Verification Report for

Project : Bio-CNG Project AJS Fuels in Savli, Gujarat.

UCR Project ID : 167

Name of Verifier	SQAC Certification Pvt. Ltd.
Date of Issue	August 17, 2022
Project Proponent	M/s AJS Fuels Pvt. Ltd., Savli, Gujarat, India.
UCR Project Aggregator	Gram Vikas Trust
Work carried by	Mr. Santosh Nair & Mr. Suuhas Tendulkar
Work reviewed by	Mr. Praful Shinganapurkar

Summary:

SQAC Certification Pvt. Ltd. has performed verification of the "Bio-CNG Project AJS Fuels in Savli, Gujarat, India" which 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.

Verification for the period : **: 01/01/2014** to **31/12/2021**

The GHG emission reductions were calculated on the basis of UCR Protocols which draws reference from, UCR Protocol Standard Baseline, AMS-III.AQ.: Introduction of Bio-CNG in transportation applications, Version 2.0 & AMS III.AO.: Methane recovery through controlled anaerobic digestion, Version 1.0. Owing to the Covid pandemic, the verification was done remotely by way of video calls / verification, phone calls and submission of documents for verification through emails.

SQAC is able to certify that the emission reductions from Bio-CNG Project AJS Fuels in Savli, Gujarat, India, (UCR ID – 167) for the period **01/01/2014** to **31/12/2021** amounts to **1,82,692 CoUs** (1,82,692 tCO2eq)

<u>Detailed Verification Report</u>:

Purpose:

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 press mud (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. The project activity comprises of measures taken to avoid the emissions of methane to the atmosphere from **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 between the years 2014 and 2021.

The project activities also involve 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 involve 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:

Specification	Value
Total Installed Capacity	1000 m^3
Mixing Proportion	(Water: Waste) 1:1
Number of units (digesters)	1
Feed Material	Cattle Dung/Poultry Litter/Organic Waste
Biogas Flow rate	0.9 m^3 /hr
Calorific Value Biogas from digester	20 MJ/ m^3
Quantity of Organic Waste Treated	20 TPD
Bio CNG Calorific Value	52 MJ/kg
Bio CNG capacity (Daily)	350 kg
Air-Fuel Stoichiometric Ratio by volume	23.9 : 1
Density @ 1 ATM, 15 °C (kg/m^3)	0.79
Autoignition Temperature (°C)	630 - 810
Toxicity	Non toxic even at high concentration & low levels of oxygen
Concentration of methane in the biogas	0.43008kg CH_4/m^3 *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*

Location of project activity:

Latitude	: 22° 35' 38.2914" N
Longitude	: 73° 20' 46.392" E
Start Date of Crediting Period	: 01/01/2014
Project Commissioned	: 2013
Commissioning date of digester	: 29/11/2013

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.

Scope:

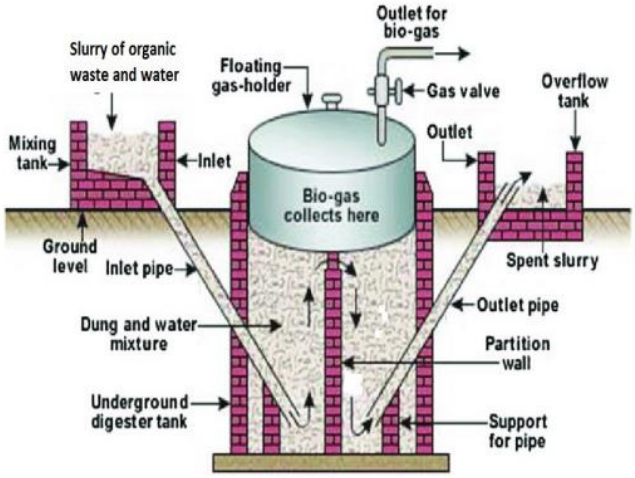
The scope covers verification of emission reductions from the project - Bio-CNG Project AJS Fuels in Savli, Gujarat (UCR ID – 167)

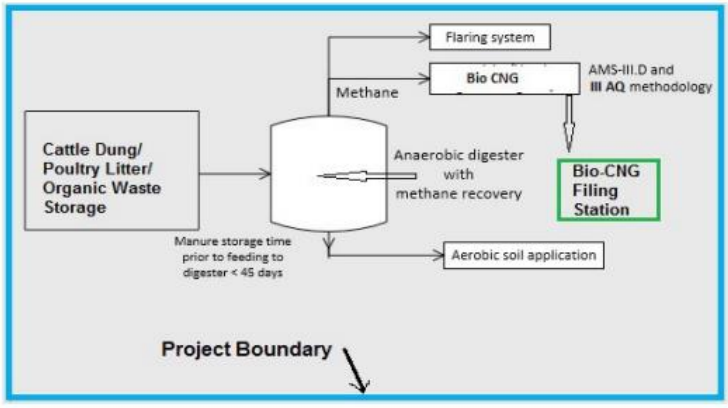
Criteria:
Verification criteria is as per the requirements of UCR Standard.

