NEW HOPE AWMS GHG MITIGATION PROJECT IN ANHUI PROVINCE

新至领碳
XING ZHI LINGTAN

Document Prepared by

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Project Title	NEW HOPE AWMS GHG Mitigation Project In Anhui Province
Version	*1.0*
Date of Issue	*26-04-2023 this version of the document issued*
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1 PROJECT DETAILS

1.1 Summary Description of the Project

NEW HOPE AWMS GHG Mitigation Project in Anhui Province (hereinafter referred to as the Project) introduces 3 new animal waste management systems (AWMSs) to treat the manure from 3 existing swine farms in Bengbu City, Anhui Province, which are owned by WUHE NEW HOPE LIUHE ANIMAL HUSBANDRY Co. LTD (hereinafter called the project owner). Each subsidiary swine farm will install one AWMS. The purpose of the project activity is to treat the manure and wastewater to avoid methane emissions generated in the baseline uncovered anaerobic lagoons.

The specific treatment process of these AWMSs are as follows: All the manure and wastewater are collected and then be separated first. The solid will be treated in aerobic composting system and the organic fertilizers will be produced, part of the organic fertilizers are distributed to local farmers for free, the rest will be sold in the local market. The liquid will be treated through anaerobic digestion and the biogas generated during the treatment process will be captured for heat generation, with surplus biogas destroyed through flaring systems (if any). The sludge produced from anaerobic digestion will be treated through aerobic composting together with the solid, the effluent will be supplied to the farmers living around for free for agriculture irrigation.

The common practice for the swine farm owners to manage the manure is to have uncovered anaerobic lagoons/ponds at their farms in the region. As per "technical specification for sanitation treatment of livestock and poultry manure[1]", in China, the uncovered anaerobic lagoons are a manure treatment method recognized by the state. In addition, since there is no legal regulation to mandate the livestock farm owners to implement anaerobic digestion, aerobic or other biological treatment techniques and to capture and/or utilize methane generated at their lagoons, therefore the continue of this common practice to treatment the manure i.e., uncovered anaerobic lagoons is the most economic, viable and reasonable for livestock farm owners.

It is estimated that approximately $1216.08*10^4$ m^3 of biogas will be produced annually. The biogas will be captured and utilized for heat generation, the heat will be only used for the daily operation of the AWMSs and the 3 swine farms and will not be produced to other users. For conservativeness, baseline emissions from heat generation are neglected.

The project activity will reduce of GHG in the atmosphere through avoiding methane emissions from anaerobic treatment of swine manure and wastewater. It is estimated that 107,899 tCO_2e emission reductions will be produced annually.

1.2 Sectoral Scope and Project Type

[1] https://oss.baigongbao.com/2020/12/14/MRyhTKQcWC.pdf

Sectoral Scope 13: waste handling and disposal.

Sectoral scope 15: livestock and manure management.

The project is not a grouped project.

The project is a non-AFOLU project.

1.3 Project Eligibility

The scope of the VCS program includes:

1) The six Kyoto Protocol greenhouse gases:
2) Ozone-depleting substances.
3) Project activities supported by a methodology approved under the VCS Program through the methodology approval process.
4) Project activities supported by a methodology approved under a VCS approved GHG program unless explicitly excluded under the terms of Verra approval.
5) Jurisdictional REDD+ programs and nested REDD+ projects as set out in the VCS Program document Jurisdictional and Nested REDD+ (JNR) Requirements.

The project activity reduces methane emissions by replacing uncovered anaerobic lagoons in the baseline scenario with the new AWMSs. Meanwhile, the project is not belonged to the projects excluded in Table 1 of VCS Standard 4.4. therefore, the project is eligible under the scope of VCS program.

According to section 3.1 of the *VCS-Standard* (Version 4.4), establishing a consistent and standardized certification process is critical to ensure the integrity of VCS projects. Accordingly, certain high-level requirements must be met by all projects, as set out below:

Reference to VCS Standard (Version 4.3)	Requirement	Justification
3.1.1	Projects shall meet all applicable rules and requirements set out under the VCS Program, including this document. Projects shall be guided by the principles set out in Section 2.2	The project meets all applicable rules and requirements as set out under the VCS Program.
3.1.2	Projects shall apply methodologies eligible under the VCS Program. Methodologies shall be applied in full, including the full application of any tools or modules referred to by a methodology, noting the exception set out in Section 3.13.1. The list of methodologies and	The project applies CDM approved methodology ACM0010 (version 08.0) which is an eligible VCS methodology along with tool or modules as applicable. Refer to section 3.1 and 3.2 of the PD below for more details.

	their validity periods is available on the Verra website.	
3.1.3	Projects and the implementation of project activities shall not lead to the violation of any applicable law, regardless of whether or not the law is enforced.	Projects are in compliance with currently applicable laws. According to the approval of Environmental Impact Assessment (EIA) of the project, the project complies with all Chinese relevant laws and regulations. Refer to section 1.14 of the PD below for more details.
3.1.4	Where projects apply methodologies that permit the project proponent its own choice of model (see the VCS Program document Program Definitions for definition of model), such model shall meet with the requirements set out in the *VCS Program document VCS Methodology Requirements* and it shall be demonstrated at validation that the model is appropriate to the project circumstances (i.e., use of the model will lead to an appropriate quantification of GHG emission reductions or removals)	Not applicable. There are no model needs to be chosen by the project proponent as per the applied methodology ACM0010 (version 08.0).
3.1.5	Where projects apply methodologies that permit the project proponent its own choice of third-party default factor or standard to ascertain GHG emission data and any supporting data for establishing baseline scenarios and demonstrating additionality, such default factor or standard shall meet with the requirements set out in the VCS Program document *VCS Methodology Requirements*.	The default factor or standard applied in this project are all methodologically permissible, so the default factor or standard meet the requirements set out in the VCS Program document *VCS Methodology Requirements*.
3.1.6	Projects shall preferentially apply methodologies that use performance methods (see the *VCS Program document VCS Methodology Requirements* for further information on performance methods) where a methodology is applicable to the project that uses a performance method for determining both additionality and the crediting baseline (i.e., a project shall not apply a methodology that uses a project method where such a performance method is	Baseline scenario and additionality have been analysed as per the applied methodology ACM0010 (version 08.0) and tool 02 (Version 07.0). Refer to section 3.4 and 3.5 of the PD for more details.

	applicable to the project). Methodologies approved under the VCS Program that use performance methods provide a list of similar methodologies that use project methods (that were approved under the VCS Program or an approved GHG program at the time the performance method was developed). Such lists are not necessarily exhaustive but can serve as the starting point for determining whether a performance method is applicable to the project. Following the approval of a methodology that uses a performance method, projects may use any applicable pre-existing methodology that uses a project method for a six-month grace period.	
3.1.7	Where the rules and requirements under an approved GHG program conflict with the rules and requirements of the VCS Program, the rules and requirements of the VCS Program shall take precedence.	Not applicable.
3.1.8	Where projects apply methodologies from approved GHG programs, they shall comply with any specified capacity limits (see the VCS Program document *Program Definitions* for definition of capacity limit) and any other relevant requirements set out with respect to the application of the methodology and/or tools referenced by the methodology under those programs.	Not applicable. There is no specified capacity limits and any other relevant requirements set out as per the applied methodology and tools.
3.1.9	Where Verra issues new requirements relating to projects, registered projects do not need to adhere to the new requirements for the remainder of their project crediting periods (i.e., such projects remain eligible to issue VCUs through to the end of their project crediting period without revalidation against the new requirements). The new requirements shall be adhered to at project crediting period renewal, as set out in Section 3.8.9.	This is the first crediting period of the project, and it has fallowed all the latest requirements of Verra.

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, no additional information relevant to the design of the grouped project.

1.5 Project Proponent

Organization name	WUHE NEW HOPE LIUHE ANIMAL HUSBANDRY Co. LTD
Contact person	Zhang Yuqin
Title	Manager
Address	Chengnan Small and Medium-sized Enterprise Park, Wuhe County, Bengbu City, Anhui Province
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Organization name	Zhejiang Xinzhi Lingtan Management Consulting Co., Ltd.
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Telephone	+86 18576261598
Email	chenweifan@xingyuan.com

1.6 Other Entities Involved in the Project

Organization name	-
Role in the project	-

Contact person	-
Title	-
Address	-
Telephone	-
Email	-

1.7 Ownership

The project owner of the project is WUHE NEW HOPE LIUHE ANIMAL HUSBANDRY Co. LTD, who has the legal right to control and operate the project activity. The business license, approval of Environmental Impact Assessment (EIA) and the equipment purchasing contract are evidence for the ownership of the project and carbon credits generated.

1.8 Project Start Date

As per 3.8 of VCS Standard (Version 4.4), the project start date of a non-AFOLU project is the date on which the project began generating GHG emission reductions or removals. The project is a non-AFOLU project, and it has been put into operation on 01/08/2021.

Thus, the project start date is 01/08/2021.

1.9 Project Crediting Period

The project adopts a 7-year renewable crediting period. The crediting period is 7 years 0 month from 01/August/2021 to 31/July/2028 (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

In all other cases, indicate the scale of the project (project or large project) and the estimated annual GHG emission reductions or removals for the project crediting period.

Project Scale	
Project	☑
Large project	

Year	Estimated GHG emission reductions or removals (tCO_2e)
01/08/2021-31/07/2022	107,899
01/08/2022-31/07/2023	107,899
01/08/2023-31/07/2024	107,899
01/08/2024-31/07/2025	107,899
01/08/2025-31/07/2026	107,899
01/08/2026-31/07/2027	107,899
01/08/2027-31/07/2028	107,899
Total estimated ERs	755,291
Total number of crediting years	7
Average annual ERs	107,899

1.11 Description of the Project Activity

The project activity is to introduce 3 new AWMSs in the 3 existing swine farms owned by WUHE NEW HOPE LIUHE ANIMAL HUSBANDRY Co. LTD. Project activity mainly include Solid-liquid separation, Anaerobic fermentation treatment process, Comprehensive utilization of biogas, Aerobic composting process, Aerobic treatment process. The process flow diagram of this project activity is shown in Figure 1-1.

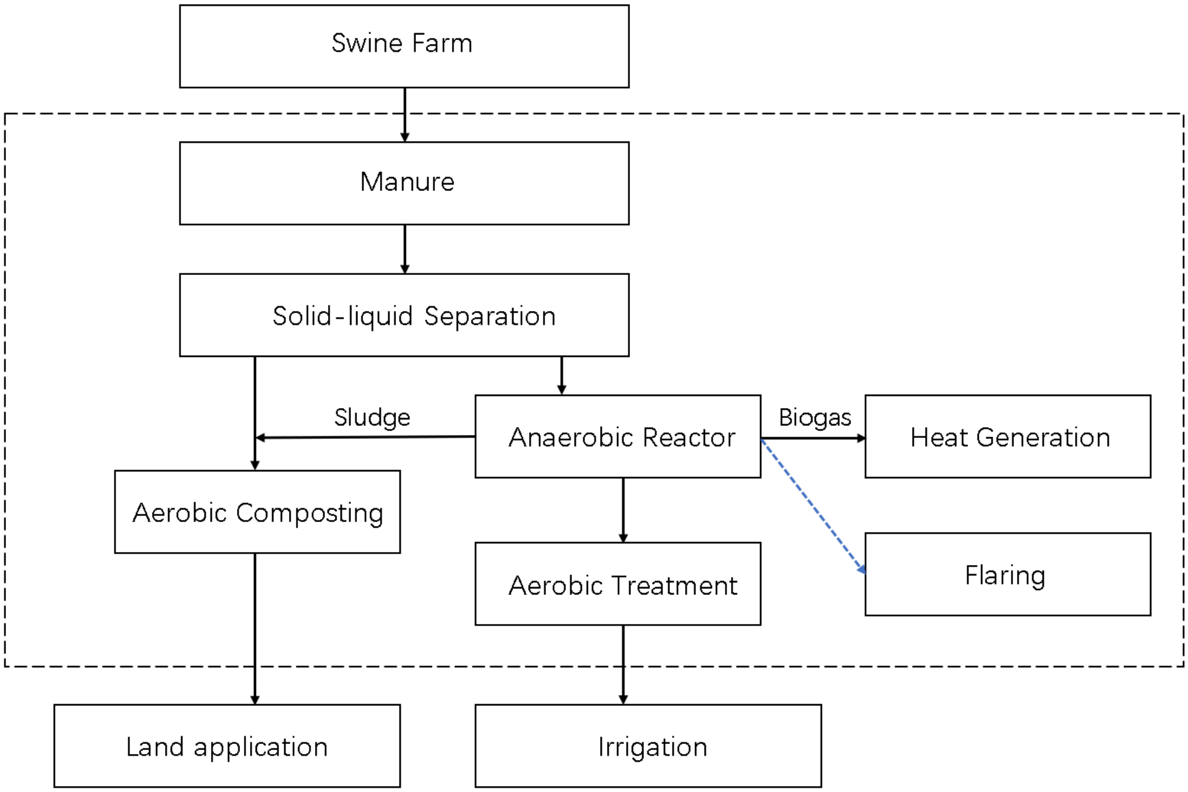

Figure 1-1 Process flow diagram of the project activity

- Livestock farm

The swine farms in the project keep 91,726 heads of market swine and 40,500 heads of breeding swine in the stock annually. Live pigs are kept for 155 days in the farm before shipment.

- Solid-liquid separation

A compound screw extrusion solid-liquid separator will be used to treat all the collected manure firstly. The solid will be treated in aerobic composting system and the liquid will be treated through anaerobic digestion and aerobic treatment process.

- Anaerobic digesters treatment process

Up-flow Anaerobic Sludge Bed Reactor (UASB) will be applied in the project activity to treat swine manure. The anaerobic treatment unit of this project is designed for medium temperature.

- Comprehensive utilization of biogas

The biogas collected from the fully enclosed anaerobic fermentation system will be purified by biogas purification device firstly, then the biogas will be sent to boilers for heat generation. The heat generated will be used for the operation of AWMSs and the 3 swine farms. Surplus biogas will be flared (if any) through the open flares.

- Aerobic composting system

The solid manure after solid-liquid separation and the sludge after anaerobic digestion are transported to the aerobic composting workshop to be mixed with high-efficiency microbial fermentation bacteria. The aerobic composting process of this project adopts tank composting. The aerobic composting system combines controlled ventilation and regular turning. When turning over, the air blower is used to supply the oxygen required for fermentation. The composting cycle of the enclosed compost tank is 2-4 weeks.

- Biogas boiler

The biogas recovered in the project is combusted to generate steam in a biogas fuelled boiler. The rated evaporating capacity of the biogas boiler is 30t/h.

- Flaring system

An emergency flare is installed to ensure that biogas would be destroyed when exigencies happened. The type of the flare is open flare.

The proposed project was implemented in 3 swine farms and the technology implemented at each swine farm was same. while the treatment capacities of each AWMS and the size of each swine farm and corresponding design of the AWMS was different, the processing capacity and equipment of the system are designed according to the size of the farm. The volume for original uncovered anaerobic lagoons and the equipment parameters used of each swine farm are shown in the following Table 1-1:

Table 1-1 The main technical parameters of equipment involved in this project

Swine Farm Name	Daxin	Huozhuang	Changhuai
Treatment of capacity of AWMS(t/d)	52.73	25.99	217.86
Biogas boiler			
Rated evaporating capacity (t/h)	10t/h	10t/h	15t/h
Rated temperature (℃)	50℃ in, 85℃ out	45℃ in, 80℃ out	50℃ in, 85℃ out
Rated pressure (Mpa)	0MPa	0MPa	0MPa
Equipment Quantity	1	1	1
Equipment Technical life	No less than 15 years		
Anaerobic digester			
Design capacity (m^3)	1191m^3+1191m^3	600 m^3	1459 m^3+1459 m^3+2826 m^3
Anaerobic technology	UASB	UASB	UASB

Stay time (day)	7	3	7
Fermentation temperature (℃)	38℃	33℃	30℃
Equipment Quantity	2	1	3
Equipment Technical life	No less than 15 years		
Aerobic fermentation tank			
Model	11FFG-90	11FFG-90	FJG-90
Capacity (m^3)	90 m^3*3	90 m^3*6	90 m^3*15
Structure	Tank	Tank	Tank
Rated power (kW)	61.67	61.67	61.67
Stay time (Day)	7-10	7-10	7-10
Equipment quantity	3	6	15
Equipment Technical life	No less than 15 Years		
Turnover machine			
Handling pile (mm)	4777	4777	4777
Handling pile height (mm)	2	2	2
Rated power (kw)	7.5	7.5	7.5
Equipment Quantity	3	6	15
Equipment Technical life	No less than 15 years		
Flared system			
Type	Open flare	Open flare	Open flare
Treatment capacity (m^3/h)	200 m^3/h	100 m^3/h	300 m^3/h
Material	Stainless steels	Stainless steels	Stainless steels
Height (m)	4.2	3	3.6
Equipment quantity	1	1	1
Equipment Technical life	No less than 15 years		

1.12 Project Location

The Project is located in Wuhe County, Bengbu City, Anhui Province, China. The location of the 3 subsidiary farms is shown in table 1-2:

Table 1-2 The location of the nine subsidiary farms in the project

Swine farm	Location	North latitude	East longitude
Daxin	Bengbu City, Wuhe County, Daxin Town, Futai and Goubei Village	32.984926°	117.663510°
Huozhuang	Bengbu City, Wuhe County, Xiaoxi Town, Huojia Village	33.0205°	117.9066°
Changhuai	Bengbu City, Wuhe County, Chengguan Town, Changhuai Garden	33.165271°	117.996898°

The geographic location of the project is shown in figure 1-2:

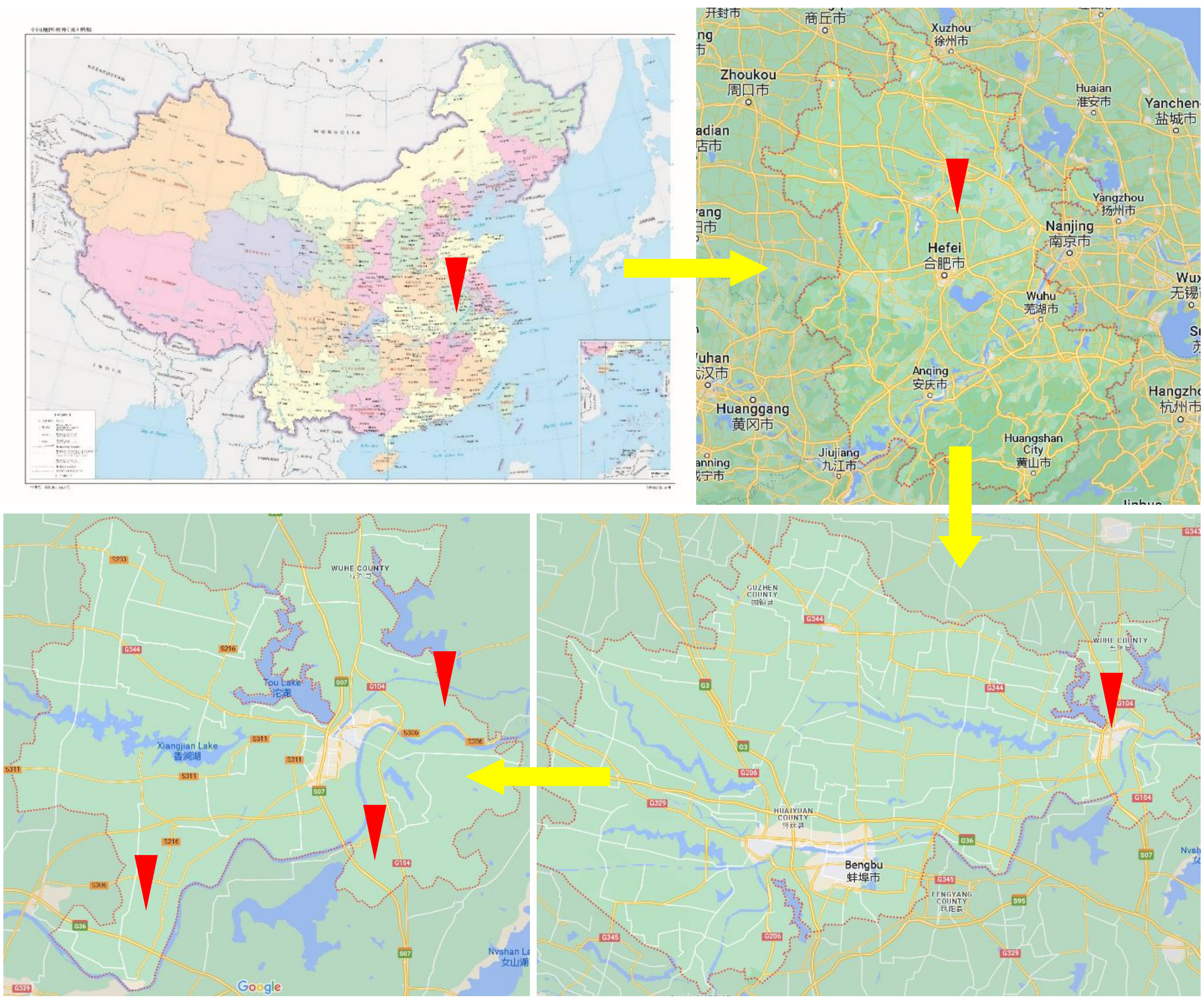

Figure 1-2 The geographic location of the project

1.13 Conditions Prior to Project Initiation

The conditions existing prior to project initiation:

The animal manure waste was left to decay in an anaerobic manure management system (Uncovered open lagoon) at the livestock farm and methane is emitted to the atmosphere directly without any methane recovery and destruction facility.

