HE XI BIOGAS RECOVERY AND UTILIZATION PROJECT

Document Prepared by China Carbon Exploration (Shanghai) Environment Technology Development Co.,Ltd

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Project Title	Hexi Biogas Recovery and Utilization Project
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1 PROJECT DETAILS

1.1 Summary Description of the Project

He xi Biogas Recovery and Utilization Project (hereinafter referred to as the project) locates in Yanshan Village, Hutang Township, Fengcheng City, Yichun City, Jiangxi Province, P.R China. The geographical coordinates for the project site are east longitude 115°36′5.02″ and north latitude 28°18′9.14″. The project is owned and implemented by Fengcheng Xinfengtai Environment Technology Co., Ltd.

The project is to build a centralized anaerobic animal manure treatment system which collects manure waste of swine from the multiple hog farms in the Fengcheng City. The project uses animal manure waste as ferment material to produce biogas in the Completely Stirred Tank Reactor (CSTR) type anaerobic digesters. The recovered biogas will be used for electricity generation at the biogas power plant. The designed installed capacity of the biogas power plant is 1MW. For simplification and be conservative, the emission reductions from electricity generation will not be accounted for. After anaerobic digestion, the digestate is used in nearby farmlands by aerobic treatment.

The project started construction on 23-Oct-2020 and started operation on 05-May-2022. Prior to the implementation of the project, the animal manure 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 project is expected to avoid GHG emissions of methane through recovery and destruction of biogas. The project is expected to achieve an annual emission reduction of 52,431 tCO_2e and a total emission reduction of 367,018 tCO_2e during the first 7-year renewable crediting period.

Audit Type	Period	Program	VVB Name	Number of years
Validation/ Verification	This PD (Version 1.0) is used for publishment, the Validation date is not yet determined	Validation	CTI Certification Co., Ltd.	7

1.2 Sectoral Scope and Project Type

Sectoral Scope 13: Waste handling and disposal.

The project is not AFOLU project and is not a grouped project.

1.3 Project Eligibility

The scope of the VCS Program includes:

1) The seven Kyoto Protocol greenhouse gases:

The project is expected to avoid Methane (CH_4) emissions from the anaerobic animal manure management system in the baseline scenario, which will be captured and destroyed in the project scenario. Thus, the project applicable to this scope.

2) Ozone-depleting substances:

Not Applicable.

3) Project activities supported by a methodology approved under the VCS Program through the methodology development and review process:

Not Applicable.

4) Project activities supported by a methodology approved under a VCS approved GHG program, unless explicitly excluded under the terms of Verra approval:

The applied methodology AMS-III.D (Version 21.0) of the project are methodologies approved under CDM Program, which is a VCS approved GHG program.

5) Jurisdictional REDD+ programs and nested REDD+ projects as set out in the VCS Program document Jurisdictional and Nested REDD+ (JNR) Requirements:

Not Applicable.

The project is a manure management project, with the manure collected from the multiple hog farms in the Fengcheng City. The project will recover and use the biogas generated from the anaerobic digester, which consists mainly of methane, for power generation, which is apparently not a project that generates GHG emissions primarily for the purpose of their subsequent reduction, removal or destruction.

Furthermore, the project does not belong to the project activities excluded in Table 1 of VCS Standard 4.5.

Thus, the project is eligible under the scope of VCS program.

1.4 Project Design

☒ 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. Thus, this section is not applicable.

1.5 Project Proponent

Organization name	Fengcheng Xinfengtai Environment Technology Co., Ltd
Contact person	Hu Xiaohui
Title	General Manager
Address	Cui Shan, Hutang Village, Hutang Township, Fengcheng City, Yichun City, Jiangxi Province, China
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Email	1031806337@qq.com

1.6 Other Entities Involved in the Project

Organization name	China Carbon Exploration (Shanghai) Environment Technology Development Co.,Ltd
Role in the project	Consultant
Contact person	Xie Pengfei
Title	Project manager
Address	Room 1102, Building 7, Kingboard Square, 269 Tongxie Road, Changning District, Shanghai, China
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1.7 Ownership

The project owner of the project is Fengcheng Xinfengtai Environment Technology Co., Ltd. The Environmental Impact Assessment (EIA) of the project has been conducted by Ji'an Donghuang Environmental Protection Co.,Ltd on Nov-2020. The EIA report has been approved by Ecology and Environment Bureau of Fengcheng City on 18-Nov-2020 before the construction of the project. (Approval No. “Feng Huan Ping Zi [2020] No.81”). The project approval of EIA, and the business license of the project owner are evidence for legislative right. Besides, the equipment purchasing contract and the construction contracts are the evidence for the ownership of the plant and equipment.

1.8 Project Start Date

According to VCS standard v4.5, the project start date is the date on which the project began generating GHG emission reductions or removals.

The anaerobic animal manure treatment system of the project was put into operation on 05-May-2022, which is the earliest date for the project to start reducing emissions. Therefore, the project start date is 05-May-2022.

1.9 Project Crediting Period

This project adopts a 7-year renewable crediting period, from 05-May-2022 to 04-May-2029 (both days included).

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

The estimated annual GHG emission reductions/removals of the project are:

☐ <20,000 tCO_2e/year

☒ 20,000 – 100,000 tCO_2e/year

☐ 100,001 – 1,000,000 tCO_2e/year

☐ >1,000,000 tCO_2e/year

Project Scale	
Project	✓
Large project	

Year	Estimated GHG emission reductions or removals (tCO_2e)
05-May-2022 to 31-Dec-2022	34,619
01-Jan-2023 to 31-Dec-2023	52,431
01-Jan-2024 to 31-Dec-2024	52,431
01-Jan-2025 to 31-Dec-2025	52,431
01-Jan-2026 to 31-Dec-2026	52,431
01-Jan-2027 to 31-Dec-2027	52,431

01-Jan-2028 to 31-Dec-2028	52,431
01-Jan-2029 to 04-May-2029	17,812
Total estimated ERs	367,018
Total number of crediting years	7
Average annual ERs	52,431

1.11 Description of the Project Activity

The project is to build a centralized anaerobic animal manure treatment system which collects manure waste of swine from surrounding livestock farms in Fengcheng City. The project uses animal manure waste as ferment material to produce biogas in the Completely Stirred Tank Reactor (CSTR) type anaerobic digesters. The recovered biogas will be used for electricity generation at the biogas power plant. After anaerobic digestion, the digestate is sent out and used for agriculture fertilization aerobically in the nearby farmlands. According to the EIA report, the designed installed capacity of the biogas power plant is 1MW. The emission reductions from electricity generation will not be accounted for.

The project is expected to avoid GHG emissions of methane through recovery and destruction of biogas.

The key system involved in the project are as follows:

(1). Livestock farms:

The project is to collect swine manure from the multiple hog farms in the Fengcheng City and produce biogas through anaerobic digestion. The project is designed to collect 165,000 tons of manure annually.

(2). Anaerobic animal manure management system:

The Completely Stirred Tank Reactor (CSTR) type anaerobic digesters are to be applied in the project activity. This kind of technology is suitable for swine waste ferment and methane recovery. Method of warming is also used by this technology to ensure stable and efficient biogas production. Two CSTR digesters with effective volume of 5,000m^3 each will be installed.

(3). Biogas pre-treatment system

Before combustion or flaring, the biogas will be pre-treated to remove impurities and moisture, to prevent the corrosion of the biogas pipeline. In addition, biogas should be continuously in a stable condition before it flows into gas engine or flare. The pre-treatment consists of prefiltration, dehumidification, dewatering, cooling and fine filtration.

(4). Biogas collection and flare

The purified biogas will be stored in a gas tank before it is sent to the electricity generating unit for power generation. In addition, an open flare system is installed to destroy excess methane from digester for preventing any over pressure and explosion risk when generator does not work due to the maintenance or any other emergency situation. The gas tank will be located in the area with safe distance from generator and digester according to requirement of related national fire proof standard. Meanwhile, the flare will only be involved when the electricity generating unit is not in operation, hence, the project proponent determined that emission reductions from flare will not be claimed, even if any methane is destroyed by flare during the crediting period.

(5). Biogas power generation system

The installed capacity of the project is 1 MW. The project is estimated to generate 1,290MWh annually. The electricity generated by the biogas power plant will be supplied to the regional grid. For simplification and be conservative, the emission reductions from electricity generation will not be accounted for.

(6). Digestate fertilization system

The digestate (liquid and solid residues) discharged by the anaerobic digester are applied to nearby orchards and farmlands for fertilization aerobically. Before fertilizing the land, provide training to users to ensure appropriate conditions and procedures for using the digestate (which will not lead to methane emissions).

