GANSU HUI COUNTY MUGE SWINE FARM MANURE MANAGEMENT SYSTEM GHG MITIGATION PROJECT

BAINENG NEW ENERGY （SHENZHEN） CO.,LTD.

Project Title	***Gansu Hui county Muge Swine Farm Manure Management System GHG Mitigation Project***
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1 PROJECT DETAILS

1.1 Summary Description of the Project

Gansu Hui county Muge Swine Farm Manure Management System GHG Mitigation Project (hereinafter referred to as the Project) introduces a new Animal Waste Management System (AWMS) to treat manure from this existing pig farm in Hui County, Longnan City, Gansu Province, which belongs to Hui County Xingjiang Muge Breeding Co., LTD. The purpose of the project activity is to treat the manure and wastewater to avoid methane emissions generated in the baseline uncovered anaerobic lagoons.

First,manure and urine produced by the swine passed through leaky boards and then entered into manure collection tanks, the manure and urine will be homogenized under the treatment of submersible mixing pumps and submersible sewage pumps and then solids and liquids will be separated. The solid manure will be processed in an aerobic composting system and organic fertilizer will be produced, and the fertilizer produced in this process will be sold at the market price. The liquids will be treated by anaerobic digestion and the biogas produced during the treatment process will be captured and sent to a boiler to generate heat, with the excess gas being destroyed through a combustion system (if available).

With the help of the above-mentioned model, a harmless and ecological use of pig manure can be achieved. It is estimated that 29674.5 tons of animal manure will be handled annually by the AWMS. Also, the generated heat through biogas will be only used for daily operation of the AWMSs and the swine farm themselves and will not be

provided 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 42,656tCO_2e emission reductions will be generated annually and total emission reductions are 298,594tCO_2e in the first crediting period.

Audit Type	Period	Program	VVB Name	Number of years
Validation	04/04/2023[1]	VCS	CTI Certification Co., Ltd.	N/A
Verification	01/06/2021–31/01/2023	VCS	CTI Certification Co., Ltd.	1.67[2]
Total	01/06/2021–31/01/2023	VCS	CTI Certification Co., Ltd.	1.67

1.2 Sectoral Scope and Project Type

Sectoral Scope 13: Waste handling and disposal; Sectoral Scope 15: Livestock and manure management

The project is not a grouped project.

1.3 Project Eligibility

[1] The validation is conducted in combination with the 1st verification. At the time of this PD&MR writing, the validation has not been completed yet, and the dates of the site visit are shown here.

[2] Calculated as follows: 610 days/365 days =1.67, as this monitoring period (01/06/2021 to 31/01/2023) covers 610 days.

As per section 2.1.1 of VCS Standard (version 4.4), the scope of the VCS Program include：

1) The six Kyoto Protocol greenhouse gases: The project is expected to avoid methane (CH4) emissions from the uncovered anaerobic lagoons in the baseline scenario, which will be captured and destroyed in the project scenario. Also, methane is one of the six Kyoto Protocol greenhouse gases, so the proposed project meets this item. Thus, the project applies to this scope.

2) Ozone-depleting substances: N/A.

3) Project activities supported by a methodology approved under the VCS Program through the methodology approval process: N/A.

4) Project activities supported by a methodology approved under a VCS approved GHG program, unless explicitly excluded under the terms of Verra approval： The applied methodology ACM0010 (Version 8.0) of the project are methodologies approved under CDM Program, which is a VCS approved GHG program.

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

The project activity reduces methane emissions by replacing uncovered anaerobic lagoons in the baseline scenario with the new AWMS. Meanwhile, the project is not belonged to the projects excluded in Table 1 of VCS Standard 4.1. 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 ensuring 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 4.4)	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 their validity periods is available on the Verra website.	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.
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),	Not applicable. There are no model needs to be chosen by the project proponent as per the applied methodology ACM0010 (version 08.0).

	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).	
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	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.

	(i.e., a project shall not apply a methodology that uses a project method where such a performance method is 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	Not applicable. There is no specified capacity limits and any other relevant requirements set out as per the applied

	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.	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.

The scope of the VCS Program excludes projects that can reasonably be assumed to have generated GHG emissions primarily for the purpose of their subsequent reduction, removal or destruction. The proposed project is the resource utilization of swine manure from the existing farm to avoid methane emission in baseline scenario, and the generation of swine manure is a natural phenomenon. Therefore, the proposed project is not belonged to those projects that can reasonably be assumed to have generated GHG emissions primarily for the purpose of their subsequent reduction, removal or destruction. The proposed project is located in Gansu Province,

China, which is not belongs to LDC[3] designated by the United Nations. Also, the proposed is not belongs to the projects excluded in Non–LDC in Table 1 of VCS Standard 4.4. Therefore, the project is eligible under the scope of VCS program.

1.4 Project Design

The project activity involves the construction and operation 1 AWMS in the existing swine farm in Longnan city, Gansu Province owned by Hui County Xingjiang Muge Breeding Co., LTD. The project has been designed to include a single location only.

T*his project is not a grouped project.*

Eligibility Criteria

The project is not a grouped project. Thus, this section is not applicable.

1.5 Project Proponent

Organization name	Hui County Xingjiang Muge Breeding Co., LTD.
Contact person	Bingquan Yang
Title	Manager
Address	Industrial concentration District, Fujia Town, Hui County, Longnan City, Gansu Province China
Telephone	+86 13637995002
Email	253586401@qq.com

[3] https://unctad.org/topic/least-developed-countries/list

1.6 Other Entities Involved in the Project

Organization name	Baineng New Energy （Shenzhen） Co.,Ltd.
Role in the project	VCS Consultant
Contact person	Zexu Zhang
Title	Project manager
Address	Room 302, No.2815 Longteng Avenue, Shanghai, 200030
Telephone	+86 13916000152
Email	pzz@cypressenergy.cn

1.7 Ownership

The project owner of the project is Hui County Xingjiang Muge Breeding Co., LTD. who has the legal right to control and operate the project activities. 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 section 3.7 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 activity is a non–AFOLU project, and it has been put into operation on 01/06/2021. Thus, the project start date is 01/06/2021.

1.9 Project Crediting Period

This project adopts renewable crediting periods of 7 years. The crediting period is 7 years from 01/06/2021 to 31/05/2028 (both days included).

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

The estimated volume of emission reduction from the project activity is 42,656 tCO_2e, which is less than 300,000 tonnes of CO_2e per year. As per section 3.9.1 of the VCS Standard (Version 4.4), the scale of the project activity is under "project" category.

Project Scale	
Project	√
Large project	×

YEAR	Estimated GHG emission reductions or removals (tCO2e)
01/06/2021-31/12/2021	24,999[4]
01/01/2022-31/12/2022	42,640
01/01/2023-31/12/2023	42,640
01/01/2024-31/12/2024	42,640
01/01/2025-31/12/2025	42,640
01/01/2026-31/12/2026	42,640
01/01/2027-31/12/2027	42,640

[4] The values estimated emission reduction from 01/06/2021 to 31/12/2021 is 42,640 tCO_2e *214 days /365 days=24,999 tCO_2e

01/01/2028-31/05/2028	17,755 [5]
Total estimated ERs	298,594
Total number of crediting years	7
Average annual ERs	42,656

1.11 Description of the Project Activity

The project activity is to introduce a new AWMS to replace the traditional uncovered anaerobic lagoons to treat the swine manure in the existing swine farm which stated operation in 01/01/2021 owned by Hui County Xingjiang Muge Breeding Co., LTD. There are 41,935 market swine and 5,885 breeding swine in the farm, it's estimated to produce 29,674.5 tons of manure waste annual. The introduced AWMS is capable to treat all the manure produced in the farm with $482.59*10^4$ m^3 biogas and 5226.02 tons solid organic fertilizer produced every year.

The project aims to build a new anaerobic animal manure treatment system for collecting pig manure, urine, washing water, and so on as fermenting materials and generating biogas in Continuous Stirred–Tank Reactor (CSTR).The construction date of AWMS is 01/03/2021 the commissioning date of the AWMS is 15/05/2021 ,and start date of operation of AWMSs is 01/06/2021.

Baseline scenario

Prior to the implementation of the project, all manure waste produced from the existing swine farm was left to decay in uncovered anaerobic lagoon at the livestock farm and methane is emitted to the atmosphere directly without any methane

[5] The values estimated emission reduction from 01/01/2028 to 31/05/2028 is 42,640 tCO_2e *152 days /365 days=17,755 tCO_2e

recovery and destruction facility. As per " technical specification for sanitation treatment of livestock and poultry manure7[6] ", 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 these lagoons. After the implementation of the project, original uncovered anaerobic lagoon has been removed, the volume for original uncovered anaerobic lagoon is described in below Table 1–1.

Project technology description

All the manure and wastewater are collected into waste collecting tanks and then be separated firstly by Solid–liquid separators. The solid will be treated in aerobic composting system and the organic fertilizers will be produced, which will be sold at market price. The liquid will be treated through anaerobic digestion and then the biogas generated during this anaerobic treatment process will be captured for heat generation. if there is surplus biogas, then the biogas will be flared through the flaring system. The generated biogas will be used for heat generation of the biogas boilers and the project is expected to avoid methane GHG emissions by recycling and burning biogas.

1、Homogenization

manure and urine produced by the swine passed through leaky boards and then entered into waste collection tanks, the manure and urine will be homogenized under the treatment of submersible mixing pumps and submersible sewage pumps to

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

improve the efficiency of fermentation. And the manure will be in the homogenization tank for 30days.

2、Solid–liquid separation

After homogenized in the homogenization tank, the mixture of manure and urine are pumped to solid–liquid separator through non–blocking slurry pump (in the process of solid– liquid separation, initial separation is done through the screen firstly, and then the water in the solid material of manure is extruded by a screw extruder). the separated solid manure after aerobic treatment will be sold at the market price, the liquid manure will enter the anaerobic fermentation stage to continue processing.

3、Anaerobic digestion process

The project design adopts fully enclosed anaerobic tank for anaerobic fermentation treatment of project wastewater Anaerobic digesters (AD) are one of the most important processes in animal waste treatment. The anaerobic digesters receive the animal manure and maintain a steady state population of methanogenic bacteria for degradation. Methanogenic bacteria convert organic manure into biogas in the environment without oxygen. Captured biogas then will be used to generate heat. In addition, AD could reduce offensive odors, pathogens from the manure slurry, and GHG emissions during the storage.

4、Comprehensive utilization of biogas

Biogas collected from the fully enclosed anaerobic ponds 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 by the AWMS and the swine farm. Surplus biogas will be flared (if any) through the open flares.

5、Aerobic composting process

The solid after solid–liquid separation and the sludge produced from anaerobic digestion are used to produce organic fertilizer through aerobic composting process. The aerobic composting process of this project adopts trough composting, and artificial turning is used to maintain the aerobic state of the composting process. The compost fermentation lasts about 30 days.