The conditions existing prior to project initiation are also the baseline scenario of the project. Refer section 3.4 of the PD for detailed baseline scenario.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

According to the approval of Environmental Impact Assessment (EIA) of the project, the project complies with all Chinese relevant laws and regulations. Mainly include:

1. Environmental Protection Law of the People's Republic of China;
2. Administrative Licensing Law of the People's Republic of China;
3. Law of the People's Republic of China on Environmental Impact Assessment;
4. Regulations on Environmental Protection Management of Construction Projects;

The project obtained the EIA approval from governmental authorities: Anhui Provincial Department of Environmental Protection. The 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 seeking registration under any other GHG programs. The project is seeking registration only in VCS program.

1.15.2 Projects Rejected by Other GHG Programs

The project activity is not participating in other environment credits, other GHG programs and has not 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

If yes, provide the name of the emissions trading program or other mechanism that allows GHG allowance trading.

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

If yes, provide the name of the other program(s) under which the project has sought or received another form of GHG-related credit.

Supply Chain (Scope 3) Emissions

This section is not applicable since the project has not impacted the emissions of any goods or services.

Have the owner(s) or retailer(s) of the impacted goods and services[2] posted a public statement saying, "VCUs may be issued for the greenhouse gas emission reductions and removals associated with [organization name(s)] [name of good or service]" since the project's start date?

☐ Yes ☒ No

Explain your response.

Has the project proponent posted a public statement saying, "VCUs may be issued for the greenhouse gas emission reductions and removals associated with [name of good or service] [describe the region or location, including organization name(s), where practicable]."

☐ Yes ☒ No

Explain your response.

Have the producer(s) or retailer(s) of the impacted good or service been notified of the project and the potential risk of Scope 3 emissions double claiming via email?

☐ Yes ☒ No

[2] Impacted goods and services are all goods and services directly impacted by the technologies and measures specified as project activities in the project description. Please see the VCS Program document *VCS Program Definitions* for additional information.

Explain your response.

1.17 Sustainable Development Contributions

The project's goal is not only renewable energy generation, but also an environmental, social, and financial solution to avoid biogas release into the atmosphere. The project provides many benefits that helps achieve China's Sustainable Development Goals (SDG), a set of 17 universal goals covering the thematic areas of environmental, economic and social development.

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

- Provide clean energy: The project makes use of biogas recovered from the animal waste treatment system for heat generation and supplies clean thermal energy, which replaces the fossil fuel fired energy. The project is expected to recover and destroy $1216.08*10^4$ m^3 of biogas for heat generation annually. This helps diversify energy structure of China and reduce the dependence on exhaustible fossil fuels for heat generation. This contributes to one of the China's actions for promoting the sustainable developing, "By 2030, increase the share of non-fossil fuels in primary energy consumption to about 20 percent"; (SDG 7)

- Provide decent work. The project can provide job opportunities for local residents, which meets one of the China's action plans "Increase labour force participation rate through implementation of the classification policy. Vigorously enforce the Law on Promotion of Employment." (SDG 8)

- Reduce GHG emissions. The project utilizes and destroys biogas 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. The project is expected to achieve an annual emission reduction of 107,899 tCO_2e. 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, as well as cities, coastal regions and ecologically vulnerable areas"; (SDG 13)

1.18 Additional Information Relevant to the Project

Leakage Management

The leakage involved in this project includes the leakage of anaerobic digestion in a digester and the leakage of organic fertilizer into the soil. The project participants have no authority, intervention, or control over the leakage of organic fertilizer into the soil. Moreover, this leakage has been included in the emission reductions calculation as per the applied methodology and tool.

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) Report for the Project has been approved by Anhui Provincial Department of Environmental Protection. Every aspect of environmental impact has been considered in the EIA report with corresponding measures during project development, the construction of the project is in line with national policies and no net harm has been detected. Meanwhile, the implementation of the project will improve local-socio economic development through creating career opportunities.

2.2 Local Stakeholder Consultation

Before the project, the stakeholder identification was conducted through the consultant meeting and questionnaire surveys. The meeting was attended by the representatives of local residents/farmers, the representatives of local government and the representatives of the project owner.

On 15/06/2020, a meeting of stakeholder consultation held in the local area. Before the meeting, the information of the project, contact and meeting notice had been published on the notice board a week ago. About 30 people participate in the meeting, the background and information about stakeholders are concluded in table 2-1 below:

Table 2-1 Background and information about participants in the meeting

Categories		Amount
Gender	Male	15
	Female	15
Education Level	College or above	2
	High school	12

	Lower secondary school	14
	Primary school or below	2
Occupations	Worker	12
	Farmer	13
	Manager	2
	Government officials	3

During the meeting, the project proponent had explained to stakeholders for the benefits, possible costs and potential risks brought by the project. Meanwhile, 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. In total 30 out of 30 questionnaires were retuned with a 100% response rate.

Based on the 30 returned questionnaires (from the survey), the summary of the comments is shown as follows:

Table 2-2 Questions and feedback from Stakeholders in the Meeting

No.	Question	Answer	Amount
1	Do you support the project?	Yes	30
		No	0
		Don’t care	0
2	What’s the negative environmental impacts of the project?	Air pollution	0
		Water pollution	0
		Noise	0
		No negative impacts	30
3	Does the project improve the current situation of livestock farm?	Yes	30
		No	0
		Don’t know	0
4	Does the project benefit local economic development?	Yes	28
		No	0

		Don't know	2
5	Does the project create employment opportunities?	Yes	30
		No	0
		Don't Know	0
6	Any impacts on local people life?	Positive	29
		Negative	0
		Don't know	1

The survey shows the stakeholders believe that the project will have positive impacts on the local ecology and employment. All stakeholders expressed their support to the project and no negative comments have been received.

In order to set up the mechanism for on-going communication with local stakeholder, a grievance book was put in Front Desk Administration of the PP. All stakeholders are allowed to record their grievances or comments in the book at any time.

2.3 Environmental Impact

As per the EIA report, the environmental impacts of the project in the construction period and operation period are summarized as follows.

1. Construction phase

1) Air pollution

The waste gas during the project construction is mainly for construction fugitive dust. Construction dust and road dust during the construction has an effect on the surrounding areas of the construction site, whereas these effects are reversible.

During the construction period, all the material and construction waste will be covered and managed in a specific site, all the road and exposed material will be watered to reduce fugitive dust.

2) Wastewater

Wastewater during the construction period mainly includes construction wastewater and domestic sewage.

Construction wastewater and domestic wastewater will be treated by following measures: construct temporary diversion ditches on the construction site; Set up a sedimentation tank and reuse the washing water for construction machinery as much as possible after simple treatment of equipment and vehicles.

3) Noise

The noise generated by the project construction has a slight impact on the surrounding sensitive points, and its pollution impact is localized and short-term.

After adopting a reasonable construction schedule, the impact of noise on the surrounding area can be reduced to an acceptable range.

4) Solid waste

Solid waste during the construction period mainly includes construction waste and domestic waste.

Construction solid waste will be transported and reused in other construction project. Domestic solid waste will be transported and treated in according to sanitation and environment management standards by local environmental sanitation department.

2. Operation phase

1) Air pollution

The main waste gas during the operation period is the effluvium generated from pig house, solid-liquid separation tank, temporary storage tank, biogas boiler and aerobic treatment process.

The emission of all the waste gas will be purified and treated to meet the requirements of Discharge Standard of Pollutants for Livestock and Poultry Breeding (GB18596-2001) and Emission Standards for Odor Pollutants (GB14554-93).

2) Wastewater

The main wastewater during operation period includes piggery flushing wastewater, pig manure liquid after solid-liquid separation, pig urine, and other domestic sewage.

All the wastewater will be sent into UASB digesters for anaerobic fermentation treatment to meet Discharge Standard of Pollutants for Livestock and Poultry Breeding (GB18596-2001). The effluent will be used for agricultural irrigation.

3) Noise

During the project operation period, the sources of noises in the Project are mainly from livestock (i.e. pigs), operating machines (such as fans and pumps) and vehicles.

By using equipment with low noise, and adopting measures such as strengthening the maintenance of equipment, taking scientific feedings on pigs and planting green belts with certain areas; it is ensured that the impact would be reduced to an acceptable range. The noise at the boundary during the project operation shall be subject to the Emission Standard for Industrial Enterprises Noise at Boundary (GB12348-2008) Class-1 standard.

4) Solid waste

During the operation period, the solid waste mainly includes medical waste generated by daily epidemic prevention, pig manure residue after solid-liquid separation, biogas residue generated by UASB digesters, and other domestic waste.

All the solid waste will be sent into aerobic composting tank for composition, the organic fertilizer will be distributed to local farmer for free, while the remaining solid waste will be transported and treated in local landfill plant.

As a result, the project proponent has taken appropriate measures to minimize adverse environmental impacts. Meanwhile, the implementation of the project will significantly improve the quality of the local environment, by achieving environmentally sound treatment of organic waste and reducing greenhouse gas emission. In addition, biogas incineration saves fossil fuels used for heat generation and contributes to local sustainable development.

2.4 Public Comments

As per section 3.18.6 of the VCS Standard (V4.4), all projects are subject to a 30-day public comment period. The date on which the project is listed on the project pipeline marks the beginning of the project's 30-day public comment period. This project will be open for public comment on the verra website. The project shall be listed, and comments shall be incorporated later.

2.5 AFOLU-Specific Safeguards

This project is a non-AFOLU project, thus, this section is not required.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

The following methodologies are applicable to the project activity.

ACM0010" GHG emission reductions from manure management systems (Version 08.0)[3]".

The latest version of the following tools will also be used in this Project activity:

[3] https://cdm.unfccc.int/methodologies/DB/99QRTE6N5QJEBOV2XP374B25SSIXBB

Tool 02: “Combined tool to identify the baseline scenario and demonstrate additionality(version07.0)[4]”

Tool 05:” Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (Version 3.0)[5]”

Tool 06:” Project emissions from flaring (Version 3.0)[6]”

Tool 08: “Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version03.0)[7]”

Tool 14: “Project and leakage emissions from anaerobic digesters (Version 02.0)[8]”

Tool 24:” Common practice (Version 03.1)[9]”

3.2 Applicability of Methodology

Justification for the choice of the selected methodology is shown in the following table:

ACM0010 (Version 08.0)” GHG emission reductions from manure management systems”	
Applicability Criteria	**Justification**
This methodology applies to project activities that include destruction of methane emissions and displacement of a more GHG-intensive service in manure management of livestock farms by introducing a new animal waste management system or a combination of animal waste management systems that result in less GHG emissions.	For this project, 3 sets of new AWMSs are installed in 3 existing swine farms in order to treat the manure and wastewater from these swine farms, which avoids methane emissions generated in the baseline uncovered anaerobic lagoon. The biogas generated during the treatment process will be collected for heat generation and the rest will be burned through flaring (if any). All the heat will be used by the operation of AWMSs and the swine farms, and will not be used by user out of the project boundary.
This methodology is applicable to manure management on livestock farms where the existing anaerobic manure treatment system, within the project boundary, is replaced by one or a combination of more than one animal waste management systems (AWMSs) that result in less GHG emissions compared to the existing system. The methodology is also applicable to Greenfield facilities.	For this project, 3 identical sets of new AWMS are installed in 3 existing swine farms in order to treat the manure and wastewater, which avoids methane emissions generated in the baseline uncovered anaerobic lagoon.

[4] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-02-v7.0.pdf
[5] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v3.0.pdf
[6] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-06-v4.0.pdf
[7] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-08-v3.0.pdf
[8] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-14-v2.pdf
[9] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-24-v1.pdf

This methodology is applicable to manure management projects under the following conditions: (a) Farms where livestock populations, comprising of cattle, buffalo, swine, sheep, goats, and/or poultry, is managed under confined conditions; (b) Farms where manure is not discharged into natural water resources (e.g., rivers or estuaries); (c) In case of anaerobic lagoons treatments systems, the depth of the lagoons used for manure management under the baseline scenario should be at least 1 m; (d) The annual average ambient temperature at the site where the anaerobic manure treatment facility in the baseline existed is higher than 5˚C; (e) In the baseline case, the minimum retention time of manure waste in the anaerobic treatment system is greater than one month; (f) The AWMS(s) in the project case results in no leakage of manure waste into ground water, for example the lagoon should have a non-permeable layer at the lagoon bottom.	(a) For this project, the swine in the farms are managed under confined conditions. (b) As per the EIA report of the livestock farm and the project, manure is not discharged into natural water resources (e.g., river or estuaries); (c) The open anaerobic lagoons considered in the baseline scenario are designed for deep storage and has a depth of 3-5 meters in accordance with the" design code for wastewater stabilization ponds (GJJ/T54-93)[10]" . (d) The annual average ambient temperature at the site is 16˚C[11], which is higher than 5˚C. (e) The minimum retention time of manure waste in the open anaerobic lagoons is not less than 45 days, i.e., at least 60 days in the baseline scenario[12]; (f) In the project case, the related equipment in the new built AWMS, such as the UASB anaerobic reactor, the aerobic reaction cell, the effluent tank and Sludge staging site, adopts anti-leakage technologies and anti-permeability materials. So, no leakage of manure waste into ground water is possible.

Tool 02: "Combined tool to identify the baseline scenario and demonstrate additionality(version07.0)"	
The tool is applicable to all types of proposed project activities. However, in some cases, methodologies referring to this tool may require adjustments or additional explanations as per the guidance in the respective methodologies. This could include, inter alia, a listing of relevant alternative scenarios that should be considered in Step 1, any relevant types of barriers other than those presented in this tool and guidance on how common practice should be established.	The project is included in all types of proposed project activities. Alternative scenarios, barrier analysis, investment analysis and common practice analysis will be carried out based on Tool 02.

[10] https://www.doc88.com/p-9408119204518.html

[11] https://weatherspark.com/y/131710/Average-Weather-in-Bengbu-China-Year-Round

[12] https://mbd.baidu.com/newspage/data/landingsuper?context=%7B%22nid%22%3A%22news_9639404512015689726%22%7D&n_type=-1&p_from=-1

Tool 05: "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (version 03.0)"	
If emissions are calculated for electricity consumption, the tool is only applicable if one out of the following three scenarios applies to the sources of electricity consumption: (a) Scenario A: Electricity consumption from the grid. The electricity is purchased from the grid only, and either no captive power plant(s) is/are installed at the site of electricity consumption or, if any captive power plant exists on site, it is either not operating or it is not physically able to provide electricity to the electricity consumer; (b) Scenario B: Electricity consumption from (an) off-grid fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants are installed at the site of the electricity consumer and supply the consumer with electricity. The captive power plant(s) is/are not connected to the electricity grid; or (c) Scenario C: Electricity consumption from the grid and (a) fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants operate at the site of the electricity consumer. The captive power plant(s) can provide electricity to the electricity consumer. The captive power plant(s) is/are also connected to the electricity grid. Hence, the electricity consumer can be provided with electricity from the captive power plant(s) and the grid.	The source of electricity consumption of the project is Scenario A: Electricity consumption from the grid (CCPG[13]).
This tool can be referred to in methodologies to provide procedures to monitor amount of electricity generated in the project scenario, only if one out of the following three project scenarios applies to the recipient of the electricity generated: Scenario I: Electricity is supplied to the grid; Scenario II: Electricity is supplied to consumers/electricity consuming facilities; or Scenario III: Electricity is supplied to the grid and consumers/electricity consuming facilities.	This project does not generate electricity.
This tool is not applicable in cases where captive renewable power generation technologies are installed to provide electricity in the project activity, in the baseline scenario or to sources of leakage. The tool only accounts for CO_2 emissions.	No captive renewable power generation technologies are installed to provide electricity in the project activity, in the baseline scenario or to sources of leakage.

Tool 06: "Project emissions from flaring (version03.0)"	
This tool provides procedures to calculate project emissions from flaring of a residual gas. The tool is applicable to enclosed or open flares and project participants should document in the CDM-PDD the type of flare used in the project activity.	For this project, one open flare is constructed in each AWMSs, total 3 flares are used in this project. Refer to section 1.11 of the PD for specification information.

[13] https://www.mee.gov.cn/ywgz/ydqhbh/wsqtkz/202012/t20201229_815386.shtml

This tool is applicable to the flaring of flammable greenhouse gases where: (a) Methane is the component with the highest concentration in the flammable residual gas; and (b) The source of the residual gas is coal mine methane or a gas from a biogenic source (e.g., biogas, landfill gas or wastewater treatment gas).	For this project, the source of the residual biogas is gas from biogenic source (Anaerobic treatment process). As per EIA report of the project, methane accounts for 60% of the biogas, which is the highest concentration in the flammable residual gas.
The tool is not applicable to the use of auxiliary fuels and therefore the residual gas must have sufficient flammable gas present to sustain combustion. For the case of an enclosed flare, there shall be operating specifications provided by the manufacturer of the flare.	No auxiliary fuels are used by the flaring system. As per EIA report of the project, methane accounts for 60% of the biogas, which have sufficient flammable gas.

Tool 08: "Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version03.0)"	
Typical applications of this tool are methodologies where the flow and composition of residual or flared gases or exhaust gases are measured for the determination of baseline or project emissions.	The amount of biogas produced from the anaerobic digestion will be collected and monitored. Refer to section 5.2 of the PD for more details.
Methodologies where CO_2 is the particular and only gas of interest should continue to adopt material balances as the means of flow determination and may not adopt this tool as material balances are the cost-effective way of monitoring flow of CO_2	The biogas generated during the treatment process including CH_4, H_2S, CO_2, etc, therefore this tool is adopted used for determining the mass flow of greenhouse gas.
The underlying methodology should specify: (a) The gaseous stream the tool should be applied to; (b) For which greenhouse gases the mass flow should be determined; (c) In which time intervals the flow of the gaseous stream should be measured; and (d) Situations where the simplification offered for calculating the molecular mass of the gaseous stream (equations (3) or (17) is not valid (such as the gaseous stream is predominantly composed of a gas other than N_2).	a) $Q_{CH4,y}$ is determined using the tool; b) CH_4 is the greenhouse gases for which the mass flow should be determined. c) The flow of the gaseous stream is measured continuously. d) The gaseous stream is dry, equation (18) and (19) are used to calculate the mass flow of greenhouse gas

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	All sources of project emissions have been accounted.