The technical parameters of main equipment used in this project are shown in the table below:

Table 1-1 Main Equipment Parameter

Parameter	Value	Unit
Completely Stirred Tank Reactor (CSTR) Type Anaerobic Digester		
Manufacturer	JIANGXI KOSEN ENTECH CO., LTD	-
Batch No.	KS20-DG1/Y	-
Number	2	-
Effective Volume	5000	m^3
Operating Pressure	4	kPa
Operating Temp	30-40	°C
Lifetime	30	years
Double Membrane Gas Holder		
Number	1	-
Effective Volume	1000	m^3
Lifetime	20	years

Power generator		
Manufacturer	Caterpillar	-
Serial Number	1686983	-
Rated Power	1200	kW
Power Factor	0.8	-
Lifetime	10	years

1.12 Project Location

The project locates in Yanshan Village, Hutang Township, Fengcheng City, Yichun City, Jiangxi Province, P.R China. The geographical coordinates for the project site are east longitude 115°36′5.02″ and north latitude 28°18′9.14″.

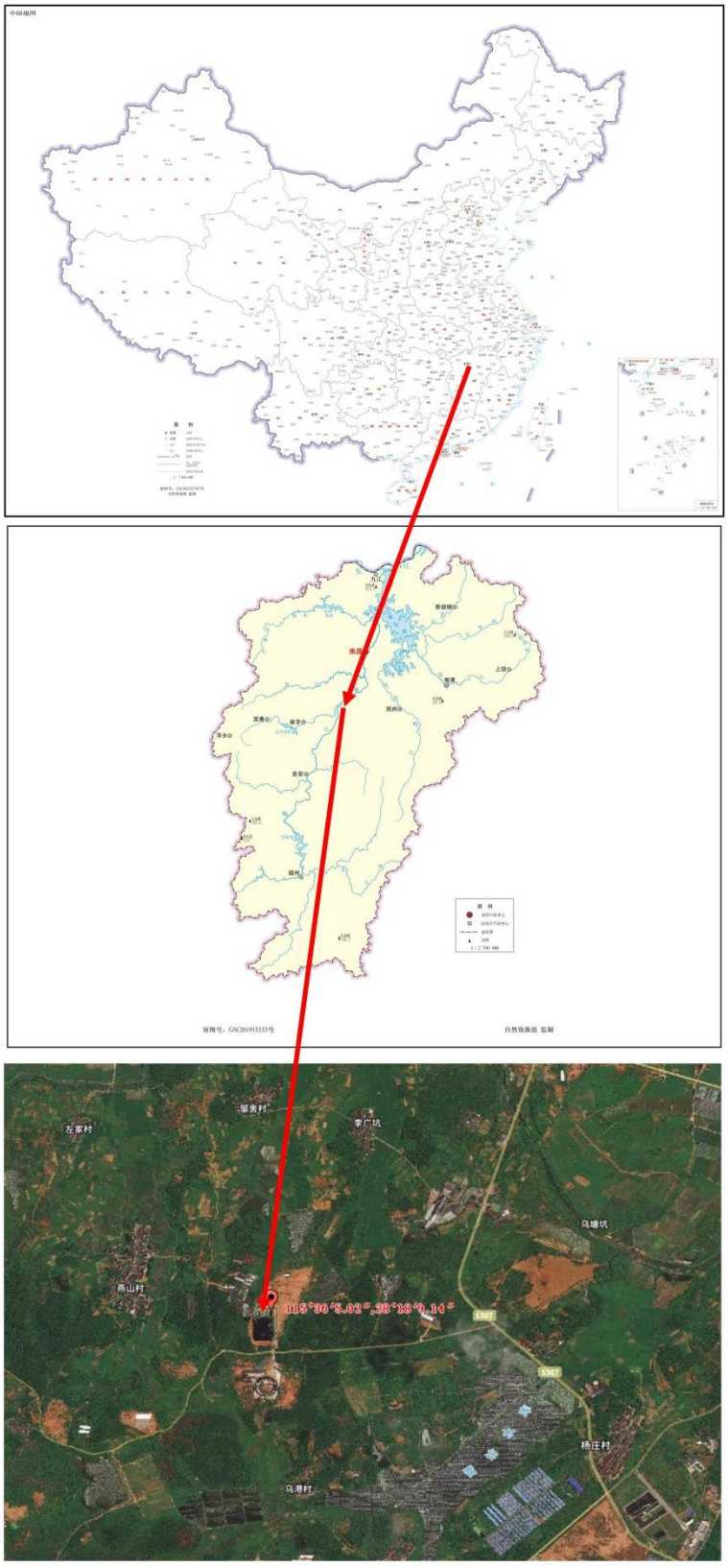

Figure 1-1 The geographic location of the project

1.13 Conditions Prior to Project Initiation

The conditions existing prior to project initiation:

The animal manure 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 conditions existing prior to project initiation is also the baseline scenario of the project. Refer section 3.4 of the description below for detailed baseline scenario.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The project complies with all chinese relevant laws and regulations. Mainly include:

1. Environmental Protection Law of People's Republic of China;

2. Law of the People's Republic of China on the Prevention and Control of Solid Waste Pollution;

3. Regulations on Prevention and Control of Pollution from Large Scale Livestock and Poultry Breeding;

4. Catalogue for the Guidance of Industrial Structure Adjustment (2019 revision);

The project has obtained the project approval and EIA approval from local government authorities: Fengcheng Development and Reform Commission and Ecology and Environment Bureau. The two approvals well demonstrate that local government permits the construction of the project. Consequently, the project is compliance with laws, status and other regulatory frameworks.

1.15 Participation under Other GHG Programs

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

The project has neither been registered, nor is seeking registration under any other GHG programs. The project is seeking registration only under VCS program.

1.15.2 Projects Rejected by Other GHG Programs

The project has never been seeking registration under any other GHG program, hence the project has never been rejected by any other GHG programs.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

Does the project reduce GHG emissions from activities that are included in an emissions trading program or any other mechanism that includes GHG allowance trading?

☐ Yes ☒ No

1.16.2 Other Forms of Environmental Credit

Has the project sought or received another form of GHG-related credit, including renewable energy certificates?

☐ Yes ☒ No

Supply Chain (Scope 3) Emissions

The project is a manure management project, which reduces GHG emission reductions by avoiding GHG emissions of methane from the open lagoon. Therefore, the project's GHG emission reductions or removals are not in a supply chain, and thus the Supply Chain (Scope 3) Emissions are not applicable.

1.17 Sustainable Development Contributions

The project will contribute to sustainable development in the following ways:

SDG8: Provide decent work. The project can provide job opportunities for local residents, which meets one of the China's action plans "Increase labor force participation rate through implementation of the classification policy. Vigorously enforce the Law on Promotion of Employment." Therefore, project will achieve SDG8[1] (Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all).

SDG12: The project uses animal manure waste as ferment material to produce biogas for electricity generation. Thus, the project will achieve SDG12[2] (Ensure sustainable consumption and production patterns). This contributes to achieve one of China's stated sustainable development priorities "By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse".

SDG13: Reduce GHG emissions. The project avoids methane emissions that would otherwise be released directly into the atmosphere, effectively reducing GHG emissions and air pollution. That means not only the project reduces GHG emissions to local environment, but also provide an environmentally sound solution to minimize odour at the livestock farm, which improves the environment in and around the livestock farm. This contributes to achieving one of China's stated sustainable development priorities "Actively adapt to climate change and strengthen resistance capacity to climate risks in agriculture, forestry, water resources and other key fields,

[1] https://sdgs.un.org/goals/goal8
[2] https://sdgs.un.org/goals/goal12

as well as cities, coastal regions and ecologically vulnerable areas." Therefore, the project will achieve SDG13[3] (Take urgent action to combat climate change and its impacts).

1.18 Additional Information Relevant to the Project

Leakage Management

Not applicable.

Commercially Sensitive Information

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

Further Information

Not applicable.

2 SAFEGUARDS

2.1 No Net Harm

The Environmental Impact Assessment (EIA) of the project has been conducted, and EIA report has been approved by Ecology and Environment Bureau of Fengcheng City on 18-11-2020 before the construction of the project. (Approval No. "Feng Huan Ping Zi [2020] No.81"). The EIA report has assessed every possible aspect of environmental impact of the project and recommended corresponding measures, where applicable. Meanwhile, the implementation of the project will improve local socio-economic development through creating career opportunities and paying taxes. The project will also contribute to the sustainable development of local community as described in section 1.17 above.

2.2 Local Stakeholder Consultation

The project owner held a local stakeholder consultation meeting on 21-Mar-2022 in the company office. Before the stakeholder consultation meeting, the project information with contact information and the stakeholder meeting notice were published on the bulletins at the project site and nearby on 21-Feb-2022. Local stakeholders were invited to attend.

During the meeting, a survey was carried out on the local residents and comments received from the survey are summarized as follows. The survey was conducted through distributing and collecting responses to a questionnaire. The survey questionnaire was designed to assess the

[3] https://sdgs.un.org/goals/goal13

project impacts on the local environment and social economic development. In total 30 out of 30 questionnaires were returned with a 100% response rate. The structure of the survey respondents is listed in Table 2-1 below.

