JINSHAN SONGLIN MARKET SWINE MANURE UTILIZATION PROJECT

Document Prepared by Climate Bridge (Shanghai) Ltd.

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Project Title	Jinshan Songlin Market Swine Manure Utilization Project
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1 PROJECT DETAILS

1.1 Summary Description of the Project

Jinshan Songlin Market Swine Manure Utilization Project (hereinafter referred to as the project) locates in Wanchun Village, Langxia Town, Jinshan District, Shanghai, P.R China. The project is owned and implemented by Shanghai Songlin Industrial & Trade Co., Ltd.

The project builds an anaerobic animal manure treatment system for the treatment of swine manure in Jinshan Modern Agricultural Park Songlin Market Swine Farm. The project uses animal manure waste as ferment material to produce biogas in the Completely Stirred Tank Reactor (CSTR) type anaerobic digesters. At this stage, part of the recovered biogas will be used to generate electricity at the biogas power plant for the daily use of the swine farm. According to the feasibility study report, the designed installed capacity of the biogas power plant is 0.52MW. Waste heat recovery boiler will also be installed at the biogas power plant to recover and supply waste heat to the auxiliary equipment of the project. The residual waste from the CSTR digesters will be used as organic fertilizer directly on agricultural land in the project vicinity.

Prior to the implementation of the project, the animal manure waste was left to decay in anaerobic manure management system (lagoon) and methane is emitted to the atmosphere directly without any methane recovery and destruction facility.

The project is expected to avoid GHG emission of methane through recovery and destruction of biogas. The project is expected to achieve an annual emission reduction of 17,340 tCO_2e and a total emission reduction of 121,384 tCO_2e during the first 7-year crediting period.

Audit Type	Period	Program	VVB Name	Number of years
Validation	-	VCS	CTI Certification Co., Ltd.	–

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, one of the Kyoto Protocol greenhouse gases: 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 is 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 approval 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 is a methodology 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 does not belong to projects that can reasonably be assumed to have generated 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. There is no additional information needed to be provided.

1.5 Project Proponent

Organization name	Shanghai Songlin Industrial & Trade Co., Ltd.
Contact person	Fu Juanlin
Title	General Manager
Address	No. 2268, Rongle East Road, Songjiang District, Shanghai, China
Telephone	+86 21 23019950
Email	3542346576@qq.com

1.6 Other Entities Involved in the Project

Organization name	Climate Bridge (Shanghai) Ltd.
Role in the project	consultant
Contact person	GAO Zhiwen
Title	General Manager
Address	Block B, Level 24, Jiangong Mansion, 33 Fushan Road, Pudong New Area, Shanghai, China 200120
Telephone	+86-21 62462036
Email	gao.zhiwen@climatebridge.com

1.7 Ownership

The project owner is Shanghai Songlin Industrial & Trade Co., Ltd. who has the legal right to control and operate the project activity. The business license, approval of the Environmental Impact Assessment (EIA), the equipment purchasing contract, and the construction contract are evidence of the ownership of the project and carbon credits generated.

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 management system was put into operation on 15-Jan-2022, which is the earliest date that the project started generating emission reductions. Thus, the project start date is 15-Jan-2022.

1.9 Project Crediting Period

This project adopts a 7-year renewable crediting period. The first crediting period is from 15-Jan-2022 to 14-Jan-2029 (both days included).

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	√
Large project	

Year	Estimated GHG emission reductions or removals (tCO_2e)
15-Jan-2022~31-Dec-2022	16,662
01-Jan-2023~31-Dec-2023	17,327
01-Jan-2024~31-Dec-2024	17,374
01-Jan-2025~31-Dec-2025	17,327
01-Jan-2026~31-Dec-2026	17,327
01-Jan-2027~31-Dec-2027	17,327
01-Jan-2028~ 20-Mar-2028	17,374
01-Jan-2029~14-Jan-2029	665
Total estimated ERs	121,384
Total number of crediting years	7
Average annual ERs	17,340

1.11 Description of the Project Activity

The project builds an anaerobic animal manure treatment system for the treatment of swine manure in Jinshan Modern Agricultural Park Songlin Market Swine Farm. 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 to generate electricity at the biogas power plant for the daily use of the swine farm. According to the feasibility study report, the designed installed capacity of the biogas power plant is 0.52MW. Waste heat recovery boiler will also be installed at the biogas power plant to recover and supply waste heat to the auxiliary equipment of the project. The residual waste from the CSTR digesters will be used as organic fertilizer directly on agricultural land in the project vicinity. The project activity is expected to have a 20-year operational lifetime.

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

The key system involved in the project are as follows:

Anaerobic animal manure management system:

The Completely Stirred Tank Reactor (CSTR) type anaerobic digesters are to be applied in the project activity. Two CSTR digesters with effective volume of 4,500m^3 and 1,200m^3 have been installed. The project is expected to produce 3,000,000 m^3 biogas per year. The biogas produced from this procedure will be pipelined to biogas pre-treatment system.

Biogas Purification System

Before electricity generation, heating or flaring, the biogas will be purified to remove impurities and moisture etc., to prevent the corrosion of the project facility. In addition, biogas should be continuously in a stable condition before it flows into gas engine or flare. The treatment consists of pre-filtration, dewatering and desulfurization, dehumidification, cooling and fine filtration.

Biogas power generation System

The biogas power plant will be installed at the project site. The total designed installed capacity of the biogas power plant will be 0.52MW. The electricity generated by the biogas power plant will be used by the swine farm. Waste heat recovery boiler will also be installed at the biogas power plant to recover and supply waste heat to the auxiliary equipment of the project.

Emergency Flare Combustion Systems

When the biogas generator set breaks down, or there is a surplus of biogas after purification, the excess biogas is burned by means of an emergency flare to ensure that it is not released directly into the environment.