Description of project:

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 comprises 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).

The project activities also involve 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 involve the gainful use of the recovered methane for replacement of fossil CNG in vehicles. Daily 350 kgs of bottled Bio-CNG is generated from the project activity.





Digester Capacity	1000 m^3
Organic Waste Treated	20 TPD
• 10 tonnes per day (TPD) of cattle dung	
• 3 TPD of poultry litter	
• 7 TPD of organic agricultural waste	
Bio-CNG	350 Kgs/Day

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 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 press mud. 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

- 10 tonnes per day (TPD) of cattle dung,
- 3 TPD of poultry litter and
- 7 TPD of organic agricultural waste

(Total 20TPD) that would have otherwise been left to decay anaerobically outside the project boundary between the years 2014 and 2021.

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 Monitoring Period	01/01/2014
Carbon credits claimed up to	31/12/2021
Total ERs generated in this crediting period (tCO_{2eq})	1,82,692 tCO_{2eq}
Leakage	NA

The baseline scenario identified 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.

Level of Assurance:

The verification report is based on the information collected through interviews conducted over video calls / phone calls, supporting documents provided during the verification, Project Concept Note (PCN) / Monitoring Report (MR), submitted to SQAC. The verification opinion is assured provided the credibility of all the above.

Verification Methodology:

Review of the following documentation was done by SQAC Verifier, Mr. Santosh Nair & Mr. Suuhas Tendulkar, who are experienced in such projects.

- Project Concept Note (PCN)
- Monitoring Report (MR)
- Commissioning Report
- Calibration report
- Data provided upon request of all the documents of the related projects

Sampling:

Not applicable

Persons interviewed:

1. Mr. Amar Patel : M/s. AJS Fuels Pvt. Ltd.

Documentation Verified:

- Project Concept Note (PCN)
- Monitoring Report (MR)
- Calibration Reports
- Test Report – Gas Sample
- AJS Bio CNG invoices
- Commissioning Certificate
- Monthly records of quantity of cattle dung/ poultry litter/other biomass/ organic waste

Applied methodologies and standardized baselines :

UCR Protocol Standard Baseline

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

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, Ver 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.

Applicability of methodologies and standardized baselines

The project activity comprises measures to avoid the emissions of methane to the atmosphere from biomass or other organic matter that would have otherwise been left to decay anaerobically in a solid waste disposal site (SWDS). The project activity also involves installation and operation of Bio-CNG plant that includes: a) Anaerobic digester(s) to produce and recover biogas b) Biogas treatment system that includes processing, purification of the biogas to obtain up-graded biogas such that methane content, its quality and the physical and chemical properties are equivalent to the CNG c) Filling stations, storage and transportation.
Biogas produced by the 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 CO_2 equivalent annually.

Applicability of double counting emission reductions

The project is not registered with any other voluntary market (National or International). Agreement for Double Counting Avoidance from Proponent has been provided duly signed on 16/08/2022

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

Leakage Emissions under AMS III.AO is not applicable as the project technology is not transferred from another activity and neither is the existing equipment being transferred to another activity.

Leakage Emissions under AM III.AQ related to the substitution of Bio-CNG for CNG from fossil origin reduces indirect ("upstream") emissions associated with the production of fossil CNG and is treated as negative leakage, hence is not considered and is conservative in the approach to calculate baseline emissions.

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

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 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 (BEy1) are calculated by using the following option:

a) Using the amount of the waste or raw material that would decay anaerobically in the absence of the project activity, with the most recent IPCC Tier 2 approach (please refer to the chapter 'Emissions from Livestock and Manure Management' under the volume 'Agriculture, Forestry and other Land use' of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories). For this calculation, information about the characteristics of the manure and of the management systems in the baseline is required. Manure characteristics include the amount of volatile solids (VS) produced by the livestock and the maximum amount of methane that can be potentially produced from that manure (Bo).

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 shall be estimated using a default factor of 0.05 m^3 biogas leaked/m^3 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.

