



PROJECT CONCEPT NOTE

CARBON OFFSET UNIT (CoU) PROJECT



Title: Renewable Project at Sangli, Maharashtra

Version 1.0

Date 31/12/2022

First CoU Issuance Period: 9 years, 10 months

Date: 01/01/2013 to 31/10/2022



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

BASIC INFORMATION	
Title of the project activity	Renewable Project at Sangli, Maharashtra
Scale of the project activity	Small Scale
Completion date of the PCN	31/12/2022
Project participants	First Climate India Private Limited (AGGREGATOR) Sahyadri Starch and Industries Private Limited (DEVELOPER)
Host Party	India
Applied methodologies and standardized baselines	AMS-III.H: Methane Recovery in Wastewater Treatment AMS-I.F: Renewable electricity generation for captive use and mini-grid
Sectoral scopes	13 - Waste Handling and Disposal
Estimated amount of total GHG emission reductions	Average ex-ante estimate is 40,053 CoUs (40,053 tCO ₂ e/annum)

SECTION A. Description of project activity

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

The project “**Renewable Project at Sangli, Maharashtra**” is located in Plot No, A-6, 7, 8 & 9, Miraj MIDC, Dist- Sangli Tal, Miraj State- Maharashtra-416410, India.

The details of the registered project are as follows:

Purpose of the project activity:

The proposed project activity was commissioned by Sahyadri Starch and Industries Private Limited (henceforth referred to as SSIPL) in their industrial premises on 29th August 2012.

The project activity involves the installation of a 12000 m³/day biogas generation unit with a gas engine of capacity 1200 kW, set to extract and capture methane-enriched biogas generated from the treatment of effluent (wastewater) and to use the captured biogas for the generation of clean power.

The project activity is based on two complementary activities for the generation of electricity as follows:

- Firstly, anaerobic treatment of effluent (wastewater) in closed digester system and collection of methane-enriched biogas from the digester. This reduces methane emissions into the atmosphere that would have otherwise been emitted from the existing open lagoons.
- Secondly, combustion of captured methane enriched biogas in a gas engine to generate renewable electricity, thus converting its methane content into carbon dioxide thereby reducing its greenhouse effect.

All the generated electricity from the UCR project activity is for captive consumption.

The project activity is expected to generate an average of 9,590.4 MWh of clean energy annually. In absence of the project activity methane would have been emitted from the anaerobic treatment of the effluent in open lagoon and equivalent amount of electricity would have been sourced from grid. The annual average estimated emission reductions from both methane capture and generation of electricity from the captured biogas are 40,053 tCO₂.

Hence, the project activity would reduce total 40,053 t-CO₂e/annum greenhouse gas emissions (GHG) by avoiding methane emission from anaerobic treatment of effluent and power generation.

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

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

- **Social benefits:**
 - The project activity would help to alleviate poverty in the area as it creates employment opportunities for the local people during the construction, operation and maintenance phases.
- **Environmental benefits:**
 - The project activity will help in conservation of fast depleting natural resources like fossil fuels dominated grid power, thereby contributing to the economic well-being of country.
 - The project activity collects and combusts methane enriched biogas for electricity generation, thus converting CH₄ to CO₂, reducing its greenhouse gas effect by displacing a certain amount of fossil fuels used for equivalent amount of electricity generation.
- **Economic benefits:**
 - In this project activity, the electrical energy is generated by the biogas which replaces coal or firewood results in reduction in fuel expenses.
 - As the plant has its own biogas generation unit, hence the carbon emission due to transportation of fuel get reduced.
 - Knowledge and income of local installation and construction workers increases. Migration from rural to urban is reduced. Social pressure, caused by waste and environmental problems, is decreased.

PP would like to highlight some of the critical Sustainable Development Goal (SDGs) which are essentially associated with the project activity.



SDG 15

“Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage and reverse land degradation and halt biodiversity loss” Since the project essentially manages various types of wastes and also helps improving soil carbon in the agricultural fields, hence it has significant positive impact on ‘Life on Land’.



SDG 13

“Take urgent action to combat climate change and its impacts”. The project will reduce GHG emissions from different wastes through biogas digesters with methane capture and destruction. Additionally, renewable power generation for captive power demand and application of residual wastes (i.e.by-products) as bio-manure into the soil application further contributes to climate change mitigation actions.



SDG 9

“Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation” The project involves development of a new infrastructure facility in the form of bio-refinery and also will promote inclusiveness with the waste suppliers, farmers who will use the bio-manure etc. Additionally, CBG and its application will ensure sustainable industrialization and innovation into the sector.



SDG 3

“Target 3.9: Substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination”.

The project will essentially reduce impacts on the quality of the water and soil by means of recovery of animal manure and agri-wastes. Also, the displacement of fossil fuel (diesel) by means of CBG helps improving the air quality and avoidance of hazardous chemicals etc. Thus, the project has direct positive impact on human health in long run.



SDG 1

“Target 1.1: Strengthen financial conditions of local people to reduce risk of low-income vulnerability against the poverty line, according to national definitions”.

The project creates both direct and indirect jobs for local population in the project region which will strengthen the financial conditions of the local stakeholders.

A.3. Location of project activity >>

Country: India
District: Sangli
City: Miraj
State: Maharashtra
Code: 416410

The project site is well connected by district and village roads to the nearest town. The geographic coordinates of the project location are:

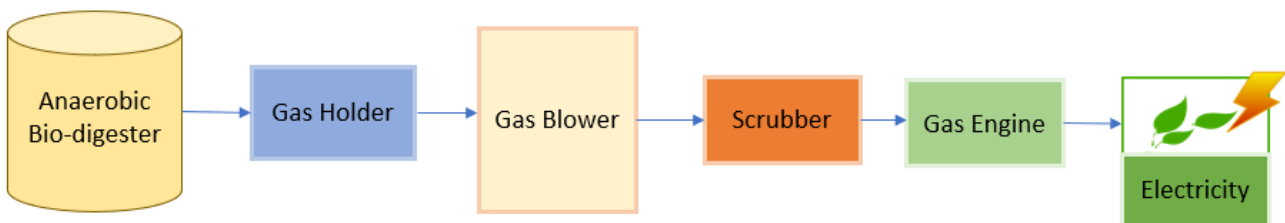
Latitude: 16.8521 N
Longitude: 74.6372 E

Map showing location of the project activity:



A.4. Technologies/measures >>

Process Flow:



The manufacturing process at SSIPL generates high COD effluent as a waste. To manage the wastewater, plant has installed anaerobic wastewater treatment system with biogas recovery. Generated biogas from the wastewater is used for electricity generation through gas engine and utilized within the plant boundary.