Table1–1. The main technical parameters of machine

Parameter	Value
Equipment name	baseline anaerobic lagoon
Quantity	1
Size(length*width*depth) (m3)	100 × 90 × 4

Parameter		Value
Equipment name	Continuous stirred tank reactor (CSTR)	
Quantity	1	
Dimension	Φ20*16m	
Material	Assembled Tank	
Temp	32–38℃	
Stirring	type	Hydraulic agitation
	FLow	90m^3/h
	pump head	20m
	Power	7.5Kw
	quantity	5(Four use and one reserve)
Boiler	Rated power	1.4MW
Double membrane gas storage cabinet	capacity	1800m^3

Parameter	Value
Equipment name	Solid–liquid separators
Quantity	3
Type	QX–120T
Size	2100*1200*1600 mm
Material	Assembled Tank
Power	4kw
Capacity	35–45m^3/h

Parameter	Value
Equipment name	Biogas cabinet
Quantity	1
Type	YJBTD–1800m^3
Volume	1800m^3
Material	PET

Parameter	Value
Equipment name	Flare
Quantity	1
Type	HJ–50
Gas Consumption	50m^3/h
Manufacturer	Quanxin Environmental Technology Co.,Ltd

Parameter	Value
Equipment name	Boiler
Quantity	1

Type	CWNS1.4MW
Size	3300*1470*1890 mm
Heat Efficiency	93-94L
Gas Consumption	157.4 m^3/h
Rated pressure(Mpa)	1.0
Rated outlet temperature(℃)	85
Rated Capacity	1.4MW

Parameter	Value	
Equipment name	Homogenizer	
Size	Tank volume	25*15*4
Submersible mixer	Type	QJB4/8-400/3-740/S
	Power	4kw
	Impeller diameters	400 mm
	Rotational speed	r/min
	Material	Cast iron
Submersible sewage pumb	type	65WQ/20-15-2.2
	Power	2.2kw
	volume	$20m^3$
	lift	15m

1.12 Project Location

The project is located in Wangzhuang Village, Chengguan Town, Hui County, Longnan City, Gansu Province, with a planned land area of 60,000 square meters. The geographic coordinates of the project site are 33°50'54.959352" north latitude and

106°5'28.195487" east longitude. The geographical location of the project is shown in Figure 1–1.

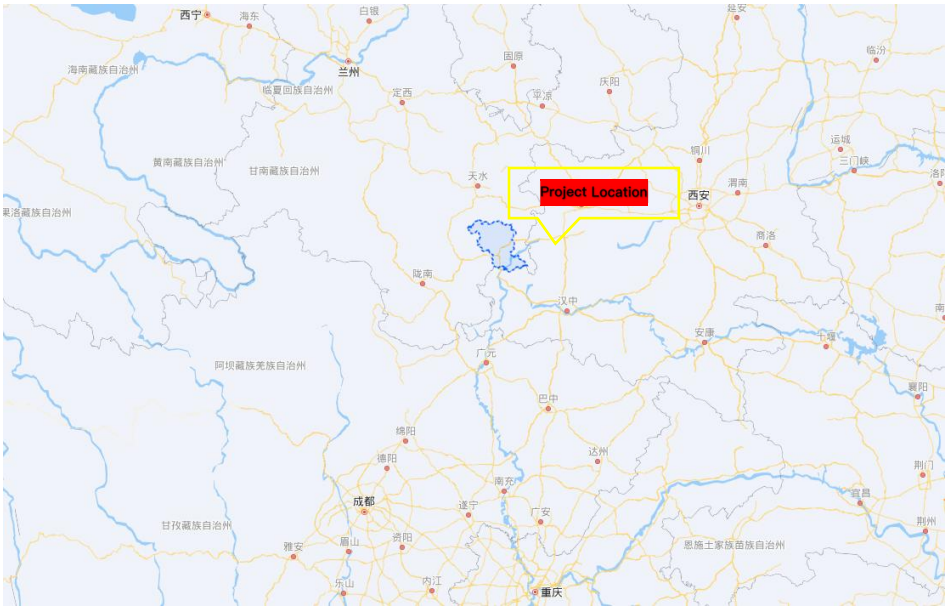

Figure 1–1 Location of the project

1.13 Conditions Prior to Project Initiation

The project is a Greenfield project. Thus, there are no project activities at the project sites before the construction of the proposed project activities. The baseline scenario is the same as the conditions existing prior to the project initiation. 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.

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

6. Regulations on prevention and control of pollution from large scale livestock and poultry breeding.

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

The project is not included in any emissions trading program or any other mechanism that includes GHG allowance trading. The GHG emission reductions and removals generated by the project will not be used for compliance under such programs or mechanisms.

China Emissions Trading Scheme (ETS) has been opened in July 2021. The major industry that includes in ETS is electricity, as well as other seven industries (i.e., oil industry, chemical industry, cement industry, iron and steel industry, non–ferrous metals industry, pulp and paper industry and civil aviation industry). For swine farm manure management doesn't belong to any of the industry mentioned above, the project is not included in China's emission trading system as well.

Besides, the project proponent had signed a declaration of "No Double Counting Statement" and declaration of "Not involved in other GHG scheme" to promise that no double count emissions reductions will appear in this project. Below are excerpts from the declaration.

As the project proponent of the Gansu Hui county Muge Swine Farm Manure Management System GHG Mitigation Project; commit that the emissions generated in the project will not be double counted, and the only emissions reductions generated in the project is under VCS program.

1.16.2 Other Forms of Environmental Credit

The project hasn't sought or received another form of environmental credits.

Supply Chain (Scope 3) Emissions

NA

1.17 Sustainable Development Contributions

1.17.1 Sustainable Development Contributions Activity Description

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 contributes to achieving sustainable development in following ways:

★ SDG Goal 7:Affordable and 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 for the operation of AWMS and swine farm. The project is expected to recover and destroy 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)

★SDG Goal 8: Decent Work and Economic Growth

The project can provide job opportunities for local residents, which meets one of the China's action plans "Increase labor force participation rate through

implementation of the classification policy. Vigorously enforce the Law on Promotion of Employment." (SDG 8)

★SDG Goal13: Climate Action

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 42,656 tCO2e. 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)

1.17.2 Sustainable Development Contributions Activity Monitoring

During the monitoring period, the project activities that results in achieving SDGs are:

1.Recycle and combust $711.20 \times 10^{4} m^3$ of biogas as clean energy used in swine farms;

2.Job opportunities are provided for 10 locals, among which6 are male, 4 are female

3.A total of 58,604 tCO_2e emission reductions is generated.

.

Table 1: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	7.2	Amount of biogas generated	Implemented activities to increase	During this monitoring period, a total of 711.20×10 ^{4}m^{3} of biogas is excepted to be generated and used by the operation of the project and the swine farm.	This is the 1st monitoring period, therefore, from the operation start date of the project activity to the end of this monitoring period, 711.20×10 ^{4}m^{3} of biogas is generated by the project.
2)	8.5	Number of jobs created	Implemented activities to increase	During this monitoring period, total job opportunities provided for 10 locals.	The project activity generates permanent job opportunities for 10 persons during the operation period. From the operation start date of the project activity to the end of this monitoring period, 10 jobs for local people were created by the project.
3)	13.0	Tonnes of greenhouse gas	Implemented activities to	The project achieved GHG emission reductions of 58,604	This is the 1st monitoring period, therefore, from the operation start date of the project

		emissions avoided or removed	decrease	tCO_2 during this monitoring period.	activity to the end of this monitoring period, the project has achieved GHG emission reductions of 58,604 tCO_2.

1.18 Additional Information Relevant to the Project

Leakage Management

The leakage involved in this project includes 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 Longnan Municipal Ecology and Environment Bureau (registered number of approvals: [2020]132). 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 project will improve the working environment of livestock

farms and reduce the harm to workers' health. The project can provide 10 jobs for local women and other people with low education.

2.2 Local Stakeholder Consultation

Before the construction of the project:

In order to solicit the opinions and attitudes of various stakeholders on the construction of this project, the project owner issued a stakeholder survey questionnaire on 16/3/2021 to investigate the opinions of local stakeholders on the construction of this project. Local stakeholders included relevant personnel of the livestock farms, local villagers and government officials. The survey questionnaire was designed to assess the project impacts on the local environment and social economic development.

The structure of the survey respondents is listed in Table 2–1 below.

Table 2–1 Structure of stakeholder survey

Items		**Amount**
Gender stakeholders surveyed	Male	32
	female	28
Age	<25	13
	25–55	35
	>55	12
Education	Junior high school or below	16
	Senior high school	33
	College or above	11
Occupation	Worker	13
	Farmer	28
	Management personnel	10

	Civil servant	9

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

Table 2-2 Summary of stakeholders' comments

Questions	**Attitude or Opinion**	**Amount**
1. Do you know the purpose of this project?	Know	38
	Heard of	17
	nothing	5
2. What do you think is the impact of the implementation of this project on the local environment?	reduce environmental pollution and improve the quality of environment	49
	No impact on the local environment	11
3. Do you know about carbon trading?	Know	23
	Heard of	27
	nothing	10
4. Do you think the implementation of this project is in harmony with the local ecological environment?	in harmony with the local ecosystem	49
	not sure whether it is in harmony	11
5. What impact do you think the implementation of this project will have on the social economy?	good impact on the social economy	55
	no impact on the social economy	5
6. What effect do you think the implementation of this project will have on local sustainable development?	promote energy conservation and emission reduction, improve environmental quality and investment environment, and promote the sustainable development of the local economy.	59
	no impact on local sustainable development	1
7. What effect do you think the implementation of this project will have on local employment?	no impact on local employment	12
	promote employment growth	48

8. Do you think this project can be promoted to other regions?	Not worth promoting	10
	actively promote	50
9. Do you support the construction and implementation of this project?	against	0
	support	60
10. Do you have any suggestions and comments on this project?	Comments/suggestions	/
	No comments and fully support	60

In general, local stakeholders are supportive of the project construction. The project owner carefully listened to and accepted the suggestions and opinions of stakeholders and stated that it will implement environmental protection facilities (AWMS) in strict accordance with the requirements in the environmental impact report form and the approval opinions of the local environmental protection bureau. There is no suggestion about the project design.

Local stakeholder consultation during the monitoring period

In this monitoring period from 01–June–2021 to 31–January–2023, A questionnaire survey was adopted for stakeholder consultation by Project proponent. From 01–August–2022 to 10–August–2022, the project proponent put up public announcements at the villages near the project site; Also, the project proponent contacted the local authorities (mainly the Ecology and Environment Bureau, Agriculture and Rural Affairs Bureau) by phone. The general information about the introduction of project, the survey date and the purpose of the questionnaire survey as well as the project proponent's phone number and email address were clearly conveyed via these public announcements and phone calls. A questionnaire survey was conducted by project proponent from 12–August–2022 to 22–August–2022. Total 30 questionnaires were distributed, and all questionnaires have been recollected. The basic information about the survey respondents is listed in Table 2–2. Responses and comments from these questionnaires are summarized in Table 2–3.

Items		Amount
Gender stakeholders surveyed	Male	19
	female	11
Age	<25	12
	25–55	15
	>55	5
Education	Junior high school or below	8
	Senior high school	10
	College or above	12
Occupation	Worker	9
	Farmer	9
	Management personnel	5
	Civil servant	7

The questionnaires mainly focus on following issues:

– Do you know the purpose of this project?

– What do you think is the impact of the implementation of this project on the local environment?

– What impact do you think the implementation of this project will have on your life?

– Are you satisfied with the environmental protection measures that the proposed project has

made?

– What do you think is the impact of the proposed project on local employment?

– What do you think is the impact of the proposed project on local economy?

– Are you agree or disagree with the construction of the proposed project?

– Do you think other regions should also vigorously promote this type of technology?

– Do you have any suggestions on this project?

Comments from these questionnaires are summarized as follows:

– 100% of the respondents understand this project.

– 100% of the respondents think the proposed project would not generate environment problem.

– 100% of the respondents believe that the implementation of the project will bring economic benefits to their lives, because they get organic fertilizer at cheaper market prices.

– 100% of the respondents are satisfied about the environment protection measures that the proposed project has made.

– 97% of the respondents believe that the implementation of this project can promote employment growth; 3% of the respondents believe that it has no impact on local employment.

– 100% of the respondents think the proposed project has good impact on local economy.

– 100% of the respondents agree with the construction of the proposed project.