(d) CH_4 emissions from flaring of biogas.	
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.	All sources of leakage emissions have been accounted.
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.	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, anaerobic treatment of liquid digestate and land application of the digestate are neglected.

Tool 24: "Common Practice (Version 03.1)"	
This methodological tool is applicable to project activities that apply the methodological tool "Tool for the demonstration and assessment of additionality", the methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality", or baseline and monitoring methodologies that use the common practice test for the demonstration of additionality.	The latest version of Combined tool to identify the baseline scenario and demonstrate additionality is referred by methodology ACM0010.
In case the applied approved baseline and monitoring methodology defines approaches for the conduction of the common practice test that are different from those described in this methodological tool, the requirements contained in the methodology shall prevail.	The latest version of Combined tool to identify the baseline scenario and demonstrate additionality is referred by methodology ACM0010.

3.3 Project Boundary

As per ACM0010, the spatial extent of the project boundary encompasses the site of the AWMS(s), including the flare or energy and/or heat generation equipment and the power/heat source.

The proposed project boundary considers the GHG emissions that come from AWMSs, including the GHG emissions from the anaerobic digestion, GHG emissions from sludge treatment by aerobic composting and GHG emissions from flaring system in these swine farms. The baseline boundary is shown in figure 3-1 below.

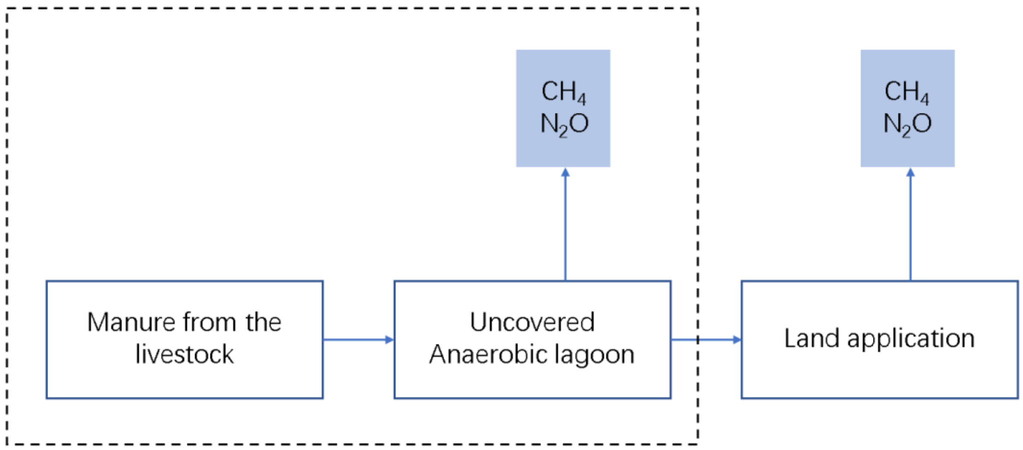

Figure 3-1 The baseline boundary

The project activity boundary is defined as figure 3-2 below:

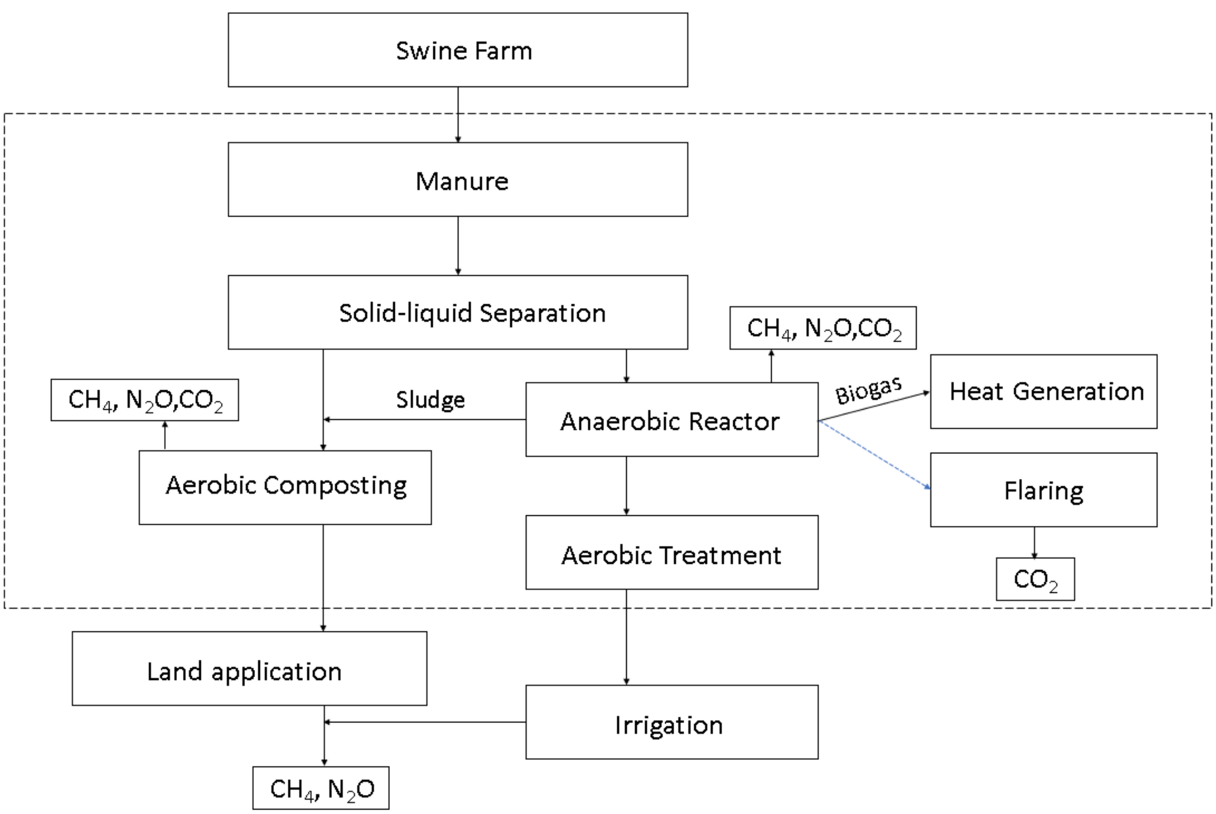

Figure 3-2 The project boundary

The greenhouse gases included or excluded from the project boundary are summarized in table 3-1 below.

Table 3-1 Emissions sources included in or excluded from the project boundary

Source		Gas	Included?	Justification/Explanation
Baseline	Emissions from the waste treatment processes	CO_2	No	CO_2 emissions from the decomposition of organic waste are not accounted
		CH_4	Yes	The major source of emissions in the baseline
		N_2O	Yes	Direct and indirect N_2O emissions are accounted
	Emissions from electricity consumption/ generation	CO_2	No	Excluded for simplification. This is conservative.
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.
	Emissions from thermal Energy generation	CO_2	No	Excluded for simplification. This is conservative.
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.
Project	Emissions from the Waste treatment processes	CO_2	No	CO_2 emissions from the decomposition of organic waste are not accounted
		CH_4	Yes	The emission from anaerobic digester and aerobic treatment
		N_2O	Yes	Direct and indirect N_2O emissions are accounted
	Emissions from on-site electricity consumption	CO_2	Yes	May be an important emission source. If electricity is consumed from the grid company
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.
	Emissions from thermal energy use	CO_2	No	Excluded for simplification. This project does not use thermal energy.
		CH_4	No	Excluded for simplification. This project does not use thermal energy.
		N_2O	No	Excluded for simplification. This project does not use thermal energy.

3.4 Baseline Scenario

Baseline scenario has been identified using the methodological tool 02 “Combined tool to identify the baseline scenario and demonstrate additionality (Version 07.0)” considering the requirements of the methodology and assessing the possible waste management options as described in 2006 IPCC Guideline for National Greenhouse Gas Inventories (Volume 4, Chapter 10, Table 10.17).

The most plausible baseline scenario is identified in the following steps:

Step 0. Demonstration that a proposed project activity is the First-of-its-kind;

Step 1. Identification of alternative scenarios;

Step 2. Barrier analysis;

Step 3. Investment analysis (if applicable);

Step 4. Common practice analysis.

Step 0: As per TOOL 02“Combined tool to identify the baseline scenario and demonstrate additionality” (Version07.0), this step is optional. So, it is not necessary to analyse this step.

Step1: Identification of alternative scenarios

Step 1a: Define alternative scenarios to the project activity

Prior to the implementation of the project, all manure waste produced from the 3 existing swine farms was left to decay in 3 uncovered anaerobic lagoons at the livestock farms and methane is emitted to the atmosphere directly without any methane recovery and destruction facility. The uncovered anaerobic lagoons were replaced by 3 sets of AWMSs in these swine farms for this project. Therefore, it belongs to the existing facilities.

According to methodology, baseline alternatives for managing the manure for the existing facilities, shall take into consideration, inter alia, the complete set of existing/possible manure management systems listed in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4, Chapter 10, Table 10.17).

The baseline and available alternatives for the manure management are listed as below table as 2006 IPCC:

No.	IPCC Alternatives	Applicability	Justification
1	The manure is collected from the pasture /Range /Paddock	Not Applicable	The swine in this project is bred in confined barns rather than pasture/range/paddock, so this alternative is excluded.
2	Daily spread: Manure removed from confinement and applied to pasture within 24 hours of excretion	Not Applicable	For a large-scale swine farm, it is highly labor intensive that manure is routinely removed from a confinement facility and is applied to cropland or pasture within 24 hours of excretion. Therefore, this alternative is not in an economically attractive prospect. So, this alternative is excluded.

3	Solid Storage: The manure is disposed of by solid storage.	Not Applicable	This alternative involves the storage of manure, typically for a period of several months, in unconfined piles or stacks. It is only a storage method of manure, not a disposal method. In addition, it is suitable for small family farms. The proposed project involves large-scale swine farm and the use of a scraping and flushing approach to remove manure that has large volumes of water. So, this manure management system is not a potential alternative baseline scenario.
4	Dry lot	Not Applicable	Dry lot usually apply in an open confinement area. However, the swine in the project are housed in confined barns, which means the infrastructures to implement dry lot is not available, therefore, this alternative is not applicable to the conditions of the farm in the project. So, this alternative is excluded.
5	The manure is disposed of as liquid/slurry.	Not Applicable	This method is only a storage method of manure, not a disposal method. Since the amount of discharged manure is very large even on a daily basis, storing the liquid manure in the tank to distribute them to the farmland requires a lot of labor work. Therefore, it is unrealistic to implement such a task for the farms under the competition of the market. So, this alternative is excluded.
6	Uncovered anaerobic lagoon	Applicable	As per " Technical specification for sanitation treatment of livestock and poultry manure[14]", uncovered anaerobic lagoon is a kind of harmless treatment of manure, which could satisfy this regulation. Since there is no legal regulation to mandate the livestock farm owners to implement anaerobic digestion, aerobic or other biological treatment techniques and to capture and/or utilize methane generated at these lagoons. So, the uncovered anaerobic lagoon is an alternatives baseline scenario.
7	Pit storage below animal confinements, <1month	Not Applicable	The farm involved in this project is a large-scale livestock farm and the manure quantity produced is too large to implement a pit storage structure under the barns. In addition, the manure stored in below animal confinements were removed within 1 month requires a lot of labor work. So, this scenario is excluded.
	Pit storage below animal confinements,>1month	Not Applicable	The farm involved in this project is a large-scale livestock farm and the manure quantity produced is too large to implement pit storage structure under the barns. In addition, the excreted volume

[14] https://oss.baigongbao.com/2020/12/14/MRyhTKQcWC.pdf

			accumulated under the barns produces enteric fermentation gas, if it is not discharged out of the barns in time, the pigs will be quickly killed by the accumulation of toxic fumes. So, this alternative is excluded.
8	Anaerobic digester	Applicable	A single Anaerobic digester is suitable for treating manure, but to implement such technology needs high investment compared to an Uncovered anaerobic lagoon, which is the most common and economic method. However, a single anaerobic process is not yet able to meet the requirements for the use of the waste and must be followed up with disposal, which requires the use of a combination of aerobic and anaerobic processes together. thus, the project activity implemented a combine anaerobic digester-aerobic treatment system without being registered as a VCS project activity seems to be a plausible alternative without considering the investment analysis.
9	Burned for fuel	Not Applicable	The farm involved in this project is a large-scale swine farm, and the manure is flushed to the anaerobic digester. Therefore, the dung and urine of the project are not excreted on fields and the waste quantity is so large, it is unlikely to dry the dung before used as fuel. So, this alternative is excluded.
10	Cattle and Swine deep Bedding, <1month	Not Applicable	This method is only a storage method of manure, not a disposal method. The deep bedding is laborious and this is counter to achieving economies of scale associated with large animal counts. The concentration of nocuous gas in the bedding is high enough to poison swine if it is disposed inappropriately, and it is favorable for the survival and breeding of vermin and microorganisms due to its high temperature and humidity. So, this alternative is excluded.
	Cattle and Swine deep Bedding, >1month	Not Applicable	
11	Composting - In-vessel	Not Applicable	Manure in this project is collected by using a scraping and flushing system. Manure in this project is in liquid with a large volume of water. So, this alternative is excluded.
12	Composting - Static pile	Not Applicable	Manure in this project is collected by using a scraping and flushing system. Manure in this project is in liquid with a large volume of water. So, this alternative is excluded.
13	Composting - Intensive windrow	Not Applicable	Manure in this project is collected by using a scraping and flushing system. Manure in this project is in liquid with a large volume of water. So, this alternative is excluded.

14	Composting – Passive windrow	Not Applicable	Manure in this project is collected by using a scraping and flushing system. Manure in this project is in liquid with a large volume of water. So, this alternative is excluded.
15	Poultry manure with litter	Not Applicable	The farm involved in this project is a large-scale swine farm, not the Poultry farm, so no poultry manure is produced. So, this alternative is excluded.
16	Poultry manure without litter	Not Applicable	The farm involved in this project is a large-scale swine farm, not the Poultry farm, so no poultry manure is produced. So, this alternative is excluded.
17	Aerobic treatment (Anaerobic Digester Aerobic Treatment system)	Applicable	This kind of wastewater contains a large amount of highly concentrated organic wastewater, which is difficult to be treated by the aerobic method and does not meet the Chinese environmental quality standards and pollutant discharge standards for discharge wastewater. At present, a combine Anaerobic Digester-Aerobic Treatment System is considered to be one of the most advanced manure management systems, but to implement such technology need high investment and proposed project will not be invested and constructed without being registered as a VCS project.

The outcome of Step 1a: In summary, the alternatives to the baseline scenario are identified by tool 02:" Combined tool to identify the baseline scenario and demonstrate additionality (Version 07.0)" as:

Scenario 6: "The manure is disposed in an uncovered anaerobic lagoon"

Scenario 8 & 17: Anaerobic Digester & Aerobic Treatment i.e., the proposed project activity not being registered as a VCS project activity

3.5 Additionality

Step 1b: Consistency with mandatory laws and regulations

According to "Technical specification for sanitation treatment of livestock and poultry manure" and the "Specifications for the construction of manure resource utilization facilities for large-scale livestock and poultry farms (for trial implementation)[15]", the Scenario 6: "The manure is disposed in an uncovered anaerobic lagoon" and Scenario 8 & 17: Anaerobic Digester & Aerobic Treatment are all Consistency with mandatory laws and regulations. So, the outcome of Step 1b is unchanged from Step 1a.

Step 2: Barrier analysis

[15] http://www.moa.gov.cn/gk/tzgg_1/tfw/201801/t20180111_6134801.htm

There are no technology barriers, acceptability barriers and financial barriers that may prevent these two alternative scenarios to occur. As per Tool 02 Combined tool to identify the baseline scenario and demonstrate additionality (Version 07.0), go to Step 3 (Investment Analysis).

Step 3: Investment analysis

The objective of Step 3 is to compare the economic or financial attractiveness of the alternative scenarios remaining after Step 2 by conducting an investment analysis. If the investment analysis is conclusive, the economically or financially most attractive alternative scenario is considered as the baseline scenario. Three options can be applied for the investment analysis: the simple cost analysis, the investment comparison analysis and the benchmark analysis.

The proposed project will generate revenue from organic fertilizers sales, not only from VERs, so the simple cost analysis method is not appropriate. Investment comparison analysis method is only applicable to projects whose alternatives are similar investment projects. The continuation of the current situation is not an investment project; thus, the investment comparison analysis is not preferable. Therefore, the project adopted the benchmark analysis method for the investment analysis.

The project adopts IRR as the financial indicator. According to the Notice on Update of Financial Benchmarks from Economic Evaluation for Construction Project: Methods and Parameters (Version 03) issued by National Development and Reform Commission, the post-tax IRR of 9.5% on equity investment is recommended for livestock industry. Thus, 9.5% is adopted as the benchmark of the project since the project is a manure management project in the livestock industry.

(a) Basic parameters

Table 3-2 Basic parameters for IRR calculation

Parameter	Unit	Value	Source of data
Total statistic investment	10,000 CNY	3787	FSR
Annual O&M cost	10,000 CNY	451	FSR
Annual Organic fertilizer sales revenue	10,000 CNY	761	FSR
Construction period	Year	0.5	FSR
Operation period	Year	20	FSR
Rate of residual value	%	5%	FSR
VAT rate (Equipment & Material)	%	13%	FSR
VAT rate (Revenue)	%	0%	FSR

Income tax rate	%	25%	FSR
Urban maintenance and construction tax	%	5%	FSR
Surtax for education	%	5%	FSR
Emission reduction	tCO_2e	107,899	Calculated
VCU Price	CNY/ton	25	Expected

(b) Comparison of the project IRR for the proposed project and the benchmark following table

Without income from selling VCUs, the IRR of the proposed project is 4.60%, lower than the benchmark IRR 9.5% and the proposed project is financially unacceptable because of its low profitability. While considering such income, the IRR of the proposed project is 13.78%, higher than the benchmark, and the proposed project is financially acceptable.

Table 3-3 Project IRR with and without revenues from VERs

	Without VERs	Benchmark	With VERs
Project IRR (post-tax)	4.60%	9.5%	13.78%

Sub-step 2d: Sensitivity analysis

The purpose of this step is to examine whether the conclusion regarding the financial attractiveness is robust to reasonable variations of the critical assumptions.