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

Table 1-1 Main Equipment Parameter[1]

Parameter	Value	Unit
Completely Stirred Tank Reactor (CSTR) Type Anaerobic Digester (primary)		
Manufacturer	SHIJIAZHUANG ZHENGZHONG TECHNOLOGY INC.	-

[1] According to Equipment Purchase Contract

Number	1	-
Effective Volume	4,500	m^3
Completely Stirred Tank Reactor (CSTR) Type Anaerobic Digester (secondary)		
Manufacturer	SHIJIAZHUANG ZHENGZHONG TECHNOLOGY INC.	-
Number	1	-
Effective Volume	1,200	m^3
Electricity Generation System		
Manufacturer	PowerLink	-
Design Capacity	520	kW

1.12 Project Location

The project locates in Wanchun Village, Langxia Town, Jinshan District, Shanghai, P.R China. The geographical coordinates for the project site are east longitude 121.210741° and north latitude 30.805471°.

The geographic location of the project is shown in Figure 1-1

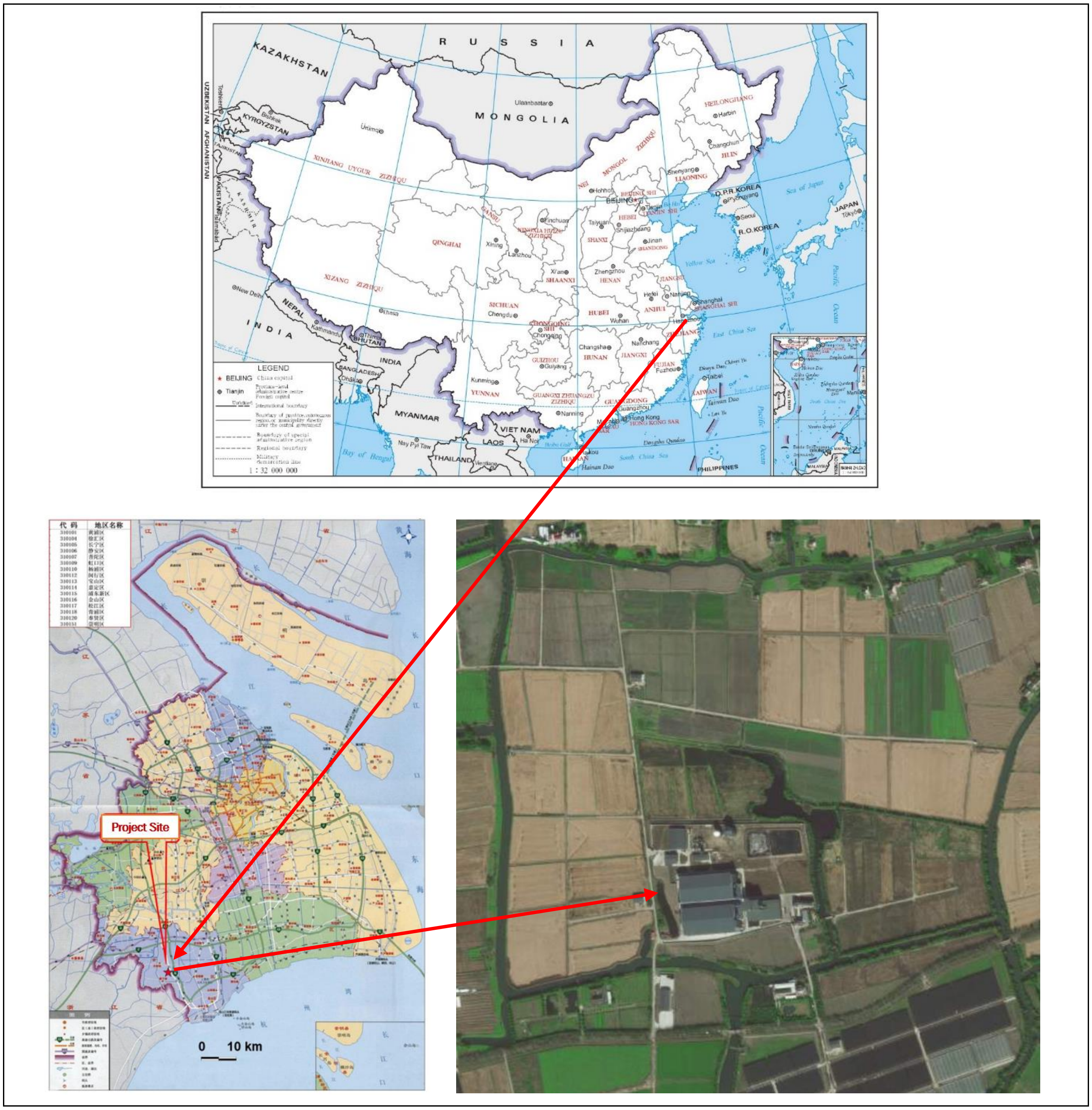

Figure 1-1 Location of the project

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 (lagoon) 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.

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];
2. Law of the People's Republic of China on the Prevention and Control of Solid Waste Pollution[3];
3. Regulations on prevention and control of pollution from large scale livestock and poultry breeding[4]
4. Catalogue for the Guidance of Industrial Structure Adjustment (2019 revision)[5];

The project has obtained the project approval and EIA approval from local government authorities: Shanghai Agriculture and Rural Committee and Shanghai Jinshan District Ecological 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

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[2] http://www.china-npa.org/uploads/1/file/public/201803/20180327160313_j8uwkhdxgn.pdf

[3] https://www.mee.gov.cn/ywgz/fgbz/fl/202004/t20200430_777580.shtml

[4] http://www.gov.cn/flfg/2013-11/26/content_2535095.htm

[5] http://www.gov.cn/xinwen/2019-11/06/content_5449193.htm

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

As per para 23 on page 83 of “VCS-Standard-v4.5”, this sub-section will be effective on or after 1 March 2024, and public statements are required for all emission reductions and removals associated with impacted goods or services for which VCUs may be requested from this date onwards. The statements required in this sub-section will be provided in the future.

1.17 Sustainable Development Contributions

The project uses animal manure waste as ferment material to produce biogas for electricity generation, at Wanchun Village, Langxia Town, Jinshan District, Shanghai, P.R China. The project achieves significant GHG emission reductions by destroying biogas that would have been vented directly into the atmosphere in the absence of the project activity. The project also provides long-term job opportunities to local people and contributes to the economic prosperity.

