the Calculation of emissions from animal manure is as follows:

Equation (1)-

$$BE_y = BE_{CH4} = GWP_{CH4} \times D_{CH4} \times UF_b \times \sum (MCF_j \times B_{0,LT} \times Q_{manure,jLT,y} \times SVS_{j,LT,y})$$

Where: **BE_y** = Baseline emissions in year y (tCO₂e)

GWP_{CH4} = Global Warming Potential (GWP) of CH₄ applicable to the crediting period (tCO₂e/t CH₄)

D_{CH4} = CH₄ density (0.00067 t/m³ at room temperature (20 °C) and 1 atm pressure)

LT = Index for all types of livestock

j = Index for animal manure management system

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

B₀ = Maximum methane producing potential of the volatile solid generated for animal type LT (m³ CH₄/kg-dm)

N_{LT} = Annual average number of animals of type LT in year y (numbers)

VS_{LT} = Volatile solids production/excretion per animal of livestock LT in year y (on a dry matter weight basis, kg-dm/animal/year)

MS%_{BL} = Fraction of manure handled in baseline animal manure management system j

UF_b = Model correction factor to account for model uncertainties (0.94)

Step 1.2 Baseline Emissions due to Bio-CNG Component (BE_{fuel,Bio-CNG,y})

According to paragraph 19 of AMS-III.AQ (Version 02.0), as the vehicles are not included in the project boundary, the baseline scenario of Bio-CNG component for the proposed project activity is that all Bio-CNG will displace CNG from fossil origin, calculated by:

Equation (1)-

$$BE_{fuel,o-CNG,y} = FS_{Bio-CNG,y} \times NCV_{Bio-CNG} \times EF_{CO2,CNG}$$

Where:

$BE_{fuel,o-CNG,y}$ = Total baseline emission from Bio-CNG component in year y (tCO₂e)

$FS_{Bio-CNG}$ = Amount of Bio-CNG distributed/sold directly to retailers, filling stations by the project activity in year y (tonnes)

$EF_{CO2,G}$ = CO₂ emission factor of CNG (tCO₂e/GJ), determined using reliable local or national data. IPCC default values (lower value of 95 per cent confidence interval (CI)) shall be used only when country or project specific data are not available or demonstrably difficult to obtain. Values shall be updated if national values or IPCC values changes

$NCV_{Bio-CNG}$ = Net calorific value of Bio-CNG (GJ/tonne). If it is demonstrated that the methane content of the Bio-CNG is minimum 96 per cent by volume then NCV of CNG shall be used. For NCV of CNG, reliable local or national data shall the used. IPCC default values shall be used only when country or project specific data are not available or demonstrably difficult to obtain. Values shall be updated if national values or IPCC values change.

5.2 Project Emissions

The project emissions are calculated by:

$$PE_y = PE_{bio,y} + PE_{fuel,Bio-CNG,y}$$

Where,

PE_y : Project emissions in year y (tCO₂e)

$PE_{bio,y}$: Project emissions due to methane recovery in year y (tCO₂e)

$PE_{fuel,Bio-CNG,y}$: Project emissions due to Bio-CNG used for transportation in year y (tCO₂e)

Step 2.1. Project Emissions-methane recovery Component ($PE_{bio,y}$)

According to paragraph 13, AMS-III.AO (Version 1.0), $PE_{bio,y}$ is calculated by:

Equation (2)-

$$PE_{bio,y} = PE_{trans,y} + PE_{power,y} + PE_{res\ waste,y} + PE_{phy\ leakage,y} + PE_{flaring,y}$$

$PE_{bio,y}$ = Project emissions due to methane recovery in year y (tCO₂e)

$PE_{trans,y}$ = Emissions from incremental transportation in the year y (tCO₂e). According to paragraph 29 of AMS III. AQ. 'Transportation emissions for biomass and waste organic matter to the biogas production site and Bio-CNG to filling stations must be considered according to the "AMS-III.AK: Biodiesel production and use for transport applications" methodology for distances exceeding 200 km; otherwise, they can be ignored.' Since the transportation distance from the

source point of raw material to the biogas production site is less than 200km. so this term is zero.