According to Guidance on the Assessment of Investment Analysis, the "variables, including the initial investment cost, that constitute more than 20% of either total project costs or total project revenues should be subjected to reasonable variation". Therefore, the total static investment, and annual organic fertilizers sales revenue were taken as uncertain factors for sensitive analysis. Furthermore, the O&M cost which was widely included in the sensitivity analysis for projects in China was also examined in the analysis. As a result, the following parameters are selected for the analysis:

- Total static investment
- Annual O&M cost
- Annual organic fertilizers sales revenue

The results of sensitivity analysis of the three indicators are shown in Table 3-4 and Figure 3-3

Table 3-4 Sensitivity analysis of the project

Range / Parameter	-10.00%	-5.00%	0.00%	5.00%	10.00%

Total static investment	5.85%	5.20%	4.60%	4.04%	3.52%
Annual O&M cost	6.03%	5.32%	4.60%	3.85%	3.09%
Annual organic fertilizer sales revenue	2.01%	3.33%	4.60%	5.81%	6.99%

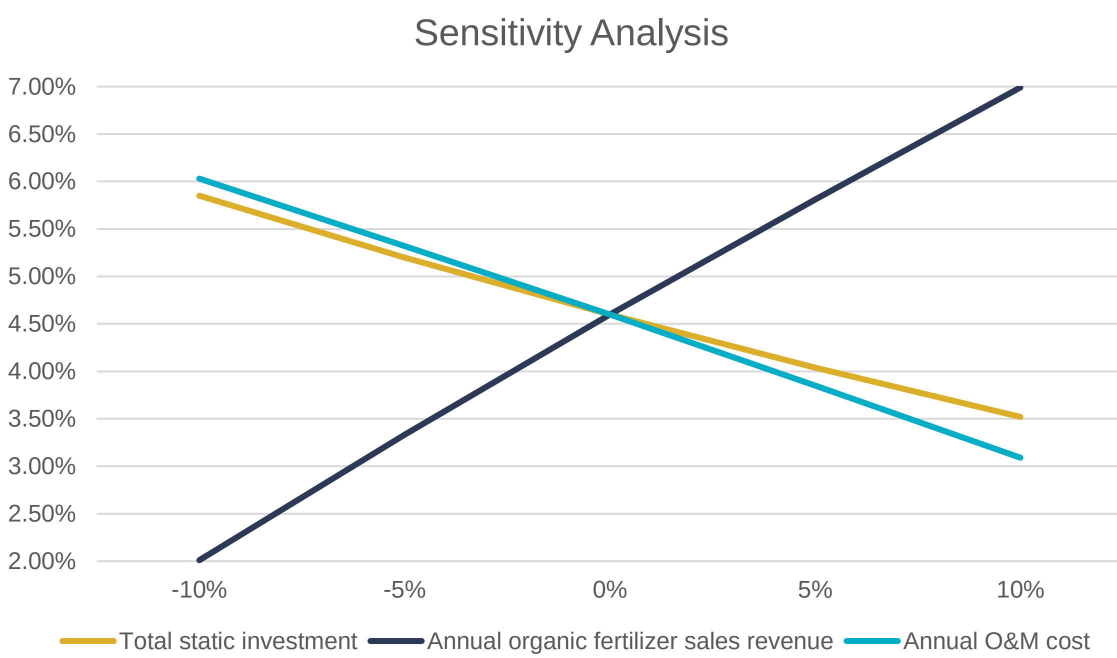

Figure 3-3 Sensitivity analysis of the project

According to the above analysis, when the total static investment, annual organic fertilizer sales revenue and manure treatment and annual O&M cost are changing within the range of -10% to 10%, the project IRR (post-tax) of the project is always lower than benchmark IRR and lacking financial attractiveness.

a) Total static investment

The IRR would exceed the benchmark IRR when the total static investment decreases by 31.59%. According to the publicly latest available sources, on the whole, the price indices for steel, fuel, power and construction materials and price indices for fixed asset investment in China have been increasing in the past years, and this trend seems unlikely to be changed before the project construction is completed. As a result, the IRR cannot increase through the decrease of total static investment.

b) Annual organic fertilizer sales revenue

The IRR would exceed the benchmark IRR when the annual organic fertilizer sales revenue increase by 21.05%. The revenue of organic fertilizers sales is determined by the production of organic fertilizers and market price. Since the scale of the swine farm will stay stable in the future, so the maximum production of organic fertilizers is predetermined. Meanwhile, the price of organic fertilizers in the local market will increase slightly, so such dramatic increase of annual organic fertilizers sales revenue to threshold is impossible to achieve

c) Annual O&M cost

The IRR would exceed the benchmark IRR when the annual O&M cost decreases by 35.52%. Based on Chinese Statistic Yearbook, the fluctuations of indices of purchasing price of raw material, power and fuel are increased significantly over last ten years and the annual average wages in the province have been constantly growing during over last ten years. Moreover, the equipment will be getting more and more with the abrasion, which means the maintenance cost will be increasing in the coming years. As a result, the drastic decreasing in Annual O&M cost is not realistic.

As shown in the sensitivity analysis above, the project IRR (after tax) will not reach the benchmark of 9.5% within reasonable fluctuation range, and the fluctuation scenario of the uncertain factors which could make the proposed project financially feasible is unlikely to occur. Therefore, the conclusion regarding the infeasibility of the proposed project is robust to reasonable variations of the critical assumptions.

In conclusion, the project is not economically and financially attractive without the VERs revenues.

Step 4: Common practice analysis

The project is not a first-of-its kind project. The project applies measures that are listed in the definitions section in the methodology tool “Combined tool to identify the baseline scenario and demonstrate additionality”, then proceed to Step 4a of the tool. The methodological tool “Common Practice” is followed as below:

Step 4.1: Calculate applicable output range as +/-50% of the design output or capacity of the proposed project activity.

The design output of the project is to produce 1,216.08*10^4m^3 of biogas annually, therefore the applicable output range is 608.04*10^4m^3 to 1,824.1,2*10^4m^3 of biogas produced annually.

Step 4.2: Identify similar projects (both VER and non-VER) which fulfil all of the following conditions:

(a) The projects are located in the applicable geographical area;

(b) The projects apply the same measure as the proposed project activity;

(c) The projects use the same energy source/fuel and feedstock as the proposed project activity, if a technology switch measure is implemented by the proposed project activity;

(d) The plants in which the projects are implemented produce goods or services with comparable quality, properties and applications areas (e.g. clinker) as the proposed project plant;

(e) The capacity or output of the projects is within the applicable capacity or output range calculated in Step 4.1;

(f) The projects started commercial operation before the project design document is published for global stakeholder consultation or before the start date of proposed project activity, whichever is earlier for the proposed project activity.

In China, the general environment for projects of biogas recovery and utilization, such as the government service, law and regulations, access to technology, access to financing and the operation cost, are only similar and comparable in provincial level. Therefore, the common practice region and comparable framework is set as provincial level and the project is compared to other projects in Anhui Province.

The start date (real action date defined under CDM) of the project activity is 01/08/2021, which is earlier than the day that the project design document is published for global stakeholder consultation, therefore only projects which started commercial operation before 01/08/2021 are considered.

In summary, all biogas recovery and utilization projects produce biogas from anaerobic digestion of animal manure waste for heat generation, located in Anhui Province, with the output range from $608.04*10^4m^3$ to $1,824.1,2*10^4m^3$ of biogas produced annually, and starting commercial operation before 01/08/2021 are identified as the similar projects.

Step 4.3: Within the projects identified in Step 4.2, identify those that are neither registered CARBON project activities, project activities submitted for registration, nor project activities undergoing validation. Note their number N_{all}.

By searching the local publicly available sources, China's DNA website, and the UNFCCC/ Verra/ Gold Standard/ CCER related website, there is no similar project without applying the VCS, CDM or other voluntary emission reduction projects.

Based on the analysis above, N_{all}=0.

Step 4: Within similar projects identified in Step 4.3, identify those that apply technologies that are different to the technology applied in the proposed project activity. Note their number N_{diff}.

There is no similar project, so N_{diff}=0 as well.

Step 5: Calculate factor $F=1-N_{diff}/N_{all}$ representing the share of similar projects (penetration rate of the measure/technology) using a measure/technology similar to the measure/technology used in the proposed project activity that deliver the same output or capacity as the proposed project activity.

According to the "Combined tool to identify the baseline scenario and demonstrate additionality", the proposed project activity is a common practice within a sector in the applicable geographical area if the factor F is greater than 0.2 and N_{all}- N_{diff} is greater than 3. As per the analysis above, the F of the project is zero, which is less than 0.2, and N_{all}- N_{diff} =0 is also less than 3. Therefore, the project is not a common practice.

To summarize, according to the above Investment Analysis and Common practice analysis, the project is not financially attractive without VERs revenue and it is not a common practice, thus, the project is additional and the baseline scenario of the project is identified as scenario 6:"The manure is disposed in an uncovered anaerobic lagoon".

3.6 Methodology Deviations

There is no methodology deviation for the project.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

As per paragraph 26 of the applied methodology.

Baseline emission are:

$$BE_y = BE_{CH4} + BE_{N2O,y} + BE_{elec/heat,y} \qquad Equation\ (1)$$

Where:

BE_y	Baseline emissions in year y (t CO_2/yr)
$BE_{CH4,y}$	Baseline CH_4 emissions in year y (t CO_2/yr)
$BE_{N2O,y}$	Baseline N_2O emissions in year y (t CO_2/yr)
$BE_{elec/heat,y}$	Baseline CO_2 emissions from electricity and/or heat used in the baseline (t CO_2/yr)

(1) Baseline CH4emissions ($BE_{CH4,y}$)

$$BE_{CH4,y} = GWP_{CH4} * D_{CH4} * \sum\nolimits_{j,LT} \left(MCF_j * B_{0,LT} * N_{LT} * VS_{LT,y} * MS\%_{Bl,j}\right) \qquad Equation\ (2)$$

Where:

$BE_{CH4,\ y}$	Baseline CH_4 emissions in year y (t CO_2/yr)
GWP_{CH4}	Global Warming Potential (GWP) of CH_4 (t CO_2e/t CH_4)

D_{CH4} Density of CH_4 (t/m^3). 0.00067t/m3 at room temperature(20˚C)and 1am pressure.

MCF_j Annual methane conversion factor (MCF_j) for the baseline $AWMS_j$. IPCC 2006, table 10.17, chapter 10, volume 4.

$B_{0,LT}$ Maximum methane producing potential of the volatile solid generated by animal type LT (m^3CH_4/kg -dm)

N_{LT} Annual average number of animals of type LT for the year y (number)

$VS_{LT,y}$ Annual volatile solid excretions for livestock LT entering all AWMS on a dry matter weight basis (kg -dm/animal/yr)

$MS\%_{Bl,j}$ Fraction of manure handled in system j in the baseline. In this project, the baseline manure management system is uncovered anaerobic lagoon only. The amount of manure handled by the anaerobic lagoon is 100%. $MS\%_{Bl,j}$ =100%

LT Type of livestock

) j Type of treatment system

Estimation of various variables and parameters for above equations:

(A) $VS_{LT,y}$ shall be determined in one of the following ways, presented in the order of preference:

Option 1: Using published country specific data. If the data is expressed in kilogram volatile solid excretion per day on a dry-matter basis (kg -dm per day), multiply the value with n_{dy} (number of days treatment plant was operational in year y).

Option 2: Estimation of $VS_{LT,y}$ based on dietary intake of livestock:

$$VS_{LT,y} = \left[GE_{LT} * \left(1 - \frac{DE_{LT}}{100}\right) + (UE * GE_{LT})\right] * \left[\left(\frac{1 - ASH}{ED_{LT}}\right)\right] * nd_y \qquad Equation\ (3)$$

Where:

$VS_{LT,y}$	Annual volatile solid excretions for livestock LT entering all AWMS on a dry matter weight basis (kg -dm/animal/yr)
GE_{LT}	Daily average gross energy intake (MJ/animal/day)
DE_{LT}	Digestible energy of the feed (per cent)
UE	Urinary energy (fraction of GELT)
ASH	Ash content of manure (fraction of the dry matter feed intake)
ED_{LT}	Energy density of the feed fed to livestock type LT (MJ/kg -dm)
nd_y	Number of days treatment plant was operational in year y

Option 3: Scaling default IPCC values $VS_{default}$ to adjust for a site-specific average animal weight as shown in equation below:

$$VS_{LT,y} = \left(\frac{W_{site}}{W_{default}}\right) * VS_{default} * nd_y \qquad Equation\ (4)$$

Where:

$VS_{LT,y}$	Annual volatile solid excretions for livestock LT entering all AWMS on a dry matter weight basis (kg -dm/animal/yr)
W_{site}	Average animal weight of a defined livestock population at the project site (kg)
$W_{default}$	Default average animal weight of a defined population (kg)
$VS_{default}$	Default value for the volatile solid excretion per day on a dry-matter basis for a defined livestock population (kg-dm/animal/day)
nd_y	Number of days treatment plant was operational in year y

Option 4: Utilizing published IPCC defaults for $VS_{LT,y}$ (IPCC 2006 guidelines, volume 4, chapter 10), multiply the value by nd_y (number of days in year y).

Developed countries $VS_{LT,y}$ values may be used provided the following conditions are satisfied:

(a) The genetic source of the production operations livestock originates from an Annex I Party; (b)The farm use formulated feed rations (FFR) which are optimized for the various animal(s), stage of growth, category, weight gain/productivity and/or genetics.

(b) The use of FFR can be validated (through on-farm record keeping, feed supplier, etc.); and

(c) The project specific animal weights are more similar to developed country IPCC default values.

$VS_{LT,y}$ is determined in the way of Option 3 provided by ACM0010 due to the lack of data for Option 1 and Option 2, and not meeting the conditions of applying Option 4 of using developed countries $VS_{LT,y}$ values.

(B) Annual average number of animals of type LT (N_{LT}) shall be determined in one of the following ways, presented in order of preference

Option 1:

$$N_{LT} = N_{da,LT} * \left(\frac{N_{p,LT}}{365}\right) \qquad Equatuin\ (5)$$

Where:

N_{LT}	Annual average number of animals of type LT for the year y (number)
$N_{da,LT}$	Number of days animal of type LT is alive in the farm in the year y (number)
$N_{p,LT}$	Number of animals of type LT produced annually for the year y (number)

Option 2: If the project developer can monitor in a reliable and traceable way the daily stock of animals in the farm, discounting dead animals and animals discarded from the productive process from the daily stock, then the annual average number of animals (N_{LT}) may be calculated as follows:

$$N_{LT} = \frac{\sum_{1}^{365} N_{AA,LT}}{365} \qquad Equation\ (6)$$

Where:

NLT	Annual average number of animals of type LT for the year y (number)
$N_{AA,LT}$	Daily stock of animals of type LT in the farm, discounting dead and discarded animals (number)

There are two types of swine in this project, i.e., Market swine and Breeding swine. For Market swine, since there is no way to trace the daily stock, so the Option 1 is adopted to calculate N_{LT} for Market swine. For Breeding swine, the PP can monitor the daily stock of breeding swine reliably, discounting dead breeding swine and discarding them from the productive process from the daily stock. So, Option 2 is adopted to calculate N_{LT} for Breeding swine.

(C) Maximum methane producing potential($B_{0,LT}$)

According to applied methodology ACM0010 (Version 08.0), this value varies by species and diet. Default values are used, and they are taken from tables 10A-4 through 10A-9 (IPCC 2006 Guidelines for National Greenhouse Gas Inventories volume 4, chapter 10).

The proposed project is located in Wuhe County Bengbu City, Anhui Province, China, Asia. According to Table 10A-7 and 10A-8 of IPCC 2006 Guidelines for National Greenhouse Gas Inventories volume 4, chapter 10, the maximum methane producing potential ($B_{0,LT}$) for Market swine and Breeding swine in the Asia region is 0.29 m^3 CH_4/kg VS.

(D) Annual methane conversion factor (MCF_j) for the baseline $AWMS_j$

(a) The MCF_j values are given in table 10.17, chapter 10, volume 4, IPCC 2006 Guidelines should be used. MCF_j values depend on the annual average temperature where the anaerobic manure treatment facility in the baseline existed. For this project, the annual average temperature is 16℃ and the value of 75% is applied.

(b) A conservativeness factor should be applied by multiplying MCF_j values (estimated as per above bullet) with a value of 0.94, to account for the 20% uncertainty in the MCF_j values as reported by IPCC 2006.

(2) Baseline N_2O emissions ($BE_{N2O,y}$)

$$BE_{N2O,D,y} = GWP_{N2O} * CF_{N2O-N,N} * \frac{1}{1000} * \left(E_{N2O,D,y} + E_{N2O,ID,y}\right) \qquad Equation\ (7)$$

Where:

$BE_{N2O,y}$	Annual baseline N_2O emissions in (t CO_2e/yr)
GWP_{N2O}	Global Warming Potential (GWP) for N_2O (t CO_2e/tN_2O)
$CF_{N2O-N,N}$	Conversion factor N_2O-N to N_2O (44/28)
$E_{N2O,D,y}$	Direct N_2O emission in year y (kg N_2O-N/year)
$E_{N2O,ID,y}$	Indirect N_2O emission in year y (kg N_2O-N/year)

$$E_{N2O,D,y} = \sum_{j,LT} EF_{N2O,D,j} * NEX_{LT,y} * N_{LT} * MS\%_{Bl,j} \qquad Equation\ (8)$$

Where:

$E_{N2O,D,y}$	Direct N_2O emission in year y (kg N_2O-N/yr)
$EF_{N2O,D,j}$	Direct N_2O emission factor for the treatment system j of the manure management system (kg N_2O-N/kg N).(Estimated with site-specific, regional or national data if such data is available, otherwise use default EF3 from table 10.21, chapter 10, volume 4, in the IPCC 2006 Guidelines for National Greenhouse Gas Inventories). The site specific, regional or national data are not available, so this project activity adopts default EF_3.
$NEX_{LT,y}$	Annual average nitrogen excretion per head of a defined livestock population (kg N/animal/yr) estimated as described in appendix 2
$MS\%_{Bl,j}$	Fraction of manure handled in system j (fraction)
N_{LT}	Annual Average number of animals of type LT for the year y estimated as per equation (5(a)) or (5(b)) (number)

$$E_{N2O,ID,y} = \sum_{j,LT} EF_{N2O,ID} * F_{gasMS,j,LT} * NEX_{LT,y} * N_{LT} * MS\%_{Bl,j} \qquad Equation\ (9)$$

Where:

$E_{N2O,ID,y}$	Indirect N_2O emission in year y (kg N_2O-N/year)
$EF_{N2O,ID}$	Indirect N_2O emission factor for N_2O emissions from atmospheric deposition of nitrogen on soils and water surfaces (kgN_2O-N/kg NH_3-N and NO_X-N). (Estimated with site-specific, regional or national data if such data is available. Otherwise, default values for EF_4 from table 11.3, chapter 11, volume 4 of IPCC 2006 Guidelines for National Greenhouse Gas Inventories can be used). The site-specific, regional or national data are not available, so this project activity adopts default EF_4.
$NEX_{LT,y}$	Annual average nitrogen excretion per head of a defined livestock population. (kg N/animal/yr) estimated as described in appendix 2
$MS\%_{Bl,j}$	Fraction of manure handled in system j (fraction)
$F_{gasMS,j,LT}$	Default values for nitrogen loss due to volatilization of NH_3 and NOX from manure management (fraction)
N_{LT}	Annual Average number of animals of type LT for the year y estimated as per equation (5(a)) or (5(b)) (number)

Estimation of various variables and parameters for above equations:

(A) Procedure for estimating $NEX_{LT,y}$

Option 1:

$$NEX_{LT} = N_{intake} * (1 - N_{retention}) * nd_y \qquad Equation\ (10)$$

Where:

N_{intake}	Daily N intake per animal (kg N/animal/yr)
$N_{retention}$	Portion of that N intake that is retained in the animal (kg N retained/animal/yr)
nd_y	Number of days treatment plant was operational in year y

N_{intake} may be calculated using:

$$N_{intake} = \left(\frac{GE}{18.45}\right) * \left(\frac{CP/100}{6.25}\right) \qquad Equation\ (11)$$

Where:

CP	Crude per cent of protein (per cent)
GE	Gross energy intake of the animal (MJ/animal/day-)
18.45	Conversion factor for dietary GE per kg of dry matter (MJ/kg). This value is relatively constant across a wide range of forage and grain-based feeds commonly consumed by livestock
6.25	Conversion from kg of dietary protein to kg of dietary N, kg feed protein $(kg\ N)^{-1}$

Option 2: In the absence of availability of project specific information on protein intake, which should be justified in the CDM-PDD, national or regional data should be used for the nitrogen excretion $NEX_{LT,y}$, if available. In the absence of such data, default values from table 10.19 of the IPCC 2006, volume 4, chapter 10) may be used and should be corrected for the animal weight at the project site in the following way:

$$NEX_{LT,y} = \frac{W_{site}}{W_{default}} * NEX_{IPCCdefault} \qquad Equation\ (12)$$

Where:

$NEX_{LT,y}$	Annual average nitrogen excretion per head of a defined livestock population (kg N/animal/yr)
W_{site}	Average animal weight of a defined livestock population at the project site (kg)
$W_{default}$	Default average animal weight of a defined population (kg)
$NEX_{IPCC\ default}$	Default value for the nitrogen excretion per head of a defined livestock population (kg N/animal/year)

$$NEX_{IPCCdefault} = N_{rate}(T) * \frac{TAM}{1000} * 365^{16} \qquad Equation\ (13)$$

Where:

$N_{rate}(T)$	the default N excretion rate, kg N/ (1000 kg animal mass)/ day, table 10.19, chapter 10, volume 4 of IPCC 2006 Guidelines
TAM	Typical animal mass for livestock in kg/animal

For this project, neither specific information on Portion of that N intake nor site-specific national or regional data is available. So, the Option 2 is adopted to calculate $NEX_{LT,y}$.