To operate the plant, proponent could have sourced electricity from the grid which is very common across the industrial sector. However, the plant has decided to operate on biogas generation system to capture or reduce the GHG emission caused by industrial waste and in- turn generate electricity.

Detail of the systems is as below:

- The anaerobic bio-digester (UASBR or Up-flow Anaerobic Sludge Blanket Reactor) operates in the mesophilic temperature range. Feed line has been well distributed at bottom across its bottom surface and well perforated for causing well contact with feed water and active sludge available within the reactor,
- Gas Liquid Separator (GLS) is fixed at the top of the UASBR. Therefore, gas and liquid are effectively separated and almost water-free biogas is taken to a gas holder passing through water seal, foam trap and lastly sedimentation trap,
- Biogas processing/cleaning equipment,
- Security flare
- Biogas power plant facility.

The UASBR will contain the organic rich effluent water in an anaerobic bio-digester to optimize the contact with anaerobic bacteria to convert the organic matter into biogas. The system processes the biogas, which involves a scrubber and a gas delivery unit (GDU) to remove hydrogen sulphide, moisture content and adjust the gas pressure before transport to the gas engines. The gas generation capacity is 12000 m3/day.



The biogas fired generators are gas engine with a re-packaged gas train for running on biogas coupled with a generator-set as required for delivery to the plant. The capacity of the power plant is 1200 kW, comprising of 1 X 1200kWe Bio-gas Genset (BGG). The average lifetime of the gensets based on manufacturers' specifications and industry standards is 15 to 20 years.

A.5. Parties and project participants >>

Party (Host)	Participants
India	First Climate (India) Pvt. Limited (AGGREGATOR)

	<p>Contact person: Partha P Chaudhuri Mobile: +91 9831012824 Address: 903 ERGO Tower, Plot No. A1-4, Block EP & GP, Sector V, Salt Lake, Kolkata 700 091</p> <p>Sahyadri Starch and Industries Pvt Ltd. (DEVELOPER) Address: Plot No. A-6, 7, 8 & 9, Miraj MIDC, Miraj, Dist: Sangli, Tal: Miraj (Maharashtra)-416410</p>
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A.6. Baseline Emissions>>

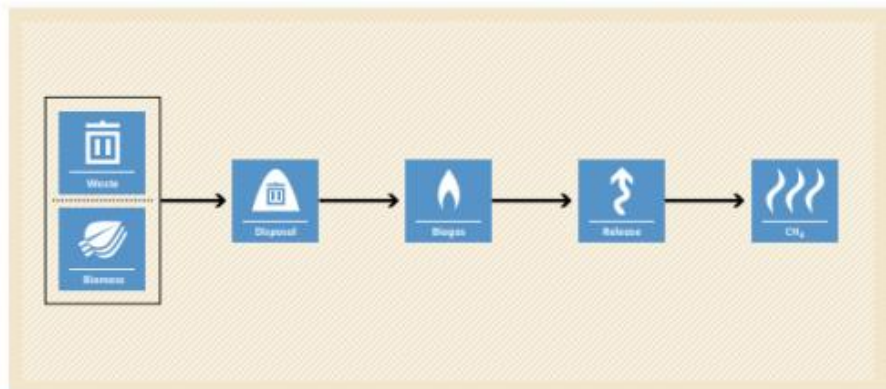
The baseline scenario identified at the PCN stage of the project activity are:

According to AMS-III.H version 19.0, the baseline scenario identified at the PCN stage of the project activity is anaerobic wastewater treatment system without biogas recovery, resulting in free release of methane into the atmosphere.

According to AMS-I.F, the project activity includes electricity generation from the renewable power plant for the captive user. And, hence the renewable power plant can be considered as the installation of new renewable power plant that supply the electricity for captive use, which displace the grid electricity consumption. Hence, the applicable baseline, as per the approved methodology AMS-I.F, the baseline of the project activity is grid electricity which would have otherwise been consumed in absence of the project activity.

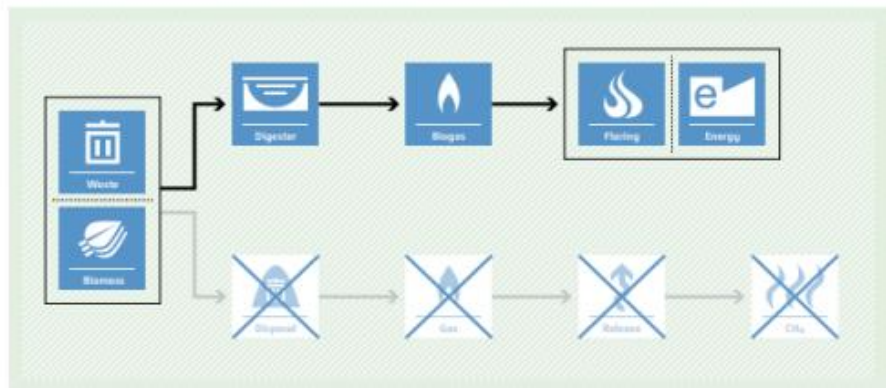
BASELINE SCENARIO

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



PROJECT SCENARIO

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



A.7. Debundling>>

This **Renewable Project at Sangli, Maharashtra** project is not a debundled component of a larger project activity.

SECTION B. Application of methodologies and standardized baselines

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

SECTORAL SCOPE – 13 Waste handling and disposal

TYPE - III: Other Project Activities

CATEGORY- AMS-III.H: Methane Recovery in Wastewater Treatment
AMS-I.F: Renewable electricity generation for captive use and mini-grid

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

The project will apply the UNFCCC approved methodology AMS-III.H Methane recovery in wastewater treatment, version 19.0.