PE_{power,y} = Emissions from electricity or fossil fuel consumption in the year y (tCO₂e)

PE_{res waste,y} = In case residual wastes are subjected to anaerobic storage, or disposed in a landfill: methane emissions from storage/disposal/treatment of waste (tCO₂e), the residual wastes are not subjected to anaerobic storage, or disposed in a landfill, so this term value is 0.

PE_{phy leakage,y} = Methane emissions from physical leakages of the anaerobic digester in year y (tCO₂e). Any potential leakage from the digester unit is nil as the project plant is designed based on a close loop without flaring. Hence, this term value is 0.

PE_{flaring, y} = Methane emissions due to incomplete flaring in year y (tCO₂e). Since flaring is not taken into account in this project activity, hence this term value is 0.

Thus, **PE_{bio,y}** = **PE_{power,y}**; where Emissions from electricity shall only be considered when captive power produced by the solar PV plant is lesser than the total consumption of the plant for that particular period. Hence, only for the portion of the grid power, if consumed, shall be considered for PE.

Step 2.2. Project Emissions due to Bio-CNG used for transportation in year y (tCO₂e)

According to paragraph 25 of AMS-III.AQ (Version 02.0), this component of the project activity emissions can be calculated as:

Equation (6)-

$$\mathbf{PE_{fuel,o-CNG,y} = PE_{elec,y} + PE_{fuel,y} + PE_{transport,y} + PE_{cultivation,y} + PE_{CH4,y}}$$

Where,

PE_{elec,y}: Project emissions due to electricity consumption in year y (tCO₂e), this component is included in the PE_{power,y} of the biogas recovered calculation, so this term is zero.

PE_{fuel,y}: Project emissions due to fossil fuels consumption in year y (tCO₂e), as the same as PE_{elec,y}, this term has been calculated in PE_{power,y} of biogas recovered component, so this term is zero.

PE_{transport,y}: Project emissions from transportation of the renewable biomass from the places of their origin to the biogas production site and the processed biogas from the biogas processing facility to the filling stations in year y (tCO₂e), as per paragraph 29 of AMS-III.AQ, the transportation distance is less than 200km, so this term is zero.

PE_{cultivation,y}: Project emissions of N₂O from renewable biomass cultivation in year y (tCO₂e), the project does not include renewable biomass cultivation, so this term is zero.

PE_{CH₄,y} : Project emissions due to the physical leakage of methane from the systems affected by the project activity for production, processing, purification, compression; storage and filling of the Bio-CNG in year y (tCO₂e).

Therefore, the formula is simplified to be:

$$PE_{fuel,Bio-CNG,y} = PE_{CH_4,y}, \text{ and}$$

$$PE_{CH_4,y} = PE_{AD,y} + PE_{Bio-CNG,y} \dots\dots\dots \text{(Equation 7, paragraph 31, AMS.III AQ)}$$

Where, **PE_{AD,y}** : CH₄ leakage emissions from the anaerobic digesters in year y (tCO₂e), Since the project activity is in a closed-loop system, hence the value is zero.

PE_{Bio-CNG,y} : Project emissions of CH₄ from biogas and Bio-CNG processing, upgrading, purification, compression, storage and transportation (leaks and dissolved in wastewater) in year y (tCO₂e)

Therefore, project emissions due to Bio-CNG transportation is simplified to be:

$$PE_{fuel,Bio-CNG,y} = PE_{Bio-CNG,y}$$

And, according to paragraph 6, Equation (5) of AMS-III.H.,

$$PE_{Bio-CNG,y} = PE_{power,upgrade,y} + PE_{ww,upgrade,y} + PE_{CH_4,equip,y} + PE_{ventgas,y}$$

Where,

PE_{Bio-CNG,y} = Project emissions related to the upgrading and compression of the biogas in year y (tCO₂e).

PE_{power,upgrade,y} = CO₂ emissions from electricity and fuel used by the upgrading facilities (tCO₂e). Since this parameter has already been covered before as **PE_{power,y}** under AMS-III. AO. Hence, it is taken as 0.

PE_{ww,upgrade,y} = Emissions from methane contained in any waste water discharge of upgrading installation in year y (tCO₂e). Since, no wastewater discharge is involved in this project, hence it is accounted as 0.