(3) Baseline CO2 emission from electricity and/or heat used in the baseline

$$BE_{elec/heat,y} = BE_{EC,y} + BE_{HG,y} \qquad Equation\ (14)$$

Where:

$BE_{elec/heat,y}$	Baseline CO_2 emissions from electricity and/or heat used in the baseline (t CO_2/yr)
$BE_{EC,y}$	Baseline emissions associated with electricity generation in year y (t CO_2/yr)
$BE_{HG,y}$	Baseline emissions associated with heat generation in year y (t CO_2/yr)

The baseline scenario of this project is an uncovered anaerobic lagoon, and no electricity and/or heat is used in the baseline. So, the baseline CO_2 emission from electricity and/or heat used in the baseline is 0.

[16] This formula refers to the formula 10.30 in chapter 10 volume IPCC2006.

4.2 Project Emissions

Two stages are involved in the manure treatment for the project activity: (1) anaerobic digester; (2) aerobic composting.

Project emissions are estimated as follows:

$$PE_y = PE_{AD,y} + PE_{Aer,y} + PE_{N2O,y} + PE_{EC/FC,y} \qquad Equation\ (15)$$

Where:

PE_y	Project emissions in year y
$PE_{AD,y}$	Project emissions associated with the anaerobic digester in year y (t CO_2e/yr)
$PE_{Aer,y}$	Project CH_4 emissions from aerobic AWMS treatment (t CO_2e/yr)
$PE_{N2O,y}$	Project N_2O emissions in year y (t CO_2/yr)
$PE_{EC/FC,y}$	Project emissions from electricity consumption and fossil fuel combustion (t CO_2e/yr)

(1) Project emissions associated with the anaerobic digester in year y ($PE_{AD,y}$)

Based on the methodology ACM0010" GHG emission reductions from manure management systems (Version 08.0)". $PE_{AD,y}$ is determined using the methodological tool "Project and leakage emissions from anaerobic digesters".

According to the TOOL14" Project and leakage emissions from anaerobic digesters (Version 02.0)", the project emissions associated with the anaerobic digester ($PE_{AD,y}$) are determined as follows:

$$PE_{AD,y} = PE_{EC,y} + PE_{FC,y} + PE_{CH4,y} + PE_{flare,y} \qquad Equation\ (16)$$

Where:

$PE_{AD,y}$	Project emissions associated with the anaerobic digester in year y (t CO_2e)
$PE_{EC,y}$	Project emissions from electricity consumption associated with the anaerobic digester in year y (t CO_2e)
$PE_{FC,y}$	Project emissions from fossil fuel consumption associated with the anaerobic digester in year y (t CO_2e)
$PE_{CH4,\ y}$	Project emissions of methane from the anaerobic digester in year y (t CO_2e)
$PE_{flare,y}$	Project emissions from flaring of biogas in year y (t CO_2e)

The anaerobic digestion process of this project does not involve the use of fossil fuels, so the project emissions from fossil fuel consumption associated with the anaerobic digester is 0, i.e., $PE_{FC,y} = 0$.

The biogas generated in this project will be captured for heat generation and all the heat generated from this project will be used only by the AWMS and swine farm, the surplus biogas will be burned by the flaring system.

In summary, the Project emissions associated with the anaerobic digester in year y (t CO_2e) are as follows i.e., $PE_{AD,y} = PE_{EC,y} + PE_{CH4,\ y} + PE_{flare,y}$.

Determination of Project emissions from electricity consumption ($PE_{EC,\ y}$)

Since the electricity consumption of the anaerobic digestion system cannot be measured separately from the entire AWMS, so the Project emissions from electricity consumption associated with the anaerobic digester and that is not related to the anaerobic digester are calculated together.

The project emissions from electricity consumption calculated according to the tool 05 “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (Version 03.0):

$$PE_{EC,y} = \sum_{j,LT} EC_{PJ,J,y} * EF_{EF,j,y} * (1 + TDL_{j,y}) \qquad Equation\ (17)$$

Where:

$PE_{EC,y}$	Project emissions from electricity consumption in year y (t CO_2e)
$EG_{PJ,J,y}$	Quantity of electricity consumed by the project electricity consumption source j in year y (MWh/yr)
$EF_{EF,j,y}$	Emission factor for electricity generation for source j in year y (t CO_2/MWh)
$TDL_{j,y}$	Average technical transmission and distribution losses for providing electricity to source j in year y

During the monitoring period, the project emissions from electricity consumption will be calculated as Tool 05 in the case of the electricity consumed from the regional power grid. And the electricity consumption sourced from the grid company will be determined through the electricity meters measurement and cross-check with the grid statement.

Determination of project emissions from flaring of biogas ($PE_{flare,y}$)

In case, there is residual gas stream which is flared by flaring and the project emissions from flaring of biogas ($PE_{flare,y}$) shall be estimated using the tool 06 “ Project emissions from flaring”(version 04.0).

The calculation procedure in this tool determines the project emissions from flaring the residual gas ($PE_{flare,y}$) based on the flare efficiency ($\eta_{flare,m}$) and the mass flow of methane to the flare ($F_{CH4,RG,m}$). The flare efficiency is determined for each minute m of year y based either on monitored data or default values.

The calculation procedure of project emissions from flaring is given in the following steps:

STEP 1: Determination of the methane mass flow of the residual gas;

STEP 2: Determination of the flare efficiency;

STEP 3: Calculation of project emissions from flaring.

Step 1: Determination of the methane mass flow in the residual gas

The tool 08 “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” shall be used to determine the following parameter $F_{CH4,m}$:

The following requirements apply:

(a) The gaseous stream to which the tool is applied is the residual biogas for flaring;

(b) The flow of the gaseous stream shall be measured continuously;

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

(d) The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 and 17 in the tool); and

(e) The time interval t for which mass flow should be calculated is every minute m.

$F_{CH4,m}$, which is measured as the mass flow during minute m, shall then be used to determine the mass of methane in kilograms fed to the flare in minute m ($F_{CH4,RG,m}$). $F_{CH4,m}$ shall be determined on a dry basis.

Therefore, option A is adopted to calculate the mass flow of the residual biogas for flaring as per Tool 08 "Tool to determine the mass flow of a greenhouse gas in a gaseous stream"

As per paragraph 23 of Tool 8:" Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 03.0)", the way to prove that the gaseous stream is dry needs to demonstrate that the temperature of the gaseous stream (Tt) is less than 60ºC (333.15 K) at the flow measurement point. For this project, the flowmeters installed in the outlet of the anaerobic tanks and the temperature of the anaerobic treatment unit of this project is designed as medium temperature, and the optimal temperature range is 35 ~ 38 ºC. Therefore, the gas temperature measured by the flowmeter does not exceed 60 ºC, it can be demonstrated that the gaseous stream is dry.

The mass flow of greenhouse gas i ($F_{i,t}$) is determined as follows:

$$F_{i,t} = V_{t,db} * v_{i,t,db} * \rho_{i,t} \qquad Equation\ (18)$$

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t} \qquad Equation(19)$$

Where:

$F_{i,t}$	Mass flow of greenhouse gas i in the gaseous stream in time interval t (kg gas/h)
$V_{t,db}$	Volumetric flow of the gaseous stream in time interval t on a dry basis (m^3 dry gas/h)
$v_{i,t,db}$	Volumetric fraction of greenhouse gas i in the gaseous stream in a time interval t on a dry basis (m^3 gas i/m^3 dry gas)
$\rho_{i,t}$	Density of greenhouse gas i in the gaseous stream in time interval t (kg gas i/m^3 gas i)
P_t	Absolute pressure of the gaseous stream in time interval t (Pa)
MM_i	Molecular mass of greenhouse gas i (kg/kmol)
R_u	Universal ideal gases constant (Pa.m^3/kmol.K)
T_t	Temperature of the gaseous stream in time interval t (K)

Step 2: Determination of the flare efficiency;

The flare efficiency depends on the efficiency of combustion in the flare and the time that the flare is operating. For determining the efficiency of combustion of enclosed flares there is the option to apply a default value or determine the efficiency based on monitored data. For open flares a default value must be applied. The time the flare is operating is determined by monitoring the flame using a flame detector and, for the case of enclosed flares, in addition the monitoring requirements provided by the manufacturer's specifications for operating conditions shall be met.

The flare in this project belongs to open flares. According to tool 06 paragraph 18: in the case of open flares, the flare efficiency in the minute m ($\eta_{flare,m}$) is 50% when the flame is detected in the minute m ($Flame_m$), otherwise $\eta_{flare,m}$ is 0%.

Since the flame is not detected in the minute, therefore, fixed value of 0% for the flare efficiency will be applied for this project, and this is for conservative.

Step 3: Calculation of project emissions from flaring

Project emissions from flaring are calculated as the sum of emissions for each minute m in year y, based on the methane mass flow in the residual gas ($F_{CH4,RG,m}$) and the flare efficiency ($\eta_{flare,m}$), as follows:

$$PE_{flare,y} = GWP_{CH4,y} * \sum_{m=1}^{52600} F_{CH4,GR,m} * \left(1 - \eta_{flare,m}\right) * 10^{-3} \quad Equation\ (20)$$

Where:

$PE_{flare,y}$	Project emissions from flaring of the residual gas in year y (tCO_2e)
GWP_{CH4}	Global warming potential of methane is valid for the commitment period (tCO_2e/tCH_4)
$F_{CH4,RG,m}$	Mass flow of methane in the residual gas in the minute m (kg)
$\eta_{flare,m}$	Flare efficiency in minute m

As described above, $F_{CH4,RG,m}$ will be determined according to equation 18 and 19, so the Project emissions from flaring can be calculated by:

$$PE_{flare,y} = GWP_{CH4,y} * V_{t,db} * v_{i,t,db} * \rho_{i,t} * \left(1 - \eta_{flare,m}\right) * 10^{-3} \quad Equation\ (21)$$

Where:

$V_{t,db}$	Volumetric flow of the residual gas for flaring in time interval t on a dry basis (m^3 dry gas/h)
$v_{i,t,db}$	Volumetric fraction of greenhouse gas i in the gaseous stream for flaring in a time interval t on a dry basis (m^3 gas i/m^3 dry gas)
$\rho_{i,t}$	Density of greenhouse gas i in the gaseous stream in time interval t (kg gas i/m^3 gas i)

Since the gaseous stream will be distributed through the same pipeline, and the temperature and pressure of gaseous stream can be stable. Therefore the $v_{i,t,db}$ and $\rho_{i,t}$ of residual gas will be same with the biogas produced in the anaerobic digester.

As all the biogas generated in the AWMS is collected for heat generation, so no biogas is flared in pre-calculation. In the monitoring period, the project emissions from flaring of biogas are calculated according to the actual situation.

Determination of project emissions of methane from the anaerobic digester ($PE_{CH4,y}$)

$PE_{CH4,y}$ was determined following the step 4 of the applied tool 14“Project and leakage emissions from anaerobic digesters(Version 02.0)”.Project emissions of methane from the anaerobic digester include 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. These emissions are calculated using a default emission factor ($EF_{CH4,\ default}$), as follows:

$$PE_{CH4,y} = Q_{CH4,y} * EF_{CH4,default} * GWP_{CH4} \qquad Equation\ (22)$$

Where:

$PE_{CH4,\ y}$	Project emissions of methane from the anaerobic digester in year y (t CO_2e)
$Q_{CH4,y}$	Quantity of methane produced in the anaerobic digester in year y (t CH_4)
$EF_{CH4,default}$	Default emission factor for the fraction of CH_4 produced that leak from the anaerobic digester (fraction)
GWP_{CH4}	Global warming potential of CH_4 (t CO_2 / t CH_4)

Estimation of various variables and parameters for above equations:

(A) Quantity of methane produced in the anaerobic digester $Q_{CH4,y}$

According to the TOOL14” Project and leakage emissions from anaerobic digesters (Version 02.0)”. 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 defined by CDM only Option 1 shall be used. For small scale projects defined by CDM, project participants may choose between Option 1 or Option 2. The proposed project belongs to large scale projects defined by CDM, so $Q_{CH4,y}$ was determined following step 1 and Option 1 of the applied tool. Below is the formula used for the calculation of $Q_{CH4,y}$.

Option1: 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.

The biogas is produced and collected from anaerobic digestion process. The flowmeters are installed at the outlet of the biogas digesters and the measured on an hourly basis time interval. So the quantity of methane produced in the digester in year y ($Q_{CH4,y}$) is the accumulation of the mass flow of methane in the gaseous stream in an hourly basis time interval. i.e., $Q_{CH4,y} = \sum_{i=1}^{8760} F_{i,t}$.

The mass flow of greenhouse gas i ($F_{i,t}$) is determined as follows:

$$F_{i,t} = V_{t,db} * v_{i,t,db} * \rho_{i,t} \qquad Equation\ (23)$$

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t} \qquad Equation(24)$$

Where:

$F_{i,t}$	Mass flow of greenhouse gas i in the gaseous stream in time interval t (kg gas/h)
$V_{t,db}$	Volumetric flow of the gaseous stream in time interval t on a dry basis (m^3 dry gas/h)
$v_{i,t,db}$	Volumetric fraction of greenhouse gas i in the gaseous stream in a time interval t on a dry basis (m^3 gas i/m^3 dry gas)
$\rho_{i,t}$	Density of greenhouse gas i in the gaseous stream in time interval t (kg gas i/m^3 gas i)
P_t	Absolute pressure of the gaseous stream in time interval t (Pa)
MM_i	Molecular mass of greenhouse gas i (kg/kmol)
R_u	Universal ideal gases constant (Pa.m^3/kmol.K)
T_t	Temperature of the gaseous stream in time interval t (K)

In summary, the Project emissions associated with the anaerobic digester in year y (t CO_2e) is the sum of the Project emissions of methane from the anaerobic digester in year y (t CO_2e), the project emissions from electricity consumption and the project emission from flaring of biogas (if any). i.e., $PE_{AD,y}= PE_{CH4,\ y}+ PE_{EC,y}+ PE_{flare,y}$.

(2) Project CH_4 emissions from aerobic AWMS treatment ($PE_{Aer,\ y}$)

IPCC guidelines specify emissions from aerobic lagoons as 0.1 percent of total methane generating potential of the waste processed, which can be used as a default for all types of aerobic AWMS treatment.

$$PE_{Aer,y} = GWP_{CH4} * D_{CH4} * 0.001 * F_{Aer} * \left[\prod_{n=1}^{N}(1 - R_{VS,n})\right] * \sum_{j,LT}(B_{0,LT} * N_{LT} * VS_{LT,y} * MS\%_j) + PE_{sl,y}$$

$$Equation\ (25)$$

Where:

GWP_{CH4}	Global Warming Potential (GWP) of CH_4 (t CO_2e/tCH_4)
$R_{VS,n}$	Fraction of volatile solid degraded in AWMS treatment method n of the N treatment steps prior to waste being treated (fraction)
D_{CH4}	Density of CH_4 (t/m^3)
F_{Aer}	Fraction of volatile solid directed to aerobic system (fraction)
LT	Type of livestock
$B_{o,LT}$	Maximum methane producing potential of the volatile solid generated by animal type LT (m^3CH_4/kg dm)
$VS_{LT,y}$	Annual volatile solid excretion livestock type LT entering all AWMS on a dry matter weight basis in (kg -dm/animal/yr)
N_{LT}	Annual average number of animals of type LT for the year y (number) as estimated in equation (5) or (6)
$PE_{sl,y}$	Project CH_4 emissions from sludge disposed of in storage pit prior to disposal during the year y (t CO_2e/yr)
$MS\%_j$	Fraction of manure handled in system j in the project activity (fraction)

All sludge produced from the aerobic composting will be sold as organic fertilizer, which will be calculated as leakage emission, so $PE_{Sl,y}$=0. So ,

$$PE_{Aer,y} = GWP_{CH4} * D_{CH4} * 0.001 * F_{Aer} * \left[\prod_{n=1}^{N}\left(1 - R_{VS,n}\right)\right] * \sum_{j,LT}(B_{0,LT} * N_{LT} * VS_{LT,y} * MS\%_j)$$

$$Equation\ (26)$$

Where:

GWP_{CH4}	Global Warming Potential (GWP) of CH_4 (t CO_2e/tCH_4)
$R_{VS,n}$	Fraction of volatile solid degraded in AWMS treatment method n of the N treatment steps prior to waste being treated (fraction)
D_{CH4}	Density of CH_4 (t/m^3)
F_{Aer}	Fraction of volatile solid directed to aerobic system (fraction)
LT	Type of livestock
$B_{o,LT}$	Maximum methane producing potential of the volatile solid generated by animal type LT (m^3CH_4/kg dm)
$VS_{LT,y}$	Annual volatile solid excretion livestock type LT entering all AWMS on a dry matter weight basis in (kg -dm/animal/yr)
N_{LT}	Annual average number of animals of type LT for the year y (number) as estimated in equation (5) or (6)
$MS\%_j$	Fraction of manure handled in system j in the project activity (fraction)

(3) Project N_2O emissions in year y ($PE_{N2O,y}$)

$$PE_{N2O,y} = GWP_{N2O} * CF_{N2O-N,N} * \frac{1}{1000} * \left(E_{N2O,D,y} + E_{N2O,ID,y}\right) \quad Equation\ (27)$$

Where:

$PE_{N2O,y}$	Project N_2O emissions in year y (t CO_2/yr)
GWP_{N2O}	Global Warming Potential (GWP) for N_2O (t CO_2e/tN_2O)
$CF_{N2O-N,N}$	Conversion factor N_2O-N to N_2O (44/28)
$E_{N2O,D,y}$	Direct N_2O emission in year y (kg N_2O-N/year)
$E_{N2O,ID,y}$	Indirect N_2O emission in year y (kg N_2O-N/year)

Option1:

$$E_{N2O,D,y} = \sum\nolimits_{j,LT} EF_{N2O,D,j} * NEX_{LT,y} * N_{LT} * MS\%_J \quad Equation\ (28)$$

Where:

$E_{N2O,D,y}$	Direct N_2O emission in year y (kg N_2O-N/yr)
$EF_{N2O,D,j}$	Direct N_2O emission factor for the treatment system j of the manure management system (kg N_2O-N/kg N)
$NEX_{LT,y}$	Annual average nitrogen excretion per head of a defined livestock population (kg N/animal/yr) estimated as described in appendix 2
$MS\%_j$	Fraction of manure handled in system j (fraction)
N_{LT}	Annual Average number of animals of type LT for the year y estimated as per equation (5(a)) or (5(b)) (number)

$$E_{N2O,ID,y} = \sum_{j,LT} EF_{N2O,ID,j} * F_{gasMS,j,LT} * NEX_{LT,y} * N_{LT} * MS\%_J \qquad Equation\ (29)$$

Where:

$E_{N2O,ID,y}$	Indirect N_2O emission in year y (kg N_2O-N/year)
$EF_{N2O,ID}$	Indirect N_2O emission factor for N_2O emissions from atmospheric deposition of nitrogen on soils and water surfaces (kgN_2O-N/kg NH_3-N and NO_X-N)
$NEX_{LT,y}$	Annual average nitrogen excretion per head of a defined livestock population (kg N/animal/yr) estimated as described in appendix 2
$MS\%_j$	Fraction of manure handled in system j (fraction)
$F_{gasMS,j,LT}$	Default values for nitrogen loss due to volatilization of NH_3 and NO_X from manure management (fraction)
N_{LT}	Annual Average number of animals of type LT for the year y estimated as per equation (5) or (6) (number)

Option2:

$$E_{N2O,D,y} = \sum_{j} EF_{N2O,D,j} * \sum_{m=1}^{12} (Q_{EM,m} * [N]_{EM,m}) \qquad Equation\ (30)$$

$$E_{N2O,ID,y} = EF_{N2O,ID} * \sum_{j,LT} F_{gasMS,j,LT} * \sum_{m=1}^{12} \left(Q_{EM,m} * [N]_{EM,m}\right) \qquad Equation\ (31)$$

Where:

$E_{N2O,D,y}$	Direct N_2O emission in year y (kg N_2O-N/yr)
$E_{N2O,ID,y}$	Indirect N_2O emission in year y (kg N_2O-N/year)
$EF_{N2O,D,j}$	Direct N_2O emission factor for the treatment system j of the manure management system (kg N_2O-N/kg N)
$Q_{EM,m}$	Monthly volume of the effluent mix entering the manure management system (m^3/month)
$[N]_{EM,m}$	Monthly total nitrogen concentration in the effluent mix entering the manure management system (kg N/m^3)
$EF_{N2O,ID}$	Indirect N_2O emission factor for N_2O emissions from atmospheric deposition of nitrogen on soils and water surfaces (kg N_2O-N/kg NH_3-N and NO_X-N)
$F_{gasMS,j,LT}$	Default values for nitrogen loss due to volatilization of NH_3 and NO_X from manure management (fraction)

The same method used to estimate the emissions in the baseline should be used to estimate the project emissions of nitrous oxide, so the Option 1 is used to calculate the Project N_2O emissions $PE_{N2O,\ y}$

(4) Project emissions from the use of heat and/or electricity ($PE_{elec/heat}$)

$$PE_{EC/FC,y} = PE_{EC,y} + \sum_{j} PE_{FC,j,y} \qquad Equation\ (32)$$

Where:

$PE_{EC,y}$ Project emissions from electricity consumption in year y. The project emissions from electricity consumption will be calculated following the latest version of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption". In case, the electricity consumption is not measured then the electricity consumption shall be estimated as follows $EC_{PJ,y} = \sum_i CP_{i,y} * 8760$, where $CP_{i,y}$ is the rated capacity (in MW) of electrical equipment is used for the project activity.