This methodology refers to the following tools:

- Project emissions from flaring
- Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation
- Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion
- Emissions from solid waste disposal sites
- Positive list of technologies

Applicability of AMS – III.H.	Project Status
<p>This methodology comprises measures that recover biogas from biogenic organic matter in wastewater by means of one, or a combination, of the following options:</p> <ol style="list-style-type: none"> a) Substitution of aerobic wastewater or sludge treatment systems with anaerobic systems with biogas recovery and combustion; b) Introduction of anaerobic sludge treatment system with biogas recovery and combustion to a wastewater treatment plant without sludge treatment; c) Introduction of biogas recovery and combustion to a sludge treatment system; d) Introduction of biogas recovery and combustion to an anaerobic wastewater treatment system such as anaerobic reactor, lagoon, septic tank or an on-site industrial plant; e) Introduction of anaerobic wastewater treatment with biogas recovery and combustion, with or without anaerobic sludge treatment, to an untreated wastewater stream; f) Introduction of a sequential stage of wastewater treatment with biogas recovery and combustion, with or without sludge treatment, to an anaerobic wastewater treatment system without biogas recovery (e.g. introduction of treatment in an anaerobic reactor with 	<p>Applicable and Fulfilled</p> <p>The project activity involves the installation of covered lagoons and the capture and combustion of methane.</p> <p>The simplified baseline methodology is applicable to this project activity because without the project activity, methane from the existing anaerobic treatment system would continue to be emitted into the atmosphere. Sludge treatment remains as the pre-project situation with sludge disposition.</p> <p>The methodology applies “Introduction of a sequential stage of wastewater treatment with biogas recovery and combustion, with or without sludge treatment, to an anaerobic wastewater treatment system without biogas recovery (e.g. introduction of treatment in an anaerobic reactor with biogas recovery as a sequential treatment step for the wastewater that is presently being treated in an anaerobic lagoon without methane recovery)”</p>

<p>biogas recovery as a sequential treatment step for the wastewater that is presently being treated in an anaerobic lagoon without methane recovery).</p>	
<p>In cases where baseline system is anaerobic lagoon the methodology is applicable if:</p> <ul style="list-style-type: none"> (a) The lagoons are ponds with a depth greater than two meters, without aeration. The value for depth is obtained from engineering design documents, or through direct measurement, or by dividing the surface area by the total volume. If the lagoon filling level varies seasonally, the average of the highest and lowest levels may be taken; (b) Ambient temperature above 15⁰C, at least during part of the year, on a monthly average basis; (c) The minimum interval between two consecutive sludge removal events shall be 30 days. 	<p>Applicable and Fulfilled</p> <ul style="list-style-type: none"> a) Lagoon depth without aeration is greater than 2 meters. b) The project is located in Maharashtra province, Average temperatures exceed 15⁰C in every month. c) The minimum interval between sludge removal events was at intervals greater than 30 days.
<p>The recovered biogas from the above measures may also be utilised for the following applications instead of combustion/flaring:</p> <ul style="list-style-type: none"> a) Thermal or mechanical, electrical energy generation directly; b) Thermal or mechanical, electrical energy generation after bottling of upgraded biogas, in this case additional guidance provided in the appendix shall be followed; or c) Thermal or mechanical, electrical energy generation after upgrading and distribution, in this case additional guidance provided in the appendix shall be followed: <ul style="list-style-type: none"> i) Upgrading and injection of biogas into a natural gas distribution grid with no significant transmission constraints; ii) Upgrading and transportation of biogas via a dedicated piped network to a group of end users; or iii) Upgrading and transportation of biogas (e.g. by trucks) to distribution points for end users; d) Hydrogen production; e) Use as fuel in transportation applications after upgrading. 	<p>Applicable and Fulfilled</p> <p>The recovered biogas will be utilized for electrical energy generation in the drying system of the starch factory.</p>
<p>If the recovered biogas is used for project activities covered under paragraph 4(a), that component of the project activity can use a corresponding methodology under Type I.</p>	<p>Applicable and Fulfilled</p> <p>Biogas is used for electricity generation which will be used for captive consumption. Hence methodology AMS-I.F is applicable.</p>
<p>For project activities covered under paragraph 4(b), if bottles with upgraded biogas are sold outside the project boundary, the end-use of the biogas shall be ensured via a contract between the bottled biogas vendor and the end-user. No emission reductions may be claimed from the displacement of fuels from the end use of bottled biogas in</p>	<p>Not applicable.</p>

<p>such situations. If, however, the end use of the bottled biogas is included in the project boundary and is monitored during the crediting period CO₂ emissions avoided by the displacement of fossil fuel can be claimed under the corresponding Type I methodology, e.g. “AMS-I.C.: Thermal energy production with or without electricity”</p>	
<p>For project activities covered under paragraph 4(c)(i), emission reductions from the displacement of the use of natural gas are eligible under this methodology, provided the geographical extent of the natural gas distribution grid is within the host country boundaries.</p>	<p>Not applicable.</p>
<p>For project activities covered under paragraph 4(c)(ii), emission reductions for the displacement of the use of fuels can be claimed following the provision in the corresponding Type I methodology, e.g. AMS-I.C.</p>	<p>Not applicable.</p>
<p>In particular, for the case of paragraph 4(b) and (c)(iii), the physical leakage during storage and transportation of upgraded biogas, as well as the emissions from fossil fuel consumed by vehicles for transporting biogas shall be considered. Relevant procedures in paragraph 18 of the appendix of “AMS-III.H.: Methane recovery in wastewater treatment” shall be followed in this regard.</p>	<p>Not applicable. Biogas generated would be used for electricity generation in the plant premises. Hence, transportation of biogas is not applicable for this project activity.</p>
<p>For project activities covered under paragraph 4(b) and (c), this methodology is applicable if the upgraded methane content of the biogas is in accordance with relevant national regulations (where these exist) or, in the absence of national regulations, a minimum of 96 per cent (by volume).</p>	<p>Not applicable.</p>
<p>If the recovered is utilized for the production of hydrogen (project activities covered under paragraph 3(d)), that component of the project activity shall use the corresponding methodology “AMS-III.O.: Hydrogen production using methane extracted from biogas”.</p>	<p>Not applicable. The recovered is not utilized for the production of hydrogen. Hence, this is not applicable.</p>
<p>If the recovered biogas is used for project activities covered under paragraph 4(e), that component of the project activity shall use corresponding methodology “AMS-III.AQ.: Introduction of Bio-CNG in transportation applications”.</p>	<p>Not applicable. The project activity does not involve use of Bio-CNG in transportation application. Hence, it is not applicable for this project activity.</p>
<p>New facilities (Greenfield projects) and project activities involving a change of equipment resulting in a capacity addition of the wastewater or sludge treatment system compared to the designed capacity of the baseline treatment system are only eligible to apply this methodology if they comply with the relevant requirements in the “General guidelines for SSC CDM methodologies”. In addition, the requirements for demonstrating the remaining lifetime of the equipment replaced, as described in the general guidelines</p>	<p>Applicable and Fulfilled As the project involves installation of a new wastewater treatment system, it will comply with all relevant requirements in the “general guidelines for SSC CDM Methodologies”. Hence, this criterion is applicable.</p>