PE_{CH₄,equip,y} = Emissions from compressor leaks in year y (tCO₂e)

PE_{ventgas,y} = Emissions from venting gases retained in upgrading equipment in year y (tCO₂e). Since, the vented gases are pumped to storage bags after refining, hence taken as 0.

$$\text{Thus, } PE_{fuel,Bio-CNG,y} = PE_{CH_4,equip,y}$$

And according to paragraph 8, equation (7) of AMS-III.H.

$$PE_{CH_4} = GWP_{CH_4} * 1/1000 * \sum \text{equipment } \omega_{ch_4,ream,y} * EF_{equipment} * T_{equipment,y}$$

Where,

$\omega_{CH_4,stream,y}$: Average methane weight fraction of the gas (kg-CH₄/kg) in year y, according to the DPR, the methane content by volume is 96% after upgrading. Therefore, average methane weight fraction of the gas is calculated as 0.5299kg- CH₄/kg. (using standard value for air density)

$EF_{equipment}$: Leakage rate for fugitive emissions from the compression technology as per specification from the compressor manufacturer in kg/hour/compressor. If no default value from the technology provider is available, the approach published by EPA shall be used. The approach published by EPA is used, the value is calculated to be 0.00192, and the detail is shown in the ER calculation spreadsheet.

$T_{equipment,y}$: Operation time of the equipment in hours in year y (in absence of detailed information, it can be assumed that the equipment is used continuously, as a conservative approach), conservative approach is chosen to calculate the operation time of the equipment in hours in year y, that is 350*24=8400.

5.3 Leakage

The equipment(s) for the Project activity are not transferred from another facility and the existing equipment will not be transferred to another activity, thus leakage effects are not considered as per the applied methodology, AMS-III.AQ and AMS-III.A.O.

Therefore, $LE_y=0$

5.4 Estimated Net GHG Emission Reductions and Removals

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y$$

$$ER_y = 231,297 - 12,896 - 0$$

$$\text{Hence, } ER_y = 218,401 \text{ tCO}_2\text{e/yr}$$

Year	Estimated baseline emissions or removals (tCO ₂ e)	Estimated project emissions or removals (tCO ₂ e)	Estimated leakage emissions (tCO ₂ e)	Estimated net GHG emission reductions or removals (tCO ₂ e)
17-June-2022 to 16- June - 2023	25,273	1,842	0	23,430
17-June -2023 to 16- June - 2024	29,592	1,842	0	27,750

17-June -2024 to 16- June - 2025	32,487	1,842	0	30,645
17-June -2025 to 16- June - 2026	34,428	1,842	0	32,586
17-June -2026 to 16- June - 2027	35,729	1,842	0	33,887
17-June -2027 to 16- June - 2028	36,601	1,842	0	34,759
17-June -2028 to 16- June - 2029	37,186	1,842	0	35,344
Total estimated ERs	231,297	12,896	0	218,401

6 MONITORING

6.1 Data and Parameters Available at Validation.

Data / Parameter	D_{CH4}
Data unit	m ³ CH ₄ / m ³ CH ₄
Description	Density of methane at normal conditions
Source of data	CDM Tool 14, version 02.0
Value applied:	0.00067
Justification of choice of data or description of measurement methods and procedures applied	Data considered from the tool 'Thermophysical properties of fluids. II. Methane, Ethane, Propane, Isobutane and Normal Butane' by B.A. Younglove, J.F. Ely

Purpose of Data	Calculation of project emissions
Comments	-

Data / Parameter	GWP_{CH4}
Data unit	tCO ₂ e/t _{CH4}
Description	Global Warming Potential for CH ₄
Source of data	IPCC Fifth Assessment Report, Chapter 8, Table 8.A.1 ⁷ (page 731)
Value applied:	28
Justification of choice of data or description of measurement methods and procedures applied	Global warming potential of methane valid for the relevant commitment period.
Purpose of Data	Used in • Calculation of baseline emissions • Calculation of project emissions
Comments	-

Data / Parameter	MCF_j
Data unit	%
Description	Methane correction factor for cow manure in baseline situation
Source of data	IPCC default value, Volume 4, Chapter 10.17, table 10.A-4
Value applied:	0.71
Justification of choice of data or description of	IPCC default value has been considered for the calculations.