Table 2-1 Structure of stakeholder survey

Item \ Distribution		Quantity	Percentage
Amount of stakeholders surveyed	Male	15	50%
	Female	15	50%
Age	＜25	3	10%
	25-55	17	57%
	＞55	10	33%
Education	Junior high school or below	18	60%
	Senior high school	7	23%
	College or above	5	17%
Occupation	Worker	10	33%
	Peasant	15	50%
	Management personnel	3	10%
	Civil servant	2	7%
	Unspecified	0	0%

Thirty questionnaires were distributed to local stakeholders, and all questionnaires have been recollected. Comments from these questionnaires are summarized in Table 2-2 below:

Table 2-2 Summary of stakeholders' comments

No.	Questions	Attitude or Opinion	Quantity	Percentage
1	Do you know about the project activity?	Very much	20	67%
		Heard of	10	33%
		Don't know	0	0%

2	Any impacts on local environment?	Positive	29	97%
		Negative	0	0%
		Don't know	1	3%
3	Do you think the project will improve the current situation of livestock farms?	Yes	29	97%
		No	0	0%
		Don't know	1	3%
4	Do you think the project will improve the local social community?	Yes	27	90%
		No	0	0%
		Don't know	3	10%
5	Do you think the project will improve the local employment situation?	Yes	25	83%
		No	0	0%
		Don't know	5	17%
6	Do you think the project will promote local economic development?	Positive impact	22	73%
		No impact	8	27%
		Negative impact	0	0%
7	What is the most probable environmental impact do you think the project will cause after the construction finish? (Multiple choice)	None	29	97%
		Air pollution	0	0%
		Water pollution	0	0%
		Noise pollution	0	0%
		Harm to indigenous	0	0%
		Don't know	1	3%

In general, local stakeholders are supportive of the project construction. The survey shows that a majority of local stakeholders think the project will help improve the lives of local people without much adverse environmental impact. Almost all of the stakeholders are supportive of the proposed project, believing that it will provide more employment opportunities and improve the current situation of livestock farms. Therefore, the implementation of the project is regarded as beneficial by most of the local stakeholders.

Communications with local stakeholders will be carried out at periodic intervals. Key implementation schedules or changes of the project will be communicated to the local authority, who will inform the neighbourhood committee and the local residents. Meanwhile, comments and suggestions from residents will be collected by the local authority. There are no negative

comments received for the project. The project has continuous input / grievance mechanism, and project information with contact information have been posted on the bulletins at the project site, which states that there is a grievance book at the project site, and everyone is welcome to give comments. In line with VCS requirements, all the processes have been implemented to receive comments from local stakeholders as well as communicate with them at periodic intervals.

2.3 Environmental Impact

The Environmental Impact Assessment (EIA) of the Project has been approved by Ecology and Environment Bureau of Fengcheng City. The environmental impacts of the project are summarized as follows.

Air pollution

This project uses biogas from the anaerobic digester to generate power, and it avoids uncontrolled releasing of biogas. Therefore, it reduces greenhouse gas and effluvium emitting to air. The biogas has been pre-treated to remove impurities and moisture before power generation, and the emissions from the project meet the emission requirements. After that, biogas is sent to the biogas generator. And the exhaust gas would be emitted to atmosphere through an exhaust cylinder which is far away from sensitive targets. Therefore, the emissions of exhaust gas has little impact on surrounding environment.

Wastewater

The wastewater during operation is mainly domestic sewage and biogas slurry from anaerobic digesters. The domestic sewage of the project is pre-treated in a septic tank and reused in anaerobic digesters. No wastewater will be discharged to the environment.

Noise

The noise of this project comes from noise from various mechanical operation and vibration. All production equipment is placed in the workshop or steel container, and sound insulation, vibration reduction, noise elimination, greening and distance attenuation measures are taken to reduce vibration and noise. The operating noise is effectively attenuated after being blocked by the solid wall.

Solid waste

The solid waste of the project is mainly domestic garbage and biogas residues. The domestic garbage is collected and then sent to disposal by local sanitation department. The biogas residues discharged by the anaerobic digester are sold to nearby businesses.

As mentioned above, the project was not considered that it would bring out negative environmental impacts. On the contrary, this project will promote local environment by reducing emissions of greenhouse gas.

2.4 Public Comments

The project is going to open for public comment on the VERRA website.

2.5 AFOLU-Specific Safeguards

The project is a non-AFOLU project, so this section is not applicable to the project.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

The methodology applied to the project is small scale CDM methodology:

AMS-III.D Methane recovery in animal manure management systems (version 21.0);

This methodology also refers to the latest approved version of the following tools:

Tool 14: Project and leakage emissions from anaerobic digesters (version 02.0);

For more detail about the methodology and tools, please refer to the following link:

https://cdm.unfccc.int/methodologies/DB/H9DVSB24O7GEZQYLYNWUX23YS6G4RC

https://cdm.unfccc.int/Reference/tools/index.html

3.2 Applicability of Methodology

The project satisfies all the applicability criteria of the methodology AMS-III.D (Version 21.0), of which the detailed description is listed in Table 3-1 below:

Table 3-1 Applicability of AMS-III.D

No.	Applicability conditions of the methodology	Project
1	This methodology covers project activities involving the replacement or modification of anaerobic animal manure management systems in livestock farms to achieve methane recovery and destruction by flaring/combustion or gainful use of the recovered methane. It also covers treatment of manure collected from several farms in a centralized plant.	Applicable. The project is a centralized plant treats animal manure waste collected from surrounding livestock farms. The project replaces existing anaerobic animal manure management systems (open lagoon) in livestock farms to achieve methane recovery and destruction by flaring/ combustion or

		gainful use of the recovered methane.
2	This methodology is only applicable under the following conditions: (a) The livestock population in the farm is managed under confined conditions;	Applicable. All the livestock population in the farms within the project boundary is managed under confined conditions.
	(b) Manure or the streams obtained after treatment are not discharged into natural water resources (e.g., river or estuaries), otherwise "AMS-III.H Methane recovery in wastewater treatment" shall be applied;	Applicable. As per the EIA report, manure is not discharged into natural water resources (e.g. river or estuaries).
	(c) The annual average temperature of baseline site where anaerobic manure treatment facility is located is higher than 5 °C;	Applicable. The annual average ambient temperature at the site where the anaerobic manure treatment facility in the baseline is in the range of 19.6 °C[4], which is higher than 5 °C.
	(d) In the baseline scenario the retention time of manure waste in the anaerobic treatment system is greater than one month, and if anaerobic lagoons are used in the baseline, their depths are at least 1 m;	Applicable. In the baseline scenario the retention time of manure waste in the anaerobic lagoons is greater than one month, and their depths are at least 1 m.
	(e) No methane recovery and destruction by flaring or combustion for gainful use takes place in the baseline scenario.	Applicable. In the baseline scenario, no methane recovery and destruction by flaring or combustion for gainful use took place.
3	The project activity shall satisfy the following conditions: (a) The residual waste from the animal manure management system shall be handled aerobically, otherwise the related emissions shall be taken into account as per relevant procedures of "AMS-III.AO Methane recovery through controlled	Applicable. As per the EIA report, the residual waste from the animal manure management systems will be sold and used for agriculture fertilization aerobically in the nearby farmlands, which will not result in methane emissions;

[4] http://jx.cma.gov.cn/zfxxgk/zwgk/sjtj_1/202303/P020230317379786742128.pdf

	anaerobic digestion". In the case of soil application, proper conditions and procedures (not resulting in methane emissions) must be ensured;	
	(b) Technical measures shall be used (including a flare for exigencies) to ensure that all biogas produced by the digester is used or flared;	Applicable. Biogas produced by the project are used directly to produce electricity, the emergency flare ensure biogas would be destroyed while exigencies happened;
	(c) The storage time of the manure after removal from the animal barns, including transportation, should not exceed 45 days before being fed into the anaerobic digester. If the project proponent can demonstrate that the dry matter content of the manure when removed from the animal barns is larger than 20%, this time constraint will not apply.	Applicable. After removal from the animal barns, the manure of the project will be put into the anaerobic digester at project site on the same day, which is within the day, not exceed 24 hours, and this means that the storage time of the manure after removal from the animal barns, including transportation, is within 24 hours, not exceeding 45 days before being fed into the anaerobic digester.
4	Projects that recover methane from landfills shall use “AMS-III.G Landfill methane recovery" and projects for wastewater treatment shall use AMS-III.H. Projects for composting of animal manure shall use “AMS-III.F Avoidance of methane emissions through composting". Project activities involving co-digestion of animal manure and other organic matters shall use the methodology “AMS-III.AO Methane recovery through controlled anaerobic digestion".	Not applicable. The project activity instances do not involve methane recovery from landfill, wastewater treatment, composting of animal manure, or co-digestion of animal manure and other organic matters.