$PE_{FC,y}$ Project emissions from fossil fuel combustion in process j during the year y. The project emissions from fossil fuel combustion will be calculated following the latest version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion". For this purpose, the processes j in the tool corresponds to all fossil fuel combustion in the AWMS (not including fossil fuels consumed for transportation of feed material and sludge or any other on-site transportation).

These emissions should only be considered for the consumption of electricity or heat that is not related to the anaerobic digester. As described above, since the electricity consumption that is not related to the anaerobic digester cannot be separated from the total electricity consumption, therefore the emission for consumption of electricity is calculated in $PE_{EC,y}$, please refer to $PE_{FC,y}$ calculation.

4.3 Leakage

Leakage covers the emissions from land application of treated manure as well as the emissions related to anaerobic digestion in a digester, occurring outside the project boundary. These emissions are estimated as net of those released under project activity and those released in the baseline scenario. Net leakage is only considered if they are positive.

$$LE_y = \left(LE_{PJ,N2O,y} - LE_{BL,N2O,y}\right) + \left(LE_{PJ,CH4,y} - LE_{BL,CH4,y}\right) + LE_{AD,y} \quad Equation\ (33)$$

Where:

$LE_{PJ,\ N2O,\ y}$ Leakage N_2O emissions released during project activity from land application of the treated manure in year y (t CO_2e/yr)

$LE_{BL,\ N2O,\ y}$ Leakage N_2O emissions released during baseline scenario from land application of the treated manure in year y (t CO_2e/yr)

$LE_{PJ,\ CH4,\ y}$ Leakage CH_4 emissions released during project activity from land application of the treated manure in year y (t CO_2e/yr)

$LE_{BL,\ CH4,\ y}$ Leakage CH_4 emissions released during baseline scenario from land application of the treated manure in year y (t CO_2e/yr)

$LE_{AD,\ y}$ Leakage emissions associated with the anaerobic digester in year y (t CO_2e)

(1) Estimation of leakage N_2O emissions released during baseline scenario from land application of the treated manure in year y, $LE_{BL,\ N2O,\ y}$

$$LE_{BL,N2O,y} = GWP_{N2O} * CF_{N2O-N,N} * \frac{1}{1000} * \left(LE_{N2O,land,y} + LE_{N2O,runoff,y} + LE_{N2O,vol,y}\right) \ Equation\ (34)$$

$$LE_{N2O,land,y} = EF_1 * \prod_{n=1}^{N} \left(1 - R_{N,n}\right) * \sum_{LT} NEX_{LT,y} * N_{LT} \qquad Equation\ (35)$$

$$LE_{N2O,runoff,y} = EF_5 * F_{leach} * \prod_{n=1}^{N} (1 - R_{N,n}) * \sum_{LT} NEX_{LT,y} * N_{LT} \qquad Equation\ (36)$$

$$LE_{N2O,vol,y} = EF_4 * F_{gasm} * \prod_{n=1}^{N} (1 - R_{N,n}) * \sum_{LT} NEX_{LT,y} * N_{LT} \qquad Equation\ (37)$$

Where:

GWP_{N2O}	Global Warming Potential (GWP) for N_2O (t CO_2e/tN_2O)
$CF_{N2O-N,N}$	Conversion factor N_2O-N to N_2O (44/28)
$LE_{N2O,land,y}$	Leakage N_2O emissions from application of manure waste in year y (kg N_2O N/year)
$LE_{N2O,runoff,y}$	Leakage N_2O emissions due to leaching and run-off in year y (kg N_2O-N/year)
$LE_{N2O,vol,y}$	Leakage N_2O emissions due to volatilization in year y (kg N_2O-N/year)
F_{gasm}	Fraction of N lost due to volatilization (fraction)
N_{LT}	Annual average number of animals of type LT estimated as per equation (5(a)) or (5(b)) (number)
$NEX_{LT,y}$	Annual average nitrogen excretion per head of a defined livestock population (kg N/animal/year) estimated as described in appendix 2
EF_1	Emission factor for N_2O emissions from N inputs (kg N_2O-N/kg N input)
EF_5	Emission factor for N_2O emissions from N leaching and runoff in (kg N_2O-N/kg N leached and runoff)
EF_4	Emission factor for N_2O emissions from atmospheric deposition of N on soils and water surfaces, [kg N- N_2O/ (kg NH_3-N + NO_X-N volatilized)]
F_{leach}	Fraction of all N added to/mineralized in managed soils in regions were leaching/runoff occurs that is lost through leaching and runoff (fraction)
$R_{N,n}$	Nitrogen reduction factor (fraction)

(2) Estimation of leakage N_2O emissions released during project activity from land application of the treated manure in year y, $LE_{PJ,\ N2O}$

$$LE_{PL,N2O,y} = GWP_{N2O} * CF_{N2O-N,N} * \frac{1}{1000} * (LE_{N2O,land,y} + LE_{N2O,runoff,y} + LE_{N2O,vol,y}) \ Equation\ (38)$$

$$LE_{N2O,land,y} = EF_1 * \prod_{n=1}^{N} (1 - R_{N,n}) * \sum_{LT} NEX_{LT,y} * N_{LT} \qquad Equation\ (39)$$

$$LE_{N2O,runoff,y} = EF_5 * F_{leach} * \prod_{n=1}^{N} (1 - R_{N,n}) * \sum_{LT} NEX_{LT,y} * N_{LT} \qquad Equation\ (40)$$

$$LE_{N2O,vol,y} = EF_4 * F_{gasm} * \prod_{n=1}^{N} (1 - R_{N,n}) * \sum_{LT} NEX_{LT,y} * N_{LT} \qquad Equation\ (41)$$

Where:

GWP_{N2O}	Global Warming Potential (GWP) for N_2O (t CO_2e/tN_2O)
$CF_{N2O-N,N}$	Conversion factor N_2O-N to N_2O (44/28)
$LE_{N2O,land,y}$	Leakage N_2O emissions from application of manure waste in year y (kg N_2O N/year)
$LE_{N2O,runoff,y}$	Leakage N_2O emissions due to leaching and run-off in year y (kg N_2O-N/year)

$LE_{N2O,vol,y}$	Leakage N_2O emissions due to volatilization in year y (kg N_2O-N/year)
F_{gasm}	Fraction of N lost due to volatilization (fraction)
N_{LT}	Annual average number of animals of type LT estimated as per equation (5(a)) or (5(b)) (number)
$NEX_{LT,y}$	Annual average nitrogen excretion per head of a defined livestock population (kg N/animal/year) estimated as described in appendix 2
EF_1	Emission factor for N_2O emissions from N inputs (kg N_2O-N/kg N input)
EF_5	Emission factor for N_2O emissions from N leaching and runoff in (kg N_2O-N/kg N leached and runoff)
EF_4	Emission factor for N_2O emissions from atmospheric deposition of N on soils and water surfaces, [kg N- N_2O/ (kg NH_3-N + NO_X-N volatilized)]
F_{leach}	Fraction of all N added to/mineralized in managed soils in regions were leaching/runoff occurs that is lost through leaching and runoff (fraction)
$R_{N,n}$	Nitrogen reduction factor (fraction)

It is possible to measure the quantity of manure applied to land in kg manure/yr (Q_{DM}) and the nitrogen concentration in kg N/kg manure (N_{DM}) in the manure to estimate the total quantity of nitrogen applied to land. In this case, $\prod_{n=1}^{N}(1 - R_{N,n}) * \sum_{LT} NEX_{LT,y} * N_{LT}$ should be substituted by $Q_{DM} * N_{DM}$.

(3) Estimation of leakage CH_4 emissions from land application of the treated manure

The calculation of methane emissions from land application of manure in the baseline and project cases are estimated as below:

$$LE_{BL,CH4,y} = GWP_{CH4} * D_{CH4} * MCD_d * \left[\prod_{n=1}^{N}(1 - R_{VS,n})\right] * \sum_{j,LT}(B_{0,LT} * N_{LT} * VS_{LT,y} * MS\%_j) \quad Equation\ (42)$$

$$LE_{PL,CH4,y} = GWP_{CH4} * D_{CH4} * MCD_d * \left[\prod_{n=1}^{N}(1 - R_{VS,n})\right] * \sum_{j,LT}(B_{0,LT} * N_{LT} * VS_{LT,y} * MS\%_j) \quad Equation\ (43)$$

Where:

$LE_{BL,CH4,y}$	Leakage CH_4 emissions released during baseline scenario from land application of the treated manure in year y (t CO_2e/yr)
$LE_{PJ,CH4,y}$	Leakage CH_4 emissions released during project activity from land application of the treated manure in year y (t CO_2e/yr)
$R_{VS,n}$	Fraction of volatile solid degraded in AWMS treatment method n of the N treatment steps prior to sludge being treated
GWP_{CH4}	Global Warming Potential (GWP) of CH_4 (t CO_2e/tCH_4)
D_{CH4}	Density of CH_4 (t/m^3)
$B_{0,LT}$	Maximum methane producing potential of the volatile solid generated by animal type LT (m^3CH_4/kg dm)
N_{LT}	Annual average number of animals of type LT estimated as per equation (5(a)) or (5(b)), expressed (number)
$VS_{LT,y}$	Annual volatile solid excretions for livestock LT entering all AWMS on a dry matter weight basis (kg -dm/animal/yr)
$MS\%_j$	Fraction of manure handled in system j in the project activity (fraction)
MCF_d	Methane conversion factor (MCF) assumed to be equal to 1

(4) Estimation of leakage emissions associated with the anaerobic digester

$LE_{AD,y}$ is determined using the methodological tool 14 “Project and leakage emissions from anaerobic digesters(Version 02.0).

The leakage emissions associated with the anaerobic digester ($LE_{AD,y}$) depend on how the digestate is managed. They include emissions associated with storage and composting of the digestate and are determined as follows:

$$LE_{AD,y} = LE_{storage,y} + LE_{comp,y} \qquad Equation\ (44)$$

Where:

$LE_{AD,y}$	Leakage emissions associated with the anaerobic digester in year y (t CO_2e)
$LE_{storage,y}$	Leakage emissions associated with storage of digestate in year y (t CO_2e)
$LE_{comp,y}$	Leakage emissions associated with composting digestate in year y (t CO_2e)

For subsequent treatment stages, the reduction of the nitrogen during a treatment stage is estimated based on referenced data for different treatment types. Emissions from the next treatment stage are then calculated following the approach outlined above, but with nitrogen adjusted for the reduction from the previous treatment stages by multiplying by (1-R_N), where R_N is the relative reduction of nitrogen from the previous stage. The relative reduction (R_N) of nitrogen depends on the treatment technology and should be estimated in a conservative manner. Default values for different treatment technologies can be found in appendix 1 (values for T_N).

The anaerobic digestion process of this project is carried out in a fully enclosed system. The biogas generated during the treatment process will be captured for power generation or flared (if any). The Emissions from combustion will be calculated in project emissions (if any). After anaerobic digestion, the fermented sludge will be treated in aerobic composting system, which will be used as fertilizer. Wastewater from the new animal waste management systems will be treated aerobically and then used for agriculture irrigation. So, the Estimation of leakage emissions associated with the anaerobic digester is 0. i.e., $LE_{AD,y}$ =0.

4.4 Net GHG Emission Reductions and Removals

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

$$ER_y = BE_y - PE_y - LE_y \qquad Equation\ (45)$$

Further, in estimating emissions reduction for claiming certified emissions reductions, if the calculated CH_4 baseline emissions from anaerobic lagoons are higher than the measured CH_4 generated in the anaerobic digester in the project situation ($Q_{CH4,y}$ in the tool “Project and leakage emissions from anaerobic digesters”), then the latter shall be used to calculate the emissions reduction for claiming certified emissions reductions. Therefore, the actual methane captured from an anaerobic digester shall be compared to the ($BE_{CH4,y}$ - $PE_{AD,y}$ in the tool “Project and leakage emissions from anaerobic digesters") and if found lower, then ($BE_{CH4,y}$ - $PE_{AD,y}$) (which is a component of BE_y -PE_y) in Equation (45) is replaced by $Q_{CH4,y}$.

As described above, emission reductions of the project are as below:

Calculation of the baseline emission:

$$BE_y = BE_{CH4,y} + BE_{N2O,y}$$

Parameter	Value		Unit
Species	Market Swine	Breeding Swine	
GWP_{CH4}	28	28	t CO_2 /t CH_4
D_{CH4}	0.00067	0.00067	t/m^3
MCF_j	75%	75%	%
Conservative Factor	0.94	0.94	/
MCF_j with cons. Factor	0.705	0.705	/
$B_{0,LT}$	0.29	0.29	m^3 CH_4 /kg_dm
N_{LT}	91726	40500	No of heads
W_{site}	55	80	kg
$W_{default}$	28	28	kg
$VS_{default}$	0.3	0.3	Kg-dm/animal/day
$VS_{LT,y}$	215.09	312.86	kg-dm/animal/yr
$MS\%_{Bl,j}$	100%	100%	%
nd_y	365	365	days
Sub total	75671	48598	tCO_2e
$BE_{CH4,y}$	**124,270**		**tCO_2e**

Parameter	Value		Unit
Species	Market Swine	Breeding Swine	
$EF_{N2O,D,j}$	0	0	kg N_2O-N/kg N
$EF_{N2O,ID}$	0.01	0.01	kg N_2O/kg N
$N_{rate(T)}$	0.42	0.24	kg N/1000kg animal mass/day
$NEX_{IPCCdefault}$	4.29	2.45	kg N/animal/year
W_{site}	55	80	kg
$W_{default}$	28	28	kg
$NEX_{LT,y}$	8.43	7.01	kg N/animal/yr
N_{LT}	91726	40500	No of heads
$MS\%_{Bl,j}$	100%	100%	/
$F_{gasMS,j,LT}$	40%	40%	/
GWP_{N2O}	265	265	tCO_2/tN_2O

$CF_{N2O-N,N}$	1.57	1.57	Conversion Factor N_2O-N to N_2O
$BE_{N2O,y}$	**1,761**		**tCO_2e**

Baseline Emissions: $BE_{CH4,y} + BE_{N2O,y}$ = 124,270 tCO_2e + 1,761 tCO_2e = 126,031 tCO_2e

Calculation of the project emission:

$$PE_y = PE_{AD,y} + PE_{Aer,y} + PE_{N2O,y}$$

$$PE_{AD,y}= PE_{EC,y}+ PE_{CH4,y}+PE_{flare,y}$$

Parameter	Value	Unit
$EC_{PJ,j,y}$	4361.6	MWh/yr
$EF_{EF,j,y}$	0.58955	tCO_2/MWh
$TDL_{j,y}$	20%	/
$PE_{EC,y}$	**3,086**	**tCO_2e**

Parameter	Value	Unit
GWP_{CH4}	28	tCO_2/tCH_4
$EF_{CH4,default}$	0.05	/
$Q_{CH4,y}$	4888.65	tCH_4
$PE_{CH4,y}$	**6,844**	**tCO_2e**

Parameter	Value	Unit
GWP_{CH4}	28	tCO_2/tCH_4
$\eta_{flare,m}$	0%	/
$Q_{CH4,y}$	0	tCH_4
$PE_{flare,y}$	**0**	**tCO_2e**

$PE_{AD,y}= PE_{EC,y}+ PE_{CH4,y}+PE_{flare,y}$ =3,086 tCO_2e +6,844tCO_2e +0 tCO_2e =9,930 tCO_2e

Parameter	Value		Unit
species	Market Swine	Breeding Swine	
GWP_{CH4}	28	28	tCO_2/tCH_4
D_{CH4}	0.00067	0.00067	t/m^3
	0.001	0.001	/
F_{Aer}	100%	100%	/
$1-R_{vs,1}$	20%	20%	/
$B_{0,LT}$	0.29	0.29	m^3 CH_4 /kg VS
N_{LT}	91726	40500	No of heads
$VS_{LT,y}$	215.09	312.86	kg-dm/animal/yr

$MS\%_j$	100%	100%	/
Sub total	21.5	13.8	tCO_2e
$PE_{Aer,y}$	**35**		**tC02e**

Parameter	Value		Unit
species	Market Swine	Breeding Swine	
$EF_{N20,D,j}$	0	0	kg N_2O-N/kg N
$NEX_{LT,y}$	8.43	7.01	kg N/animal/yr
N_{LT}	91726	40500	No of heads
$MS\%_j$	100%	100%	/
Sub total	**0**	**0**	**kg N_2O-N/year**
$EF_{N20,D,j}$	0.006	0.006	kg N_2O-N/kg N
$NEX_{LT,y}$	8.43	7.01	kg N/animal/yr
N_{LT}	91726	40500	No of heads
$MS\%_j$	50%	50%	/
Sub total	**2,320**	**851**	**kg N_2O-N/year**
$E_{N20,D,y}$	**3,172**		**kg N_2O-N/year**