⁷ https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_all_final.pdf

measurement methods and procedures applied	
Purpose of Data	IPCC default value has been considered for the calculations.
Comments	-

Data / Parameter	UF _b
Data unit	Fraction
Description	Model correction factor to account for model uncertainties
Source of data	IPCC default value, Volume 4, Chapter 10, table 10.A-4
Value applied:	0.94
Justification of choice of data or description of measurement methods and procedures applied	IPCC default value has been considered for the calculations.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	B _{0,LT}
Data unit	m ³ CH ₄ /kg-dm
Description	Maximum methane production potential of the volatile solid generated for the animal type (Cow)
Source of data	IPCC 2006 Guidelines, table 10.A-4, chapter 10, volume 4.
Value applied:	0.13
Justification of choice of data or description of measurement methods and procedures applied	IPCC default value.
Purpose of Data	Calculation of baseline emissions.

Comments	-
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Data / Parameter	EF _{CO₂,CNG}
Data unit	tCO ₂ e/GJ
Description	CO ₂ emission factor of CNG
Source of data	IPCC default value
Value applied:	0.0543
Justification of choice of data or description of measurement methods and procedures applied	IPCC default value has been considered
Purpose of Data	For the calculation of the Baseline Emission
Comments	-

Data / Parameter	EF _{equipment,y}
Data unit	kg/h/compressor
Description	Leakage rate for fugitive emissions from the compression technology
Source of data	N/A
Value applied:	0
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	For the calculation of the Project Emission
Comments	-

Data / Parameter	TDL _y
Data unit	%
Description	Average technical transmission and distribution losses for providing electricity in year y
Source of data	The default value in 'Tool to calculate baseline, project and or leakage emissions from electricity consumption' (Version 01)
Value applied:	20
Justification of choice of data or description of measurement methods and procedures applied	Default Value
Purpose of Data	For the calculation of the Project Emission
Comments	-

Data / Parameter	EF _{grid, OM, y}
Data unit	tCO ₂ /MWh
Description	Operating margin CO ₂ emission factor for NEWNE (Now Indian grid) grid
Source of data	Central Electricity Authority: CO₂ Emission Database CEA CO₂ Baseline database , Version 09.
Value applied:	0.9776
Justification of choice of data or description of measurement methods and procedures applied	The operating margin emission factor is a 3-year generation weighted average data, based on the most recent data available on CEA database. Data compiled in CEA CO ₂ CDM database is in line with the requirements Version 04.0.0 of "Tool to calculate the emission factor for an electricity system".
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$EF_{grid, BM, y}$
Data unit	tCO ₂ /MWh
Description	Build margin CO ₂ emission factor of grid
Source of data	Central Electricity Authority CO₂ Emission Database CEA CO₂ Baseline database , Version 09.
Value applied:	0.9673
Justification of choice of data or description of measurement methods and procedures applied	The build margin emission factor is the most recent data available from CEA CO ₂ Baseline database. Data compiled in CEA CO ₂ CDM database is in line with the requirements Version 04.0.0 of “Tool to calculate the emission factor for an electricity system”
Purpose of Data	Calculation of baseline emissions
Comments	The build Margin is calculated ex ante and fixed for the entire crediting period.

Data / Parameter	$EF_{grid, CM, y}$
Data unit	tCO ₂ /MWh
Description	Combined margin CO ₂ emission factor for grid
Source of data	Central Electricity Authority: CO₂ Emission Database CEA CO₂ Baseline database , Version 09.
Value applied:	0.9750
Justification of choice of data or description of measurement methods and procedures applied	The combined margin emissions factor is calculated as follows: $EF_{grid, CM, y} = EF_{grid, OM, y} * w_{OM} + EF_{grid, BM, y} * w_{BM}$ The following default values should be used for w_{OM} and w_{BM}: For Wind power generation project activities: $w_{OM} = 0.75$ and $w_{BM} = 0.25$ for the selected crediting period Data compiled in CEA CO₂ CDM database is in line with the requirements Version 04.0.0 of “Tool to calculate the emission factor for an electricity system”
Purpose of Data	Calculation of baseline emissions