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)
$EF_{CO2,\ BIO\text{-}CNG}$	CO_2 emission factor of CNG (tCO_2e/GJ), determined using reliable local or national data (0.053 TCO_2/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)

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

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

BE_{y1} = Using the amount of manure that would decay anaerobically in the absence of the project activity based on direct measurement of the quantity of manure treated together with its specific volatile solids (VS) content

$N_{LT,y}$ = Average number of animals of type LT in a year

W_{site} = Avg. Wt. at Site (cattle/poultry) in kg

$W_{default}$ = Avg. Default Wt. of (Cow/Chicken) as per IPCC for India in kg

nd_y = Number of days in year y where the treatment was operational (Avg 330 days/yr)

$VS_{default\_cattle/poultry}$ = Volatile solids of livestock LT entering the animal manure management system in 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. $DCH_4 = CH_4$ 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 (m3 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

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.

$VS_{Default,\ poultry}$ 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

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 (NE_{ma}) has been found appropriate considering the default Values for Moderate Quality Forage taken from IPCC 2006, Ch. 10, Vol. 4, Table 10.8 Page 10.23. Based on the above value, at 50 to 60% feed digestibility levels, the Dry Matter Intake comes around 49 kg/day for a 295kg cattle head as per the equation (Equation 10.18a in IPCC 2006 chapter 10, volume 4, Page 10.22) as follows :

$DMI = BM0.75\ x[\{[(0.0119xNE_{ma}\ 2\ )+0.1938]\}/NE_{ma}]$ where:

DMI = Dry Matter Intake;

BM = Live Body Weight = Default Value of 275 Kg (as given in IPCC 2006 table 10.A.6, chapter 10, volume 4, Page 10.77 considered).

NE_{ma} = estimated dietary net energy concentration of diet (Default Values for Moderate Quality Forage taken from IPCC 2006, Ch. 10, Vol. 4, Table 10.8 Page 10.23 = 5.5 MJ kg^{-1}

$VS_{Default,\ Cow}$ is the value for the volatile solid excretion rate per day on a dry-matter basis for a defined livestock population (kg dm/animal/day) = 2.6

GWP_{CH4} = 21 is the default IPCC value of CH_4 applicable to the crediting period (tCO_2e/tCH_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 value of CH_4 applicable to the crediting period (tCO_2e/tCH_4)

$BEy = GWP_{CH4} \times D_{CH4} \times UF_b \times \sum MCF_j \times B_{0,LT} \times N_{LT,y} \times VS_{LT,y} \times MS_{\%Bl,j}$

$PEy = PE_{PL},y + PE_{flare},y + PE_{power} + PE_{transport},y + PE_{storage} + PE_{AD},y$

$$\sum_{x=1}^{y} (1 - e^{-k_j}) \cdot e^{-k_j (y-x)}$$

$$\varphi \cdot (1-f) \cdot (1-OX) \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \times GWP_{CH4}$$

BE $_{y1}$ = 4919 + 1571 = 6490

BE $_{y2}$ = 350 x 43.5 x 0.0543 x 330/1000 = 272

Year	2014	2015	2016	2017	2018	2019	2020	2021
BE $_{y3}$	5579	10215	14069	17271	19933	22145	23984	25512

PE $_{y}$ = 1257+6.93 = 1263.93 = 1264

Project Activity Emissions

Year	BE_{y1}	BE_{y2}	BE_{y3}	PE_{y}	ER (tCO_2)
2014	6490	272	5579	1264	11077
2015	6490	272	10215	1264	15713
2016	6490	272	14069	1264	19567
2017	6490	272	17271	1264	22769
2018	6490	272	19933	1264	25431
2019	6490	272	22145	1264	27643
2020	6490	272	23984	1264	29482
2021	6490	272	25512	1264	31010
				TOTAL	**1,82,692**

Issuance Period: 08 years, 00 months – 01/01/2014 to 31/12/2021

Annual Emission Reductions :

Year	Emission Reductions (tCO_{2eq})
2014	11077
2015	15713
2016	19567
2017	22769
2018	25431
2019	27643
2020	29482
2021	31010
Total	**1,82,692**

Conclusions:

Based on the audit conducted on the basis of UCR Protocol, which draws reference from UCR Protocol Standard Baseline, AMS-III.AQ.: Introduction of Bio-CNG in transportation applications, Version 2.0 & AMS III.AO. Methane recovery through controlled anaerobic digestion, Version 1.0, the documents submitted during the verification including the Data, Project Concept Note (PCN) / Monitoring Report (MR), SQAC is able to certify that the emission reductions from the project - Bio-CNG Project AJS Fuels in Savli, Gujarat (UCR ID – 167) for the period **01/01/2014 to 31/12/2021** amounts to **1,82,692 CoUs (1,82,692 tCO_2eq)**