Parameter	Value		Unit
species	Market Swine	Breeding Swine	
$EF_{N20,iD}$	0.01	0.01	kg N_2O-N/kg NH_3 and NO_x-N
$F_{gasMS,j,LT}$	40%	40%	/
$NEX_{LT,y}$	8.43	7.01	kg N/animal/yr
N_{LT}	91726	40500	No of heads
$MS\%_j$	50%	50%	%
Sub total	1,547	568	kg N_2O-N/year
$EF_{N20,iD}$	0.01	0.01	kg N_2O-N/kg NH_3 and NO_x-N
$F_{gasMS,j,LT}$	45%	45%	/
$NEX_{LT,y}$	8.43	7.01	kg N/animal/yr
N_{LT}	91726	40500	No of heads
$MS\%_j$	50%	50%	%
Sub total	1,740	639	kg N_2O-N/year
$E_{N20,ID,y}$	**4,493**		**kg N_2O-N/year**

$$PE_{N2O,y} = GWP_{N2O} * CF_{N2O-N,N} * \frac{1}{1000} * \left(E_{N2O,D,y} + E_{N2O,ID,y}\right)$$

= 265 * 1.57 * 0.001 * (3172 + 4493) = 3,189 tCO_2e

Project Emissions: $PE_{AD,y}+PE_{Aer,y}+PE_{N20,y}$=9,930 tCO_2e + 35 tCO_2e + 3,189 tCO_2e=13,154 tCO_2e

Calculation of leakage:

$$LE_y = (LE_{PJ,N2O,y} - LE_{BL,N2O,y}) + (LE_{PJ,CH4,y} - LE_{BL,CH4,y})$$

Parameter	Value		Unit
species	Market Swine	Breeding Swine	
N_{LT}	91726	40500	No of heads
N_{rate}	0.42	0.24	kg N/1000kg animal mass/day
$NEX_{LT,y}$	8.43	7.01	kg N/animal/yr
$R_{N,n}$	80%	80%	/
EF_1	0.01	0.01	kg N_2O-N/kg N
EF_5	0.0075	0.0075	kg N_2O-N/kg N
EF_4	0.01	0.01	KgN-N_2O-N/kg NH_3-N+NO_X-N
F_{leach}	30%	30%	/
F_{gasm}	20%	20%	/
GWP_{N2O}	265	265	tCO_2/tN_2O
$LE_{N2O,land,y}$	1,547	568	kg N_2O-N/year
	2,114		kg N_2O-N/year
$LE_{N2O,runoff,y}$	348	128	kg N_2O-N/year
	476		kg N_2O-N/year
$LE_{N2O,vol,y}$	309	114	kg N_2O-N/year
	423		kg N_2O-N/year
$LE_{BL,N2O,y}$	**1,255**		**tCO_2e**

Parameter	Value		Unit
species	Market Swine	Breeding Swine	
N_{LT}	91726	40500	No of heads
N_{rate}	0.42	0.24	kg N/1000kg animal mass/day
$NEX_{LT,y}$	8.43	7.01	kg N/animal/yr
$R_{N,n}$	25%	25%	/
$R_{N,n}$	5%	5%	/
EF_1	0.01	0.01	kg N_2O-N/kg N
EF_5	0.0075	0.0075	kg N_2O-N/kg N
EF_4	0.01	0.01	KgN-N_2O-N/kg NH_3-N+NO_X-N
F_{leach}	30%	30%	/
F_{gasm}	20%	20%	/
GWP_{N2O}	265	265	tCO_2/tN_2O
$LE_{N2O,land,y}$	5,510	2,022	kg N_2O-N/year
	7,533		kg N_2O-N/year
$LE_{N2O,runoff,y}$	1,240	455	kg N_2O-N/year
	1,695		kg N_2O-N/year
$LE_{N2O,vol,y}$	1,102	404	kg N_2O-N/year

	1,507	kg N_2O-N/year
$LE_{BL,N2O,y}$	**4,470**	**tCO_2e**

Parameter	Value		Unit
species	Market Swine	Breeding Swine	
GWP_{CH4}	28	28	tCO2/tCH4
D_{CH4}	0.00067	0.00067	t/m^3
MCF_d	1	1	/
$VS_{LT,y}$	215.09	312.86	kg-dm/animal/yr
N_{LT}	91726	40500	No of heads
$B_{0,LT}$	0.29	0.29	m^3 CH4/kg-VS
R_{VS}	85%	85%	/
$MS\%_j$	100%	100%	/
	16,100	10,340	tCO2e
$LE_{BL,CH4,y}$	**26,440**		**tCO2e**

Parameter	Value		Unit
species	Market Swine	Breeding Swine	
GWP_{CH4}	28	28	tCO_2/tCH_4
D_{CH4}	0.00067	0.00067	t/m^3
MCF_d	1	1	/
$VS_{LT,y}$	215.09	312.86	kg-dm/animal/yr
N_{LT}	91726	40500	No of heads
$B_{0,LT}$	0.29	0.29	m^3 CH_4/kg-VS
R_{VS}	80%	80%	/
R_{VS}	20%	20%	/
$MS\%_j$	100%	100%	/
	17,174	11,029	tCO_2e
$LE_{PJ,CH4,y}$	**28,203**		**tCO_2e**

$LE_y = (LE_{PJ,N2O,y} - LE_{BL,N2O,y}) + (LE_{PJ,CH4,y} - LE_{BL,CH4,y})$ = (4,470 – 1,255) + (28,203 – 26,440) = 4,978 tCO_2e

ERy = BEy – PEy – LEy = 126,031 tCO_2e – 13,154 tCO_2e – 4,978 tCO_2e = 107,899 tCO_2e

In the pre-estimation, the CH_4 baseline emissions $BE_{CH4,y}$ is 124,270 tCO_2e, the biogas $Q_{CH4,y}$ captured is 1216.08*10^4m^3, which equals to 136,882 tCO_2e. The project emissions associated with the anaerobic digester $PE_{AD,y}$ is 9,930 tCO_2e. Actual methane captured from anaerobic digesters is higher than the difference between $BE_{CH4,y}$ and $PE_{AD,y}$, so in the Pre-estimation, the equation 45 can be used to calculate emission reduction.

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)
01/08/2021-31/07/2022	126,031	13,154	4,978	107,899
01/08/2022-31/07/2023	126,031	13,154	4,978	107,899
01/08/2023-31/07/2024	126,031	13,154	4,978	107,899
01/08/2024-31/07/2025	126,031	13,154	4,978	107,899
01/08/2025-31/07/2026	126,031	13,154	4,978	107,899
01/08/2026-31/07/2027	126,031	13,154	4,978	107,899
01/08/2027-31/07/2028	126,031	13,154	4,978	107,899
Total	**882,214**	**92,078**	**34,845**	**755,291**

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	GWP_{CH4}
Data unit	$t\ CO_2e/tCH_4$
Description	Global Warming Potential of CH_4
Source of data	IPCC 2014
Value applied	28
Justification of choice of data or description of measurement methods and procedures applied	100-year values are adopted from Box 3.2, table 1, IPCC Fifth Assessment Report, 2014[17]
Purpose of Data	Calculation of baseline emissions and project emissions
Comments	N/A

[17] https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full.pdf

Data / Parameter	GWP_{N2O}
Data unit	t CO_2e/tN_2O
Description	Global Warming Potential of N_2O
Source of data	IPCC 2014
Value applied	265
Justification of choice of data or description of measurement methods and procedures applied	100-year values are adopted from Box 3.2, table 1, IPCC Fifth Assessment Report, 2014
Purpose of Data	Calculation of baseline emissions and project emissions
Comments	N/A

Data / Parameter	D_{CH4}
Data unit	t/m^3
Description	Density of CH_4
Source of data	ACM0010 Version 08.0
Value applied	0.00067
Justification of choice of data or description of measurement methods and procedures applied	0.00067 t/m^3 at room temperature 20°C and 1 atm pressure.
Purpose of Data	Used in project emission/baseline calculations
Comments	N/A

Data / Parameter	MCF_j
Data unit	/
Description	Methane conversion factor for the baseline $AWMS_j$
Source of data	IPCC 2006 table 10.17, chapter 10, volume 4
Value applied	75%

Justification of choice of data or description of measurement methods and procedures applied	MCFj value for uncovered anaerobic lagoon (baseline AWMS) is chosen. A conservativeness factor has been applied by multiplying MCF_j value (i.e., 75%) with a value of 0.94, to account for the 20 per cent uncertainty in the MCF_j values as reported by IPCC 2006. For this project, the annual average temperature is 16℃ and the conservative value of 75% is applied. Therefore, MCF_j value of 70.5% will be applied.
Purpose of Data	Used in project emission/baseline calculations
Comments	N/A

Data / Parameter	$B_{0, LT}$
Data unit	m^3CH_4/kg -dm
Description	Maximum methane producing potential of the volatile solid generated by animal type LT
Source of data	IPCC 2006 table 10A-7 and 10A-8, chapter 10, volume 4
Value applied	$B_{0, LT}$ (Market swine) =0.29 $B_{0, LT}$ (Breeding swine) =0.29
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Used in baseline and project emission calculations
Comments	N/A

Data / Parameter	$MS\%_{Bl,j}$
Data unit	Fraction
Description	Fraction of manure handled in system j in the baseline
Source of data	Project proponents
Value applied	100%

Justification of choice of data or description of measurement methods and procedures applied	In this project, the baseline manure management system is uncovered anaerobic lagoon only. The amount of manure handled by the anaerobic lagoon is 100%.
Purpose of Data	Used in baseline emission calculations
Comments	N/A

Data / Parameter	$W_{default}$
Data unit	kg
Description	Default average animal weight of a defined population
Source of data	IPCC 2006 table 10A-7 and 10A-8, chapter 10, volume 4
Value applied	$W_{default}$ (Market swine) = 28 kg $W_{default}$ (Breeding swine) = 28 kg
Justification of choice of data or description of measurement methods and procedures applied	/
Purpose of Data	Used in baseline emission calculations
Comments	N/A

Data / Parameter	$VS_{default}$
Data unit	kg-dm/animal/day
Description	Default value for the volatile solid excretion per day on a dry-matter basis for a defined livestock population
Source of data	IPCC 2006 table 10A-7 and 10A-8, chapter 10, volume 4
Value applied	$VS_{default}$ (Market swine) = 0.3 $VS_{default}$ (Breeding swine) = 0.3
Justification of choice of data or description of measurement methods and procedures applied	/
Purpose of Data	Used in project/baseline emission calculations

Comments	N/A

Data / Parameter	$NEX_{IPCC\ default}$
Data unit	Kg N/animal/day
Description	Default value for the nitrogen excretion per head of a defined livestock population
Source of data	Calculated by the equation: $NEX_{IPCC\ default} = N_{rate(T)} * TAM/1000*365$
Value applied	$NEX_{IPCC\ default}$ (Market swine) =4.29 $NEX_{IPCC\ default}$ (Breeding swine) =2.45
Justification of choice of data or description of measurement methods and procedures applied	/
Purpose of Data	Baseline, Project and leakage emissions calculations
Comments	N/A

Data / Parameter	$N_{rate,\ (T)}$
Data unit	kg N (1000 kg animal mass)$^{-1}$ day^{-1}
Description	default N excretion rate
Source of data	IPCC 2006 table 10.19, chapter 10, volume 4
Value applied	$N_{rate,(T)}$ (Market swine) =0.42 $N_{rate,(T)}$ (Breeding swine) =0.24
Justification of choice of data or description of measurement methods and procedures applied	/
Purpose of Data	$NEX_{IPCC\ default}$ calculations
Comments	N/A

Data / Parameter	TAM
Data unit	kg $animal^{-1}$
Description	typical animal mass for livestock category
Source of data	IPCC 2006 table 10A-7 and 10A-8, chapter 10, volume 4
Value applied	TAM (Market swine) =28 TAM (Breeding swine) =28
Justification of choice of data or description of measurement methods and procedures applied	/
Purpose of Data	$NEX_{IPCC\ default}$ calculations
Comments	N/A

Data / Parameter	$F_{gas\ MS,j,LT}$
Data unit	Fraction
Description	Default values for nitrogen loss due to volatilization of NH_3 and NO_X from manure management
Source of data	IPCC 2006 table 10.22, chapter 10, volume 4
Value applied	$F_{gasMS,j,LT}$, (anaerobic lagoon) : 40% $F_{gasMS,j,LT}$, (solid storage) : 45%
Justification of choice of data or description of measurement methods and procedures applied	Site specific data is unavailable therefore default values are opted for.
Purpose of Data	Used in project/baseline emission calculations
Comments	N/A

Data / Parameter	$EF_{N2O,D,j}$
Data unit	Kg N_2O-N/kg N
Description	Direct N_2O emission factor for the treatment system j of the manure management system

Source of data	IPCC 2006 table 10.21, chapter 10, volume 4
Value applied	$EF_{N2O, D}$=0 for anaerobic lagoon and digester, $EF_{N2O, D}$=0.006 for aerobic lagoon
Justification of choice of data or description of measurement methods and procedures applied	Site specific data is unavailable therefore default values are opted for.
Purpose of Data	Used in project/baseline emission calculations
Comments	N/A

Data / Parameter	$EF_{N2O,ID,j}$
Data unit	kgN_2O-N/kg NH_3-N and NO_X-N
Description	Indirect N_2O emission factor for the treatment system j of the manure management system
Source of data	IPCC 2006 table 11.3, chapter 11, volume 4
Value applied	0.01
Justification of choice of data or description of measurement methods and procedures applied	Site specific data is unavailable therefore default values are opted for.
Purpose of Data	Used in project/baseline emission calculations
Comments	N/A

Data / Parameter	$EF_{CH4,default}$
Data unit	t CH_4 leaked / t CH_4 produced
Description	Default emission factor for the fraction of CH_4 produced those leaks from the anaerobic digester (fraction)
Source of data	Tool 14:" Project and leakage emissions from anaerobic digesters (version 02.0)"
Value applied	0.05
Justification of choice of data or description of	UASB type digesters

measurement methods and procedures applied	
Purpose of Data	Calculation of project emissions
Comments	$PE_{CH4,y}$ for ex-ante estimation adopted equation(4) of Methodological tool " Project and leakage emissions from anaerobic digesters", the amount of biogas collected at the digester will be monitored.

Data / Parameter	$R_{VS,n}$
Data unit	Fraction
Description	Fraction of volatile solid degraded in AWMS treatment method n of the N treatment steps prior to waste being treated
Source of data	Refer to Appendix 1 of methodology ACM0010 (version 08.0)
Value applied	For project scenario, two stages are involved: an anaerobic digester $R_{VS,n}$ = 80% an aerobic treatment (Forced aeration systems) $R_{VS,n}$ = 20%[18] For base scenario: a one cell lagoon $R_{VS,n}$ = 85%[19] all value is chosen conservatively.
Justification of choice of data or description of measurement methods and procedures applied	Estimated from Table provided in Appendix 1 of ACM0010. The most conservative value for the given technology must be used.
Purpose of Data	project emission/ leakage calculation
Comments	The most conservative value for the given technology must be used

Data / Parameter	$R_{N,n}$
Data unit	Fraction

[18] For proposed project, prior to the sludge being treated, it undergoes two stages of homogenization pretreatment, and anaerobic fermentation, which similar to the anaerobic treatment of underfloor pit storage and covered first cell of two cell lagoon. Therefore, the corresponding R_{VS} of each stage is 20% and 80% respectively as Annex 1 of the methodology.

[19] For proposed project, the baseline is uncovered anaerobic lagoon which belongs to the anaerobic treatment of One-cell lagoon in the Appendix 1 of applied methodology ACM0010 (version 08.0), so, the $R_{VS,n}$ is 85% which is the most conservative value.

Description	Nitrogen reduction factor
Source of data	Refer to Appendix 1 of methodology ACM0010 (version 08.0)
Value applied	For project scenario, two stages are involved: an anaerobic digester $R_{N,n}$ = 25% an aerobic treatment $R_{N,n}$ = 5%[20] For base scenario: a one cell lagoon $R_{N,n}$ = 80% all value is chosen conservatively.
Justification of choice of data or description of measurement methods and procedures applied	Estimated from Table provided in Appendix 1 of ACM0010. The most conservative value for the given technology must be used.
Purpose of Data	Calculation of leakage emission
Comments	The most conservative value for the given technology must be used

Data / Parameter	EF_1, EF_4, EF_5
Data unit	kg N_2O-N/kg N for EF_1, EF_5 and [kg N_2O-N/ (kg NH_3-N and NO_X-N) for EF_4
Description	Emission factor for N_2O emissions from N inputs; from N leaching and runoff; from atmospheric deposition of N on soils and water surfaces
Source of data	IPCC 2006 Guidelines default values are be used, since country specific or region-specific data are not available. EF_1 from table 11.1, chapter 11, volume 4. EF_4 and EF_5 from table 11.3, chapter 11, volume 4
Value applied	EF_1 = 0.010 EF_4 =0.010 EF_5 = 0.0075
Justification of choice of data or description of measurement methods and procedures applied	Site specific data is unavailable therefore default values are opted for.
Purpose of Data	Calculation of leakage emission

[20] Since R_{VS} of each stage is 20% and 80%. Therefore $R_{N,n}$ is 5% and 25% corresponding as methodology appendix 1.

Comments	N/A

Data / Parameter	F_{gasm}
Data unit	Fraction
Description	Fraction of N lost due to volatilization
Source of data	Default values from table 11.3, chapter 11, volume 4 of IPCC 2006 guidelines
Value applied	0.2
Justification of choice of data or description of measurement methods and procedures applied	Site specific data is unavailable therefore default values are opted for.
Purpose of Data	Used in project/baseline emission calculations
Comments	N/A

Data / Parameter	F_{leach}
Data unit	Fraction
Description	Fraction of all N added to/mineralized in managed soils in regions where leaching/runoff occurs that is lost through leaching and runoff
Source of data	Default values from table 11.3, chapter 11, volume 4 of IPCC 2006 guidelines
Value applied	0.3
Justification of choice of data or description of measurement methods and procedures applied	Site specific data is unavailable therefore default values are opted for.
Purpose of Data	Calculation of leakage emission
Comments	N/A

Data / Parameter	MCF_d

Data unit	/
Description	Methane conversion factor for leakage calculation
Source of data	Methodology ACM0010(version 08.0)
Value applied	1
Justification of choice of data or description of measurement methods and procedures applied	According to paragraph 51 of the methodology ACM0010" GHG emission reductions from manure management systems (version08.0)", Methane conversion factor for leakage calculation assumed to be equal 1
Purpose of Data	Calculation of leakage emission
Comments	N/A

Data / Parameter	$EF_{EF,j,y}$
Data unit	tCO_2/MWh
Description	Emission factor for electricity generation
Source of data	Published by Ministry of Ecology and Environment of China, which is the DNA of China[21]
Value applied	0.58955
Justification of choice of data or description of measurement methods and procedures applied	According to tool" Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"
Purpose of Data	Calculation of leakage emission
Comments	N/A

Data / Parameter	R_u
Data unit	$Pa.m^3/kmol.K$
Description	Universal ideal gases constant
Source of data	Tool 08:" Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 03.0)"

[21] http://mee.gov.cn/ywgz/ydqhbh/wsqtkz/202012/t20201229_815386.shtml

Value applied	8,314
Justification of choice of data or description of measurement methods and procedures applied	/
Purpose of Data	Calculation of project emission
Comments	N/A

Data / Parameter	MM_i
Data unit	kg/kmol
Description	Molecular mass of greenhouse gas i
Source of data	Tool 08:" Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 03.0)"
Value applied	16.04 kg/mol for methane
Justification of choice of data or description of measurement methods and procedures applied	/
Purpose of Data	Calculation of project emission
Comments	N/A

Data / Parameter	$\eta_{flare,m}$
Data unit	%
Description	Flare efficiency in minute m
Source of data	Tool 06" Project emissions from flaring (Version 03.0)"
Value applied	0%
Justification of choice of data or description of measurement methods and procedures applied	/
Purpose of Data	Calculation of project emission

Comments	N/A

5.2 Data and Parameters Monitored

Data / Parameter	$N_{p,LT}$
Data unit	Number
Description	Number of animals of type LT produced annually for the year y
Source of data	Project proponents
Description of measurement methods and procedures to be applied	Each pig involved in this project has a unique electronic ear tag when was born, which is an electronic device dedicated to the identification and electronic management of animals, can track automatically. This electronic ear tag is connected to the Data Collection System (DCS), which can store and read information. Therefore, the number of swine produced in the farm can be monitored through the auto tracking devices of electronic ear tag once pig slaughter monthly and obtained by the DCS. At the same time, the technicians in farms will record manually the number of swine produced in the farms monthly. Also, the number of monthly exported from the stock will also be recorded.
Frequency of monitoring/recording	Monthly
Value applied	216,000 heads of market swine used for ex-estimated and this value sourced from Project evaluation report.
Monitoring equipment	N/A
QA/QC procedures to be applied	Archive electronically during project plus 5 years.
Purpose of data	Use for the calculation of N_{LT}
Calculation method	N/A
Comments	Indirect information (food purchase records and sale records) will be cross-checked.