Comments	The Combined Margin is calculated ex ante and fixed for the crediting period.
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Data / Parameter	NCV _{Bio-CNG}
Data unit	GJ/t
Description	Net calorific value of Bio-CNG
Source of data	IPCC default value
Value applied:	46.5
Justification of choice of data or description of measurement methods and procedures applied	IPCC default value is used. From IPCC Volume 2 Chapter 1 Table 1.2,
Purpose of Data	For the calculation of the Baseline Emission
Comments	-

6.2 Data and Parameters Monitored

Data / Parameter	Q _{cow,manure,y}
Data unit	T/year
Description	Weight of cow manure treated in baseline digester in year y
Source of data	Weighbridge
Description of measurement methods and procedures applied	Quantity of cow manure treated is measured using electronic weighbridge regularly and records are kept on paper and electronically
Frequency of monitoring/recording	Continuous with annual aggregation
Value applied:	To be considered on actual
Monitoring equipment	Weighbridge

QA/QC procedures applied	Regular weighing of waste by project proponent will be carried out in a weighbridge according to Monitoring plan. The weigh bridge would be calibrated annually
Purpose of data	Calculation of baseline emissions
Calculation method	The parameter is measured and if any calculation is required, the calculation is based on measured parameters
Comments	The data would be archived electronically and maintained for the entire crediting period plus two years.

Data / Parameter	$Q_{\text{pressmud,manure},y}$
Data unit	T/year
Description	Weight of pressmud treated in baseline digester in year y
Source of data	Weighbridge
Description of measurement methods and procedures applied	Quantity of press mud treated is measured using electronic weighbridge regularly and records are kept on paper and electronically
Frequency of monitoring/recording	Continuous with annual aggregation
Value applied:	To be considered on actual
Monitoring equipment	Weighbridge
QA/QC procedures applied	Regular weighing of waste by project proponent will be carried out in a weighbridge according to Monitoring plan. The weigh bridge would be calibrated annually
Purpose of data	Calculation of baseline emissions
Calculation method	The parameter is measured and if any calculation is required, the calculation is based on measured parameters
Comments	The data would be archived electronically and maintained for the entire crediting period plus two years.

Data / Parameter	$Q_{\text{blogas},y}$
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Data unit	Nm ³
Description	Amount of biogas collected at the digester outlet in year y
Source of data	Plant records, gas flow meter
Description of measurement methods and procedures applied	The value is measured using Calibrated Flow meter analyser
Frequency of monitoring/recording	Continuous measurement by the flow meter analyser. Data to be aggregated monthly and yearly
Value applied:	To be considered on actual
Monitoring equipment	Flow Meter Analyser
QA/QC procedures applied	The inbuilt flow meter analyser would be calibrated once in 3 years or as per manufacturer's specification, whichever is earlier
Purpose of data	Calculation of baseline emissions
Calculation method	The parameter is measured and if any calculation is required, the calculation is based on measured parameters.
Comments	-

Data / Parameter	EC_{PJJ,y}
Data unit	MWh
Description	Amount of electricity consumed from the grid as a result of the project activity
Source of data	Electricity meter reading from electricity meter bill by the State Electricity Board or any Private Supplier
Description of measurement methods and procedures applied	Data is measured and recorded continuously through meters and meter readings are archived electronically. The data will be calculated by monitoring the difference between the reading in meter at the end of the month and beginning of the month. This parameter will be updated ex-post each year over the crediting period.

Frequency of monitoring/recording	Monthly
Value applied:	To be considered on actual
Monitoring equipment	Electricity meter (Electricity Board Energy Meter)
QA/QC procedures applied	As the meters will be maintained by third party agency the accuracy of data is ensured. The meters are entirely under the control of State Electricity Board/DISCOM. The metering system will be calibrated according to CEA regulations which specifies Electricity meters to be calibrated once in 5 years. Calibration frequency: One in five years
Purpose of data	Calculation of Project emissions
Calculation method	The parameter is measured and if any calculation is required, the calculation is based on measured parameters
Comments	The data would be archived electronically and maintained for the entire crediting period plus two years.