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

- This project will increase income of local residences and accelerate economy development in rural areas. Thus, the project will achieve SDG 8 “Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all”[6].
- The project activity will substantially reduce waste generation through prevention, reduction, recycling and reuse. Thus, the project will achieve SDG 12 “Ensure sustainable consumption and production patterns”[7].
- The project will achieve a GHG emission reduction during the crediting period. The project will recover and destroy biogas that would otherwise be released directly into the atmosphere, effectively reducing greenhouse gas emissions, which contributes to China’s commitment to peak carbon dioxide emissions before 2030. Thus, the project will achieve SDG 13 “Take urgent action to combat climate change and its impacts”[8].

The Project will contribute to sustainable development, please check the following table:

[6] https://sdgs.un.org/goals/goal8

[7] https://sdgs.un.org/goals/goal12

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

SDG	Indicators	Chinese Sustainable Development Progress	Project activity contribution
	SDG 8 “Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all”.	China has deeply implemented the innovation-driven development strategy, and small, medium and micro enterprises have developed rapidly. Adhering to the policy of giving priority to employment, the unemployment rate has remained at a low level. By coordinating epidemic prevention and control with economic and social development, China has become the only major economy to achieve positive growth in 2020, and has made positive contributions to global economic recovery.	The project activity will increase employment opportunities for local villagers. This contributes to one of China’s actions for promoting sustainable developing: "by 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value”.
	SDG 12 “Ensure sustainable consumption and production patterns”.	China has made great efforts to develop a circular economy, publicizing, encouraging and promoting economical consumption patterns. To initially control the production and management of industrial solid waste and municipal waste. Through prevention, reduction, recycling and reuse, the generation of waste is greatly reduced, the recycling level of main waste is significantly improved, and the dependence on primary resources is reduced.	The project uses animal manure waste as ferment material to produce biogas for electricity generation. Thus, the project will achieve Target 12.5 of SDG 12 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”.
	SDG 13 “Take urgent action to combat climate	In 2020, China's energy consumption per unit of GDP was reduced by 24.4% compared with	The project uses CSTR to treat animal manure, collect and destroy the generated

	change and its impacts”.	2012; carbon dioxide emissions per unit of GDP was reduced by 18.8% compared with 2015 and 48.4% compared with 2005, all of which have already fulfilled China's commitment to the international community in 2020 ahead of schedule.	biogas to avoid methane emissions. This contributes to achieve China’s stated sustainable development priorities " China's carbon dioxide emissions would strive to peak by 2030 and strive to achieve carbon neutrality by 2060 ".

1.18 Additional Information Relevant to the Project

Leakage Management

As per “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.

The biogas slurry from the anaerobic digester is passed through a solid-liquid separation system, then all of the digestate used to the field as liquid fertilizer and irrigation water, and the digestate applied directly to the project's surrounding farmland as organic fertilizer. The digestate will not be stored under anaerobic conditions. In addition, the project does not involve composting of digestate. Therefore, leakage emissions of the project associated with the anaerobic digester is not accounted for.

Commercially Sensitive Information

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

Further Information

There is no additional relevant legislative, technical, economic, sectoral, social, environmental, geographic, site-specific and/or temporal information that may have a bearing on the eligibility of the project, the net GHG emission reductions or removals, or the quantification of the project’s net GHG emission reductions or removals.

2 SAFEGUARDS

2.1 No Net Harm

The Environmental Impact Assessment (EIA) of the Project which prepared by Shanghai Huamin Environment Co., Ltd. has been approved by Shanghai Jinshan District Ecological Environment Bureau on 15-Dec-2020, with approval No. “Jinhuanxu [2020] No.360”. Every aspect of environmental impact has been considered in the EIA report with corresponding measures during project development. The environmental impacts, treatment, and effects arising from the Project during operation have been analysed in section 2.3 of this report below. And no net harm has been detected.

Meanwhile, the implementation of the project will contribute to local sustainable development as described in section 1.17 of this report above.

2.2 Local Stakeholder Consultation

The Project owner collected comments by local stakeholders on the project activity. Survey questionnaires were distributed to relevant personnel of the livestock farms, local villagers and government officials by the Project owner on 10-Jun-2021. The survey questionnaire was designed to assess the project impacts on the local environment and social economic development. 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	16	53%
	Female	14	47%
Age	<25	7	23%
	25-55	18	60%
	>55	5	17%
Education	Junior high school or below	10	33%
	Senior high school	13	43%
	College or above	7	23%
Occupation	Worker	14	47%
	Peasant	9	30%

	Management personnel	4	13%
	Civil servant	2	7%
	Unspecified	1	3%

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	Amount	Percentage
1	Do you know about the project activity?	Very much	21	70%
		Heard of	6	20%
		Nothing	3	10%
2	Do you think the project will improve the current situation of livestock farms?	Yes	27	90%
		No	0	0%
		Don't know	3	10%
3	Do you think the project will improve the local employment situation?	Yes	23	77%
		No	0	0%
		Don't know	7	23%
4	Do you think the project will improve the local social community?	Yes	19	63%
		No	0	0%
		Don't know	11	37%
5		Positive impact	22	73%

	Do you think the project will promote local economic development?	No impact	8	27%
		Negative impact	0	0%
6	What is the most probable environmental impact do you think the project will cause after the construction finish? (multiple choice)	None	23	77%
		Air pollution	0	0%
		Water pollution	0	0%
		Noise pollution	0	0%
		Harm to indigenous animals and plants	0	0%
		Don’t know	7	23%
7	What is your attitude to the project activity?	Support	26	87%
		Against	0	0%
		Indifferent	4	13%

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 life of local people without much adverse environmental impact. The survey shows that almost all of the stakeholders are supportive to the proposed project, believing that the Project will provide more employment opportunities, improve the current situation of livestock farm. Therefore, the implementation of the Project is regarded as beneficial by most of the local stakeholders.

LSC during the project implementation stage:

Communications with Local stakeholders will be carried out at periodic intervals. Key implementation schedules or changes of the project will be communicated to the neighbourhood committee and the local residents, the comments and suggestions from residents will be collected. And the local government agencies and competent authorities will conduct spot checks on the implementation of the project at periodic intervals. There are no negative comments received for the project so far. 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 Shanghai Jinshan District Ecological Environment Bureau. The environmental impacts of the project are summarized as follows.