5	Utilization of the recovered biogas in one of the options detailed in AMS-III.H is also eligible under this methodology. The respective procedures in AMS-III.H shall be followed in this regard. If the recovered biogas is used to power auxiliary equipment of the project activity, it should be taken into account accordingly, using zero as its emission factor; however, energy used for such purposes is not eligible as an SSC CDM Type I project component.	Applicable. The biogas recovered is used to generate electricity. For simplification and be conservative, the emission reductions from electricity generation will not be accounted for.
6	New facilities (Greenfield projects) and project activities involving capacity additions compared to the baseline scenario are only eligible if they comply with the related and relevant requirements in the "General guidelines for SSC CDM methodologies".	Applicable. The project is a Greenfield project. The emission reductions sourced from methane recovery is 52,431 tCO_2e/yr, which is lower than the threshold of 60,000 tCO_2e/yr. The designed installed capacity of the project is 1MW, which is lower than the threshold of 15MW. Therefore, the Project is in line with General Guidelines to SSC CDM methodologie.
7	The requirements concerning demonstration of the remaining lifetime of the replaced equipment shall be met as described in the "General guidelines for SSC CDM methodologies".	Not applicable. The project is a Greenfield project, does not involve the replaced equipment. Therefore, this is irrelevant.
8	Measures are limited to those that result in aggregate emission reductions of less than or equal to 60 kt CO_2 equivalent annually from all Type III components of the project activity.	Applicable. The emission reductions from the recovery and destruction of methane (viz. Type III components of the project) is 52,431 tCO_2e/yr, which is less than 60 kt CO_2 equivalent.

In addition, the project meets the applicability conditions of the applied tools applied in the PD as follows:

Table 3-2 Applicability of applied tools

Tool	Applicability	Project
Applicability conditions in TOOL14"Project and leakage emissions from anaerobic digesters"	The following sources of project emissions are accounted for in this tool: (a) CO_2 emissions from consumption of electricity associated with the operation of the anaerobic digester; (b) CO_2 emissions from consumption of fossil fuels associated with the operation of the anaerobic digester; (c) CH_4 emissions from the digester (emissions during maintenance of the digester, physical leaks through the roof and side walls, and release through safety valves due to excess pressure in the digester); and (d) CH_4 emissions from flaring of biogas.	Applicable. All sources of project emissions have been accounted.
	The following sources of leakage emissions are accounted for in this tool: (a) CH_4 and N_2O emission from composting of digestate; (b) CH_4 emissions from the anaerobic decay of digestate disposed in a SWDS or subjected to anaerobic storage, such as in a stabilization pond.	Not applicable. The project does not involve composting or anaerobic storage of digestate.
	Emission sources associated with N_2O emissions from physical leakages from the digester, transportation of feed material and digestate or any other on-site transportation, piped distribution of the biogas, aerobic treatment of liquid digestate and land application of the digestate are neglected because these are minor emission sources or because they are accounted in the methodologies referring to this tool.	Applicable. As per the applied methodology, N_2O emissions are neglected because these are minor emission sources.

3.3 Project Boundary

According to the methodology AMS-III.D, the project boundary includes the physical, geographical site(s) of (a) The livestock; (b) Animal manure management systems (including

centralised manure treatment plant where applicable); (c) Facilities which recover and flare/combust or use methane.

Hence, the project boundary of the project includes the physical and geographical sites of the livestock, the animal manure management system, the electricity generating unit and the emergency flare.

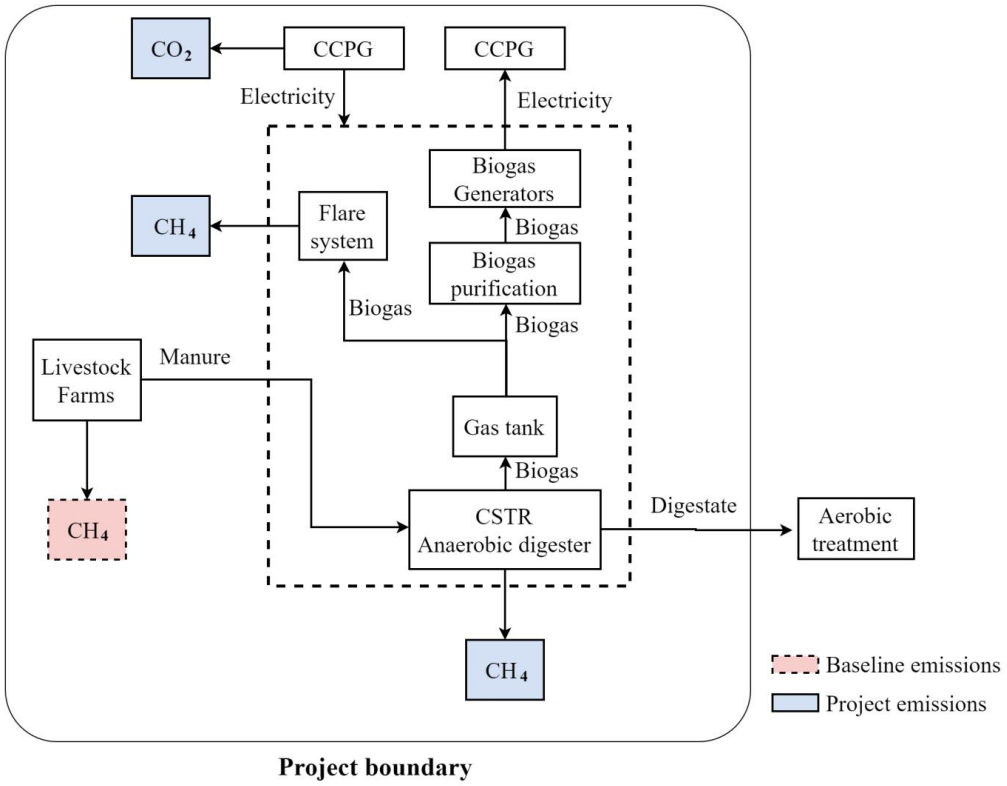

Figure 3-1 Project boundary of the project

Table 3-4 Emission sources included in or excluded from the project boundary

Source		Gas	Included?	Justification/Explanation
Baseline	Direct emissions from the manure treatment processes	CO_2	No	Excluded for simplification.
		CH_4	Yes	The major source of emissions in the baseline
		N_2O	No	Excluded for simplification.
Project	Physical leakage of biogas in the manure management systems	CO_2	No	Excluded for simplification.
		CH_4	Yes	Main emission sources.
		N_2O	No	Excluded for simplification.

Source		Gas	Included?	Justification/Explanation
	Emissions from flaring or combustion of the gas stream	CO_2	No	Excluded for simplification.
		CH_4	No	Excluded for simplification. The enclosed flare in the project is installed for emergency, and the emissions are assumed to be very small. The project will not claim this part of emission reductions.
		N_2O	No	Excluded for simplification.
	Emissions from use of fossil fuels or electricity	CO_2	Yes	The project will consume electricity during operation of the project, and the emissions from use of electricity are considered as the main emission sources. The project does not involve fossil fuel consumption, so the emissions from use of fossil fuels are not included.
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.
	Emissions from incremental transportation distances	CO_2	No	Excluded for simplification.
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.
	Emissions from the storage of manure	CO_2	No	Excluded for simplification.
		CH_4	No	In the project, the storage time of the manure after removal from the animal barns, including transportation, is within 24 hours before being fed into the anaerobic digester, hence emissions from the storage of manure are not accounted for.
		N_2O	No	Excluded for simplification.

3.4 Baseline Scenario

As per para. 17 of AMS-III.D, the baseline scenario 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.

Hence, the baseline scenario of the project is the animal manure waste was left to decay in anaerobic manure management system (open lagoon) at the livestock farms and methane is emitted to the atmosphere directly without any methane recovery and destruction facility.

3.5 Additionality

As per para. 15-16 of applied methodology AMS-III.D, project activities may demonstrate the additionality by showing that there is no regulation in the host country, applicable to the project site, that requires the collection and destruction of methane from livestock manure. If so, it is not required to apply the "Guidelines on the demonstration of additionality of small-scale project activities". This additionality condition also applies to Greenfield project activities. Furthermore, for project activities applying this methodology in combination with a Type I methodology, that has an energy component whose installed capacity is less than 5 MW, this procedure for additionality demonstration also applies to that component.

In line with AMS-III.D, the project recovers biogas to generate electricity with a total designed installed capacity of 1 MW, which is lower than 5MW. The regulations relative to the project in China are identified as below.

a) Law of the People's Republic of China on Environment Protection;

b) Law of the People's Republic of China on the Prevention and Control of Solid Waste Pollution;

c) Law of the People's Republic of China on the Prevention and Control of Atmospheric Pollution;

d) Regulations on prevention and control of pollution from intensive livestock and poultry breeding;

e) Discharge standard of pollutants for livestock and poultry breeding (GB 18596).

It has been identified that all the above laws and regulations in China do not require the collection and destruction of methane from livestock manure. In line with AMS-III.D, the project is deemed automatically additional.

3.6 Methodology Deviations

There is no methodology deviation for the project.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

According to the methodology AMS-III.D, baseline emissions (BE_y) are calculated by using one of the following two options:

(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 2019 Refinement to 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 (B_o);

(b) Using the amount of manure that would decay anaerobically in the absence of the project activity based on direct measurement of the quantity of manure treated together with its specific volatile solids (*SVS*) content.