shall be followed.																									
The location of the wastewater treatment plant as well as the source generating the wastewater shall be uniquely defined and described in the PCN.	Applicable and Fulfilled The location of the project activity, including the wastewater treatment plant and the source generating the wastewater, is uniquely defined in the PCN.																								
Measures are limited to those that result in aggregate emissions reductions of less than or equal to 60 kt CO ₂ equivalent annually from all Type III components of the project activity.	Applicable and Fulfilled The estimated annual ERs are less than the 60,000 tCO ₂ limit for Type III components.																								
Applicability of AMS – I.F.	Project Status																								
This methodology is applicable for project activities that: (a) Install a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity (Greenfield plant); (b) Involve a capacity addition, (c) Involve a retrofit of (an) existing plant(s); or (d) Involve a replacement of (an) existing plant(s).	Applicable and Fulfilled The project is an installation of a biogas based genset to generate electricity by utilizing the biogas captured in the project activity.																								
Illustration of respective situations under which each of the methodology (“AMS-I.D.: Grid connected renewable electricity generation”, “AMS-I.F.: Renewable electricity generation for captive use and mini-grid” and “AMS-I.A.: Electricity generation by the user”) applies is included in Table 2 below:	Applicable and Fulfilled The installed project displaces the grid electricity consumption. Hence, AMS – I.F is applicable.																								
<table border="1"> <thead> <tr> <th>Project type</th> <th>AMS-I.A</th> <th>AMS-I.D</th> <th>AMS-I.F</th> </tr> </thead> <tbody> <tr> <td>1 Project supplies electricity to a national/regional grid</td> <td></td> <td>√</td> <td></td> </tr> <tr> <td>2 Project displaces grid electricity consumption (e.g. grid import) and/or captive fossil fuel electricity generation at the user end (excess electricity may be supplied to a grid)</td> <td></td> <td></td> <td>√</td> </tr> <tr> <td>3 Project supplies electricity to an identified consumer facility via national/regional grid (through a contractual arrangement such as wheeling)</td> <td></td> <td>√</td> <td></td> </tr> <tr> <td>4 Project supplies electricity to a mini grid⁵ system where in the baseline all generators use exclusively fuel oil and/or diesel fuel</td> <td></td> <td></td> <td>√</td> </tr> <tr> <td>5 Project supplies electricity to household users (included in the project boundary) located in off grid areas</td> <td>√</td> <td></td> <td></td> </tr> </tbody> </table>	Project type	AMS-I.A	AMS-I.D	AMS-I.F	1 Project supplies electricity to a national/regional grid		√		2 Project displaces grid electricity consumption (e.g. grid import) and/or captive fossil fuel electricity generation at the user end (excess electricity may be supplied to a grid)			√	3 Project supplies electricity to an identified consumer facility via national/regional grid (through a contractual arrangement such as wheeling)		√		4 Project supplies electricity to a mini grid ⁵ system where in the baseline all generators use exclusively fuel oil and/or diesel fuel			√	5 Project supplies electricity to household users (included in the project boundary) located in off grid areas	√			
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In the case of project activities that involve the capacity addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units.	Not Applicable Project activity is a Greenfield project. Hence, this criterion is not applicable.																								
In the case of retrofit or replacement, to qualify as a small-scale project, the total output of the retrofitted or replacement unit shall not exceed the limit of 15 MW.	Not Applicable Project does not involve retrofit or replacement of existing unit. Hence, this criterion is not applicable.																								

<p>If the unit added has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the unit added co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW.</p>	<p>Not Applicable This is a green field project.</p>
<p>Combined heat and power (co-generation) systems are not eligible under this category.</p>	<p>Not Applicable Project activity does not involves co-generation.</p>
<p>Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology: (a) The project activity is implemented in an existing reservoir with no change in the volume of reservoir; (b) The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the project emissions section, is greater than 4 W/m²; (c) The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the project emissions section, is greater than 4 W/m²</p>	<p>Not Applicable This is a biogas-based electricity generation system. Hence, this criterion is not applicable.</p>
<p>If electricity and/or steam/heat produced by the project activity is delivered to a third party, i.e. another facility or facilities within the project boundary, a contract between the supplier and consumer(s) of the energy will have to be entered that ensures that there is no double counting of emission reductions.</p>	<p>Not Applicable This a purely captive project and no electricity exported from the plant premises.</p>
<p>In the case the project activities utilizes biomass, the “TOOL16: Project and leakage emissions from biomass” shall be applied to determine the relevant project emissions from the cultivation of biomass and the utilization of biomass or biomass residues.</p>	<p>Not Applicable The project activity does not involve use of biomass or biomass residue.</p>

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

There is no double accounting of emission reductions in the project activity due to the following reasons:

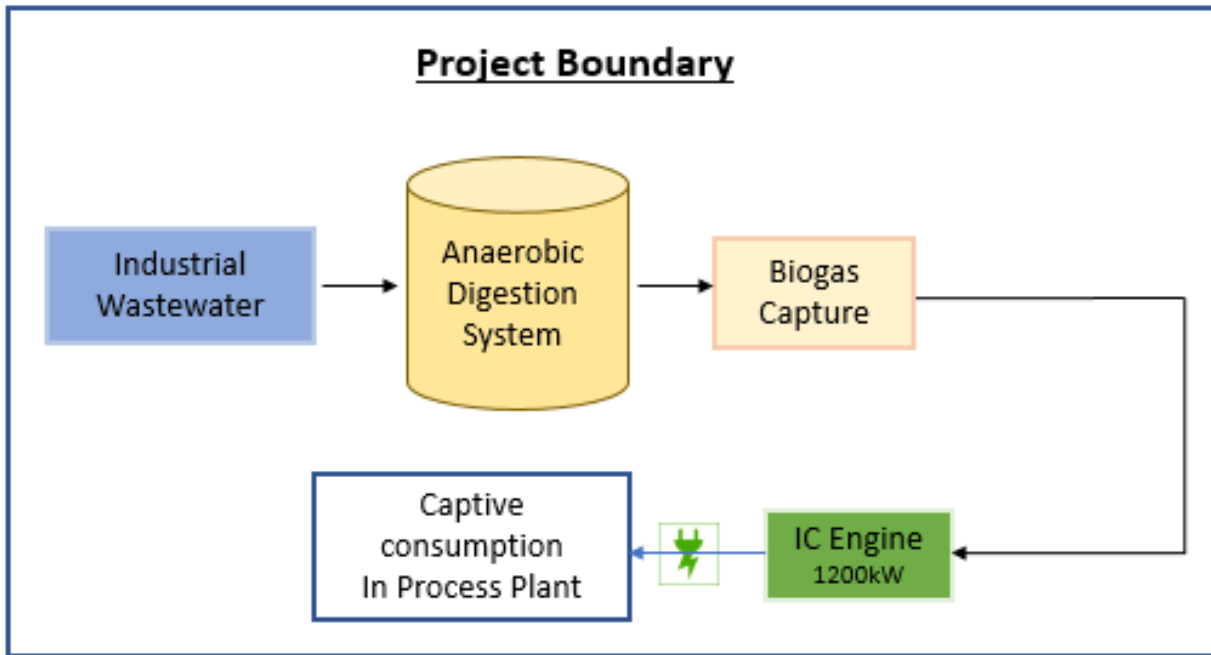
- Project is uniquely identifiable based on its location coordinates,
- Project has dedicated commissioning certificate and connection point,
- Project is associated with energy meters which are dedicated to the consumption point for project developer.

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

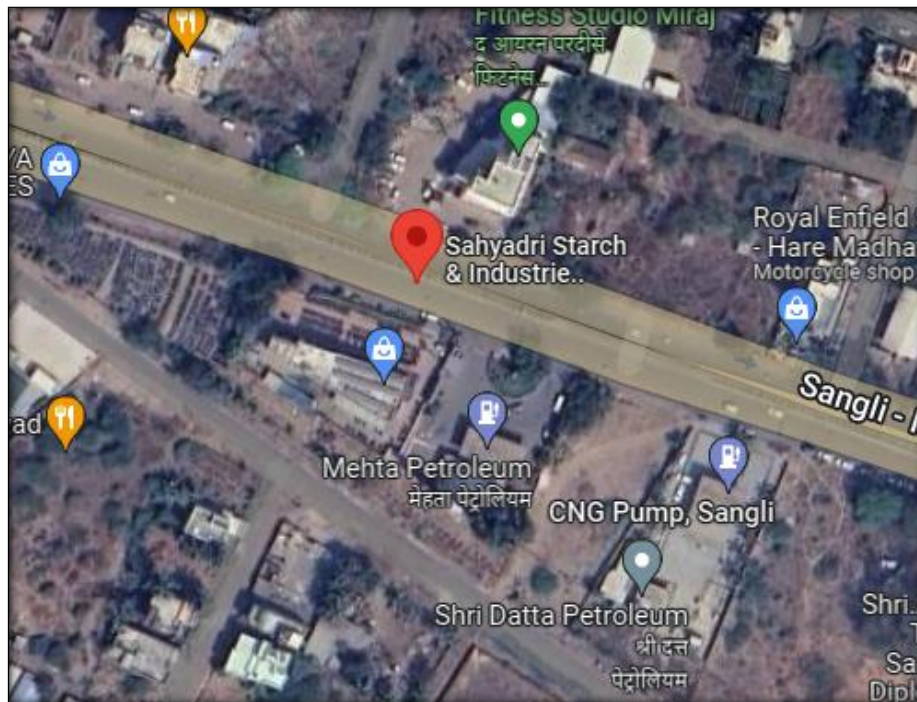
In line with the methodology, the project boundary encompasses the industrial facilities of SSIPL, which is

illustrated in the diagram below.

SCHEMATIC DIAGRAM SHOWING BOUNDARY



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



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	GHG	Included?	Justification/Explanation
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Baseline	Emissions from anaerobic digestion of effluent.	CO ₂	Included	Major source of emission
		CH ₄	Included	Major source of emission
	Emissions from electricity imported from grid.	N ₂ O	Excluded	Excluded for simplification. This is conservative.
Project Activity	Emissions from on-site electricity generation.	CO ₂	Excluded	Electricity is generated from collected biogas, hence these emissions are not accounted for.
		CH ₄	Excluded	Excluded for simplification. This is conservative.
	Emissions from residue from anaerobic digester composting	N ₂ O	Excluded	Excluded for simplification. This is conservative.

B.5. Establishment and description of baseline scenario (UCR Standard or Methodology) >>

Baseline Scenario

According to AMS-III.H version 19.0, the baseline scenario involves a baseline system with anaerobic wastewater treatment system without biogas recovery, which is the case here. In the absence of the project, the mill would have continued operating its wastewater treatment facility without any upgrade of technology. The baseline scenario is identified as the continuation of current situation, resulting in free release of methane into the atmosphere.

According to methodology AMS-III.H version 19.0, baseline emissions for the systems affected by the project activity may consist of:

- Emissions on account of electricity or fossil fuel used (BE_{power,y})
- Methane emissions from baseline wastewater treatment systems (BE_{ww,treatment,y});
- Methane emissions from baseline sludge treatment systems (BE_{s,treatment,y});
- Methane emissions on account of inefficiencies in the baseline wastewater treatment systems and presence of degradable organic carbon in the treated wastewater discharged into river/ lake/ sea (BE_{ww,discharge,y});
- Methane emissions from the decay of the final sludge generated by the baseline treatment systems (BE_{s,final,y}).

$$BE_y = BE_{power,y} + BE_{ww,treatment,y} + BE_{s,treatment,y} + BE_{ww,discharge,y} + BE_{s,final,y}$$

Where:

- BE_y : Baseline emissions in year y (tCO₂e)
- BE_{power,y} : Baseline emissions from electricity or fuel consumption in year y (tCO₂e)
- BE_{ww,treatment,y} : Baseline emissions of the wastewater treatment systems affected by the project activity in year y (tCO₂e)
- BE_{s,treatment,y} : Baseline emissions of the sludge treatment systems affected by the project activity in year y (tCO₂e)
- BE_{ww,discharge,y} : Baseline methane emissions from degradable organic carbon in treated wastewater discharged into sea/river/lake in year y (tCO₂e).
- BE_{s,final,y} : Baseline methane emissions from anaerobic decay of the final sludge produced in year y (tCO₂e). If the sludge is controlled combusted, disposed in a landfill with biogas recovery, or used for soil application in the baseline scenario, this term shall be neglected.