1 Air pollution

Air pollution during the operation period is mainly generated by the biogas generator, which is discharged through 15m high exhaust pipe after low nitrogen combustion treatment. The NOx can meet the requirements of Table 2 of the "Pollutant Emission Limits and Measurement Methods for Heavy Duty Diesel Vehicles (China Stage VI)" (GB17691-2018). The SO_2 matter in the waste gas of the project satisfy the emission limits of Table 1 of the “Comprehensive Emission Standards for Air Pollutants” (DB31/933-2015).

2 Wastewater

The wastewater during operation is mainly biogas slurry from anaerobic digesters. The biogas slurry passes through the solid-liquid separation system, the biogas liquid is all returned to the field as liquid fertilizer and irrigation.

3 Noise

The noise of this project comes from various mechanical operations and noise generated by vibration. The noise impact will be reduced by choosing low-noise equipment, reasonable layout, and measures such as building sound insulation, muffling and distance attenuation. The noise at the project boundary can meet the Class 1 standard of "Environmental Noise Emission Standards for Industrial Enterprises" (GB12348-2008).

4 Solid waste

The solid waste of the project mainly waste filter material, which is recycled by the manufacturer.

Hazardous waste: The hazardous waste, e.g. mineral oil, generated by the project mechanical facilities shall be properly collected and stored in the hazardous waste temporary deposit, and shall be submitted to the qualified entities for centralized treatment regularly.

In conclusion, the impact on the environment during the operation period of the project is small. The project activities can reduce greenhouse gas emissions and environmental pollution caused by methane emissions. The project owner will take appropriate measures to minimize the adverse impact on the environment.

2.4 Public Comments

This project will open for public comment on the verra website.

2.5 AFOLU-Specific Safeguards

Not applicable.

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);

Tool 05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (version 03.0)

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	The 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 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 FSR, manure or the streams obtained after treatment are 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 temperature of baseline site where anaerobic manure treatment facility is located is 18.1°C[9], 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. No methane recovery and destruction by flaring or combustion for gainful use takes place in the baseline scenario.
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 anaerobic digestion". In the case of soil application, proper conditions and procedures (not resulting in methane emissions) must be ensured;	Applicable. The residual waste from the animal manure management system of the project will be handled aerobically and will not result in methane emissions.
	(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 combusted for energy use, and the

[9] Shanghai Statistical Yearbook 2022

		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. The storage time of the manure after removal from the animal barns, including transportation will not exceed 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".	Irrelevant. The project does not involve landfill methane recovery, wastewater treatment, composting 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. For simplification and be conservative, the emission reductions from utilization of the recovered biogas 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 reduction sourced from methane recovery is 17,340 tCO_2e/yr, which is lower than the threshold of 60,000 tCO_2e/yr; the designed installed capacity of the project is 0.52MW, which is lower than the threshold of 15MW.

		Therefore, the Project is in line with" General Guidelines to SSC CDM methodologies"
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".	Irrelevant. 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 reduction from the recovery and destruction of methane (viz. Type III components of the project) is 17,340 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	The project
Tool 14: Project and leakage emissions from anaerobic digesters (version 02.0)	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;	Irrelevant. The digestate from the anaerobic digesters will be used as organic fertilizer directly on agricultural land in the

	(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.	project vicinity. Thus, there are no CH_4 and N_2O emissions from this procedure.
	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 farm, the animal manure management system, the biogas power plant and the emergency flare system.

Figure 3-1 describes the project boundary of the Project Activity.

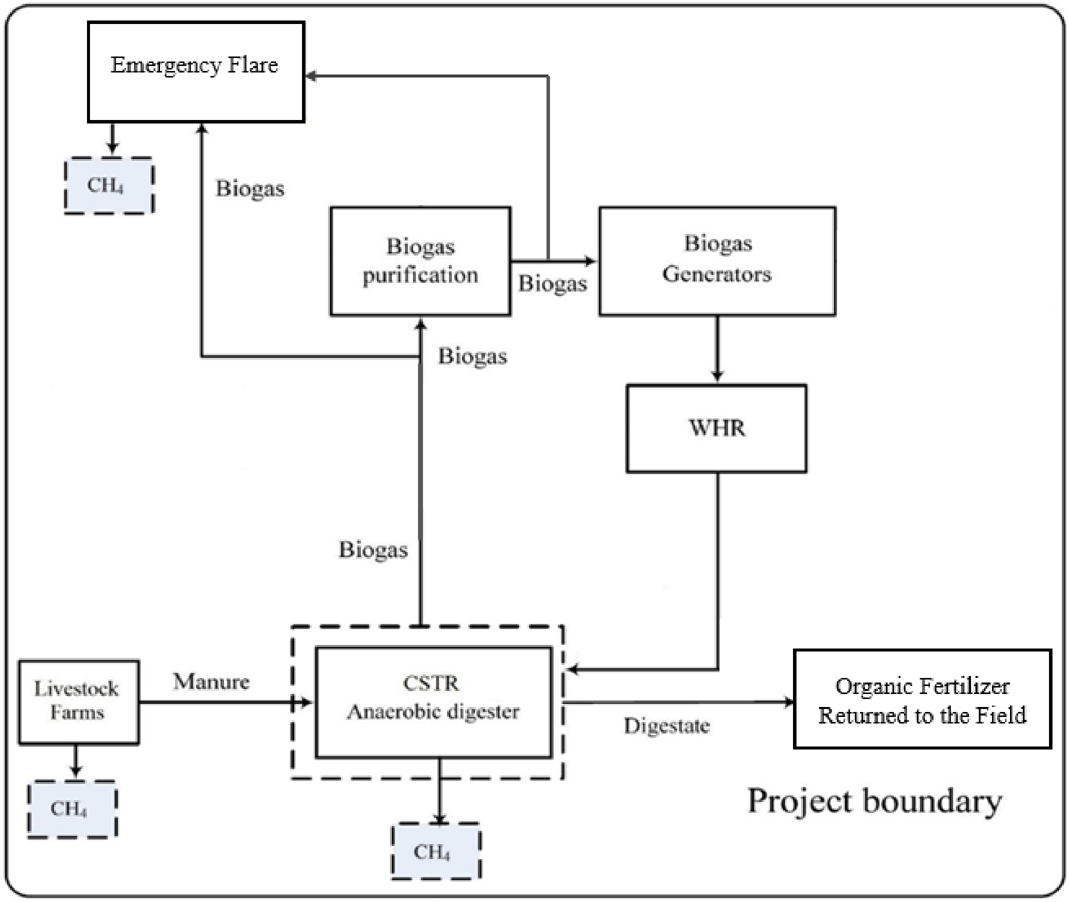

Figure 3-1 the project boundary of the Project Activity

Table 3-3 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 source.
		N_2O	No	Excluded for simplification.
		CO_2	No	Excluded for simplification.

