Verification Report for

Project : Agriwaste Biogas Project at APMC in Vadodara, Gujarat

UCR Project ID : 001

Name of Verifier	SQAC Certification Pvt. Ltd.
Date of Issue	28/10/2021
Client	Gram Vikas Trust
Project Proponent	Ms. Nutan Pancholi
Work carried by	Mr. Suuhas Tendulkar & Ms. Sheetal Wader
Work reviewed by	Mr. Santosh Nair

Summary:
SQAC Certification Pvt. Ltd. has performed verification on the replacement of Non-Renewable Biomass with biogas for serving the captive electricity and energy needs at the facility using agricultural waste at the facility.

Verification for the period 1st January 2014 till 31st December 2020.

In our opinion, the total GHG emission reductions over the crediting / verification period stated in the Project Concept Note (PCN) / Monitoring Report (MR), submitted to SQAC are deviating by approximately 14%.

The GHG emission reductions were calculated on the basis of UCR Protocols which draws reference from, UCR Protocol Standard Baseline, AMS.I.C. Thermal energy production with or without electricity and AMS-III.AO Methane recovery through controlled anaerobic digestion. 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 the Agriwaste Biogas Project at APMC in Vadodara, Gujarat for the period 1st January 2014 till 31st December 2020 amount to 59,858 CoUs (59,858 tCO2eq/yr)

Detailed Verification Report:

Purpose:
The client has set up 3 independent biogas plants (digesters) of 85m3 capacity each for serving the captive electricity and energy needs at the facility using agricultural waste at the APMC in Vadodara facility.
By using the biogas captured from the digesters the project activity generates power for captive use. The project activity is the controlled biological treatment of biomass or other organic matters through anaerobic digestion in closed reactors equipped with biogas recovery for electricity generation and a combustion/flaring system.

The objectives of this verification are, by way of suitable evidences, to establish that:

1. The project has been commissioned as per the documented / video evidence
2. The details provided in the PCN are correct
3. The emission reductions from the project claimed are correct and in accordance with the requirements of the UCR Standard.

Scope:

The scope covers verification of emission reductions from the project - Agriwaste Biogas Project at APMC in Vadodara, Gujarat.

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

Description of project:
The project Agriwaste Biogas Project at APMC in Vadodara, Gujarat is located in near Ajwa Rd, NH-8, Nehru Chacha Nagar, Sayaji Park Society, City Vadodara, State Gujarat, India.

The purpose of the project activity is to set up 3 (three) independent biogas plants (digesters) of 85m3 capacity. In the absence of the project activity, biomass and other organic matter (including manure where applicable) would be left to decay within the project boundary and methane would be 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.

Further, by using the captured biogas for electricity generation for captive usage, the project activity avoids carbon emissions related to the baseline scenario in which electricity would be imported from the local coal fired dominated grid.

Commissioning dates of digesters (as per commissioning certificate):

Digester # 1 ($85m^3$)	Digester # 2 ($85m^3$)	Digester # 3 ($85m^3$)
18/01/2013	27/09/2017	27/09/2017

Total Biogas Units in the monitoring period: 3

The operational domestic biogas units are 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 340 days a year operation, the project activity was never non-operational for a period of 25 days or more during any year of the monitoring period, since this is the main wholesale market supplying fruits and vegetables to the city of Vadodara.

Total GHG emission reductions achieved or net anthropogenic GHG removals by sinks achieved in this monitoring period:

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

Summary of the Project Activity and ERs Generated for the Monitoring Period	
Start date of this Monitoring Period	01/01/2014
Carbon credits claimed up to	31/12/2020
Total ERs generated (tCO_{2eq})	59,858 tCO_{2eq}
Leakage	NA

The baseline scenario identified is:

- the situation where, in the absence of the project activity, biomass and other organic matter (including manure where applicable) are left to decay within the project boundary and methane is emitted to the atmosphere. The baseline emissions are the amount of methane emitted from the decay of the degradable organic carbon in the biomass and other organic matter.

- the fuel consumption of the technologies that would have been used in the absence of the project activity, times an emission factor for the fossil fuel displaced. Hence the baseline scenario is also electricity imported from a grid in the absence of the project activity.

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 above.

Verification Methodology:

Review of the following documentation was done by SQAC Team, Mr. Suuhas Tendulkar & Ms. Sheetal Wader, both of whom are experienced in such projects.