The project applies option (b) to calculate baseline emissions from the manure treatment processes (BE_y).

$$BE_y = GWP_{CH4} \times D_{CH4} \times UF_b \times \sum_{j,LT} MCF_j \times B_{0,LT} \times Q_{manure,j,LT,y} \times SVS_{j,LT,y} \quad \text{Equation (1)}$$

Where:

BE_y = Baseline emissions in year *y* (t CO_2e)

GWP_{CH4} = Global Warming Potential (GWP) of CH_4 applicable to the crediting period (t CO_2e/t CH_4)

D_{CH4} = CH_4 density (0.00067 t/m^3 at room temperature (20°C) and 1 atm pressure)

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

LT = Index for all types of livestock

j = Index for animal manure management system

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

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

MCF_j = Annual methane conversion factor (MCF) for the baseline animal manure management system *j*, as per paragraph 18 of AMS-III.D

$B_{0,LT}$ = Maximum methane producing potential of the volatile solid generated for animal type *LT* (m^3 CH_4/kg-dm), as per paragraph 18 of AMS-III.D

1) The maximum methane-producing capacity of the manure ($B_{o,LT}$) varies by species and diet. The preferred method to obtain $B_{o,LT}$ measurement values is to use data from country-specific published sources, measured with a standardised method ($B_{o,LT}$) shall be based on total as-excreted *VS*. These values shall be compared to IPCC default values and any significant differences shall be explained. If country specific $B_{o,LT}$ values are not available, default values from tables 10.16A (UPDATED) of *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10* can be used, provided that the project participants assess the suitability of those data to the specific situation of the treatment site.

As per table 10.16A (UPDATED) of *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10*, the maximum methane producing potential (B_0) for dairy swine from other regions with low productivity systems is 0.29 m^3/kg-dm.

2) Methane Conversion Factors (*MCF*) values are determined for a specific manure management system and represent the degree to which $B_{o,LT}$ is achieved. Where available country-specific *MCF* values that reflect the specific management systems used in particular countries or regions shall be used. Alternatively, the IPCC default values provided in table 10.17 (UPDATED) of *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10* can be used. The site annual average temperature is taken from official data at the nearest meteorological station, or from data available from historical on-site observations.

Please refer to section 4.4 about the ex-ante calculation.

4.2 Project Emissions

According to the methodology AMS-III.D, project emissions consist of:

(1) Physical leakage of biogas in the manure management systems which includes production, collection and transport of biogas to the point of flaring/combustion or gainful use ($PE_{PL,y}$);

(2) Emissions from flaring or combustion of the gas stream ($PE_{flare,y}$);

(3) CO_2 emissions from use of fossil fuels or electricity for the operation of all the installed facilities ($PE_{power,y}$);

(4) CO_2 emissions from incremental transportation distances;

(5) Emissions from the storage of manure before being fed into the anaerobic digester ($PE_{storage,y}$).

$$PE_y = PE_{PL,y} + PE_{flare,y} + PE_{power,y} + PE_{transp,y} + PE_{storage,y} \quad \text{Equation (2)}$$

Where:

PE_y = Project emissions in year *y* (t CO_2e)

$PE_{PL,y}$ = Emissions due to physical leakage of biogas in year *y* (t CO_2e)

$PE_{flare,y}$ = Emissions from flaring or combustion of the biogas stream in the year *y* (t CO_2e)

$PE_{power,y}$ = Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year *y* (t CO_2e)

$PE_{transp,y}$ = Emissions from incremental transportation in the year *y* (t CO_2e), as per relevant paragraph in AMS-III.AO

$PE_{storage,y}$ = Emissions from the storage of manure (t CO_2e)

1. Emissions due to physical leakage of biogas in year *y*

Project emissions due to physical leakage of biogas from the animal manure management systems used to produce, collect and transport the biogas to the point of flaring or gainful use are estimated as:

(a) 10% of the maximum methane producing potential of the manure fed into the management systems implemented by the project activity:[5]

Since the option in paragraph 1(b) of AMS-III.D is chosen, thus, $PE_{PL,y}$ is determined as:

$$PE_{PL,y} = 0.10 \times GWP_{CH4} \times D_{CH4} \times \sum_{i,LT} B_{0,LT} \times Q_{manure,LT,y} \times SVS_{LT,y} \times MS\%_{i,y} \quad \text{Equation (3)}$$

Where:

$MS\%_{i,y}$ = Fraction of manure handled in system *i* in year *y*

[5] 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 10 guidelines specify a default value of 10% of the maximum methane producing potential (Bo) for the physical leakages from anaerobic digesters.

If the project activity involves sequential manure management systems, the procedure specified in paragraph 18(e) of AMS-III.D shall be used to estimate the project emissions due to physical leakage of biogas in each stage

(b) Optionally, the relevant procedure in the methodological tool 14 "Project and leakage emissions from anaerobic digesters" may be followed. In such a case, $PE_{PL,y}$ is equivalent to $PE_{CH4,y}$ in the tool.

For the project, option (a) is adopted.

2. Emissions from flaring or combustion of the biogas stream in the year y

In the case of flaring of the recovered biogas, project emissions are estimated using the procedures described in the methodological tool "Project emissions from flaring" (version 03.0).

Based on the EIA, all the methane generated by the project will be used as energy supply. In order to ensure no biogas is released under exigencies, an emergency flare system is installed at the project site, this emergency flare system is not used under normal operation. In addition, in case this emergency flare system operated, the emissions reductions during this period will be excluded for conservativeness, thus $PE_{flare,y}$ is excluded as well, so $PE_{flare,y}$ = 0 tCO_2e.

3. Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year y

Project emissions from electricity and fossil fuel consumption are determined by following the methodological tool 14 "Project and leakage emissions from anaerobic digesters", where $PE_{Power,y}$ is the sum of $PE_{EC,y}$ and $PE_{FC,y}$ in the tool.

The project does not use any fossil fuel, so $PE_{FC,y}$ is not included in the project emissions.

If the electricity consumed is generated on-site using biomass residues, wind, hydro or geothermal power, then $PE_{EC,y}$=0. Otherwise, the project participants may choose between the following two options to calculate.

Option 1: Procedure using monitored data. $PE_{EC,y}$ shall be calculated using the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", where the project emission sources *j* referred to in the tool is the total electricity consumption associated with the anaerobic digestion facility.

Option 2: Procedure using a default value.

Cause there is no specidicated electricity monitoring equipment for the project facilities, while the quantity of the methane produced in the anaerobic digester can be accurately measured the Option 2 is chosen. Under this option, project emissions from electricity consumption associated with the anaerobic digester are calculated as follows:

$$PE_{EC,y} = Q_{CH4,y} \times F_{EC,default} \times EF_{EL,default}$$ Equation (4)

$PE_{EC,y}$ = Project emissions from electricity consumption associated with the anaerobic digester in year *y* (t CO_2)

$Q_{CH4,y}$ = Quantity of methane produced in the anaerobic digester in year *y* (t CH_4)

$F_{EC,default}$ = Default factor for the electricity consumption associated with the anaerobic digester per ton of methane generated (MWh / t CH_4)

$EF_{EL,default}$ = Default emission factor for the electricity consumed in year y (t CO_2 / MWh)

There are two different procedures to determine the quantity of methane produced in the digester in year *y* ($Q_{CH4,y}$). For large scale projects only Option A shall be used. For small scale projects, project participants may choose between Option A or Option B.

Option A: Procedure using monitored data

$Q_{CH4,y}$ shall be measured using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream". When applying the tool, the following applies:

(a) The gaseous stream to which the tool is applied is the biogas collected from the digester;

(b) CH_4 is the greenhouse gas i for which the mass flow should be determined; and

(c) The flow of the gaseous stream should be measured on an hourly basis or a smaller time interval; and then accumulated for the year *y*. Please note that units need to be converted to tons, when applying the results in this tool.

Option B: Procedure using a default value

$$Q_{CH4,y} = Q_{biogas,y} \times f_{CH4,default} \times \rho_{CH4}$$ Equation (5)

Where:

$Q_{CH4,y}$ = Quantity of methane produced in the anaerobic digester in year *y* (t CH_4)

$Q_{biogas,y}$ = Amount of biogas collected at the digester outlet in year *y* (Nm^3 biogas)

$f_{CH4,default}$ = Default value for the fraction of methane in the biogas (m^3 CH_4/ m^3 biogas)

ρ_{CH4} = Density of methane at normal conditions (t CH_4/ Nm^3 CH_4)

If missing data are encountered in the course of determining amount of biogas collected at the digester outlet ($Q_{biogas,y}$), it may be substituted by following the instruction from paragraph 3 of Appendix to the 'Methodological tool: Tool to determine the mass flow of a greenhouse gas in a gaseous stream'. This provision is applicable for project activities or PoAs, where end users of the subsystems or measures are households/ communities/ small and medium enterprises (SMEs).

We measured the flow rate of biogas, therefore Option B is adopted.

$f_{CH4,default}$ can apply a value of 60% biogas corrected to reference conditions. The default value was provided by tool 14 and was derived based on reported values from registered projects and research papers.

ρ_{CH4} can apply a value of 0.00067 t CH_4/ m^3 CH_4.