Source		Gas	Included?	Justification/Explanation
	Emissions from flaring or combustion of the gas stream	CH_4	No	Excluded for simplification. The enclosed flare is installed for emergency, the emissions are assumed to be very small. The project will not claim this part of emission reduction
		N_2O	No	Excluded for simplification.
	Emissions from use of fossil fuels or electricity	CO_2	Yes	The project consumes electricity during operation, so emission from use of electricity is the main emission source. The project does not involve fossil fuel consumption, so the emission from use of fossil fuels is 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	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.
		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 (lagoon) 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 installed capacity of 0.52MW, 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 large scale livestock and poultry breeding;

e) Discharge standard of pollutants for livestock and poultry breeding (GB 18596-2001);

f) Technical standard of pollution prevention for livestock and poultry breeding (HJ/T 81-2001).

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 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 (a) to calculate baseline emissions from the manure management (BE_y), and baseline emissions are determined as follows:

$$BE_y = GWP_{CH4} \times D_{CH4} \times UF_b \times \sum_{j,LT} MCF_j \times B_{0,LT} \times N_{LT,y} \times VS_{LT,y} \times MS\%_{Bl,j} \quad (1)$$

Where:

BE_y	=	Baseline emissions in the year y (tCO_2e)
GWP_{CH4}	=	Global Warming Potential (GWP) of CH_4 applicable to the crediting period (tCO_2e/tCH_4)
D_{CH4}	=	CH_4 density (0.00067t/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
MCF_j	=	Annual methane conversion factor (MCF) for the baseline animal manure management system j
$B_{0,LT}$	=	Maximum methane producing potential of the volatile solid generated for animal type LT (m^3CH_4/kg-dm)
$N_{LT,y}$	=	Annual average number of animals of type LT in year y (numbers)
$VS_{LT,y}$	=	Volatile solids production/excretion per animal of livestock LT in year y (on a dry matter weight basis, kg-dm/animal/year)
$MS\%_{Bl,j}$	=	Fraction of manure handled in baseline animal manure management system j

a) Maximum methane producing potential of the manure (B_0):

As per the paragraph 17(a) of AMS-III.D (Version 21.0), 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 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) of farm finishing swine from other regions with high productivity systems is 0.45 m^3CH_4/kg-dm.

b) Volatile solids production/excretion per swine in year y ($VS_{LT,y}$):

As per the paragraph 17 (b) of AMS-III.D (Version 21.0), VS are the organic material in livestock manure and consist of both biodegradable and non-biodegradable fractions. For the calculations the total VS excreted by each animal species is required.

If country specific VS values are not available, IPCC default values from 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 10 table 10.13A(NEW) can be used provided that the project participants assess the suitability of those data to the specific situation of the treatment site particularly with reference to feed intake levels;

The project chooses the default value from the table 10.13A(NEW) of 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10. The default VS value of a farm finishing swine from Asia with high productivity systems is 5.1kg-VS/1000kg-animal mass/day. And according to the table 10A.5(New) of 2019 Refinement to the 2006 IPCC, the default weight of farm finishing swine is 56 kg. Thus, the default VS value of a farm finishing swine is also equal to 104.24 kg-VS/yr.

$$VS_{LT,y} = VS_{(T,P)} = \left(VS_{rate(T,P)} \times \frac{TAM_{(T,P)}}{1000}\right) \times 365 \qquad (2)$$

Where:

$VS_{(TP)}$	=	annual VS excretion for livestock category *T*, for productivity system *P* (when applicable), kg VS $animal^{-1}$ yr^{-1}

$VS_{rate(T,P)}$	=	default VS excretion rate, for productivity system *P* (when applicable), kg VS (1000 kg animal mass)$^{-1}$ day^{-1} (see Table 10.13a)
$TAM_{(T,P)}$	=	typical animal mass for livestock category *T*, for productivity system *P* (when applicable), kg animal^{-1}

c) Methane Conversion Factors (*MCF*):

As per the paragraph 17 (f) of AMS-III.D (Version 21.0), Methane Conversion Factors (MCF) values are determined for a specific manure management system and represent the degree to which B_o 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.

For the MCF, the project applies 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. According to Figure 10A.1 (New) Mapping of IPCC climate zones in 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 03, the climate zone of shanghai belongs to Warm Temperate Moist, so the MCF of the project should apply 73%.

d) The annual average number of animals ($N_{LT,y}$):

As per the paragraph 17 (g) of AMS-III.D (Version 21.0), the annual average number of animals ($N_{LT,y}$) is determined as follows:

$$N_{LT,y} = N_{da,y} \times \left(\frac{N_{p,y}}{365}\right) \tag{3}$$

Where:

$N_{da,y}$	=	Number of days animal is alive in the farm in the year y (numbers), 365 is applied for ex-ante calculation.
$N_{p,y}$	=	Number of animals produced annually of type LT for the year y (numbers), 10,000 dairy cattle is applied for ex-ante calculation.

Please refer to section 4.4 for detailed calculation process of baseline emission.