In addition, the project owner established the mechanism for on–going communication with local stakeholders. That is, a continuous Input / Grievance Expression Process Book is prepared at the project site, and any stakeholders can express their opinions and views on the project. During this monitoring period, no comments or Input / Grievance Expression received from stakeholder

2.3 Environmental Impact

The Environmental Impact Assessment (EIA) Report for the Project has been approved by Longnan Ecological Environment Bureau. The environmental impacts and mitigation measures during the construction period and the operation period are summarized as follows .

Construction period

Air pollution

During the construction period, the exhaust gas from the construction site is mainly dust, of which the amount generated by transport vehicles driving accounts for about 60% of the total dust. Therefore, certain measures need to be taken during the construction period, such as setting up fine mesh dust nets and frequently watering the transport roads in and out of the block to suppress dust, etc., which can effectively reduce the impact of dust .

Wastewater

The wastewater during the construction period of the project is mainly generated from the domestic sewage of construction workers, groundwater during foundation excavation and rinsing water after pouring concrete .The groundwater and rinsing water will be intercepted and treated centrally. The domestic sewage can be collected in a septic tank and treated centrally, and then discharged into the surrounding water bodies after precipitation and clarification .

Therefore, the wastewater generated during the construction of the project has little impact on the surrounding environment .

Noise

Noise during the construction period is mainly generated by the construction machineries and vehicles. To minimize noise pollution, low-noise equipment is employed as much as possible, the use of high- noise equipment is strictly prohibited during the night.

Solid waste

Solid waste during the construction period includes construction waste and domestic waste. Waste rocks and soil generated from excavation are temporarily stored at the construction site and used in earthwork backfilling after the end of the construction . Other construction waste is partly recycled and partly backfilled. Harmful or dangerous solid waste, such as waste paints and oil, are stashed in a storage room; the collection, storage, transport and handling of da ngerous solid waste shall comply with applicable environmental laws and regulations . Domestic garbage Domestic garbage is collected in bins and disposed of by the sanitation department .

Operation period

Wastewater

Strengthen the prevention and control of wastewater pollution . The project shall implement the separation of sewage and rainwater. The waste liquid generated from gas-water separation and gas purification and plant domestic sewage will be remitted to the biogas facility for treatment . digested effluent will be used to irrigate the surrounding crops after treatment and is not allowed to be discharged to the surrounding water bodies .

Air pollution

Strengthen the prevention and control of waste gas pollution. The collection pond and anaerobic digestion should seal well in order to reduce emission of malodorous gases.

In the process of organic fertilizer production, waste gas collection and treatment measure shall be implemented as design plan. Strengthen solid waste pollution prevention. All biogas residues are used for organic fertilizer production .

Solid waste

Strengthen solid waste management. All digestate is used for organic fertiliser production .Waste desulfurizers should be collected centrally and disposed of properly in accordance with the relevant regulations on solid waste management .The company's solid waste temporary storage site should be impermeable, rainwater scouring and have sewage collection measures to avoid secondary pollution .

In conclusion, the project will not have a significant negative impact on the surrounding environment during both construction and operation period. On the contrary, the implementation of the project will significantly improve the quality of the local environment, achieve environmentally sound treatment of agricultural organic waste, reduce the impact of agricultural organic waste on surface water and groundwater, and reduce greenhouse gas emissions. In addition, biogas incineration saves fossil fuels used to generate electricity and contributes to sustainable development .

2.4 Public Comments

Besides, as per section 3.17.6 of the VCS Standard (Version 4.4), 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. The proposed project[7] (VCS ID: 3950) was open for public comments for 30-

[7] https://registry.verra.org/app/projectDetail/VCS/3950

days from 09–January–2023 to 08–February–2023 on the website of Verra Registry. During the publicity period, there are no comment was received for the Project.

2.5 AFOLU–Specific Safeguards

Not applicable.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

The following methodology and tools are applicable to the project activity..

ACM0010“GHG emission reductions from manure management systems (Version 08.0)”.

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

Tool 02: “Combined tool to identify the baseline scenario and demonstrate additionality (Version07.0)”

Tool 03: “Tool to calculate project or leakage CO2 emissions from fossil fuel combustion” (Version 03.0)

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

Tool 07: “Tool to calculate the emission factor for an electricity system” (Version 07.0)

Tool 08: "Tool to determine the mass flow of a greenhouse gas in a gaseous stream (Version03.0)"

Tool 14: "Project and leakage emissions from anaerobic digesters (Version 02.0)"

Tool 24: "Common practice (Version 03.1)"

All above methodology and tools can be found through:

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

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, new AWMS is installed in existing swine farm in order to treat the manure and wastewater from these swine farm, which avoids methane emissions generated in the baseline uncovered anaerobic lagoons and the biogas generated during the treatment process will be captured for heat generation, which result in less GHG emissions.
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.	For this project, new AWMS are installed in existing swine farm in order to treat the manure and wastewater from the swine farm, which was treated in the baseline uncovered anaerobic lagoons prior to the implementation of the project. The project activity will reduce of GHG in the atmosphere through avoiding methane emissions from

The methodology is also applicable to Greenfield facilities.	anaerobic treatment of swine manure and wastewater.
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) The project activity was to introduce a new AWMS to replace the traditional uncovered anaerobic lagoons to treat pig manure from the swine farm owned by Hui County Xingjiang Muge Breeding Co., LTD.. All swine is managed under confined conditions. (b)The swine manure is dumped into open anaerobic lagoons, and it is prohibited to discharge into any natural water resources without treatment according to Regulations on Prevention and Control of Pollution from Livestock and Poultry Farming. (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)". (d) The annual average ambient temperature at the site is 13˚C[8], 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. (f) The project uses professional and precise equipment, which is impermeable.

[8] https://baike.baidu.com/item/%E5%9F%8E%E5%85%B3%E9%95%87/3468339

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 activity is designed to introduce new AWMSs to a swine farm to treat the swine manure to avoid methane emissions generated in the baseline uncovered anaerobic lagoons. Alternative scenarios, barrier analysis, investment analysis and common practice analysis will be carried out based on Tool 02. Refer to section 3.4 and 3.5 of the PDD for more details.

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).	All the electricity used by the project will be supplied by STATE GRID GANSU ELECTRIC POWER COMPANY (SGGSCC)[9], which falls under scenario A of Tool 05 (Version 03.0). Therefore, emissions related to electricity consumption need to be calculated based on Tool 05.

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

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.	
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: (a) Scenario I: Electricity is supplied to the grid; (b) Scenario II: Electricity is supplied to consumers/electricity consuming facilities; or (c) Scenario III: Electricity is supplied to the grid and consumers/electricity consuming facilities.	This methodological tool is applied for calculating for emission by electricity consumption in project activity. The proposed project does not generate electricity, So, this criterion is not applicable.
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.	Tool 05 is only used to calculate project emissions of electricity consumption supplied by SGGSCC. For conservativeness, baseline emissions of captive biogas heat generation system are ignored. Only CO_2 emissions will be accounted.

Tool 07: "Tool to calculate the emission factor for anelectricity system(version07.0)"

This tool may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity that is where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand–side energy efficiency projects).	The project does not generateelectricity.
Under this tool, the emission factor for the project electricity system can be calculated either for grid power plants only or, as an option, can include off–grid power plants. In the latter case, two sub–options under the step 2 of the tool are available to the project participants, i.e. option IIa and option IIb. If option IIa is chosen, the conditions specified in 〝Appendix 1: Procedures related to off–grid power generation〞 should be met. Namely, the total capacity of offgrid power plants (in MW) should be at least 10 per cent of the total capacity of grid power plants in the electricity system; or the total electricity generation by off–grid power plants (in MWh) should be at least 10 per cent of the total electricity generation by grid power plants in the electricity system; and that factors which negatively affect the reliability and stability of the grid are primarily due to constraints in generation and not	The project consumes electricity from China Northwest Power Grid. The emission factor is calculated for grid power plants only.

to other aspects such as transmission capacity	
In case of CDM projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I country.	The project is in China, a non–Annex country.
Under this tool, the value applied to the CO_2 emission factor of biofuels is zero.	Excluded for simplification. This emission source is assumed to be very small

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 PDD 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、O_2, CO, CO_2, N_2 and H_2, of which CH_4 is the main component. Therefore, this tool is adopted used for determining the mass flow of a 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) Methodological tool" Tool to determine the mass flow of a greenhouse gas in a gaseous stream" is applied in the PDD. b) The mass flow is determined in the monitoring plan of the PDD. c) The flow of the gaseous stream will be 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 (d) CH_4 emissions from flaring of biogas.	The AWMS system operate with electricity consumption ,the physical leak will be calculated,the AWMS does not consumption the fossil fuel from other place ,the biogas generated from the AWMS will be burned for heat, and the residue will be flare ,so the project meet the (a)(c)
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.	The project activity will replace the current open anaerobic lagoons with new closed anaerobic digester. The biogas generated during the treatment process will be captured for heat generation. After anaerobic digestion, the fermented sludge will be treated in aerobic composting system, which will be used as fertilizer. As a result, the proposed project meets this criterion.
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	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.

referring to this tool.	

Methodological tool: "common practice (version03.1)"	
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.	Combined tool to identify the baseline scenario and demonstrate additionality (Version07.0) is applied to identify the baseline scenario by the project.
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 ACM0010 methodology.

3.3 Project Boundary

As per ACM0010" GHG emission reductions from manure management systems" (version 08.0), 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 the swine farm. The baseline situation is shown in figure 3–1 below.

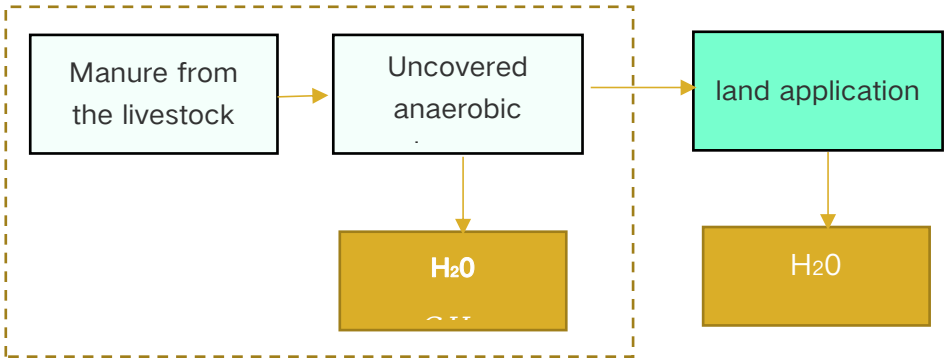

Figure 3–1 The baseline situation in the swine farm

The project activity boundary is defined as Figure 3–2 below.