- Project Concept Note (PCN)
- Monitoring Report (MR)

- Commissioning Report of all Bio Digestors
- Data provided upon request of all the documents of the related projects

Sampling Method:
Since there are only 3 independent biogas plants (digesters) of 85m3 capacity each, the sampling size considered was 100%.

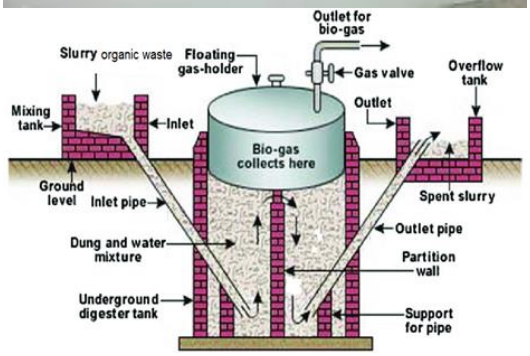
Applied methodologies and standardized baselines :
UCR Protocol Standard Baseline
AMS.I.C. Thermal energy production with or without electricity, and
AMS-III.AO Methane recovery through controlled anaerobic digestion.

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

Specification	Value
Capacity per unit	85 m^3
Mixing Proportion	(Water: Waste) 1:1
Number of units (digesters)	3
Feed Material	Agricultural /Food/Vegetable/Fruit Waste
Biogas Power Engine Capacity	12 kwh
Working Days	340
Calorific Value Biogas	20 MJ/m^3





Applicability of double counting emission reductions

Each of the biogas unit is constructed within the market facility. Each biogas unit has a unique ID, which is visible on the biogas unit. The project activity has not applied for carbon credits under any other GHG programs.

Project boundary, sources and greenhouse gases (GHGs)

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

- (a) All plants generating electricity and/or thermal energy located at the project site,
- (b) Industrial, commercial or residential facility, or facilities, consuming energy generated by the system and the processes or equipment affected by the project activity;
- (c) Where the treatment of biomass or other organic matters through anaerobic digestion takes place;

	Source	GHG	Included?	Justification/Explanation
Baseline	Emissions from biomass decay	CO_2	Included	Major source of emission
		CH_4	Included	Major source of emission
	Emissions from electricity generated using fossil fuels	N_2O	Excluded	Excluded for simplification. This is conservative
Project Activity	Emissions from on-site electricity use	CO_2	Excluded	Electricity is generated from collected biogas, hence these emissions are not accounted for. CO2 emissions from the decomposition of organic waste are not accounted
	Emissions from residue from anaerobic digester composting	CH_4	Excluded	Excluded for simplification. This is conservative
		N_2O	Excluded	Excluded for simplification. This is conservative

The project activity recovers and utilizes biogas for producing electricity and applies this methodology in addition to using a Type III component of a SSC methodology, hence any incremental emissions occurring due to the implementation of the project activity is neglected.

Establishment and description of baseline scenario (UCR Protocol)

The baseline scenario is the situation where, in the absence of the project activity, biomass and other organic matter are left to decay within the project boundary and methane is emitted to the atmosphere. The baseline emissions are the amount of methane emitted from the decay of the degradable organic carbon in the biomass and other organic matter. The yearly baseline emissions are the amount of methane that would have been emitted from the decay of the cumulative quantity of the waste diverted or removed from the disposal site, to date, by the project activity, calculated as the methane generation potential using the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site.” For renewable energy technologies that displace technologies using fossil fuels, the simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity, times an emission factor for the fossil fuel displaced. Hence the baseline scenario is also electricity is imported from a grid.

The project proponent was not bound to incur this investment as it was not mandatory by national and sectoral policies. Thus, the continued operation of the project activity would continue to replace fossil fuel derived grid electricity.

A "grid emission factor" refers to a CO2 emission factor (tCO2/MWh) which will be associated with each unit of electricity provided by an electricity system.

The UCR recommends an emission factor of 0.9 tCO2/MWh for the 2014-2020 years as a fairly conservative estimate for Indian projects not previously verified under any GHG program.

Estimated Annual Emission Reductions:

$BE_y = BE_{y1} + BE_{grid}$

BE_y = Total Baseline Emissions in a year.