In the project case:

- the electric consumption of wastewater treatment is the same in the baseline and project situation.
- there is no sludge treatment in the baseline and in the project situation
- Plant has adopted ZLD system and no treated effluent is discharged into sea/river/lake.
- Final sludge is used for soil application as a bio manure.

The system affected is only the baseline wastewater treatment system. Therefore, equation (1) can be reduced to:

$$BE_y = BE_{ww,treatment,y} \quad \text{Equation (1b)}$$

Methane emissions from the baseline wastewater treatment systems affected by the project ($BE_{ww,treatment,y}$) are determined using the COD removal efficiency of the baseline plant as follows:

$$BE_{ww,treatment,y} = \sum_i (Q_{ww,i,y} \times COD_{inflow,i,y} \times \eta_{COD,BL,i} \times MCF_{ww,treatment,BL,i}) \times B_{o,ww} \times UF_{BL} \times GWP_{CH4} \quad (\text{Eq 2})$$

Where:

$Q_{ww,i,y}$	Volume of wastewater treated in baseline wastewater treatment system i in year y (m^3). For ex ante estimation, forecasted wastewater generation volume or the designed capacity of the wastewater treatment facility can be used. However, the ex post emissions reduction calculation shall be based on the actual monitored volume of treated wastewater
$COD_{inflow,i,y}$	Chemical oxygen demand of the wastewater inflow to the baseline treatment system i in year y (t/m^3). Average value may be used through sampling with the confidence/precision level 90/10. Monitored values of the COD inflow during crediting period will be used to calculate the baseline emissions ex post
$\eta_{COD,BL,i}$	COD removal efficiency of the baseline treatment system i
$MCF_{ww,treatment,BL,i}$	Methane correction factor for baseline wastewater treatment systems i. MCF value is identified as 0.8 corresponding to anaerobic deep lagoon (depth more than 2 meters) (IPCC and methodology)
i	Index for baseline wastewater treatment system
$B_{o,ww}$	Methane producing capacity of the wastewater (IPCC value of $0.25kgCH_4/kg$ COD)
UF_{BL}	Model correction factor to account for model uncertainties (0.89)
GWP_{CH4}	Global Warming Potential for methane

Calculation of $BE_{ww,treatment,y}$

Parameter	Value applied	Source
$Q_{ww,i,y}$	333000 (m^3)	Based on one year of historical data of the plant.
$COD_{inflow,i,y}$	0.024 (t/m^3)	Based on a 10-day measurement campaign.
$\eta_{COD,BL,i}$	90 %	Calculated as detailed below

$MCF_{ww,treatment,BL,i}$	0.8	Corresponding to anaerobic deep lagoon (depth more than 2 meters)
$Bo_{,ww}$	0.25 kgCH ₄ /kg COD	Default value as per the methodology
UF_{BL}	0.89	Default value as per the methodology
GWP_{CH_4}	28 tCO ₂ /tCH ₄	IPCC default value

The COD removal efficiency of the baseline is calculated as:

$$\eta_{COD,BL,i} = 1 - (COD_{outflow,i,y} / COD_{inflow,i,y}) \times 0.89$$

Where:

$COD_{inflow,i,y}$	24000 mg/l
$COD_{outflow,i,y}$	2400 mg/l

$$\eta_{COD,BL,i} = 0.9895 \times 0.89 = 88.07\%$$

Methane emissions from the baseline wastewater treatment system affected by the project $BE_{ww,treatment,y}$ are thus calculated as 35,848 tCO₂e/year.

Project Emission:

According to the methodology, project emissions may consist of:

- (a) CO₂ emissions from electricity and fuel used by the project facilities ($PE_{power,y}$),
- (b) Methane emissions from wastewater treatment systems affected by the project activity, and not equipped with biogas recovery in the project scenario ($PE_{ww,treatment,y}$),
- (c) Methane emissions from sludge treatment systems affected by the project activity, and not equipped with biogas recovery in the project situation ($PE_{s,treatment,y}$),
- (d) Methane emissions on account of inefficiency of the project activity wastewater treatment systems and presence of degradable organic carbon in treated wastewater ($PE_{ww,discharge,y}$),
- (e) Methane emissions from the decay of the final sludge generated by the project activity treatment systems ($PE_{s,final,y}$),
- (f) Methane fugitive emissions due to inefficiencies in capture systems ($PE_{fugitive,y}$),
- (g) Methane emissions due to incomplete flaring ($PE_{flaring,y}$),
- (h) Methane emissions from biomass stored under anaerobic conditions which would not have occurred in the baseline situation ($PE_{biomass,y}$)

It is expected that electricity consumed for the operation of the project activity including biogas recovery will be sourced from on-site power generation from biogas. The project activity does not involve project emissions from (c) (d) (e) (h).

$PE_{ww,treatment,y}$ is not applicable because the wastewater treatment system affected by the project activity will be equipped with biogas recovery in the project scenario.

Thus, project emissions consist of:

$$PE_y = PE_{fugitive,y} + PE_{flaring,y} \quad \text{Equation(3)}$$

Where:

PE_y :Project activity emissions in the year y (t CO₂e)

$PE_{fugitive,y}$:Methane emissions from biogas release in capture systems in year y (tCO₂e)

$PE_{flaring,y}$:Methane emissions due to incomplete flaring in year y (tCO₂e).