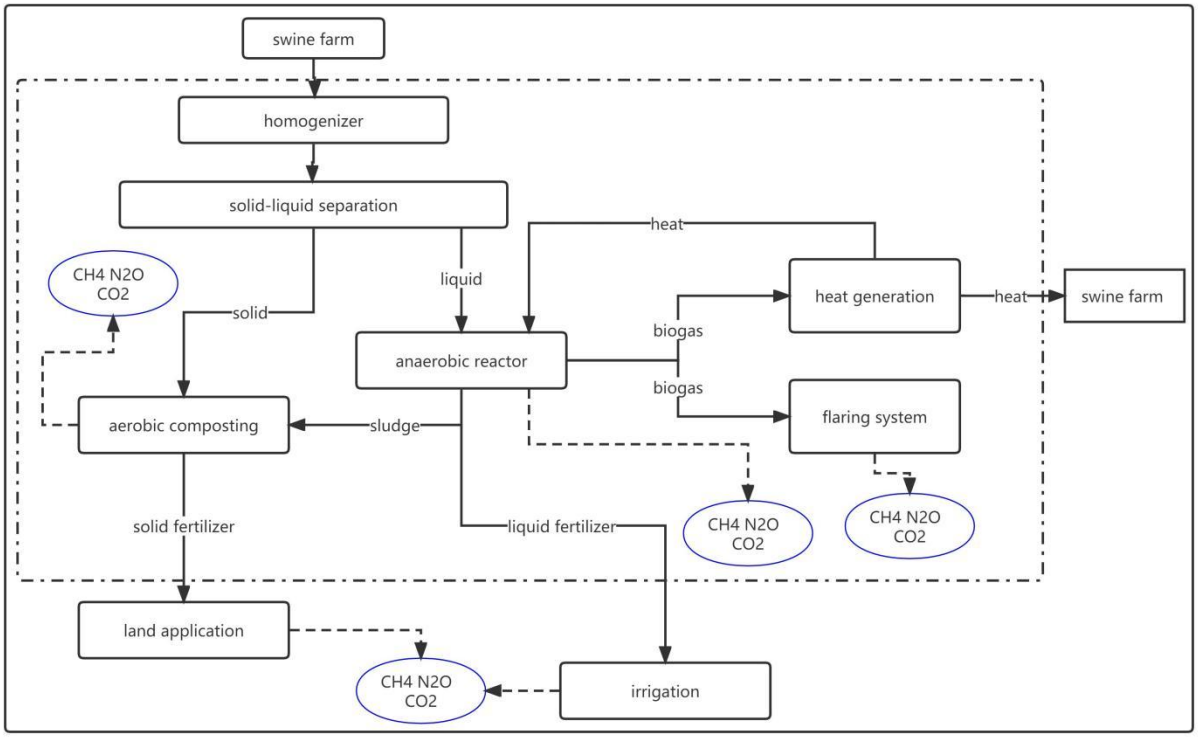

Figure 3–2 The project boundary of the project

The greenhouse gases included or excluded from the project boundary are summarized in Table3–1 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 thermal energy use	CO_2	No	Excluded for simplification. This emission source is assumed to be very small

Source		Gas	Included?	Justification/Explanation
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small
	Emissions from on-site electricity use	CO_2	Yes	an important emission source since the electricity consumed by the project is from the grid company.
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.
	Emissions from the waste treatment processes	N_2O	Yes	Direct and indirect N_2O emissions are accounted
		CO_2	No	CO_2 emissions from the decomposition of organic waste are not accounted
		CH_4	Yes	The emission from anaerobic digesters and aerobic treatment

3.4 Baseline Scenario

Baseline scenario has been identified using the methodological tool 02 “Combined tool to identify the baseline scenario and demonstrate additionality (Version07.0)” considering the requirements of the methodology and assessing the possible waste management options as described in 2006 IPCC Guidelines 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 analyze 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 existing swine farm was left to decay in uncovered anaerobic lagoon at the livestock farm and methane is emitted to the atmosphere directly without any methane recovery and destruction facility. The uncovered anaerobic lagoon was replaced by AWMS in the existing swine farm for this project. Therefore, it belongs to the new facilities.

According to methodology, baseline alternatives for managing the manure for the new 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	It is highly labor intensive to remove the manure and apply on a daily basis. Therefore, this manure management system is not in an economically attractive prospect. So, the exclusion of this potential baseline scenario can be justified.
3	Solid Storage: The manure is disposed by solid storage.	Not Applicable	This 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 leaky board and flushing approach to remove manure which has large volumes of water. So, this manure management system is not a potential alternative baseline scenario.
4	Dry lot	Not Applicable	In dry climates animals may be kept on unpaved feedlots where the manure is allowed to dry until it is periodically removed. Upon removal the manure may be spread on fields. This system is not applicable to the conditions of these farms in the project. The proposed project is non-free captive mode. This method is only a storage method of manure, not a disposal method. So, this system is

			excluded.
5	The manure is disposed as liquid/slurry.	Not Applicable	This method is only a storage method of manure, not a disposal method. Manure is stored as excreted or with some minimal addition of water in either tanks or earthen ponds outside the animal housing, usually for periods less than one year. Since the amount of discharged manure is very large even on a daily bases, storing the liquid manure in the tank to distribute them to the farmland requires a lot of labour work. Therefore, it is unrealistic to implement such a task for the farms under the competition of the market. Therefore, this option faces significant barrier and is excluded from the baseline scenario.
6	Uncovered anaerobic lagoon	Applicable	As per "Technical specification for sanitation treatment of livestock and poultry manure[10]", the uncovered anaerobic lagoon is a kind of harmless treatment of manure. After being treated in the uncovered anaerobic pond, the manure can be used for agricultural irrigation, Prior to the implementation of the project, the animal manure waste was left to decay in uncovered anaerobic lagoons. Therefore, animal waste that has been treated by uncovered anaerobic lagoon can satisfy the above regulations. 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

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

			and/or utilize methane generated at these lagoons. So, the uncovered anaerobic lagoon is a alternatives baseline scenario.
7	Pit storage below animal confinements, <1month	Not Applicable	This method is only a storage method of manure, not a disposal method. The farm involved in this project is large-scale livestock farm and the manure quantity produced is too large to implement pit storage structure under the barns. In addition, the manure stored in below animal confinements were removed within 1 month requires a lot of labour work. so, this scenario is excluded.
	Pit storage below animal confinements,>1month	Not Applicable	This method is only a storage method of manure, not a disposal method. The farm involved in this project is 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 accumulated under the barns produces enteric fermentation gas, if it is not discharged out of the barns in time, the swine will be quickly killed by the accumulation of toxic fumes. waste and urine pass through the leaky floor enter into the manure storage tank below the injection and then transport to the screed tank for subsequent treatment
8	Anaerobic digester (Anaerobic digester–Aerobic Treatment system)	Applicable	A single Anaerobic digester is suitable for treating manure, but to implement such technology need high invest compared to 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. 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 invest and the proposed project will not be invested and constructed without being registered as a VCS project.
9	Burned for fuel	Not Applicable	The manure in this project is flushed to the anaerobic digester, the dung and urine generated from the farm are too large even on a daily basis, so it is unlikely to dry the dung before using as fuel.
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, the deep bedding practice is excluded from consideration.
	Cattle and Swine deep Bedding, >1month	Not Applicable	
11	Composting – In–vessel	Not Applicable	Manure in this project is collected by using leaky board and flushing system. Manure in this project is in liquid with large volume of water. Therefore, it

			is excluded from the possible baseline scenario.
12	Composting – Static pile	Not Applicable	Composting in piles with forced aeration but no mixing will consume a great deal of electricity for forced aeration because of the large quantity of swine manure. It is suitable to solid treat manure, not applicable for manure with larger volume of water. Therefore, it is excluded from the list of possible baseline scenarios.
13	Composting – Intensive windrow	Not Applicable	Composting in windrows with regular turning for mixing and aeration emits a large quantity of odor and GHGs during turning and consumes a lot of electricity for the aeration operation. It is suitable to treat solid manure. So, it is excluded from the list of possible baseline scenarios.
14	Composting — Passive windrow	Not Applicable	Composting in windrows with infrequent turning for mixing and aeration takes a long time and occupies a large area of land. In this project, the land the PP apply for is aimed to raise pigs ,there is no other place for the passive windrow.so it is excluded from the list of possible baseline scenarios. and it will emit more GHG than the anaerobic treatment system, so it is excluded from the list of possible baseline scenarios
15	Poultry manure with litter	Not Applicable	The farm involved in this project is swine farm, not the Poultry farm, so no poultry manure produced. This system is excluded.
16	Poultry manure without litter	Not Applicable	
17	Aerobic treatment (Anaerobic digester– Aerobic Treatment system)	Applicable	A single aerobic treatment technique is not suitable for treating low concentration organic wastewater in wastewater. 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 to water bodies. 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 invest and the proposed project will not be invested and constructed without being registered as a VCS project.

Outcome of Step 1a: In summary, the alternatives to the baseline scenario are identified by the 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.

Step 1b: Consistency with mandatory laws and regulations

There is no legal law and regulation to mandate the livestock farm owners to implement anaerobic digestion, aerobic or other biological treatment techniques to treat the animal manure in China. Only the manure is prohibited to discharge directly into environment without any treatment as per Regulations on Prevention and Control of Pollution from Livestock and Poultry Farming[11] issued by the State Council.

[11] http://politics.people.com.cn/n/2013/1126/c1001-23662445.html

According to "Technical specification for sanitation treatment of livestock and poultry manure[12]" and the "Specifications for the construction of manure resource utilization facilities for large-scale livestock and poultry farms (for trial implementation)[13]", aerobic treatment or other biological treatment techniques methods to dispose manure waste are encouraged by the state and not mandatory.

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

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

Undertake investment analysis of all the alternatives that don't face any barriers, as identified in Step II. For each alternative, all costs and economic benefits attributable to the waste management scenario should be illustrated in a transparent and complete manner.

Table 3-2 shows the investment analysis results of the uncovered anaerobic lagoon

Costs and benefits	1	2	3~15	16
Cash inflow	0	0	0	0

[12] https://oss.baigongbao.com/2020/12/14/MRyhTKQcWC.pdf
[13] http://www.moa.gov.cn/gk/tzgg_1/tfw/201801/t20180111_6134801.html

Revenues from organic fertilizers sales	0	0	0	0
Subsidy income	0	0	0	0
Fixed assets residue value	0	0	0	0
Recovered current capital	0	0	0	0
Cash outflow	92,000	12,000	12,000	12,000
Construction investment	80,000	0	0	0
Current capital	0	0	0	0
O&M cost	12,000	12,000	12,000	12,000
Sales tax and associate charge	0	0	0	0
Net cash flow (after tax)	-92,000	-12,000	-12,000	-12,000
NPV (discount rate=9%)	-173,145.19			
IRR	undefined			

There are no potential revenues involved in the baseline scenario. There are only negative flows in the baseline scenario, so the Internal Rate of Return (IRR) cannot be calculated, and the economic comparison should be based on the Net Present Value (NPV) indicator. Table summaries the results of financial analysis of Anaerobic Digester Treatment without VCU revenues.

Coats and benefits	**1**	**2**	**3-15**	**16**
Cash inflow		1,776,847	1,776,847	1,776,847
Revenues from organic fertilizers sales		1,776,847	1,776,847	1,776,847

Fixed assets residue value	0	0	0	278,500
Cash outflow	2,785,000	1,596,557	1,596,557	1,596,557
Construction investment	2,785,000	0	0	0
O&M cost		1,596,024	1,596,024	1,596,024
Stamp tax[14]	0	533	533	533
Net cash flow (after tax)[15]	**0.80%**			
NPV(discount rate=9%)	**-1,151,634**			

The NPV of both the project activity and the uncovered anaerobic lagoon are negative, and the NPV of the project activity is far more negative than that of the uncovered anaerobic lagoon, which means the cost of the project activity without VCS revenues is much higher than the uncovered anaerobic lagoon. So the uncovered anaerobic lagoon is the most attractive course of action and is considered to be the baseline scenario.

The anaerobic digester system is considered to be one of the most advanced manure management systems in the world. High costs involved in the investment compared to other available systems are required to implement such technology. Additionally, the investment required to generate heat from biogas is still too high and the cost is much higher than prices in the market, so the IRR of the project activity is lower than

[14] This project is only subject to stamp tax in China.

[15] http://www.chinatax.gov.cn/n810341/n810765/n812171/n812710/c1192026/content.html

the average level and it is difficult for the project proponents to get loans from the banks. Only the project proponents can prove that they can get revenues from VCS Standard certification, it can attract the banks to provide loans for this project. For these reasons, without the revenues, PP is willing to adopt other manure management systems of lower costs which will lead to more GHG emissions.