Data / Parameter	$N_{da,LT}$
Data unit	Number

Description	Number of days animal of type LT is alive in the farm in the year y
Source of data	Project proponents
Description of measurement methods and procedures to be applied	Each pig involved in this project has a unique electronic ear tag when was born, which is an electronic device dedicated to the identification and electronic management of animals. This electronic ear tag is connected to the Data Collection System (DCS), which can store and read information. Therefore, the days of swine alive in the farm can be traced through the electronic ear tag by the technical staff in each farm and obtained by the DCS.
Frequency of monitoring/recording	Monthly
Value applied	155 days which sourced from Project evaluation report, and this value is in line with the number of days for pigs to be slaughtered by existing large-scale breeding groups in China.
Monitoring equipment	N/A
QA/QC procedures to be applied	Archive electronically during project plus 5 years.
Purpose of data	Used for the calculation of N_{LT}, which used in the calculation of the baseline emission. Project emission and leakages emission.
Calculation method	N/A
Comments	Indirect information (sale records) will be cross-checked

Data / Parameter	$N_{AA,LT}$
Data unit	Number
Description	Daily stock of animals in the farm, discounting dead and discarded animals
Source of data	Project proponents
Description of measurement methods and procedures to be applied	Each pig involved in this project has a unique electronic ear tag when was born, which is an electronic device dedicated to the identification and electronic management of animals. This electronic ear tag is connected to the Data Collection System (DCS), which can store and read information. The technicians in farms monitor and record the number of breeding swine through the auto tracking devices of electronic ear tag daily, of which new imported animals are included and dead and discharge animals

	are excluded. The annual average number of animals ($N_{AA,LT}$) is calculated as an average of the daily stock of breeding swine in the farms without considering dead animals and discarded animals.
Frequency of monitoring/recording	Daily
Value applied	40,500 heads of Breeding swine were used to ex-estimated, and this value sourced from Project evaluation report.
Monitoring equipment	N/A
QA/QC procedures to be applied	Archive electronically during project plus 5 years.
Purpose of data	Used for the calculation of N_{LT}, which used in the calculation of the baseline emission. Project emission and leakages emission.
Calculation method	N/A
Comments	The project proponents monitor the population of breeding pigs through the auto tracking device, which is connected to the Data Collection System (DCS). Therefore, the data of $N_{AA, LT}$ can be obtained through DCS.

Data / Parameter	W_{site}
Data unit	kg
Description	Average animal weight of a defined livestock population at the project site
Source of data	Project proponents
Description of measurement methods and procedures to be applied	Measured by the weight measurer
Frequency of monitoring/recording	Monthly
Value applied	55 kg for commercial pigs and 80 kg for breeding pigs which sourced from Project evaluation report.
Monitoring equipment	weight measurer

QA/QC procedures to be applied	This parameter is used in equation 4 for estimating $VS_{LT,y}$ using option 3, and in equation 2 (appendix 2) for estimating $NEX_{LT,y}$ when using IPCC 2006 default values. Sampling procedures will be used to estimate this variable, taking into account the following guidance: (a) To ensure representativeness, each defined livestock population should be classified into a minimum of three age categories; (b) For each defined livestock population, a minimum of one monthly sample per age category should be taken; (c) When estimating baseline emissions and emissions released during baseline scenario from land application of the treated manure in the leakage section, the lower bound of the 95% confidence interval obtained from the sampling measurements should be used; (d) When estimating project emissions and emissions released during project activity from land application of the treated manure in the leakage section, the upper bound of the 95% confidence interval obtained from the sampling measurements should be used. The weight measurer will be calibrated annually to ensure the reliability of the parameter.
Purpose of data	Used for estimating $VS_{LT,y}$
Calculation method	N/A
Comments	N/A

Data / Parameter	F_{Aer}
Data unit	Fraction
Description	Fraction of volatile solids directed to aerobic treatment
Source of data	Project proponents
Description of measurement methods and procedures to be applied	As this parameter is not monitored in the actual operation, so in the monitoring period, to be conservative, the value of this parameter in the emission reduction calculation is 100%
Frequency of monitoring/recording	Annually
Value applied	100%

Monitoring equipment	N/A
QA/QC procedures to be applied	/
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	nd_y
Data unit	number
Description	Number of days treatment plant was operational in year y
Source of data	Project proponents
Description of measurement methods and procedures to be applied	The number of days treatment plant was operational will be recorded manually by the responsible staff.
Frequency of monitoring/recording	Daily
Value applied	365 days for ex-ante estimation. The actual number of days treatment plant was operational used in the monitoring periods will be monitored by project proponents
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of Baseline emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	v_f
Data unit	m^3

Description	Biogas flow
Source of data	Project proponents
Description of measurement methods and procedures to be applied	Measured by the flow meters.
Frequency of monitoring/recording	Continuously by flow meter and reported cumulatively on weekly basis
Value applied	$1216.08*10^4 m^3$ of biogas are expected to be generated by the project annually which sourced from Project evaluation report.
Monitoring equipment	flow meters
QA/QC procedures to be applied	The calibration of flow meters, including the frequency of calibration, should be done in accordance with national standards or requirements.
Purpose of data	Calculation of project emissions and leakage
Calculation method	N/A
Comments	The biogas flow will be measured at four points, as shown in the figure. But if the project participants can demonstrate that leakage in distribution pipeline is zero, it need be measured at any three points. The biogas flow to electricity or heat equipment in a moment can be considered destroyed, by monitoring that the equipment was working at this time. For the proposed project, the biogas generated during the treatment process will be captured for power generation, so the biogas produced from the anaerobic digestion, the amount of biogas used for electricity generation and the amount of biogas flared (if any) will be monitored through the flow meter.

Data / Parameter	$EC_{PJ,j,y}$
Data unit	MWh
Description	Quantity of electricity consumed by the proposed project in year y
Source of data	Direct measurement or calculated based on measurements from more than one electricity meters
Description of measurement methods	Measured by electricity meters installed at the electricity consumption sources.

and procedures to be applied	
Frequency of monitoring/recording	Continuous measurement and at least monthly recording
Value applied	4361.6 MWh for ex ante estimation. During the monitoring period, if the electricity consumption sourced from the gird company, then the value will be determined as per the electricity meters monitoring and Cross-check with the grid statement.
Monitoring equipment	electricity meters
QA/QC procedures to be applied	The calibration of meters, including the frequency of calibration, should be done in accordance with national standards or requirements
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	$TDL_{j,y}$
Data unit	/
Description	Average technical transmission and distribution losses for providing electricity to source j in year y
Source of data	Tool 05" Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"
Description of measurement methods and procedures to be applied	According to the tool 05" Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"
Frequency of monitoring/recording	This value will change once the tool is updated
Value applied	20%
Monitoring equipment	N/A
QA/QC procedures to be applied	/

Purpose of data	Calculation of project emissions
Calculation method	/
Comments	N/A

Data / Parameter	$V_{t,db}$
Data unit	m^3 dry gas/h
Description	Volumetric flow of the gaseous stream in time interval t on a dry basis
Source of data	Flow meters
Description of measurement methods and procedures to be applied	Volumetric flow measurement should always refer to the actual pressure and temperature.
Frequency of monitoring/recording	Continuous measurement
Value applied	Biogas was estimated according to the amount of manure for Ex ante estimation and will be monitored in the monitoring period.
Monitoring equipment	N/A
QA/QC procedures to be applied	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to the manufacturer's specifications
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	$V_{i,t,db}$
Data unit	m^3 gas i/m^3 dry gas
Description	Volumetric fraction of greenhouse gas i in a time interval t on a dry basis

Source of data	gas analyzers
Description of measurement methods and procedures to be applied	Continuous gas analyzers operating in dry-basis. Volumetric flow measurement should always refer to the actual pressure and temperature
Frequency of monitoring/recording	Continuous measurement
Value applied	CH_4 fraction of biogas is 60% for pre-calculation.
Monitoring equipment	N/A
QA/QC procedures to be applied	Calibration should include zero verification with an inert gas (e.g., N_2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	T_t
Data unit	K
Description	Temperature of the gaseous stream in time interval t
Source of data	Measured by instrument
Description of measurement methods and procedures to be applied	Instruments with recordable electronic signal (analogical or digital) are required. Examples include thermocouples, thermos resistance, etc
Frequency of monitoring/recording	Continuous unless differently specified in the underlying methodology
Value applied	293.15 K was used in the pre-calculation for the density of CH4 as the applied methodology ACM0010(Version08.0), in actual monitoring period, the temperature of the gaseous stream is monitored by the recordable electronic signal. The temperature Tt(K) is calculated as the equation T(K)=t(°C) +273.15.

Monitoring equipment	Instruments with recordable electronic signal (analogical or digital)
QA/QC procedures to be applied	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency)

Data / Parameter	P_t
Data unit	Pa
Description	Pressure of the gaseous stream in time interval t
Source of data	Measured by instrument
Description of measurement methods and procedures to be applied	Instruments with recordable electronic signal (analogical or digital) are required. Examples include thermocouples, thermos resistance, etc
Frequency of monitoring/recording	Continuous unless differently specified in the underlying methodology
Value applied	101.325 kPa for the pre-calculation for the density of CH4 as the applied methodology ACM0010 (Version08.0), in actual monitoring period, the pressure of the gaseous stream is monitored by the recordable electronic signal.
Monitoring equipment	Instruments with recordable electronic signal (analogical or digital)
QA/QC procedures to be applied	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications

Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency)

Data / Parameter	$\rho_{i,t}$
Data unit	kg gas i/m³ gas i
Description	Density of greenhouse gas i in the gaseous stream in time interval t
Source of data	Calculated
Description of measurement methods and procedures to be applied	Calculated based on temperature and pressure of the gaseous stream in time interval t.
Frequency of monitoring/recording	-
Value applied	0.00067 t/m³ for ex-estimated. In monitoring period, this parameter is calculated based on temperature of the gaseous stream in time interval t and pressure of the gaseous stream in time interval t
Monitoring equipment	N/A
QA/QC procedures to be applied	-
Purpose of data	Calculation of project emissions
Calculation method	-
Comments	N/A

Data / Parameter	$MS\%_j$
Data unit	Fraction

Description	Fraction of manure handled in system j in project activity
Source of data	Project proponents
Description of measurement methods and procedures to be applied	/
Frequency of monitoring/recording	Annually
Value applied	100% for ex-estimated. As this parameter is not monitored in the actual operation. so, in the monitoring period, to be conservative, the value of this parameter in the emission reduction calculation is 100% or total $MS\%_j$ in different treatment system is 100% since the treatment process of this project is an anaerobic-aerobic combined treatment technology, main including anaerobic fermentation, and aerobic composting.
Monitoring equipment	N/A
QA/QC procedures to be applied	100% is the maximum value and conservative
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

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:

(1) Monitoring framework

The project owner will be responsible for the whole monitoring work. The VCS Monitoring Team will be established to collect and record monitoring data within the project boundary. The VCS monitoring team will be responsible for the normal operation of the manure treatment system and the collection and record of all the monitoring data. All the data will be reviewed by the project developer and VVB. Each member of the VCS monitoring team will be trained by the project owner at least once a year. The overall monitoring system structure of the project shows as below:

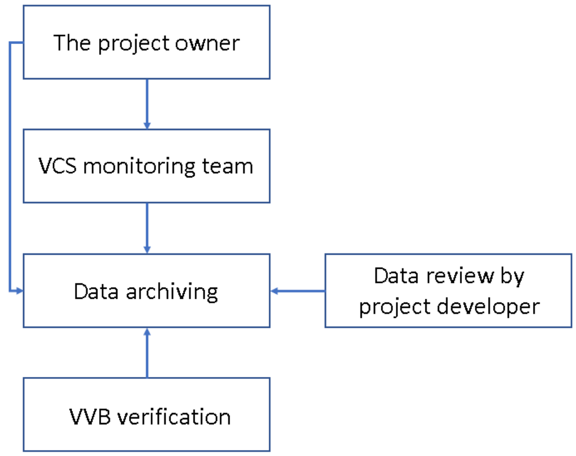

Figure 5-1 Operation and management structure of the Project

(2) Monitoring equipment and installation

Installation and configuration of meters are shown as Figure 5-2. In order to ensure measurements with a low degree of uncertainty, the data metering equipment will be calibrated and checked by an appropriately qualified third party according to an appropriate national standard. The calibration records will be appropriately maintained and made available for review by VVB.

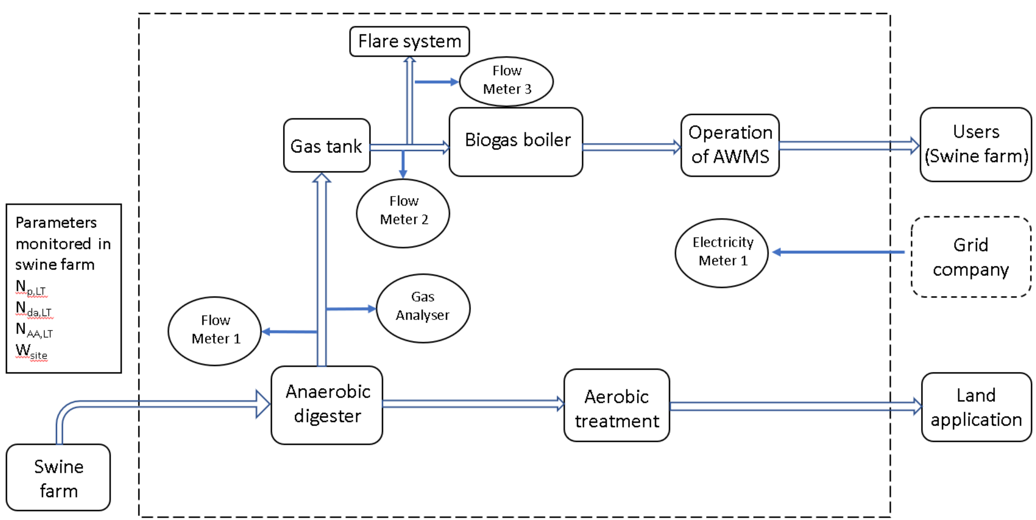

Figure 5-3 Installation and Configuration of meters

(3) Quality control and quality assurance procedures

A quality management system will be established, which ensures the quality and accuracy of the measured data.

(4) Training

For all members involved in the project, necessary trainings will be provided by the project owner. Besides, the project owner should ensure that only skilled employees are allowed to undertake the monitoring work. The training contents should be regard to the general and technical aspects of the project to the extent appropriate, as well as basic understandings of VCS Standard and climate change.

(5) Data management

All data collected as part of monitoring plan should be saved with at least 1 backup copy until the end of the crediting period. After the crediting period ends, the data should be archived electronically on hard disks and be kept at least 2 years after the end of the last crediting period.

(6) Corrective actions

The project will sign an agreement that it will not participate in other environment credits, other GHG programs and has not been rejected by any other GHG Programs. The whole VCS monitoring team will follow recognized standard data evaluation methods to guarantee that the data is reliable and accurate. The quality control and quality assurance procedures include the handling and correction of nonconformities in the implementation of the project or the monitoring plan. In case such nonconformities are observed:

- An analysis of the nonconformity and its causes will be carried out immediately by the project owner, with the help of external experts if necessary.

- A corrective action plan should then be developed to eliminate the non-conformity and its causes to prevent its recurrence.

- Corrective actions are implemented and reported back to the VCS monitoring team.

- Relative information will be included in the monitoring report and reported to VVB during the verification.

If the data record is missing or damaged during the monitoring periods, the following makeup process will be conducted:

-The general principle is that Conservative value will be used for the missing or damaged data. This is most conservative approach. The monitoring personnel will be trained before the starting of the project operation to ensure that each team member is fully aware of and able to strictly follow this conservative principle. During the monitoring process, the monitoring personnel will be required to strictly abide by the above conservative principle in data recording, i.e., use Conservative value for all the missing or damaged data.

-If this is due to the working error of the monitoring personnel, further train the person until he or she can perform the job properly. And in the meantime, use Conservative value for the missing or damaged data;

-If this is due to the inability or attitude of a particular worker in monitoring team, dismiss such worker and re-hire those with proper ability and attitude. And in the meantime, use Conservative value for the missing or damaged data;

-If some data recorded are significantly higher than the normal range, the monitoring personnel should ask for the reason. If the measurement is high due to the damage of measurement equipment, Conservative value will be used for that day's data. And need to calibrate and maintain the measuring equipment immediately and avoid this situation in the future.

If the monitoring results are satisfactory in terms of correct reporting, data completeness and correct analysis, the data will be accepted for the monitoring report.

Sample plan

The sampling objective

To determining the average animal weight of a defined livestock population at the project site during the crediting period with a 95/10 confidence/precision.

According to "Sampling and surveys for CDM project activities and programmes of activities (Version 09.0)", the sampling plan is as follows:

Parameter	W_{site}
Objectives and reliability requirements	Determining the Average animal weight of a defined livestock population at the project site during the crediting period. According to standard of the "Sampling and surveys for CDM project activities and programmes of activities (Version 09.0)", PP shall use 95/10 confidence/precision as the criteria for the reliability of sampling efforts for large-scale project. According to the methodology" ACM0010" GHG emission reductions from manure management systems (Version 08.0)", each defined livestock population should be classified into a minimum of three age categories; For each defined livestock population, a minimum of one monthly sample per age category should be taken. In this project, the monitoring activities of the Average animal weight of a defined livestock population at the project site will be conducted in the three age groups of Market swine and Breeding swine at least one monthly.

Target population and sampling frame	For the ex-calculation, A total of 91,726 Market swine and 40,500 Breeding swine included in this project and the data of the average animal weight of a defined livestock population at the project site is from the Project evaluation report. During the monitoring periods, the target population will be changed as the actual situation.
Sampling method	Stratified random sampling will be used

The sampling sizes

According to the standard of the "Sampling and surveys for CDM project activities and programmes of activities (Version 09.0)", PP shall use 95/10 confidence/precision as the criteria for the reliability of sampling efforts for large-scale project. The sampling size will be calculated as the Appendix 6 of the guideline of the "Sampling and surveys for CDM project activities and programmes of activities (Version 04.0)".

Implementation and Monitoring frequency

The Sampling process will start as soon as the target population is determined. The Sampling process will be determined by the VCS monitoring team. The one monthly monitoring activity of the samples will be completed during each monitoring periods.

The monitoring data will be collected and recorded throughout the entire crediting period. All archived data and documentation will be kept for at least 2 years after the end of the last crediting period.

APPENDIX

Use appendices for supporting information. Delete this appendix (title and instructions) where no appendix is required.