Equations used for the calculation of $PE_{fugitive,y}$

Project activity emissions from methane release in capture systems are determined as follows:

(a) Based on the methane emission potential of wastewater:

$$PE_{fugitive,y} = PE_{fugitive,ww,y} \quad \text{Equation (5)}$$

Where:

$PE_{fugitive,ww,y}$ Fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment systems in the year y (tCO₂e)

$$PE_{fugitive,ww,y} = (1 - CFE_{ww}) \times MEP_{ww,treatment,y} \times GWP_{CH_4} \quad \text{Equation (6)}$$

Where:

CFE_{ww} :Capture efficiency of the biogas recovery equipment in the wastewater treatment systems (a default value of 0.9 shall be used)

$MEP_{ww,treatment,y}$:Calculated as 1611.18 tCH₄ (see details below)

$$MEP_{ww,treatment,y} = Q_{ww,y} \times Bo_{ww} \times UF_{PJ} \times \sum k COD_{removed,PJ,k,y} \times MCF_{ww,treatment,PJ,k} \quad \text{Equation (7)}$$

Where:

Parameter	Value applied	Source
$Q_{ww,i,y}$	333000 (m ³)	Based on one year of historical data of the plant
$COD_{removed,PJ,k,y}$	0.0216 (t/m ³)	Based on a 10-day measurement campaign
$MCF_{ww,treatment,BL,i}$	0.8	Corresponding to anaerobic deep lagoon (depth more than 2 meters)
Bo_{ww}	0.25 kgCH ₄ /kg COD	Default value as per the methodology
UF_{PJ}	1.12	Default value as per the methodology
GWP_{CH_4}	28 tCO ₂ /tCH ₄	IPCC default value

$COD_{removed,PJ,k,y}$ is the difference between $COD_{inflow,PJ,y}$ and $COD_{outflow,PJ,y}$ of the treatment system installed in the Project.

Inflow and outflow of COD are regularly measured and monitored by project proponent. The values applied for ex-ante calculations of project emissions are the average values of COD_{inflow} and COD_{outflow} .

Where:

COD _{inflow,i,y}	24000 mg/l
COD _{outflow,i,y}	2400 mg/l
COD _{removed,PJ,k,y}	21600 mg/l

Therefore, PE_{fugitive,ww,y} = (1 – 0.9) x 1611.18 x 28 = 4511 tCO₂

Flaring

Project emissions due to incomplete flaring are expected to be zero because all biogas recovered will be combusted in the gensets. If there is not enough gas to power the genset, the digester will remain shut off until there is enough gas accumulated.

Therefore, PE_{flaring,y} is assumed to be zero .

Ex-ante annual estimates of project emissions are calculated as PE_y = 4511 tCO₂.

Leakage

No leakage emissions need to be accounted unless if the technology is using equipment transferred from another activity, which is not the case here.

Net GHG Emission Reductions and Removals

$$ER_{y,exante} = BE_{y,exante} - PE_{y,exante}$$

Equation (8)

Where:

ER_{y,exante} Ex ante emission reduction in year y (tCO_{2e})

BE_{y,exante} Ex ante baseline emissions in year y (tCO_{2e})

PE_{y,exante} Ex ante project emissions in year y (tCO_{2e})

Therefore, ER_{y,exante}= 31,338 tCO_{2e}/annum

Baseline Scenario

According to AMS-I.F, the project activity includes electricity generation from the renewable power plant for captive use. Hence, the project activity can be considered as installation of new biogas fired engine which generate electricity for captive use which would otherwise have been sourced from the national grid.

Hence, the applicable baseline, as per the approved methodology AMS-I.F., the baseline of the project activity is the “kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO_{2e}/kWh) calculated in a transparent and conservative manner.

According to AMS-I.F. v4.0, baseline emissions from electricity displacement are calculated as follows:

Baseline emissions are the product of amount electricity displaced with the electricity produced by the renewable generating unit and an emission factor.

$$BE_y = EG_{BL} \times EF_{CO_2,y}$$

Where:

<i>BE_y</i>	Baseline emissions in year y (t CO ₂)
<i>EGBL,y</i>	Quantity of net electricity displaced as a result of the implementation of the project activity in year y (MWh)
<i>EFCO_{2,y}</i>	Emission factor (t CO ₂ /MWh) <ul style="list-style-type: none"> • The emission factor of an electric grid shall be calculated as per the procedures provided in AMS-I.D.; • For a mini-grid system other than described in paragraph 18 above, the baseline emission factor shall be determined as per the weighted average emissions for the current generation mix following the procedure provided in AMS-I.D.; • The emission factor for captive electricity generation shall be calculated as per the procedures described in the latest version of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”

EG_{BL}, = Quantity of net electricity generation/supplied by the project plant/unit= 9590.4 MWh

Baseline emission reductions (BE_y)= 8716 tCO₂/annum

Estimated Annual or Total baseline emission reductions (BE_y) = 44,565 CoUs /year (44,565 tCO₂eq/yr)

Therefore, Total E_{Ry,exante}= 40,053 tCO₂e/annum

B.6. Prior History>>

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

B.7. Changes to start date of crediting period >>

The commissioning date of the project was on 29th August 2012 and the start date of crediting period considered for this UCR project activity will be from 1st January 2013. [as per UCR Program Manual Ver5].

B.8. Permanent changes from PCN monitoring plan, applied methodology or applied standardized baseline >>

There are no permanent changes from registered PCN monitoring plan and applied methodology.

B.9. Monitoring period number and duration>>

First Issuance Period: 9 years, 10 months – 01/01/2013 to 31/10/2022

B.8. Monitoring plan>>

Following parameters being used in emission reductions determination (Fixed Ex-Ante):

Data/Parameter	$MCF_{ww,treatment,BL,i}$
Data unit	Factor
Description	Methane correction factor for baseline wastewater treatment systems i
Source of data	MCF values as per Table 2 of AMS-III.H. V.19
Value(s) applied	0.8
Measurement methods and procedures	IPCC default value applies
Purpose of data	Calculation of baseline emissions
Comments	-

Data/Parameter	$\eta_{COD,BL,i}$
Data unit	%
Description	COD removal efficiency of the baseline treatment system
Source of data	Third party measurements and calculations in line with AMS-III.H
Value(s) applied	90 %
Measurement methods and procedures	Calculated Value
Purpose of data	Calculation of baseline emissions
Comments	-

Data/Parameter	$B_{o,ww}$
Data unit	CH ₄ /kg COD
Description	Methane producing capacity of the wastewater
Source of data	IPCC default value
Value(s) applied	0.25
Measurement methods and procedures	IPCC default value applies in line with Equation 2 of AMS-III.H V.19
Purpose of data	Calculation of baseline methane emissions
Comments	-

Data/Parameter	UF_{BL}
Data unit	Factor
Description	Model correction factor to account for model uncertainties (0.89)
Source of data	AMS-III.H v 19
Value(s) applied	0.89
Measurement methods and procedures	As specified in methodology
Purpose of data	Calculation of baseline emissions
Comments	Reference: FCCC/SBSTA/2003/10/Add.2, page 25