The comparison of economic attractiveness is carried out by applying Step 3 Investment analysis of Tool 02" Combined tool to identify the baseline scenario and demonstrate additionality (Version 07.0)". The compared alternatives are Scenario 6: "The manure is disposed of in an uncovered anaerobic lagoon"; and Scenario 8&17: Anaerobic Digester Treatment i.e., the proposed project activity not being registered as a VCS project activity.

Sub-step 3a. Determine appropriate analysis method

Three analysis methods are suggested in the "Tools for the demonstration and assessment of additionality" (Version 07.0.0). They are simple cost analysis (the option I), investment comparison analysis (option II), and benchmark analysis (option III).

The investment comparison analysis method (option II) applies to projects whose alternatives are also investment projects. Only on such a basis, comparison analysis can be conducted. The alternative baseline scenario of the proposed project doesn't belong to investment projects. Therefore, option II is not an appropriate method.

The proposed project will use the benchmark analysis method (option III) based on the consideration that benchmark, Project IRR is available.

Sub-step 3b. Benchmark Analysis Method (Option III)

According to the "Financial benchmark rate of return of construction projects" issued by NDRC, the financial benchmark of the animal industry for Project IRR (after tax) is 9.5% for the total investment.

Sub-step 3c: Calculation and comparison of financial indicators

(a) Basic parameters

Annual organic fertilizers sales	5226.02 t	Project Evaluation Report
price of organic fertilizers	340 RMB/t	Project Evaluation Report
Total static investment	278.5*10⁴RMB	Project Evaluation Report
O&M cost	159.60.*10⁴RMB	Project Evaluation Report
Operation period	15 years	Project Evaluation Report
Emission reduction	42,656tCO2e	Calculated
VCU Price	CNY 10/ton	Expected

	1	**2**	**3~15**	**16**
Cash inflow (without VCU)		1,776,847	1,776,847	2,055,347

Cash inflow (with VCU)		2,203,407	2,203,407	2,481,907
Revenues from fertilizers sales		1,776,847	1,776,847	1,776,847
Revenue from VCU		426,560	426,560	426,560
Salvage value recovery		0	0	278,500
Cash outflow (without VCU)	2,785,000	1,596,557	1,596,557	1,596,557
Cash outflow (with VCU)	2,785,000	1,715,979	1,715,979	1,715,979
Investment in fixed assets (total investment)	2,785,000	0	0	0
Working capital investment	0	0	0	0
O&M cost		1,596,024	1,596,024	1,596,024
Stamp tax[16]		533	533	533
Adjustment of income tax (without VCU)		0	0	0
Adjustment of income tax (with VCU)		119,422	119,422	119,422
Net cash flow (without VCU)	-2,785,000	180,290	180,290	458,790
Net cash flow (with VCU)	-2,785,000	487,427	487,427	765,927
IRR (without VCU) after tax	**0.8%**			
IRR (with VCU) after tax	**15.72%**			
NPV (without VCU)	**-1,151,634**			
NPV (with VCU)	**1119687.52**			

[16] According to the National Taxation Bureau of China ,this kind of project does not need to Pay income tax http://www.chinatax.gov.cn/n810341/n810765/n812171/n812710/c1192026/content.html

(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 0.8%, lower than the benchmark IRR of 9.5%[17]which is lastest version published by the China Development and Reform Commission set for the project associated with Animal husbandry constructed after 2013 sitll vaild for the project, and the proposed project is financially unacceptable because of its low profitability. While considering such income, the IRR of the proposed project is 15.72%, higher than the benchmark, and the proposed project is financially acceptable

Sub-step 3d: 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 fertilizers sales 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 fertilizers sales

*O&M cost

[17] https://www.ndrc.gov.cn/fggz/gdzctz/tzfg/201907/W020191104862129391071.pdf

The variation range of –10%~10% which was employed in the Project Design Report and prevailing in China was used. The results of sensitivity analysis of the three parameters of the proposed project are shown in the following table:

Item	90%	95%	100%	105%	110%
Static total investment	1.98%	1.37%	0.80%	0.28%	-0.20%
Annual organic fertilizers sales	-13.01%	-4.94%	0.80%	5.53%	9.69%
Annual O&M cost	9.18%	5.24%	0.80%	-4.53%	-11.74%

The sensitivity analysis was further conducted, and the project IRR (after tax) could reach the benchmark of 9.5% if one of the following conditions can be achieved:

*Total static investment; decrease 48%.

*Annual fertilizers sales: increase 9.75%.

*O&M cost: decrease 10.42%.

Since all the data used for the investment analysis was sourced from the PER, which was completed by an authorized entity. Therefore, the data used in the investment analysis are believed to be reliable and credible and none of the above conditions can be achieved:

Total static investment decreasing 48%: 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. In addition, the project was put into operation.. As a result, the IRR cannot increase through the change of equipment cost.

Annual fertilizers sales increasing 9.75%: The fertilizers are determined by the manure of the swine farm. The number of production of the fertilizers is the maximum number ,because the number of market swine and breeding swine will not exceed the 41935 and 5885,and the price is set with the agreement to help the local farmer so ,it is impossible for the price increase the 9.75%. Therefore, the increase of annual organic fertilizers sales to threshold is impossible to achieve.

O&M cost decreasing 10.42%: However, the decrease of it is not likely to occur. Based on the Chinese Statistic Yearbook, the fluctuations of indices of the purchasing price of raw material, power, and fuel are insignificant over the last ten years and the annual average wages in Gansu Province have been constantly growing over the 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 decrease of 10.42% in 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 a 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 summary, the NPV of both the project activity and the uncovered anaerobic lagoon are negative and the NPV of the project activity is far more negative than that of the uncovered anaerobic lagoon which means the cost of the project activity without VCS revenues is much higher than the uncovered anaerobic lagoon, so, the uncovered anaerobic lagoon is the most attractive course of action and is considered to be the baseline scenario.

3.5 Additionality

Additionality for the project activity is demonstrated using Tool 02" Combined tool to identify the baseline scenario and demonstrate additionality (Version 07.0)". Step 1 to 3 have been finished in Section 3.4 of the JPM.As per Tool 24 "Common practice (Version 03.1)", Step 4 common practice analysis will be conducted as follows:

Step 4: Common practice analysis

The proposed project will achieve obvious greenhouse gas (GHG) emission reductions through

capturing methane generated during the swine manure treatment process and the biogas can

be used for heating or flared. Therefore, according to the tool 24"Common practice (version03.1), the measure of the proposed project belongs to "Methane formation avoidance".

Thus, sub-steps are adopted to take the common practice analysis.

Sub-step 4a. The proposed CDM project activity(ies) applies measure(s) that are listed in the

definitions section above.

The proposed project is belonged to type (D) measure listed in the latest version of the tool 24

common practice (version03.1)", i.e., Methane formation avoidance (example: use of biomass

that would have been left to decay in a solid waste disposal site resulting in the formation and

emission of methane, for energy generation). As per additionality tool, the Tool24 “common

practice (version 03.1)” available on the UNFCCC website is applied as below:

Sub-step 4a.1: calculate applicable capacity or output range as +/-50% of the total design capacity or output of the proposed project activity

For this project, swine farms involving 41920 heads of marketing pigs, 5885 heads of

breeding swine in stock are included, and are estimated to produce 29674.5 tons of manure every year, Therefore, the project belonging to “ Methane formation avoidance ” that can handle manure from 14,837.25 tons to 44,511.75 tons are included.

Sub-step 4a.2: identify similar projects (both CDM and non-CDM) which fulfill all of the following

conditions:

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

The common practice analysis is limited to the provincial level as the provincial government is at the highest level of local governments. Local regulatory frameworks are generally set by local governments (e.g., price regulation, investment policy). only the activities in the same province could be regarded as sharing the same “ comparable environment ”. Therefore,Gansu province is considered to be a geographical area with comparable investment climate and is selected for geographical boundaries of common practice analysis.

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

As described above, the project installs new AWMSs to treat the manure from swine farms, which can avoid methane emissions generated in the baseline uncovered anaerobic lagoons. And the measure of the proposed project belongs to "Methane formation avoidance" as per Tool 24"Common practice (version03.1).

(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; The project is to treat the manure from the swine farms avoid methane emissions generated in the baseline uncovered anaerobic lagoons through installing new set of AWMSs. The biogas captured for heating, which is used for the AWMSs and the swine farms.

(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;

29674.5 tons of animal manure waste can be treated annually and the biogas captured for heat generation. If the similar projects can treat the manure waste and produce electricity should be considered as the comparable service.

(e) The capacity or output of the projects is within the applicable capacity or output range

calculated in Step 1;

Based on the calculation in Sub-step 4a.1, the output/capacity ranges of similar project are that can handle manure from 14838 tons to44512 tons annually.

(f) The projects started commercial operation before the project design document ("CDM–PDD")

is published for global stakeholder consultation or before the start date of proposed project

activity, whichever is earlier for the proposed project activity.

The similar project stared commercial operation before the start date of proposed project at 01–June–2021, which is earlier date.Based on above analysis, it can conclude project belonging to "Methane formation avoidance" with treatment of manure operated before 01–June–2021, that can handle manure from 14,837.25 tons to 44,511.75 tons annually in Gansu province is the similar project as the proposed project activity

Sub–step 4a.3: within the projects identified in Step 2, identify those that are neither registered

CDM project activities, project activities submitted for registration, nor project activities

undergoing validation. Note their number N_{all}.

Through searching UNFCC website, CDM website, China CER exchange info–platform, GS website, VCS website[18], Gansu Development and reform commission[19], and Department of Agriculture and rural affairs of Gansu Province[20], there are no similar projects, therefore N_{all}=0.

[18] https://registry.verra.org/app/search/VCS

[19] http://fzgg.gansu.gov.cn/

[20] http://www.gs.xinhuanet.com/gsnync/

Sub–step 4a.4: within similar projects identified in Step 3, identify those that apply technologies

different that the technology applied in the proposed project activity. Note their number Ndiff.

N_{diff}=0

Sub–step 4a.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 analysis above, N_{all}= N_{diff} =0, and the factor F=1–N_{diff}/N_{all}=1–1 =0< 0.2. Therefore, the result of common practice assessment is: N_{all}–N_{diff}=0 < 3 Therefore, the proposed activity is not a common practice in the region.

Conclusion of the assessment and demonstration of additionality

To summarize, "the project is undertaken without being registered as a VCS project activity" is not financially attractive to investors, thus it is not feasible. Being registered as a VCS project, the VCUs revenues can alleviate the identified barriers, therefore the proposed project is additional.

3.6 Methodology Deviations

There is no methodology deviation for the project.

4 IMPLEMENTATION STATUS

4.1 Implementation Status of the Project Activity

The units of the project activity have been commissioned on 01/06/2021. During the period of monitoring period, all the manure and wastewater are collected into waste collecting tanks and then be separated firstly by Solid–liquid separators. The solid will be treated in aerobic composting system and the organic fertilizers will be produced,

In the monitor period , all the equipment of the AWMS operate smoothly. The monthly average inventory was 38,697 market swine and 5,064 breeding swine. All animal waste generated by the swine farm has treated in the project. The animal manure has first kept in a homogenizing tank for 30 days and then separated into liquid and solid by a solid–liquid separation plant. The liquid after separators will be treated through anaerobic digestion and then all the biogas is generated during this anaerobic treatment process will be captured for heat generation.There is no biogas was flared through the flaring system and the AWMS generate 7,111,953 m^3 biogas The generated biogas will be used for heat generation for the swine farm.besides there is about 7130.60 ton of the organic fertilizer produced 60% of which were given to local villagers for free, which is a great help to the local people,

There are no events or situations that occurred during the monitoring period which may impact the applicability of the methodology.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

This section details the applicable formulas from the methodologies applied to the project Activity.