The values of $F_{EC,default}$ use the default value from tool 14. $F_{EC,default}$=0: The tool 14 specifies that for conventional digesters with continuously stirred tank reactor type for wastewater, $F_{EC,default}$= 1.02 MWh/ t CH_4. According to the EIA report, the project is conventional digesters with continuously stirred tank reactor type for wastewater. So the project $F_{EC,default}$ can apply a value of 1.02 MWh/ t CH_4.

According to the tool 14, the $EF_{EL,default}$ can apply a value of 1.3 tCO_2/MWh.

4. Emissions from incremental transportation in the year *y*

The project has no incremental transportation compared to the baseline scenario, so there are no emissions from incremental transportation. $PE_{transp,y}$ = 0.

5. Emissions from the storage of manure

Project emissions on account of storage of manure before being fed into the anaerobic digester shall be accounted for if both conditions (a) and (b) below are satisfied:

(a) The storage time of the manure after removal from the animal barns, including transportation, exceeds 24 hours before being fed into the anaerobic digester;

(b) The dry matter content of the manure when removed from the animal barns is less than 20%.

The storage time of the manure after removal from the animal barns, including transportation, is within 24 hours before being fed into the anaerobic digester, hence emissions from the storage of manure is not accounted for, $PE_{storage,y}$ = 0 tCO_2e.

In conclusion, the project emissions of the project activity is calculated as follows:

$$PE_y = PE_{PL,y} + PE_{power,y} + PE_{transp,y} \quad \text{Equation (6)}$$

Where

PE_y = Project emissions in year *y* (t CO_2e)

$PE_{PL,y}$ = Emissions due to physical leakage of biogas in year *y* (t CO_2e)

$PE_{power,y}$ = Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year *y* (t CO_2e)

$PE_{transp,y}$ = Emissions from incremental transportation in the year *y* (t CO_2e)

Please refer to section 4.4 for detailed calculation process of project emissions.

4.3 Leakage

As per Tool 14"Project and leakage emissions from anaerobic digesters" (version 02.0), the leakage emissions associated with the anaerobic digester depend on how the digestate is managed. The leakage emissions include emissions associated with storage of digestate and composting of the digestate.

As per the EIA report of the project, after anaerobic digestion, the digestate is used for aerobic agriculture fertilization in nearby farmlands for free as soon as it is removed from the digester. Digestate will not be stored under anaerobic conditions. In addition, the project activity does not involve composting of digestate or anaerobic decay of digestate disposed in a SWDS or subjected to anaerobic storage, such as in a stabilization pond. Therefore, leakage emissions of the project associated with the anaerobic digester are not accounted for, leakage emissions are 0.

4.4 Net GHG Emission Reductions and Removals

The emission reductions ER_y by the project during a given year y is the difference between the baseline emissions (BE_y) and the sum of project emissions (PE_y), as follows:

$$ER_y = BE_y - PE_y \quad \text{Equation (7)}$$

Further, the emission reductions achieved by the project activity will be determined ex post through direct measurement of the amount of methane fuelled, flared or gainfully used. It is likely that the project activity involves manure treatment steps with higher methane conversion factors (*MCF*) than the *MCF* for the manure treatment systems used in the baseline situation, therefore the emission reductions achieved by the project activity are limited to the ex post calculated baseline emissions minus the project emissions using the actual monitored data for the project activity (i.e. $N_{LT,y}$, $MS\%_{i,y}$, $MS\%_{I}$, All, as well as $VS_{LT,y}$ in cases where adjusted values

for animal weight are used). The emission reductions achieved in any year are the lowest value of the following:

$$ER_{y,ex\ post} = min\left[\left(BE_{y,ex\ post} - PE_{y,ex\ post}\right), \left(MD_y - PE_{power,y,ex\ post}\right)\right] \quad \text{Equation (8)}$$

Where:

$ER_{y,ex\ post}$ = Emission reductions achieved by the project activity based on monitored values for year *y* (t CO_2e)

$BE_{y,ex\ post}$ = Baseline emissions calculated using equation 1 (for projects using option in paragraph 17(a) of AMS-III.D) using ex post monitored values of $N_{LT,y}$ and if applicable $VS_{LT,y}$. For projects using option in paragraph 17(b) of AMS-III.D, the ex post monitored values for $Q_{manure,j,LT,y}$ and $SVS_{j,LT,y}$ are used

$PE_{y,ex\ post}$ = Project emissions calculated using equation 6 of AMS-III.D using ex post monitored values of $N_{LT,y}$,$MS\%_{\ i,y,}$ $MS\%_{\ l,}$ $AI_{l,}$ $Q_{res\ waste,y}$ and if applicable $VS_{LT,y}$

MD_y = Methane captured and destroyed or used gainfully by the project activity in year *y* (t CO_2e)

$PE_{power,y,ex\ post}$ = Emissions from the use of fossil fuel or electricity for the operation of the installed facilities based on monitored values in the year *y* (t CO_2e)

Biogas flared or combusted, (MD_y) shall be determined using the flare efficiency and methane content of biogas.

$$MD_y = BG_{burnt,y} \times w_{CH4,y} \times D_{CH4} \times FE \times GWP_{CH4} \quad \text{Equation (9)}$$

Where:

$BG_{burnt,y}$ = Biogas flared or combusted in year *y* (m^3)

$w_{CH4,y}$ = Methane content in biogas in the year *y* (volume fraction)

FE = Flare efficiency in the year *y* (fraction)

Alternatively, if project activities utilize the recovered methane for power generation, MD_y may be calculated as follows, based on the amount of monitored electricity generation, without monitoring methane flow and concentration.

$$MD_y = \frac{EG_y \times 3600}{NCV_{CH4} \times EE_y} \times D_{CH4} \times GWP_{CH4}$$ Equation (10)

Where:

EG_y = Total electricity generated from the recovered biogas in year *y* (MWh)

3600 = Conversion factor (1 MWh = 3600 MJ)

NCV_{CH4} = NCV of methane (MJ/Nm^3) (use default value: 35.9 MJ/Nm^3)

EE_y = Energy conversion efficiency of the project equipment, which is determined by adopting one of the following criteria:

- Specification provided by the equipment manufacture. The equipment shall be designed to utilize biogas as fuel, and efficiency specification is for this fuel. If the specification provides a range of efficiency values, the highest value of the range shall be used for the calculation;
- Default efficiency of 40%.

As per described above, Ex-ante calculation of GHG emission reductions is as following:

1.Calculation of baseline emissions:

Based on section 4.1, the baseline emissions are calculated as follows:

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

Table 4-1 Ex-ante value of parameters to calculate BE_y

Parameter	Value	Data sources
GWP_{CH4}	28 t CO_2e/t CH_4	IPCC Fifth Assessment Report (AR5)
D_{CH4}	0.00067 t/m^3	AMS-III.D
UF_b	0.94	AMS-III.D
MCF_j	76%	Table 10.17 (UPDATED) of *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10*

$B_{O,LT}$	0.29 m^3CH_4/kg-dm	Table 10.16A (UPDATED) of *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10*
$Q_{manure,j,LT,y}$	26,400 t/year	FSR
$SVS_{j,LT,y}$	615 kg-dm/t	FSR

Hence, the ex-ante calculated baseline emissions of methane from the manure treatment processes of the project are:

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

=28×0.00067×0.94×76%×0.29×26,400×615

=63,103 t CO_2e

2. Calculation of project emissions

Table 4-2 Ex-ante value of parameters to calculate project emissions

Parameter	Value	Data sources
GWP_{CH4}	28 t CO_2e/t CH_4	IPCC Fifth Assessment Report (AR5)
D_{CH4}	0.00067 t/m^3	AMS-III.D
$B_{O,LT}$	0.29 m^3CH_4/kg-dm	Table 10.16A (UPDATED) of *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10*
$Q_{manure,j,LT,y}$	26,400 t/year	FSR
$SVS_{j,LT,y}$	615 kg-dm/t	FSR
$MS\%_{i,y}$	100%	EIA
$Q_{biogas,y}$	3,450,000 Nm^3	EIA
$f_{CH4,default}$	0.6	Tool 14
ρ_{CH4}	0.00067t/m^3	Tool 14
$F_{EC,default}$	1.02 MWh/tCH_4	Tool 14
$EF_{EL,default}$	1.3	Tool 14

2.1 Emissions due to physical leakage of biogas in year y

As described in 4.2, project emissions due to physical leakage of biogas is calculated as below:

$$PE_{PL,y} = 0.10 \times GWP_{CH4} \times D_{CH4} \times \sum_{i,LT} B_{0,LT} \times Q_{manure,LT,y} \times SVS_{LT,y} \times MS\%_{i,y}$$

=0.10×28×0.00067×0.29×26,400×615×100%

=8,833 t CO_2e

2.2 Emissions from flaring or combustion of the biogas stream in the year y

As described in 4.2, $PE_{flare,y}$ is excluded, hence $PE_{flare,y}$ = 0 t CO_2e.

2.3 Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year y

As described in 4.2, the project does not use any fossil fuel, so $PE_{FC,y}$ is not included in the project emissions.