$BE_{grid} = EG_{y,grid} \times EF_{y,grid}$

BE_{grid}	=	Baseline emissions for the grid electricity displaced by the project in year y (t CO2e)
$EG_{y,grid}$	=	Amount of grid electricity displaced by project in year y (MWh)
$EF_{y,grid}$	=	Emission factor of the grid (t CO2e/MWh) = 0.9 (UCR Standard)

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

BE_{y1}	=	Baseline emissions from biomass and other organic matter left to decay within the project boundary and methane is emitted to the atmosphere
$BE_{swds,y}$	=	Baseline emission determination of digested waste that would otherwise have been disposed in stockpiles shall follow relevant procedures in AMS-III.E. This is equal to the yearly methane generation potential of the SWDS at the year y, considering all the wastes deposited in it since its beginning of operation, and without considering any removal of wastes by the project activity.
$BE_{manure,y}$	=	Baseline emissions from the manure co-digested by the project activities = 0
$BE_{WW,y}$	=	Baseline emissions from the wastewater co-digested = 0
$MD_{reg,,y}$	=	Amount of methane that would have to be captured and combusted in the year y to comply with the prevailing regulations (tonne) = 0
GWP_{CH4}	=	21 is the default IPCC value of CH_4 applicable to the crediting period ($tCO_{2e}/t\ CH_4$)

In this case the project activity treats only freshly generated wastes, hence the baseline emissions at any year y during the crediting period is calculated using the amount and composition of wastes gasified since

the beginning of the project activity (2014 year "x=1") up to the year (2020) y, using the first order decay model as referred to in the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site".

Estimated total baseline emission reductions (BE_y) = 59,858 CoUs (59,858 tCO_{2eq})

Monitoring period number and duration

First Issuance Period: 7 years, 0 months – 01/01/2014 to 31/12/2020

		2017		
	2014-2016	01-09-2017	10-12-2017	**2018-2020**
	TPD	**TPD**	**TPD**	TPD
Quantity of Waste, T	2	2	6	6
No. of working days in a year	340	253	87	340
TPA	**680**	**1028**		**2040**

Rate of decay Part a $\sum_{x=1}^{y}(1-e^{-kj})e^{-kj(y-x)}$

Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**
0.426	0.354	0.294	0.245	0.203	0.169	0.140

Methane Potential

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

		Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**
1	***∑Part a* $W_{j,x}$***	290	530	730	1045	1737	2313	2791
2	1*DOCj	290	530	730	1045	1737	2313	2791
3	2*φ	261	477	657	940	1564	2082	2512
4	3*(1-f)	261	477	657	940	1564	2082	2512
5	4*(1-0X)	261	477	657	940	1564	2082	2512
6	5*16/12	348	636	876	1254	2085	2775	3349
7	6*F	174	318	438	627	1042	1388	1675
8	7*DOC_f	87	159	219	313	521	694	837
9	8*MCF	87	159	219	313	521	694	837
10	9*GWPCH4	1825	3341	4602	6583	10945	14571	17584

Total	**t CO2e**	1825	3341	4602	6583	10945	14571	17584

Year	2014	2015	2016	2017	2018	2019	2020
TOTAL Waste quantity (Tonnes)	680	680	680	1028	2040	2040	2040
Days/yr	340	340	340	340	340	340	340
% Food, agricultural waste	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
BE_{y1}*(tCo2)*	1825	3341	4602	6583	10945	14571	17584

Year	2014	2015	2016	2017	2018	2019	2020
Hours of power generation per day	10	10	10	10	24	24	24
MW/yr	40.8	40.8	40.8	40.8	97.92	97.92	97.92
BE_{grid} (tCo2)	36	36	36	36	88	88	88

Total baseline emission reductions (BE_y) = 59,858 tCO_{2eq} (59,858 CoUs)

Annual baseline emission reductions (BE_y)

Year	Emission Reductions (tCO_{2eq})
2014	1861
2015	3377
2016	4638
2017	6619
2018	11033
2019	14659
2020	17672
Total	**59,858**

Conclusions:

Based on the audit conducted on the basis of UCR Protocol, which draws reference from UCR Protocol Standard Baseline, AMS.I.C. Thermal energy production with or without electricity and AMS-III.AO Methane recovery through controlled anaerobic digestion, 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 - Agriwaste Biogas Project at APMC in Vadodara, Gujarat for the period 1st January 2014 till 31st December 2020 amounts to **59,858 CoUs (59,858 tCO2eq/yr)** .