4.2 Project Emissions

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

(a) 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 ($PE_{PL,y}$);

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

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

(d) CO_2 emissions from incremental transportation distances;

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

$$PE_y = PE_{PL,y} + PE_{flare,y} + PE_{power,y} + PE_{transp,y} + PE_{storage,y} \quad (4)$$

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:

$$PE_{PL,y} = 0.10 \times GWP_{CH4} \times D_{CH4} \times \sum_{i,LT} B_{0,LT} \times N_{LT,y} \times VS_{LT,y} \times MS\%_{i,y} \quad (5)$$

Where:

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 ºC) and 1 atm pressure)
LT	=	Index for all types of livestock
j	=	Index for animal manure management system
$N_{LT,y}$	=	Annual average number of animals of type LT in year y (numbers)
$VS_{LT,y}$	=	Volatile solids production/excretion per animal of livestock LT in year y (on a dry matter weight basis, kg-dm/animal/year)

$MS\%_{i,y}$	=	Fraction of manure handled in system i in year y. 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
$B_{0,LT}$	=	Maximum methane producing potential of the volatile solid generated for animal type LT (m^3 CH_4/kg-VS), as per paragraph18 of AMS-III.D

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 FSR, 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 "Project and leakage emissions from anaerobic digesters" (version 02.0), 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. Thus, $PE_{FC,y}$ = 0 tCO_2e.And the project use electricity for operation from ECPG (East China Power Grid), so $PE_{EC,y}$ should be determined through the steps outlined below.

Step 1: Determination of the quantity of methane produced in the digester ($Q_{CH4,y}$)

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 1 shall be used. For small scale projects, project participants may choose between Option 1 or Option 2.

Option 1: Procedure using monitored data

Option 2: Procedure using a default value

Cause the project is small-scale, according to the tool, the Option 2 is chosen. Under this option, the flow of the biogas is measured and a default value is used for the fraction of methane in the biogas, as follows:

$$Q_{CH4,y} = Q_{biogas,y} \times f_{CH4,default} \times \rho_{CH4} \tag{6}$$

Where:

$Q_{CH4,y}$	=	Quantity of methane produced in the digester in year y (t CH_4)
$Q_{biogas,y}$	=	Amount of biogas collected at the digester outlet in year *y* (m^3 biogas)
$f_{CH4,defaulted}$	=	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 / m^3 CH_4)

Step 2: Determination of project emissions from electricity consumption (*$PE_{EC,y}$*)

This step is applicable if the anaerobic digester consumes electricity, such as for mixing, recirculation of digestate, or processing of feed material. 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 $PE_{EC,y}$:

Option 1: Procedure using monitored data

Option 2: Procedure using a default value

Cause there is no specidicated electricity monitoring equipment for the project facilities, the Option 2 is chosen. Under this option, project emissions from electricity consumption associated with the anaerobic digester are calculated as follows:

$$PE_{EC,y} = Q_{CH4,y} \times F_{EC,default} \times EF_{EL,default} \quad (7)$$

Where:

$PE_{EC,y}$	=	Project emissions from electricity consumption in year y (t CO_2 / yr)
$Q_{CH4,y}$	=	Quantity of methane produced in the digester in year y (t CH_4)
$EF_{EL,default}$	=	Default emission factor for the electricity consumed in year y (t CO_2/MWh)
$F_{EC,default}$	=	Default factor for the electricity consumption associated with the anaerobic digester per ton of methane generated (MWh /t CH_4)

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 condition (a) and condition (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 5~7 hours, 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.

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

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.

The digestate from the anaerobic digesters The residual waste from the CSTR digesters will be used as organic fertilizer directly on agricultural land in the project vicinity. Digestate will not be stored under anaerobic conditions. In addition, the project does not involve composting of digestate. Therefore, leakage emissions of the project associated with the anaerobic digester is not accounted for, leakage emissions is 0.

4.4 Net GHG Emission Reductions and Removals

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. $N_{LT,y}$, $MS\%_{i,y}$, 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:

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

Where:

$ER_{y,ex\ post}$	=	Emission reductions achieved by the project activity based on monitored values for year y (tCO_2e)
$BE_{y,ex\ post}$	=	Baseline emissions calculated using equation 1. For projects using option in paragraph 17(a) using ex post monitored values of $N_{LT,y}$ and if applicable $VS_{LT,y}$. For projects using option in paragraph 17(b), 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 3 using ex post monitored values of $N_{LT,y}$, $MS\%_{i,y}$, and if applicable $VS_{LT,y}$

MD_y	=	Methane captured and destroyed or used gainfully by the project activity in year *y* (tCO_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* (tCO_2e)

As per para.28 of AMS-III.D, biogas flared or combusted, (MD_y) shall be determined using the flare efficiency and methane content of biogas:

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

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) (use default value: 60 %)
FE	=	Flare efficiency in the year y (fraction)

As per para.33 of AMS-III.D (Version 21.0), project activities where a portion of the biogas is destroyed through flaring and the other portion is used for energy may consider applying the flare efficiency to the portion of the biogas used for energy, if separate measurements of the respective flows are not performed. When the amount of methane that is combusted for energy and that is flared is separately monitored, or when only the biogas flow to the flare is monitored and the biogas used for energy is calculated based on electricity generation, a destruction efficiency of 100% can be used for the amount that is combusted for energy.

Thus, FE apply a default value of 100% for this project.

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

1. Calculation of baseline emissions:

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

Parameter	Value	Data sources
GWP_{CH4}	27.9 tCO_{2e}/tCH_4	IPCC Sixth Assessment Report (AR6)
D_{CH4}	0.00067 t/m^3	AMS-III.D
UF_b	0.94	AMS-III.D
MCF_j	73%	Table 10.17 (UPDATED) of 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 10

$B_{o,LT}$	Finishing swine: 0.45 m^3CH_4/kg-VS	Table 10.16A (UPDATED) of 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10
$VS_{Lt,y}$	Finishing swine: 5.1 kg-VS/1000kg-mass/day 104.24 kg-dm/animal/year(dry basis)	Table 10.13A (NEW) of 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10
$TAM_{(T,P)}$	Finishing swine: 56.00 kg	TABLE 10A.5 of 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10
$MS\%_{Bl,j}$	100%	FSR
nd_y	365 days	FSR
$N_{da,y}$	168 days	FSR
$N_{p,y}$	80,000	FSR

As per equations (1), (2) and (3), the result of the ex-ante calculated baseline emissions of methane from the manure treatment processes of the project is:

Table 4-2 Ex-ante Baseline Emissions BE_y

Index for all types of livestock (LT)	The annual average number of animals ($N_{LT,y}$)	Volatile solids production of livestock LT in year y ($VS_{LT,y}$) (kg-dm/animal/year)	Baseline Emissions (BE_y) tCO_2e
-	$N_{LT,y} = N_{da,y} \times (\frac{N_{p,y}}{365})$	$VS_{LT,y} = VS_{(T,P)}$	$BE_y = GWP_{CH4} \times D_{CH4} \times UF_b \times \sum_{j,LT} MCF_j \times B_{0,LT} \times N_{LT,y} \times VS_{LT,y} \times MS\%_{Bl,j}$
Finishing swine	36,822	104.24	22,156
Total	-	-	22,156