The baseline is the AWMS identified through the baseline selection procedure in Section 3.4 of this PDD. As per paragraph 26 of the applied methodology,

Baseline emissions are:

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

where:

BE_y	Baseline emissions in year y (t CO_2/yr)
$BECH_{4,y}$	Baseline CH_4 emissions in year y (t CO_2/yr)
$BEN_2O_{,y}$	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)

i) Baseline CH_4 emissions ($BECH_{4,y}$)

$$BE_{CH4,y} = GWP_{CH4} * D_{CH4} * \sum_{j,LT} (MCF_j * B_{0,LT} * N_{LT} * VS_{LT,y} * MS\%_{Bl,j})$$

(Equation 2)

where:

$BECH_{4,y}$	Baseline CH_4 emissions in year y (t CO_2/yr)
GWP GWP_{CH_44}	Global Warming Potential (GWP) of CH_4 (t CO_2e/t CH_4)

D_{CH_4}	Density of CH_4 (t/m^3). 0.00067t/m^3 at room temperature (20℃) and 1am pressure.
MCF_j	Annual methane conversion factor (MCF) for the baseline AWMSj. IPCC 2006 Guidelines, table 10.17, chapter 10, volume 4.
$B_{0,LT}$	Maximum methane producing potential of the volatile solid generated by animal type LT (m$^3 CH_4$/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)
$MS\%_{BI,j}$	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%. $MS\%_{BI,j}$=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:

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

(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)
n_{dy}	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:

$$VS_{LT,y} = (\frac{W_{site}}{W_{default}}) * VS_{default} * nd_y \quad \text{(Equation 4)}$$

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)
n_{dy}	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 n_{dy} (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 which are optimized for the various animal(s), stage of growth, category, weight gain/productivity and/or genetics;

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

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

There is no published country specific data available, so we could not use Option 1. The energy intake of the swine is not available, so we could not use Option 2. Option 3 utilizes the average weight of the swine, this data is available and therefore Option 3 is adopted to calculate $VS_{LT,y}$.

(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:

$$N_{LT} = N_{da,LT} * (\frac{N_{p,LT}}{365}) \qquad \text{(Equation 5)}$$

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:

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

where:

N_{LT} 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)

Since PP can monitor the daily stock of two types of swine (marker swine and breeding swine) in a reliable way, discounting dead and discarded swine from the productive process from the daily stock. So, the Option 2 is adopted to calculate N_{LT}.

In the ex ante calculation, the projected average annual stocking data in the PER is used as the value for N_{LT} to directly calculate baseline emissions.

(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, chapter10).

The proposed project is located in Longnan city, Gansu Province, China, Asia. According to IPCC 2006 Guidelines for National Greenhouse Gas Inventories volume 4, chapter10, the maximum methane producing potential($B_{0,LT}$) for Market swine and Breeding swine in Asia region is 0.29 m^3 CH_4/kg-dm.

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

(a)The MCF values given in table 10.17, chapter 10, volume 4, IPCC 2006 Guidelines should be used. MCF 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 13.0℃, so the value of MCF is71%

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

ii)Baseline N_2O emissions (BE$N_2O_{,y}$)

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

where:

BE$N_2O_{,y}$	Annual baseline N_2O emissions in (t CO_2e/yr)
GWPN_2O	Global Warming Potential (GWP) for N_2O (t CO_2e/tN_2O)
CF$N_2O_{-N,N}$	Conversion factor N_2O-N to N_2O (44/28)
E$N_2O_{,D,y}$	Direct N_2O emission in year *y* (kg N_2O-N/year)
E$N_2O_{,ID,y}$	Indirect N_2O emission in year *y* (kg N_2O-N/year)

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

where:

E$N_2O_{,D,y}$	Direct N_2O emission in year *y* (kg N_2O-N/yr)

$EF_{N_2O,D,j}$ 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 EF_3 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.(For uncovered anaerobic lagoons in the baseline, j equals 0)

$NEX_{LT,y}$ 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) and (6) (number)

$$E_{N2O,ID,y} = \sum_{j,LT} EF_{N_2O,ID} * F_{gasMS,j,LT} * NEX_{LT,y} * N_{LT} * MS\%_{Bl,j} \quad \text{(Equation 9)}$$

where:

$EN_2O_{,ID,y}$ Indirect N_2O emission in year *y* (kg N_2O–N/year)

$EF N_2O_{,ID}$ 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). (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 volatilisation of NH_3 and NO_x from manure management (fraction) (For uncovered anaerobic lagoons in the baseline, j equals 0)

N_{LT} Annual Average number of animals of type LT for the year *y* estimated as per equation (5) and (6) (number)

Estimation of various variables and parameters for above equations:

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

Option 1:

$$NEX_{LT,y} = N_{intake} * (1 - N_{retention}) * nd_y \quad \text{(Equation 10)}$$

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)

n_{dy} Number of days treatment plant was operational in year y

N_{intake} may be calculated using:

$$N_{intake} = (\frac{GE}{18.45}) * (\frac{CP/100}{6.25}) \quad \text{(Equation 11)}$$

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:

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

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)

$$NEX_{IPCC\ default} = N_{rate(T)} * \frac{TAM}{1000} * 365 \qquad \text{(Equation 13)}$$

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

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

As per the requirements in the national standard Nutrient requirements of swine (GB/T 39235–2020), the Crude per cent of protein CP, the digestible energy DE,the metabolizable energy ME, the net energy NE and other values will be tested, while the Gross energy GE and Portion of that N intake that is retained in the animal Nretension in Option 1 are not included in the routine testing of swine farms, as local regulations do not require mandatory testing of these values, thus the project–specific information on protein intake is not available. Therefore, neither specific information on Portion of that N intake nor site–specific national or regional data is available.In summary, the parameter $NEX_{LT,y}$ can't be calculated using option 1 and the Option 2 is adopted to calculate $NEX_{LT,y}$.

iii) Baseline CO_2 emission from electricity and/or heat used in the baseline

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

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 CO2 emission from electricity and/or heat used in the baseline is 0.Additionally, the biogas produced during the treatment process of this project is collected and used as fuel to provide heating for the farm and AWMS. This project is not connected to any other users or regional power or heat grids. Therefore, the CO_2 emissions from the use of electricity and/or heat in the baseline are zero, which is very conservative.

5.2 Project Emissions

Two stages are involved in the manure treatment for the project activity, which is anaerobic digester. Project emissions are estimated as follows:n factors and default values).

Project emissions are estimated as follows:

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

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)
$PE_{N_2O,y}$	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)

i) 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 14 "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:

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

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)
$PE_{CH_4,y}$	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)

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

As the electricity consumption of the anaerobic digestion system cannot be measured separately from the entire AMMS, the Project emissions from electricity consumption is associated with the anaerobic digester and that is not related to the anaerobic digester will be calculated together. The project emissions from electricity consumption calculated according to Tool 05 "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (Version 03.0)"

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

Where：

$PE_{EC,y}$	Project emissions from electricity consumption in year y (t CO_2e)
$EC_{PJ,j,y}$	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*

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. $EC_{PJ,j,y}$ is the total power consumption of the project and $PE_{EC,y}$ is the emissions from the total power consumption of the project

As per am–tool–07–v7.0 Tool to calculate the emission factor for an electricity system, the emissions factor is calculated as follows:

$$EFEF,j,y = EF_{grid,OM,y} \times W_{OM} + EF_{grid,BM,y} \times W_{BM} \quad \text{(Equation 18)}$$

Where:

EFgrid,OM,y= Operating margin CO_2 emission factor in year y (tCO_2/MWh)

EFgrid,BM,y= Build margin CO_2 emission factor in year y (tCO_2/MWh)

W_{OM}= Weighting of operating margin emissions factor (per cent)

W_{BM}= Weighting of build margin emissions factor (per cent)

For this project, w_{OM} = 0.5 and w_{BM} = 0.5 for the first crediting period

On 29–12–2020, China DNA published the latest emission factor of China power grid "2019 Baseline Emission Factors for Regional Power Grids in China", which is calculated by China DNA using the latest version currently available of the "Tool to calculate the emission factor for an electricity system" (t CO2/MWh) of the CDM.•

Operating Margin: 0.8922 tCO2/MWh

• Build Margin: 0.4407 tCO2/MWh

• Combined Margin: 0.66645 tCO2/MWh

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., $PE_{FC,y}=0$

.In case, there is residual gas stream which will be 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) CH4 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 (FCH4,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 Too 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. The flow meter 3 to monitor the amount of biogas burned through the flare is installed at the flare inlet. The biogas is produced by an anaerobic digester with a reaction temperature of 32 ~ 38 ºC and is not heated up before it is delivered to the flare.

Therefore, the gas temperature measured by the flow meter 3 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:

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

$$F_{i,t} = V_{t,db} \times \upsilon_{i,t,db} \times \rho_{i,t} \qquad \text{Equation 19}$$

$$\rho_{i,t} = \frac{P_t \times MM_i}{R_u \times T_t} \qquad \text{Equation 20}$$

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)
$\upsilon_{i,t,db}$	=	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 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 flares 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 (ηflare,m) is 50% when the flame is detected in the minute m ($Flame_m$), otherwise ηflare,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 (ηflare,m),

as follows:

$$PE_{flare,y} = GWP_{CH_4} \times \sum_{m=1}^{525600} F_{CH_4,RG,m} \times (1 - \eta_{flare,m}) \times 10^{-3}$$

Equation 21

Where:

$PE_{flare,y}$	=	Project emissions from flaring of the residual gas in year y (t CO_2e)
GWP_{CH_4}	=	Global warming potential of methane valid for the commitment period (t CO_2e/t CH_4)
$F_{CH_4,RG,m}$	=	Mass flow of methane in the residual gas in the minute m (kg)
$\eta_{flare,m}$	=	Flare efficiency in the minute m

As described above, $F_{CH_4,RG,m}$ will be determined according to equation 18 and 19, so the project emissions from flaring can be calculated by:

$$PE_{flare,y} = GWP_{CH_4} \times V_{t,db} \times \upsilon_{i,t,db} \times \rho_{i,t} \times (1 - \eta_{flare,m}) \times 10^{-3}$$

Equation 22

Where:

$V_{t,db}$	=	Volumetric flow of the gaseous stream in time interval t on a dry basis (m^3 dry gas/h)
$\upsilon_{i,t,db}$	=	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)

All biogas from the project is burned to produce heat for the swine farm and AWMS, so the project emission from flaring of biogas is 0, i.e., PEflare,y=0

Determination of project emissions of methane from the anaerobic digester (PE$CH_{4,y}$)

PE $CH_{4,y}$ was determined following the step 4 of the applied Tool "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:

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

where:

PE$CH_{4,y}$	Project emissions of methane from the anaerobic digester in year y (t CO_2e)
Q$CH_{4,y}$	Quantity of methane produced in the anaerobic digester in year y (t CH_4)
EF$CH_{4,default}$	Default emission factor for the fraction of CH_4 produced that leaks from the anaerobic digester (fraction)
GWP CH_4	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 $QCH_{4,y}$

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 ($Q_{CH_{4,y}}$). For large scale projects only Option 1 shall be used. For small scale projects, project participants may choose between Option 1 or Option 2. The proposed project belongs to large scale projects, so Q$CH_{4,y}$ was determined following step 1 and Option 1 of the applied tool. Below is the formula used for the calculation of Q$CH_{4,y}$.