Data/Parameter	UF _{PJ}
Data unit	Factor
Description	Model correction factor to account for model uncertainties (1.12)
Source of data	AMS-III.H v 19
Value(s) applied	1.12
Measurement methods and procedures	As specified in methodology
Purpose of data	Calculation of project emissions
Comments	Reference: FCCC/SBSTA/2003/10/Add.2, page 24

Data/Parameter	GWP _{CH4}
Data unit	tCO ₂ e/tCH ₄
Description	Global Warming Potential of methane
Source of data	IPCC default values
Value(s) applied	28
Measurement methods and procedures	IPCC data used
Purpose of data	Calculations of baseline and project emissions
Comments	tCO ₂ e/tCH ₄

Following parameters being monitored for emission reductions determination:

Data / Parameter:	EG_{PJ, electrical, y}
Data unit:	MWh/year
Description:	Amount of electricity supplied in year y
Source of data:	Onsite measurement
Measurement procedures (if any):	Measurement would be done by installing 3 phase energy meter at HT side or LT side of generation end.
Monitoring frequency:	Monitoring procedure: Continuously with energy meters Data Type: measured Recording frequency: Daily / Monthly Consolidated Archiving method: Electronic
QA/QC procedures:	Installed energy meter would be as per national or IEC standard. Calibration would be carried out once in every five years.
Any comment:	Generation data would be archiving electronically up to 2 years from the end of crediting period.

Data/Parameter	$Q_{ww,i,y}$
Data unit	m^3
Description	Flow of wastewater entering (inflow) the anaerobic digester
Source of data	On-site measurement
Measurement methods and procedures	Measurements will be taken using flowmeter(s) at inlet of the anaerobic digester
Frequency of monitoring/recording	Monitored continuously (at least hourly measurements are undertaken,)
Value applied	333000 m^3/yr used for ex-ante estimates
Monitoring equipment	Flow Meter
QA/QC Procedures to be applied	Flowmeter(s) to be maintained according to manufacturer's specifications
Purpose of data	Calculation of baseline emissions Calculation of project emissions
Calculation method	N/A
Comments	-

Data/Parameter	$COD_{ww,inflow,y}$
Data unit	tCOD/ m^3
Description	Chemical Oxygen Demand of the wastewater entering (inflow) the anaerobic digester
Source of data	On-site measurement
Measurement methods and procedures	Measure the COD according to national or international standards. COD is measured through representative sampling.
Frequency of monitoring/recording	Periodically
Value applied	0.024 used for ex-ante estimates
Monitoring equipment	Laboratory analysis
QA/QC Procedures to be applied	Samples and measurements shall ensure a 90/10 confidence/precision level
Purpose of data	Calculation of baseline emissions and project emissions
Calculation method	N/A
Comments	-

Data/Parameter	COD _{ww,outflow,y}
Data unit	tCOD/m ³
Description	Chemical Oxygen Demand of the wastewater at the outlet (outflow) of the anaerobic digester
Source of data	On-site measurement
Measurement methods and procedures	Measure the COD according to national or international standards. COD is measured through representative sampling.
Frequency of monitoring/recording	Periodically
Value applied	0.0024 used for ex-ante estimates
Monitoring equipment	Laboratory analysis
QA/QC Procedures to be applied	Samples and measurements shall ensure a 90/10 confidence/precision level
Purpose of data	Calculation of baseline emissions and project emissions
Calculation method	N/A
Comments	-

Data/Parameter	BG _{bumt,y}
Data unit	m ³
Description	Biogas volume in year y
Source of data	On-site measurement
Measurement methods and procedures	In all cases, the amount of biogas recovered, fuelled or flared shall be monitored ex post, using continuous flow meters. If the biogas streams flared and fuelled (or utilized) are monitored separately, the two fractions can be added together to determine the total biogas recovered, without the need to monitor the recovered biogas before the separation. The methane content measurement shall be carried out close to a location in the system where a biogas flow measurement takes place
Frequency of monitoring/recording	Monitored continuously
Value applied	Value not used for ex-ante estimates, to be monitored ex-post
Monitoring equipment	Flow meter(s)
QA/QC Procedures to be applied	Flowmeter(s) to be maintained according to manufacturer's specifications and would be crosschecked w.r.t. effluent coming to digester and generated electricity by the gas.
Purpose of data	Calculation of baseline emissions
Calculation method	N/A
Comments	-

Data/Parameter	$W_{CH_4,y}$
Data unit	%
Description	Methane content in biogas in year y
Source of data	On-site measurement
Measurement methods and procedures	The fraction of methane in the gas should be measured with a continuous analyser or, alternatively, with periodical measurements at a 90/10 confidence/precision level. It shall be measured using equipment that can directly measure methane content in the biogas - the estimation of methane content of biogas based on measurement of other constituents of biogas such as CO ₂ is not permitted. The methane content measurement shall be carried out close to a location in the system where a biogas flow measurement takes place.
Frequency of monitoring/recording	Monitored continuously (at least hourly measurements are undertaken, if less, confidence/precision level of 90/10 shall be attained)
Value applied	Value not used for ex-ante estimates, to be monitored ex-post
Monitoring equipment	Gas analyzer(s)
QA/QC Procedures to be applied	Gas analyzer(s) to be maintained according to manufacturer's specifications
Purpose of data	Calculation of baseline emissions
Calculation method	N/A
Comments	-

Data/Parameter	$EF_{CO_2,y}$
Data unit	tCO ₂ /MWh
Description	The emission factor of an electric grid;
Source of data	Central Electricity Authority (CEA) Database, 2022.
Measurement methods and procedures	Combined Margin Emission Factor has been considered as per the provision of EF calculation under the methodology prescription as per Tool 7
Value applied	0.9088
Purpose of data	Calculation of baseline emissions
Comments	N/A

Data/Parameter	EG _{BL,y}
Data unit	MWh/year
Description	Quantity of net electricity displaced in year y
Source of data	Plant records, electronic records
Measurement methods and procedures	Quantity of electricity generated by gas engine shall be measured using an energy meter to be installed at the plant level and records are kept on electronically.
Frequency of monitoring/recording	Continuous monitoring, monthly and annual aggregation
Value applied	To be considered on actual
Monitoring equipment	3 phase energy meter installed with gas engine.
QA/QC Procedures to be applied	The energy meter shall be calibrated once 3 years or as per manufacturer's recommendation, whichever is earlier.
Purpose of data	Calculation of baseline emissions
Calculation method	N/A
Comments	The data would be archived electronically and maintained upto 2 years after the end of the entire crediting period.