According to equations (4) and (5).

$$PE_{power,y} = PE_{EC,y} = Q_{biogas,y} \times f_{CH4,default} \times \rho_{CH4} \times F_{EC,default} \times EF_{EL,default}$$

= 3,450,000×0.6×0.00067×1.02×1.3

= 1,839 t CO_2e

2.4 Emissions from incremental transportation in the year y

As described in 4.2, $PE_{transp,y}$ is excluded, hence $PE_{transp,y}$ = 0 for the project.

2.5 Emissions from the storage of manure

As described in 4.2, $PE_{storage,y}$ is excluded, hence emissions from the storage of manure are not accounted for, $PE_{storage,y}$ = 0 tCO_2e.

So, the ex-ante estimated project emissions shall calculate as per equation (2):

$PE_y = PE_{PL,y} + PE_{flare,y} + PE_{power,y} + PE_{transp,y} + PE_{storage,y}$ = 10,672 tCO_2e

3. Calculation of leakage

As described above, leakage is 0.

4. Calculation of emission reductions

For the project, the emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$

=63,103-10,672

=52,431 tCO_2e

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
05-May-2022~31-Dec-2022	41,665	7,046	0	34,619
01-Jan-2023~31-Dec-2023	63,103	10,672	0	52,431
01-Jan-2024~31-Dec-2024	63,103	10,672	0	52,431
01-Jan-2025~31-Dec-2025	63,103	10,672	0	52,431
01-Jan-2026~31-Dec-2026	63,103	10,672	0	52,431
01-Jan-2027~31-Dec-2027	63,103	10,672	0	52,431
01-Jan-2028~31-Dec-2028	63,103	10,672	0	52,431
01-Jan-2029~04-May-2029	21,438	3,626	0	17,812
Total	441,722	74,704	0	367,018

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	GWP_{CH4}
Data unit	t CO_2e/t CH_4
Description	Global Warming Potential (GWP) of CH_4 applicable to the crediting period
Source of data	IPCC
Value applied	28
Justification of choice of data or description of measurement methods and procedures applied	Default value of 28 from IPCC Fifth Assessment Report (AR5). Shall be updated according to any future revision to VCS standard by VERRA.
Purpose of Data	Calculation of baseline emissions

	Calculation of project emissions
Comments	-

Data / Parameter	D_{CH4}
Data unit	t/m^3
Description	Density of CH_4
Source of data	AMS-III.D
Value applied	0.00067 (at 20° C and 1 atm pressure)
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline emissions Calculation of project emissions
Comments	-

Data / Parameter	UF_b
Data unit	-
Description	Model correction factor to account for model uncertainties
Source of data	AMS-III.D
Value applied	0.94
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	MCF_j
Data unit	-

Description	Annual methane conversion factor (MCF) for the baseline animal manure management system j
Source of data	2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.
Value applied	76%
Justification of choice of data or description of measurement methods and procedures applied	No country or regional specific value is available. Default value from table 10.17 (UPDATED) of *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10* is applied. In the project, the anaerobic manure treatment facility in the baseline is uncovered anaerobic lagoon, and the annual average ambient temperature at the site where baseline AWMS existed is 19.6°C, therefore, MCF_j value is adopted accordingly.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$B_{0,LT}$
Data unit	$m^3CH_4/kg\text{-}dm$
Description	Maximum methane producing potential of the volatile solid generated for animal type *LT*
Source of data	Table 10.16A (UPDATED) of *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10.*
Value applied	0.29
Justification of choice of data or description of measurement methods and procedures applied	No country or regional specific value is available. The proposed project is located in Jiangxi Province, China, Asia. Thus, the default value $B_{0,LT}$ of market swine from table 10.16A (UPDATED) of *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10* is applied.
Purpose of Data	Calculation of baseline emissions Calculation of project emissions
Comments	-

Data / Parameter	$MS\%_{i,y}$

Data unit	-
Description	Fraction of manure handled in system i in year *y*
Source of data	AMS-III.D
Value applied	100%
Justification of choice of data or description of measurement methods and procedures applied	The project does not involve sequential manure management system, hence all manure would be handled in system i, 100% is applied for $MS\%_{i,y}$.
Purpose of Data	Calculation of project emissions
Comments	-

Data / Parameter	$f_{CH4,default}$
Data unit	m^3 CH_4 / m^3 biogas
Description	Default value for the fraction of methane in the biogas
Source of data	Tool 14 "Project and leakage emissions from anaerobic digesters" (Version 02.0).
Value applied	0.6
Justification of choice of data or description of measurement methods and procedures applied	Default value of 0.6 m^3 CH_4 / m^3 biogas is applied.
Purpose of Data	Calculation of project emissions
Comments	-

Data / Parameter	ρ_{CH4}
Data unit	t CH_4 / m^3 CH_4
Description	Density of methane at normal conditions
Source of data	Tool 14 "Project and leakage emissions from anaerobic digesters" (Version 02.0).
Value applied	0.00067

Justification of choice of data or description of measurement methods and procedures applied	Default value of 0.00067t CH_4/m^3 CH_4 is applied.
Purpose of Data	Calculation of project emissions
Comments	-

Data / Parameter	$F_{EC,default}$
Data unit	MWh / t CH_4
Description	Default factor for the electricity consumption associated with the anaerobic digester per ton of CH_4 generated
Source of data	Tool 14 "Project and leakage emissions from anaerobic digesters" (Version 02.0).
Value applied	1.02
Justification of choice of data or description of measurement methods and procedures applied	● 0 - Covered anaerobic lagoons (gravity fed) / conventional digesters; ● 0.01 - upflow anaerobic sludge blanket reactor (UASB) / filter bed reactor for wastewater / fluidized bed reactor; ● 1.02 - Conventional digesters with continuously stirred tank reactor type for wastewater; ● 1.54 - Any anaerobic digester for solid waste with preprocessing of wastes (e.g. pulverizing). For digesters other than those specified above, which are fed by gravity, and have no recirculation and therefore no electrical energy is required to operate, apply a value of 0. The project is conventional digesters with continuously stirred tank reactor type. So the project $F_{EC,default}$ can apply a value of 1.02 MWh / t CH_4.
Purpose of Data	Calculation of project emissions
Comments	-

Data / Parameter	$EF_{EL,default}$

Data unit	t CO_2 / MWh
Description	Default emission factor for the electricity consumed in year *y*
Source of data	Tool 14 "Project and leakage emissions from anaerobic digesters" (Version 02.0).
Value applied	1.3
Justification of choice of data or description of measurement methods and procedures applied	Default value of 1.3 t CO_2/MWh is applied
Purpose of Data	Calculation of project emissions
Comments	-

Data / Parameter	*FE*
Data unit	-
Description	The flare efficiency
Source of data	Project emissions from flaring (version 03.0)
Value applied	90%
Justification of choice of data or description of measurement methods and procedures applied	Default value of 90% is applied
Purpose of Data	Calculation of emission reductions
Comments	-

Data / Parameter	$W_{CH4,y}$
Data unit	-
Description	Methane content in biogas in the year *y* (volume fraction)
Source of data	AMS-III.D default value
Value applied	60%
Justification of choice of	Default value of 60% is applied as per AMS-III.D

data or description of measurement methods and procedures applied	
Purpose of Data	Calculation of emission reductions
Comments	-

5.2 Data and Parameters Monitored

Data / Parameter	$Q_{manure,j,LT,y}$
Data unit	t/year
Description	Quantity of manure treated from livestock type *LT* at animal manure management system j (dry basis)
Source of data	Ex-post values are from operation records Ex-ante values are sourced from FSR.
Description of measurement methods and procedures to be applied	Quantity of manure (wet basis) is measured by electric truck scale at the project site daily by project staff and recorded in the monthly operation records. Water content of manure (wet basis) is measured by electric scale as per GB/T25169 Technical specifications for monitoring of animal manure and then recorded in the monthly operation records.
Frequency of monitoring/recording	Annually, based on daily measurement and monthly aggregation
Value applied	26,400 for ex ante estimation
Monitoring equipment	Electric truck scale, electric scale
QA/QC procedures to be applied	Monitoring equipment is to be calibrated at periodic interval as per national regulations. The quantity of animal manure from different farms shall be recorded separately for crosscheck.
Purpose of data	Calculation of baseline emissions Calculation of project emissions
Calculation method	Quantity of manure (dry basis) = quantity of manure (wet basis)×(1-water content of manure (wet basis))
Comments	-