10. **Calculation of project emissions**

Table 4-3 Ex-ante value of parameters to calculate project emissions

Parameter	Value	Data sources

GWP_{CH4}	27.9 tCO_2e/tCH_4	IPCC Sixth Assessment Report (AR6)
D_{CH4} (ρ_{CH4})	0.00067 t/m^3	AMS-III.D
$B_{o,LT}$	Finishing swine: 0.45 m^3CH_4/kg-VS	Table 10.16A (UPDATED) of 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10
$VS_{default}$	Finishing swine: 5.1 kg-VS/1000kg-mass/day 104.24 kg-dm /animal/year (dry basis)	Table 10.13A (NEW) of 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10
$TAM_{(T,P)}$	Finishing swine: 56.00 kg	TABLE 10A.5 of 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10
$MS\%_{i,y}$	100%	AMS-III.D
$N_{da,y}$	168 days	FSR
$N_{p,y}$	80,000	FSR
$Q_{biogas,y}$	3,000,000	FSR
$f_{CH4,default}$	0.6	"Tool to Project and leakage emissions from anaerobic digesters"
ρ_{CH4}	0.00067 tCH_4/m^3 CH_4	"Tool to Project and leakage emissions from anaerobic digesters"
$EF_{EL,default}$	1.3 tCO_2/MWh	"Tool to Project and leakage emissions from anaerobic digesters"
$F_{EC,default}$	1.02 MWh/t CH_4	"Tool to Project and leakage emissions from anaerobic digesters"

2.1 Emissions due to physical leakage of biogas in year y

As described in 4.2, project emissions from physical leakage of biogas are calculated as per equations (2), (3) and (5).

Table 4-4 Ex-ante calculation from physical leakage of biogas ($PE_{PL,y}$)

Index for all types of livestock (*LT*)	The annual average number of animals ($N_{LT,y}$)	Volatile solids production of livestock LT in year y ($VS_{LT,y}$) (kg-dm/animal/year)	Physical leakage of biogas ($PE_{PL,y}$) tCO_2e

-	$N_{LT,y} = N_{da,y} \times (\frac{N_{p,y}}{365})$	$VS_{LT,y} = VS_{(T,P)}$	$PE_{PL,y} = 0.10 \times GWP_{CH4} \times D_{CH4} \times \sum_{j,LT} B_{0,LT} \times N_{LT,y} \times VS_{LT,y} \times MS\%_{i,y}$
Finishing swine	36,822	104.24	3,229
Total	-	-	3,229

So, the ex-ante calculated result of the project's Physical leakage of biogas is 3,229 tCO_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 for the project.

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 emission.

As described in 4.2, project emissions from electricity consumption ($PE_{EC,y}$) are calculated as per equations (5) and (7).

Table 4-5 Ex-ante calculation from electricity consumption ($PE_{EC,y}$)

Quantity of methane produced in the digester in year y (t CH_4/ yr)	Project emissions from electricity consumption in year y (t CO_2 / yr)
$Q_{CH4,y} = Q_{biogas,y} \times f_{CH4,default} \times \rho_{CH4}$	$PE_{EC,y} = Q_{CH4,y} \times F_{EC,default} \times EF_{EL,default}$
1,206	1,600

So, the ex-ante calculated result of the project's electricity consumption is 1,600 tCO_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 emission shall calculate as per equation (4):

$PE_y = PE_{PL,y} + PE_{flare,y} + PE_{power,y} + PE_{transp,y} + PE_{storage,y} = PE_{PL,y}$= 4,829 tCO_2e

3. Calculation of leakage

According to the discussion in section 4.3, LE_y = 0.

4. Calculation of emission reductions (Ex ante calculation)

Estimated annual emission reductions of the project can be calculated as following :

$$ER_y = BE_y - PE_y - LE_y = BE_y - PE_y \quad (10)$$

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
15-Jan-2022~31-Dec-2022	21,306	0	4,644	16,662
01-Jan-2023~31-Dec-2023	22,156	0	4,829	17,327
01-Jan-2024~31-Dec-2024	22,217	0	4,842	17,374
01-Jan-2025~31-Dec-2025	22,156	0	4,829	17,327
01-Jan-2026~31-Dec-2026	22,156	0	4,829	17,327
01-Jan-2027~31-Dec-2027	22,156	0	4,829	17,327
01-Jan-2028~04-Sep-2028	22,217	0	4,842	17,374
01-Jan-2029~14-Jan-2029	850	0	185	665
Total	155,213	0	33,829	121,384
Average	22,173	0	4,833	17,340

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	27.9
Justification of choice of data or description of measurement methods and procedures applied	Default value of 27.9 from IPCC Sixth Assessment Report (AR6). Shall be updated according to any future COP/MOP decisions.
Purpose of Data	Calculation of baseline emissions and project emissions
Comments	-

Data / Parameter	D_{CH4}
Data unit	t/m^3
Description	CH_4 density
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 and project emissions
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
Value applied	60%
Justification of choice of data or description of measurement methods and procedures applied	-

Purpose of Data	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	73%
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. The climate zone of baseline site where anaerobic manure treatment facility is located in is Warm Temperate Moist, the corresponding annual methane conversion factor (MCF) is 73%.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$VS_{LT,y}$
Data unit	Kg-dm/animal/year
Description	Volatile solids production/excretion per animal of livestock LT in year y
Source of data	2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied	Animal type: Finishing swine; $VS_{LT,y}$: 104.24
Justification of choice of data or description of measurement methods and procedures applied	Default value from table 10.13A (NEW) of 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10 is applied. The default value for weight of finishing swine is 56kg from Asia with high productivity systems from 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10 table 10A.5(New). The default VS value of finishing swine is 5.10 kg-dm/1000kg animal/day(dry basis) and it is conservative. Thus, $VS_{LT,y}$ is 104.24 kg-dm/animal/year for ex-ante estimation.
Purpose of Data	-
Comments	-

Animal type	$VS_{LT,y}$
Finishing swine	104.24

Data / Parameter	$B_{0,LT}$
Data unit	m^3 CH_4/kg-VS
Description	Maximum methane producing potential of the volatile solid generated for animal type LT
Source of data	2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied	Animal type: Finishing swine; $B_{0,LT}$: 0.45
Justification of choice of data or description of measurement methods and procedures applied	No country or regional specific value is available. Default values from table 10.16A (UPDATED) of 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10 is applied.