6.3 Monitoring Plan

Monitoring is a key procedure to verify the real and measurable emission reductions from the proposed project. To guarantee the proposed project's real, measurable and long-term GHG emission reductions, the monitoring plan is established.

Monitoring Team will essentially encompass the following staff

- **Manager:** Engineer responsible for recording of the monitored parameters and the defined frequency
- **Executive:** Responsible for the data collection (monitoring) from various departments and compilation.
- **QA/QC officer:** Responsible to assure the quality control of the information and the GCC project documents.

Training

The training of the team will be carried out on monitoring of the data and record keeping through and planned schedule made in advance and a record of various training programmes undertaken will be kept for verification.

Monitoring Principles

The general monitoring principles to be followed will be based on

1. Frequency of data monitoring
2. Reliability of the measuring equipment in terms of calibration
3. Reporting of the data and parameters proposed to be monitored

Emergency Preparedness

Site Manager ensures that the project personnel acquire the skills to carry out emergency tasks properly through capacity building practices and trainings.

The whole staff receives health and safety trainings to minimize exposure to workplace hazards. At every shift, at least one trained technical personnel are present. All relevant information such as data files, maintenance, defect records and other monitoring related records are kept at a designated location in a transparent and organized manner.

In case of emergency situation, the responsible staff shall immediately report to site manager to take any action necessary.

7 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

7.1 Data and Parameters Monitored

Data / Parameter	$Q_{cow,manure,y}$
Data unit	T/year
Description	Weight of cow manure treated in baseline digester in year y
Value applied:	10,470
Comments	The data would be archived electronically and maintained for the entire crediting period plus two years.

Data / Parameter	$Q_{pressmud,manure,y}$
Data unit	T/year
Description	Weight of cow manure treated in baseline digester in year y

Value applied:	17,450
Comments	The data would be archived electronically and maintained for the entire crediting period plus two years.

Data / Parameter	EC _{PJJ,y}
Data unit	MWh
Description	Amount of electricity consumed from the grid as a result of the project activity
Value applied:	1,576.78
Comments	The data would be archived electronically and maintained for the entire crediting period plus two years.

Data / Parameter	Q _{Biogas,y}
Data unit	Nm ³
Description	Amount of biogas collected at the digester outlet in year
Value applied:	2,390
Comments	The data would be archived electronically and maintained for the entire crediting period plus two years.

7.2 Baseline Emissions

The equation for baseline emissions is:

$$BE_y = BE_{bio,y} + BE_{fuel,Bio-CNG,y}$$

Where

BE_y : Baseline emissions in year y (tCO₂e)

BE_{bio,y} : Baseline emissions from methane recovery component in year y (tCO₂e)

BE_{fuel,Bio-CNG,y} : Baseline emissions from Bio-CNG component in year y (tCO₂e)

For the present Monitoring period, using the default and monitored values

$$BE_y = BE_{bio,y} + BE_{fuel,Bio-CNG,y} = 18,162 + 6,002 = 24,165 \text{ tCO}_2/\text{yr.}$$

7.3 Project Emissions

$$PE_y = PE_{y,transp} + PE_{power} + PE_{pl}$$

PE_y = Project emissions in year y (tCO₂e)

PE_{PL} = Emissions due to physical leakage of biogas in year y (t CO₂e)

PE_{power} = Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year y (t CO₂e)

PE_{transp} = Emissions from incremental transportation in the year y (t CO₂e), as per relevant paragraph in AMS-III.AO

For the present Monitoring period, using the default and monitored values

$$PE_y = PE_{power} = 1,762 \text{ tCO}_2/\text{yr}$$

7.4 Leakage

There are no leakage emissions considered because the project activity simply distributes the fermented product to the farmers without storing it or composting it.