Data / Parameter	$SVS_{j,LT,y}$
Data unit	Kg-dm/t
Description	Specific volatile solids content of animal manure from livestock type LT and animal manure management system *j* in year *y*
Source of data	Ex-post values are from operation records Ex-ante values are sourced from FSR.
Description of measurement methods and procedures to be applied	The Specific volatile solids content of animal manure is measured by lab staff daily and recorded in the monthly operation records. Method for determination of Volatile Solids in animal waste. From: USDA. Agricultural Waste Management Field Handbook. Chapter 4 - Agricultural Waste Characteristics. Page 2. Definitions • Total Solids: Residue remaining after water is removed from waste material by evaporation; dry matter; • Volatile Solids: The part of total solids driven off as volatile (combustible) gases when heated to 600°C; organic matter; • Fixed Solids: The part of total solids remaining after volatile gases driven off at 600°C; ashes. Determination method 1 Evaporate free water on steam able and dry in oven at 103 °C for 24 hours or until constant weight to obtain the Total Solids. 2 Place Total Solids residue in furnace at 600°C for at least 1 hour. Volatile Solids are determined from weight difference of total and Fixed Solids. Volatile matter (drybasis)=$\frac{W_2-W_f}{W_2-W_1}$ Where W_1 is the weight of sample container, W_2 is combined weight of the sample container and oven dried sample, W_f is the combined constant weight of the sample container and sample after heating at 600°C.
Frequency of monitoring/recording	Annually
Value applied	615 for ex ante estimation
Monitoring equipment	Electric scales
QA/QC procedures to be	Monitoring equipment is to be calibrated at periodic interval as

applied	per national regulations.
Purpose of data	Calculation of baseline emissions Calculation of project emissions
Calculation method	-
Comments	-

Data / Parameter	$Q_{biogas,y}$
Data unit	Nm^3
Description	Amount of biogas collected at the digester outlet in year *y*
Source of data	Ex-post values are from operation records Ex-ante values are sourced from EIA of the project
Description of measurement methods and procedures to be applied	The amount of biogas collected at the digester outlet shall be monitored ex post by flow meter. Continuously measured by flow meter. The meter readings will be automatically converted to value at room temperature (20 °C) and 1 atm pressure. The flow meter will be read by project staff and recorded daily in the monthly operation records.
Frequency of monitoring/recording	Annually, based on continuous flow measurement with accumulated volume recording
Value applied	3,450,000 for ex ante estimation
Monitoring equipment	Flow meter
QA/QC procedures to be applied	Flow meter will be calibrated at periodic interval as per national regulations.
Purpose of data	Calculation of project emissions
Calculation method	-
Comments	-

Data / Parameter	$BG_{burnt,y}$
Data unit	m^3
Description	Biogas flared or combusted in year *y*

Source of data	Ex-post values are from operation records Ex-ante values are sourced from EIA of the project
Description of measurement methods and procedures to be applied	The amount of biogas recovered and flared or used gainfully shall be monitored ex post, using flow meters. Continuously measured by flow meter with temperature sensor and pressure sensor. The meter readings will be automatically converted to value at room temperature (20 °C) and 1 atm pressure.
Frequency of monitoring/recording	Annually, based on continuous flow measurement with accumulated volume recording.
Value applied	3,450,000 for ex ante estimation
Monitoring equipment	Flow meter
QA/QC procedures to be applied	Flow meter will be calibrated at periodic interval as per national regulations.
Purpose of data	Calculation of project emissions
Calculation method	-
Comments	-

5.3 Monitoring Plan

The monitoring plan presented in this PD assures that real, measurable, long-term GHG emission reductions can be monitored, recorded and reported. It is a crucial procedure to identify the final VCUs of the project. This monitoring plan will be implemented by the project owner during the project operation. The details of the monitoring plan are specified as follows:

(A) Monitoring structure

The Project owner organizes a specific VCS team in project development department to be responsible for data collection, supervision and witness the whole process of data measuring and recording. A VCS manager is appointed to take full responsibility for the overall monitoring of the project. The monitoring and measurement are to be carried out by designated monitoring officers. In addition, the Project developer appoints internal verifiers who is responsible for internal check of the measurement, collection of relevant receipts and invoices, and the calculation of the emission reductions. A monitoring and management manual of the project that identifies detailed duties and responsibilities of the relevant parties is developed and served as the basis of the project monitoring. Figure 5-1 shows the operation and management structure of the Project.

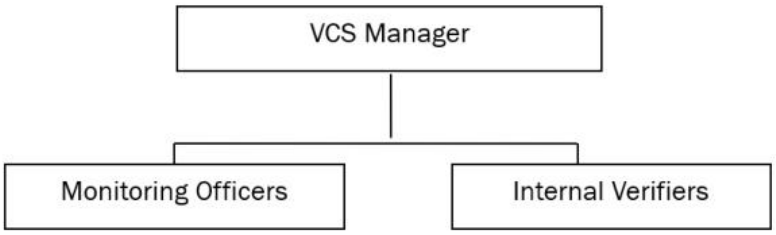

Figure 5-1 Operation and management structure of the project

(B) Data and parameters to be monitored

Table 5-1 Data and parameters to be monitored

Equipment No.	Parameter to be Monitored	Description
E1	$Q_{manure,j,LT,y}$	Quantity of manure treated from livestock type LT at animal manure management system j (dry basis), calculated as follows: Quantity of manure (dry basis) = quantity of manure (wet basis)×(1-water content of manure (wet basis)) Quantity of manure (wet basis) is measured by electric truck scale. Water content of manure (wet basis) is measured by electric scale as per GB/T25169 Technical specifications for monitoring of animal manure
E2	$SVS_{j,LT,y}$	Specific volatile solids content of animal manure from livestock type LT and animal manure management system j in year y is measured as per the guideline in annex 2 of AM0073
E3	$Q_{biogas,y}$	For the project, the flow meters is installed at the outlet of the anaerobic digester. Flow meters will undergo maintenance/calibration subject to appropriate industry standards. The monitoring frequency should be continuous. The biogas flow will be daily accumulated reading.
E4	$BG_{burnt,y}$	Biogas flared or combusted in year y is continuously measured by flow meter with temperature sensor and pressure sensor. The meter readins will be automatically converted to value at room temperature (20 ℃) and 1 atm pressure

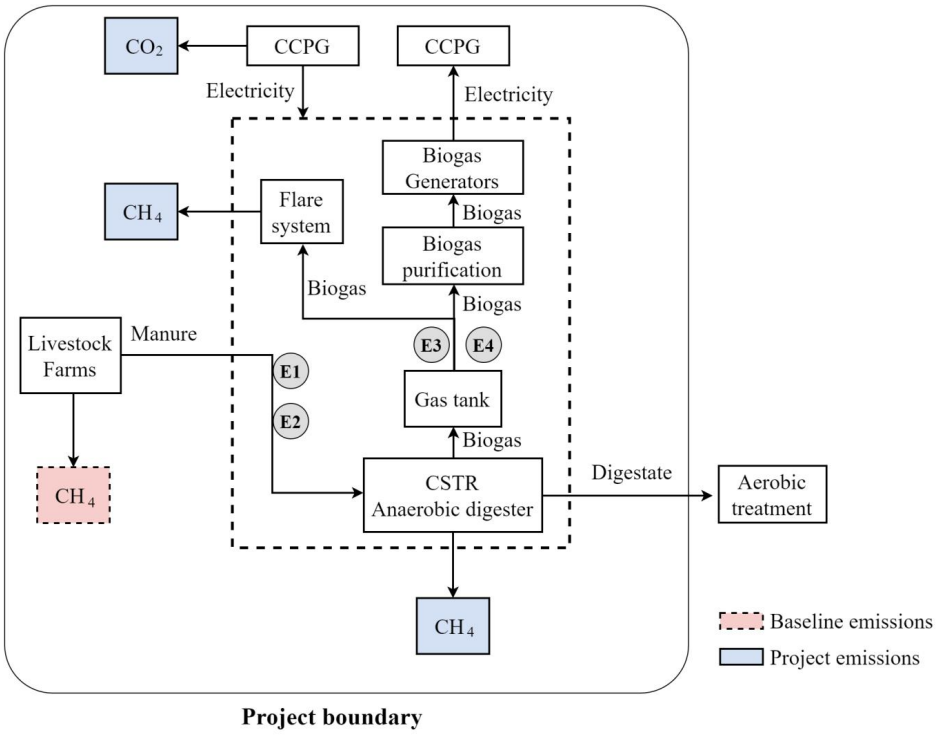

Figure 5-2 Project monitoring diagram

(C) Data collection

Monitoring officers are responsible for data collection. Designated teams will read and collect the monitored data regularly. The computer system will automatically monitor and record relevant meter data. Automatic records will serve as the main data source for emission reductions calculation. All data files, relevant receipts will be collected by a designated monitoring officer, who will prepare backup in time and archive all documents properly.

(D) Quality assurance

All metering equipment for monitoring will be chosen in accordance with VCS requirements and will be calibrated regularly for accuracy by qualified party according to the national regulations. To assist in future verifications, the project owner will preserve the calibration records, along with the data files of project monitoring. Calibration records and the data files of project monitoring will be archived electronically and be kept at least for 2 years after the end of the crediting period.

Error check routines will be established on site and at the point of data storage to detect data measuring/transmission failures as well as malfunctions. In the case of malfunction of the meters, the meter supplier will provide technical support to engage the problem promptly and emission reductions during the corresponding period will be calculated conservatively.

(E) Data file management

All monitoring data will be electronically filed by the end of each month and the electronic data files will be archived in both disk copy and printed hard copy. Other documents in paper e.g. forms and environment assessment reports will be preserved as well. All data collected as part of monitoring will be archived electronically and be kept at least for 2 years after the end of the crediting period. The project owner will provide original records and documents if necessary.