Option1: Procedure using monitored data

$Q_{CH_{4,y}}$ 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 mass flow of greenhouse gas i ($F_{i,t}$) is determined as follows:

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

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

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)

$\upsilon_{i,t,db}$ 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 Project emissions from electricity consumption, project emissions from flaring of biogas (if any), and Project emissions of methane from the anaerobic digester in year y (t CO_2e). i.e., $PE_{AD,y} = PE_{EC,y} + PE_{CH_4,y} + PE_{flare}$.

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

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

$$PE_{Aer,y} = GWP_{CH4} * D_{CH4} * 0.001 * F_{Aer} * [\prod_{n=1}^{N}(1 - R_{VS,n})] * \sum_{j,LT}(B_{0,LT} * N_{LT} * VS_{LT,y} * MS\%_j) + PE_{sl,y} \quad \text{(Equation 25)}$$

where:

GWP Global Warming Potential (GWP) of CH_4 (t CO_2e/tCH_4)

CH_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	Density of CH_4 (t/m^3)
CH_4	
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$^3 CH_4$/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(a)) or (5(b))
$PE_{sl,y}$	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 used for land application, which is calculated as leakage emission, so the $PE_{sl,y}$=0.

iii) Project N_2O emissions in year y ($PEN_2O_{,y}$)

$$PE_{N2O,y} = GWP_{N2O} * CF_{N2O-N,N} * \frac{1}{1000} * (E_{N2O,D,y} + E_{N2O,ID,y}) \quad \text{(Equation 26)}$$

where:

$PEN_2O_{,y}$	Project N_2O emissions in year y (t CO_2/yr)
$GWPN_2O$	Global Warming Potential (GWP) for N_2O (t CO_2e/tN_2O)
$CFN_2O_{-N,N}$	Conversion factor N_2O–N to N_2O (44/28)
$EN_2O_{,D,y}$	Direct N_2O emission in year y (kg N_2O–N/year)
$EN_2O_{,ID,y}$	Indirect N_2O emission in year y (kg N_2O–N/year)

Since this project first homogenizes the manure, then conducts aerobic composting and anaerobic digestion, in accordance with ACM0010:

"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–RN), where RN is the relative reduction of nitrogen from the previous stage. The relative reduction (RN) 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 TN)"

and in combination with Option 1 in ACM0010, the direct and indirect N2O emission from this project are calculated by the following formulas:

Option1:

$$E_{N2O,D,y} = EF_{N2O,D,1} * NEX_{LT,y} * N_{LT} * MS\%_1 + (1 - R_{N,1}) * EF_{N2O,D,2} * NEX_{LT,y} * N_{LT} * MS\%_2 + (1 - R_{N,1}) * EF_{N2O,D,3} * NEX_{LT,y} * N_{LT} * MS\%_3 \quad \text{(Equation 27)}$$

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) (For homogenization, aerobic composting and anaerobic digestion in the project, j takes the values of 1, 2, and 3, respectively)

$R_{N,n}$ Nitrogen reduction factor (For homogenization in the project, n equals 1)

$NEX_{LT,y}$ 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) (For homogenization, aerobic composting and anaerobic digestion in the project, j takes the values of 1, 2, and 3, respectively)

N_{LT} Annual Average number of animals of type LT for the year *y* estimated as per equation (5) and (6) (number)

$$E_{N2O,ID,y} = EF_{N2O,ID} * F_{gasMS,1,LT} * NEX_{LT,y} * N_{LT} * MS\%_1 + (1 - R_{N,1}) * EF_{N2O,ID} * F_{gasMS,2,LT} * NEX_{LT,y} * N_{LT} * MS\%_2 + (1 - R_{N,1}) * EF_{N2O,ID} * F_{gasMS,3,LT} * NEX_{LT,y} * N_{LT} * MS\%_3$$

(Equation 28)

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) (For homogenization, aerobic composting and anaerobic digestion in the project, j takes the values of 1, 2, and 3, respectively)
$F_{gasMS,j,LT}$	Default values for nitrogen loss due to volatilisation of NH_3 and NO_x from manure management (fraction) (For homogenization, aerobic composting and anaerobic digestion in the project, j takes the values of 1, 2, and 3, respectively)
N_{LT}	Annual Average number of animals of type LT for the year *y* estimated as per equation (5) and (6) (number)
$R_{N,n}$	Nitrogen reduction factor (For homogenization in the project, n equals 1)

In the ex–ante calculations, the efficiency of the solid–liquid separation equipment from the PER was used to derive the values for $MS\%_2$ and $MS\%_3$. However, in actual operation, there was no metering equipment installed at the project site. Therefore, to ensure conservative calculations, both values were taken as 100% in the calculation of actual emission reductions.

For the estimation of direct and indirect N_2O emissions from the AMWS of the project, we have chosen to use Option 1 as detailed in the ACM0010 methodology. At the moment, the project lacks the necessary facilities and/or technical capacity to

conduct monthly measurements of the effluent volume and its nitrogen content, as required by Option 2. And, the estimating N_2O emissions for the duration of the project's crediting period will be used the fixed method (Option 1).

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

$$PE_{EC/FC,y} = PE_{EC,y} + \sum_j PE_{FC,j,y} \qquad \text{(Equation 31)}$$

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 i 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 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 above $PE_{EC,y}$ calculation.

And there is no equipment used fossil fuels on the project site. The local electricity supply is reliable, and the project's primary equipment — the anaerobic digestion

tanks — will not be affected by these brief power interruptions. So,the $PE_{FC,y}$=0

Therefore, $PE_{elec/heat}$=0.

5.3 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.

$$LE_y = (LE_{PJ,N2O,y} - LE_{BL,N2O,y}) + (LE_{PJ,CH4,y} - LE_{BL,CH4,y}) + LE_{AD,y} \quad \text{(Equation 32)}$$

Where:

$LE_{PJ,N_2O,y}$	Leakage N_2O emissions released during project activity from land application of the treated manure in year y (t CO_2e/yr)
$LE_{BL,N_2O,y}$	Leakage N_2O emissions released during baseline scenario from land application of the treated manure in year y (t CO_2e/yr)
$LE_{PJ,CH_4,y}$	Leakage CH_4 emissions released during project activity from land application of the treated manure in year y (t CO_2e/yr)
$LE_{BL,CH_4,y}$	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)

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

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

(Equation 33)

$$LE_{N2O,land,y} = EF_1 * \prod_{n=1}^{N}(1 - R_{N,n}) * \sum_{LT} NEX_{LT,y} * N_{LT} \quad \text{(Equation 34)}$$

$$LE_{N2O,runoff,y} = EF_5 * F_{leach} * \prod_{n=1}^{N}(1 - R_{N,n}) * \sum_{LT} NEX_{LT,y} * N_{LT} \quad \text{(Equation 35)}$$

$$LE_{N2O,vol,y} = EF_4 * \prod_{n=1}^{N}(1 - R_{N,n}) * F_{gasm} * \sum_{LT} NEX_{LT,y} * N_{LT} \quad \text{(Equation 36)}$$

where:

GWP — Global Warming Potential (GWP) for N_2O (t CO_2e/tN_2O)

N_2O

CF N_2O_N,N — Conversion factor N_2O–N to N_2O (44/28)

LE N_2O_nd,y — Leakage N_2O emissions from application of manure waste in year y (kg N_2O–N/year)

LE N_2O_runoff,y — Leakage N_2O emissions due to leaching and run–off in year y (kg N_2O–N/year)

LE N_2O_vol,y — Leakage N_2O emissions due to volatilisation 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) and (6) (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/mineralised in managed soils in regions where leaching/runoff occurs that is lost through leaching and runoff (fraction)

$R_{N,n}$ — Nitrogen reduction factor (fraction). For uncovered anaerobic lagoon in baseline, n

equals 0

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

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

(Equation 37)

$$LE_{N2O,land,y} = EF_1 * \prod_{n=1}^{N}(1 - R_{N,n}) * \sum_{LT} NEX_{LT,y} * N_{LT} \quad \text{(Equation 38)}$$

$$LE_{N2O,runoff,y} = EF_5 * F_{leach} * \prod_{n=1}^{N}(1 - R_{N,n}) * \sum_{LT} NEX_{LT,y} * N_{LT} \quad \text{(Equation 39)}$$

$$LE_{N2O,vol,y} = EF_4 * \prod_{n=1}^{N}(1 - R_{N,n}) * F_{gasm} * \sum_{LT} NEX_{LT,y} * N_{LT} \quad \text{(Equation 40)}$$

where:

GWP	Global Warming Potential (GWP) for N_2O (t CO_2e/tN_2O)
N_2O	
$CF_{N_2O_N,N}$	Conversion factor N_2O–N to N_2O (44/28)
$LE_{N_2O,la nd,y}$	Leakage N_2O emissions from application of manure waste in year y (kg N_2O–N/year)
$LE_{N_2O,runoff,y}$	Leakage N_2O emissions due to leaching and run–off in year y (kg N_2O–N/year)
$LE_{N_2O,vol,y}$	Leakage N_2O emissions due to volatilisation 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) and (6) (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/mineralised in managed soils in regions where leaching/runoff occurs that is lost through leaching and runoff (fraction)

$R_{N,n}$ Nitrogen reduction factor (fraction) For homogenization, and anaerobic-aerobic combined treatment in the project, n takes the values of 1 and 2, respectively.

It is not 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 $Q_{DM}*N_{DM}$.

iii) 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:

$$LE_{BL,CH4,y}=GWP_{CH4}*D_{CH4}*MCF_d*[\prod_{n=1}^{N}(1-R_{VS,n})]*\sum_{j,LT}(B_{0,LT}*N_{LT}*VS_{LT,y}*MS\%_j) \quad \text{(Equation 41)}$$

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

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 Global Warming Potential (GWP) of CH_4 (t CO_2e/tCH_4)

CH_4

D Density of CH_4 (t/m^3)

CH_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* estimated as per equation (5) and (6), 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 Methane conversion factor (MCF) assumed to be equal to 1

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).

iV) 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:

$$LE_{AD,y} = LE_{storage,y} + LE_{comp,y} \quad \text{(Equation 43)}$$

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)

Because this project does not involve anaerobic storage of biogas residue and composting treatment of biogas residue, so $LE_{AD,y} = 0$.

5.4 Estimated 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:

$$ER_y = BE_y - PE_y - LE_y \quad \text{(Equation 44)}$$

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 ($QCH_{4,y}$ 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 ($BECH_{4,y}$ – $PE_{AD,y}$ in the tool "Project and leakage emissions from anaerobic digesters") and if found lower, then ($BE\ CH_{4,y}$ – $PE_{AD,y}$) (which is a component of BE_y –PE_y) in Equation (45) is replaced by $QCH_{4,y}$.