Animal type	$B_{0,LT}$
Finishing swine	0.45

	The project adopts data from other regions with high productivity systems.
Purpose of Data	Calculation of baseline emissions and project emissions
Comments	-

Data / Parameter	$MS\%_{BL,i}$
Data unit	-
Description	Fraction of manure handled in baseline animal manure management system j
Source of data	FSR
Value applied	100%
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline 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	$EF_{EL,default}$
Data unit	t CO_2/MWh
Description	Default emission factor for the electricity consumed in year y
Source of data	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 tCO_2/MWh 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	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	Conventional digesters with continuously stirred tank reactor type for wastewater Default value of 1.02 MWh/t CH_4 is applied
Purpose of Data	Calculation of project emissions
Comments	-

Data / Parameter	$f_{CH4,fault}$
Data unit	m^3 CH_4/m^3 biogas
Description	Default value for the fraction of methane in the biogas

Source of data	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	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 0.00067 t CH_4/m^3 CH_4 is applied
Purpose of Data	Calculation of project emissions
Comments	-

5.2 Data and Parameters Monitored

Data / Parameter	$N_{p,y}$
Data unit	Number
Description	Number of animals produced annually of type LT for the year y
Source of data	Project proponents

Description of measurement methods and procedures to be applied	The number of Finishing swine produced in the farm will be recorded manually by the responsible staff.
Frequency of monitoring/recording	Annually, based on monthly records
Value applied	80,000 estimated ex ante and will be monitored ex post
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	To calculate the annual average number of animals ($N_{LT,y}$)
Calculation method	-
Comments	-

Data / Parameter	nd_y
Data unit	number
Description	The number of days the treatment plant was operational in year y.
Source of data	Project proponents
Description of measurement methods and procedures to be applied	365 days used for ex-ante estimation. The actual number of days the treatment plant was operationally used in the monitoring periods will be monitored and recorded by staff.
Frequency of monitoring/recording	Annually, based on daily records and monthly aggregation
Value applied	365
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	To estimate the annual volatile solid excretions for livestock LT entering all animal waste management systems on a dry matter weight basis ($VS_{LT,y}$).
Calculation method	-
Comments	-

Data / Parameter	$N_{da,y}$
Data unit	Day
Description	Number of days animal is alive in the farm in the year y
Source of data	Project proponents
Description of measurement methods and procedures to be applied	168 days used for ex-ante estimation. The actual number of days animal is alive in the farm in the monitoring periods will be monitored and recorded by staff.
Frequency of monitoring/recording	Annually, based on daily records and monthly aggregation
Value applied	*168*
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	To calculate the annual average number of animals ($N_{LT,y}$)
Calculation method	-
Comments	-

Data / Parameter	$Q_{biogas,y}$
Data unit	m^3 biogas
Description	Amount of biogas collected at the digester outlet in year *y*
Source of data	Flow meter
Description of measurement methods and procedures to be applied	The volumetric flow measurement should always refer to the actual pressure and temperature. Instruments with recordable electronic signal (analogical or digital) are required
Frequency of monitoring/recording	Annually, based on continuous flow measurement with accumulated volume recording (e.g. hourly/daily accumulated reading)
Value applied	3,000,000 (Ex-ante estimation)

Monitoring equipment	Flow meter
QA/QC procedures to be applied	-
Purpose of data	Calculation of emission reductions
Calculation method	-
Comments	-

Data / Parameter	$BG_{burnt,y}$
Data unit	m^3
Description	Biogas flared or combusted in year y
Source of data	Flow meter
Description of measurement methods and procedures to be applied	If the biogas flared and fuelled (or utilized) is continuously monitored separately, the two fractions can be added to determine the biogas recovered. In that case, recovered biogas need not be monitored separately. The system should be built and operated to ensure that there is no air ingress into the biogas pipeline.
Frequency of monitoring/recording	Annually, based on continuous flow measurement with accumulated volume recording (e.g. hourly/daily accumulated reading)
Value applied	3,000,000 (Ex-ante estimation)
Monitoring equipment	Flow meter
QA/QC procedures to be applied	-
Purpose of data	Calculation of emission reductions
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.

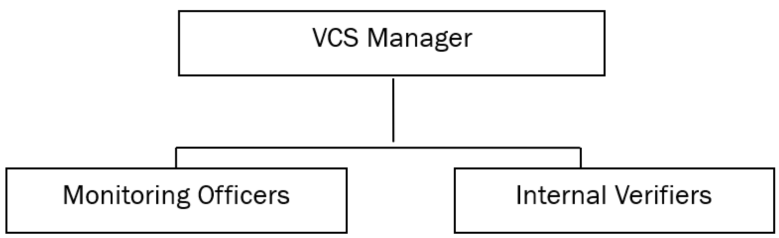

Figure 5-1 Operation and management structure of the project

(B) Data and parameters to be monitored

Data and parameters to be monitored are listed below. Table 5-1 lists the corresponding parameters monitored:

Table 5-1 Data and parameters to be monitored

Parameter to be Monitored	Description
$N_{p,y}$	The actual number of finishing swine produced in the farm will be recorded manually by the responsible staff.
nd_y	The actual number of days the treatment plant was operationally used in the monitoring periods will be monitored and recorded by staff.
$N_{da,y}$	The actual number of days animal is alive in the farm in the monitoring periods will be monitored and recorded by staff.

$Q_{biogas,y}$	Amount of biogas collected at the digester outlet in year y is continuously measured by flow meter installed after the CSTR anaerobic digesters and will be recorded.
$BG_{burnt,y}$	Quantity of biogas utilized by the project in year y is continuously measured by flow meter installed before all the biogas utilization devices (e.g., Electricity Generation System)

(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.

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.