7.5 Net GHG Emission Reductions and Removals

The total emission reduction achieved in current monitoring period is

$$ER_y = BE_y - PE_y - LE_y$$

$$ER_y = 24,165 - 1,762 - 0 = 22,403 \text{ tCO}_2\text{e}$$

Hence, total emission reductions for the project activity in current monitoring period are **22,403 tCO₂**

Year	Estimated baseline emissions or removals (tCO ₂ e)	Estimated project emissions or removals (tCO ₂ e)	Estimated leakage emissions (tCO ₂ e)	Estimated net GHG emission reductions or removals (tCO ₂ e)
17-June-2022 to 31-March-2023	24,165	1,762	0	22,403
Total estimated ERs	24,165	1,762	0	22,403

The ER generated during the current monitoring period is less than the estimated values, which is conservative

APPENDIX 1: LSC MINUTES OF MEETING



Minutes of Meeting

STAKEHOLDERS CONSULTATION MEETING

VCS Project : Varanasi Smart City Bio-Conversion Project
Organizer : Gobardhan Varanasi Foundation-SPV
Project Location : Shahanshahpur Village, Varanasi district, Uttar Pradesh
Meeting Location : Gobardhan Varanasi Foundation-SPV, Training Room,
Shahanshahpur Village, Varanasi district, Uttar Pradesh

Date : 10-08-2023

Time : 11:30 am

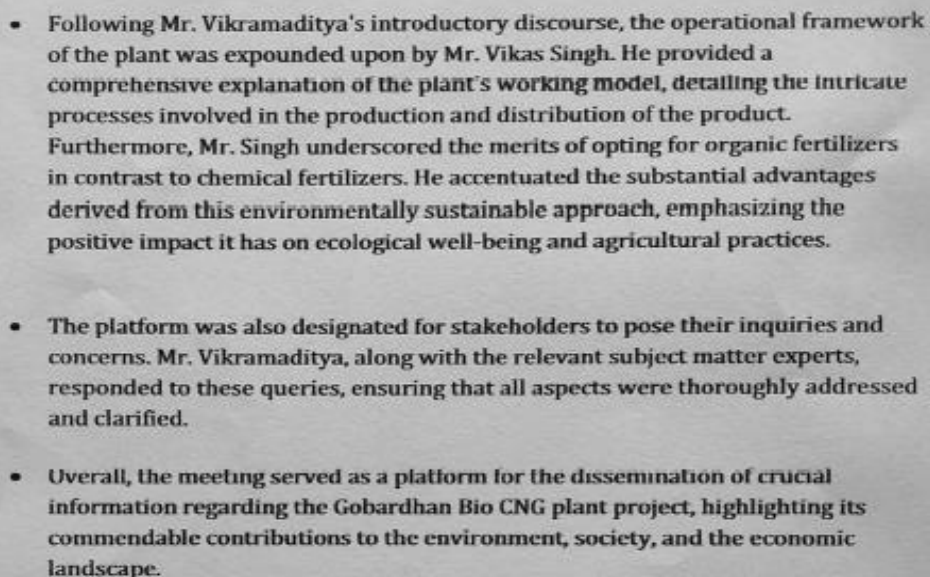
1. Attendees list : (list attached)

2. Discussion :

- The commencement of the meeting was initiated by representatives from Varanasi Smart City Ltd, who extended a warm welcome to the local stakeholders. The central focus of the discussion revolved around comprehensive insights into the Gobardhan Bio CNG plant project and its notable contributions to the realms of environment, society, and economics.
- On behalf of Gobardhan Varanasi Foundation SPV, Mr. Vikramaditya extending his greetings to the assembled stakeholders. Subsequently, he embarked on elucidating the establishment of the Gobardhan Bio CNG plant, accentuating its multifaceted socio-economic advantages, in tandem with the pivotal environmental benefits it offers. Stakeholders were briefed on the environmental benefits of a bio-CNG plant. The discussion covered waste-to-bio-CNG advantages. Environment benefits includes Reduced methane emissions from waste, cleaner-burning bio-CNG lowers carbon footprint and enhanced waste management and air quality, social aspects include job creation and economic growth and Healthier living environments for communities. Economic benefits are renewable energy source, reducing fossil fuel dependency. Revenue generation and cost savings from waste diversion.

Gobardhan Varanasi Foundation - SPV

Plant Office: Kanha Trinay Gaushala Village: Shahanshahpur, Ardalnagar-Kausha road Varanasi - 221305 Uttar Pradesh INDIA



At 1:30 PM, the meeting was formally adjourned, with the organizers expressing their gratitude to the stakeholders for their active and valuable participation throughout the proceedings.