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	
GWPCH_4	27.9	27.9	tCO_2/tCH_4
DCH_4	0.00067	0.00067	t/m^3
MCF_j	0.71	0.71	/
Conservative Factor	0.94	0.94	/
MCF_j with cons. Factor	0.67	0.67	/
$B_{o,LT}$	0.29	0.29	m^3 CH_4 /kg_dm
N_{LT}	41,935	5,885	No of heads
W_{site}	79	93	kg
$W_{default}$	28	28	kg
$VS_{default}$	0.3	0.3	Kg-dm/animal/day
$VS_{LT,y}$	308.95	363.70	kg-dm/animal/yr
$MS\%_{Bl,j}$	1	1	%
n_{dy}	365	365	days
Sub total	47,056	7,774	tCO2e
BE$CH_{4,y}$	**54,830**		tCO2e

Parameter	Value		Unit
species	Market Swine	Breeding Swine	
$EF_{N2O,D,0}$	0	0	kg N_2O-N/yr
$N_{rate(T)}$	0.42	0.24	kg N/1000kg animal mass/day
$NEX_{IPCCdefault}$	4.29	2.45	kg N/animal/year
W_{site}	79	93	kg
TAM	28.00	28.00	kg

$W_{default}$	28	28	kg
$NEX_{LT,y}$	12.10	8.14	kg N/animal/yr
N_{LT}	41,935	5,885	No of heads
$MS\%_{Bl,j}$	100%	100%	/
$E_{N2O,D,y}$	0	0	kg N_2O–N/year
$EF_{N2O,ID}$	0.01	0.01	kg N_2O–N/yr
$F_{gasMS,0,LT}$	40%	40%	/
GWP_{N2O}	273	273	tCO_2/tN_2O
$CF_{N20-N,N}$	44/28	44/28	Conversion Factor N_2O–N to N_2O
$E_{N2O,ID,y}$	870.08	82.29	tCO_2/tN_2O
$BE_{N2O,y}$	**952**		tCO_2e

Baseline Emissions: BE$CH_{4,y}$+ BE$N_2O_{,y}$=54,830tCO_2e +952tCO2e **=55,782tCO_2e**

Calculation of the project emission

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

Parameter	Value	Unit
$EC_{PJ,j,y}$	2680	MWh/yr
$EF_{EF,j,y}$	0.66645	tCO_2/MWh
$TDL_{j,y}$	20%	/
$PE_{EC,y}$	**2143**	tCO2e

Parameter	Value	Unit
GWPCH_4	27.9	tCO_2/tCH_4
EF$CH_{4,default}$	0.028	/
Q$CH_{4,y}$	1,940	tCH_4
PE$CH_{4,y}$	**1,516**	tCO2e

Parameter	Value	Unit
GWPCH_4	27.9	tCO_2/tCH_4
$H_{flare,\ m}$	0	/
$QCH_{4,y}$	0	tCH_4
PE_{flare}	**0**	tCO2e

$PE_{AD,y}$= $PE_{EC,y+}$ $PECH_{4,y}$+$PE_{flare,y}$ =2,143tCO_2e +1,516tCO_2e =3,659tCO_2e

Parameter	Value		Unit
species	**Market Swine**	**Breeding Swine**	
GWPCH_4	27.9	27.9	tCO_2/tCH_4
DCH_4	0.00067	0.00067	t/m^3
F_{Aer}	1	1	/
$1–R_{vs,1}$	0.8	0.8	/
$B_{0,LT}$	0.29	0.29	m^3 CH_4 /kg VS
N_{LT}	41,935	5,885	No of heads
$VS_{LT,y}$	308.95	363.70	kg–dm/animal/yr
$MS\%_j$	1	1	/
Sub total	56.19	9.28	tCO2e
$PE_{Aer,y}$	**66**		tCO2e

Parameter	Value		Unit
species	**Market Swine**	**Breeding Swine**	
EF_N2O,D,1	0.01	0.01	kg N2O-N/kg N
NEXLT,y	12.10	8.14	kg N/animal/yr
NLT	41,935	5,885	No of heads
MS%1	100%	100%	/
EN2O,D,y(HOM)	**5074.14**	**479.04**	kg N2O-N/year

EF_N_2O,ID	0.01	0.01	kg N2O-N/kg N
F_gasMS,1,LT	0.85	0.85	/
NEXLT,y	12.10	8.14	kg N/animal/yr
NLT	41,935	5,885	No of heads
MS%1	100%	100%	/
EN2O,ID,y(HOM)	**4,313.01**	**407.18**	kg N2O-N/year
EN2O,y(HOM)	**10,273.37**		kg N2O-N/year
1-RN,1[22]	95%	95%	/
EF_N2O,D,3	0	0	kg N2O-N/kg N
NEXLT,y	12.10	8.14	kg N/animal/yr
NLT	41,935	5,885	No of heads
MS%3	50%	50%	/
EN2O,D,y(AD)	0	0	kg N2O-N/year
1-RN,1	95%	95%	/
EF_N2O,ID	0.01	0.01	kg N2O-N/kg N
F_gasMS,3,LT	0.50	0.50	/
NEXLT,y	12.10	8.14	kg N/animal/yr
NLT	41,935	5,885	No of heads
MS%3	50%	50%	/
EN2O,ID,y(AD)	1,205.11	113.77	kg N2O-N/year
EN2O,y(AD)	1,318.88		kg N2O-N/year
1-RN,1[23]	95%	95%	/
EF3_N2O,D,2	0.006	0.006	kg N2O-N/kg N
NEXLT,y	12.10	8.14	kg N/animal/yr
NLT	41,935	5,885	No of heads
MS%2	50%	50%	/
EN2O,D,y(COM)	1,446.13	1,365.26	kg N2O-N/year
1-RN,1	95%	95%	/
EF_N2O,ID	0.01	0.01	kg N2O-N/kg N
F_gasMS,2,LT	0.6	0.6	/
NEXLT,y	12.10	8.14	kg N/animal/yr
NLT	41,935	5,885	No of heads
MS%2	50%	50%	/
EN2O,ID,y(COM)	1,446.13	136.53	kg N2O-N/year
EN2O,y(COM)	4,394.05		kg N2O-N/year

[22] Because AD (Anaerobic digestion) is the next step of the homogenate ,so it should take Rn of the homogenate (HOM) into consideration

[23] Because COM (Aerobic composting) is the next step of the homogenate ,so it should take Rn of the homogenate into consideration

PE_N2O	6,859	tCO2e

Project emission: $PE_y = PE_{AD,y} + PE_{Aer,y} + PE_{N2O,y}$ =3,659tCO2e +66tCO2e +6,859tCO_2e =10,584tCO_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}	41,935	5,885	No of heads
$NEX_{LT,y}$	12.10	8.14	kg N/animal/yr
$R_{N,0}$	80%	80%	Anaerobic lagoon
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}	0.3	0.3	/
F_{gasm}	0.2	0.2	/
GWP_{N20}	273	273	tCO_2/tN_2O
LE$N_2O_{,land,y}$	1,014.83	95.81	kg N_2O–N/year
	1,110.64		kg N_2O–N/year
LE$N_2O_{,runoff,y}$	228.41	21.56	kg N_2O–N/year
	249.90		kg N_2O–N/year
LE$N_2O_{,vol,y}$	203.03	19.16	kg N_2O–N/year
	222.13		kg N_2O–N/year
LE$_{BL,}N_2O_{,y}$	**678**		tCO2e

Parameter	Value		Unit
species	Market Swine	Breeding Swine	
N_{LT}	41,935	5,885	No of heads
NEX_{LT}	12.10	8.14	kg N/animal/yr
$R_{N,1}$	5%	5%	homogenate
$R_{N,2}$	25%	25%	Anaerobic digester
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}	0.3	0.3	/
F_{gasm}	0.2	0.2	/
GWP_{N20}	273	273	tCO_2/tN_2O
LE$N_2O_{,land,y}$	3,615.32	341.32	kg N_2O–N/year
	3956.64		kg N_2O–N/year
LE$N_2O_{,runoff,y}$	813.45	76.80	kg N_2O–N/year
	890.25		kg N_2O–N/year
LE$N_2O_{,vol}$	723.06	68.26	kg N_2O–N/year
	791.32		kg N_2O–N/year
$LE_{PJ,}N_2O$	**2,417**		tCO2e

Parameter	Value		Unit
species	Market Swine	Breeding Swine	
$GWPCH_4$	27.9	27.9	tCO_2/tCH_4
DCH_4	0.00067	0.00067	t/m^3
MCF_d	1	1	/

$VS_{LT,y}$	308.95	363.70	kg-dm/animal/yr
N_{LT}	41,935	5,885	No of heads
$B_{0,LT}$	0.29	0.29	m^3 CH_4/kg-VS
$R_{VS,0}$	85%	85%	/
$MS\%_j$	100%	100%	/
$LE_{BL,}CH_{4,y}$	10,534.97	1,740.44	tCO2e
Total	**12,275**		tCO2e

Parameter	**Value**		**Unit**
species	**Market Swine**	**Breeding Swine**	
GWPCH_4	27.9	27.9	tCO_2/tCH_4
DCH_4	0.00067	0.00067	t/m^3
MCF_d	1	1	/
$VS_{LT,y}$	308.95	363.70	kg-dm/animal/yr
N_{LT}	41,935	5,885	No of heads
$B_{0,LT}$	0.29	0.29	m^3 CH_4/kg-VS
$R_{VS,1}$	20%	20%	homogenate
$R_{VS,2}$	80%	80%	Anaerobic digester
$MS\%_j$	100%	100%	/
$LE_{PJ,}CH_{4,y}$	11,237.30	1,856.46	tCO2e
Total	**13,094**		tCO2e

$LE_y = (LE_{PJ,N2O,y} - LE_{BL,N2O,y}) + (LE_{PJ,CH4,y} - LE_{BL,CH4,y})$ = (2,417tCO2e−678tCO2e) +(13,094tCO2e−12,275tCO2e) =2,558tCO_2e

Emission Reduction: $ER_y=BE_y-PE_y-LE_y$=55,782tCO2e−10,584tCO2e−2,558tCO2e=42,640tCO_2e

Year	Estimated baseline emissions or removals (tCO2e)	Estimated project emissions or removals (tCO2e)	Estimated leakage emissions (tCO2e)	Estimated net GHG emission reductions or removals (tCO2e)
01/06/2021–31/12/2021	32,705	6,206	1,500	24,999
01/01/2022–31/12/2022	55,782	10,584	2,558	42,640
01/01/2023–31/12/2023	55,782	10,584	2,558	42,640
01/01/2024–31/12/2024	55,782	10,584	2,558	42,640
01/01/2025–31/12/2025	55,782	10,584	2,558	42,640
01/01/2026–31/12/2026	55,782	10,584	2,558	42,640
01/01/2027–31/12/2027	55,782	10,584	2,558	42,640
01/01/2028–31/05/2028	23,229	4,408	1,066	17,755
Total	**390,626**	**74,118**	**17,914**	**298,594**

6 MONITORING

6.1 Data and Parameters Available at Validation

Data / Parameter	GWP_{CH_4}

Data unit	tCO_2/tCH_4
Description	Global Warming Potential of CH_4
Source of data	IPCC AR6
Value applied	27.9
Justification of choice of data or description of measurement methods and procedures applied	100–year values are adopted from AR6, which complies with the requirement described in Section 1.1 of VCS Standard (V4.4)
Purpose of Data	Calculation of baseline emissions、project emissions and leakage emissions
Comments	N/A

Data / Parameter	GWP_{N_2O}
Data unit	tCO_2/tN_2O
Description	Global Warming Potential of N_2O
Source of data	IPCC AR6
Value applied	273
Justification of choice of data or description of measurement methods and procedures applied	100–year values are adopted from AR6, which complies with the requirement described in Section 1.1 of VCS Standard (V4.4)
Purpose of Data	Calculation of baseline emissions、project emissions and leakage emissions
Comments	N/A

Data / Parameter	D_{CH_4}
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℃ 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 AWMSj
Source of data	IPCC 2006 table 10.17, chapter 10, volume 4
Value applied	67%
Justification of choice of data or description of measurement methods and procedures applied	MCF_j value for uncovered anaerobic lagoon (baseline AWMS) is chosen.A conservativeness factor has been applied by multiplying MCF value (i.e. 71%) with a value of 0.94, to account for the 20 percent uncertainty in the MCF values as reported by IPCC 2006 For this project, the annual average temperature is 13.0℃[24] and Longnan belongs to Warm temperate dry (the ratio of potential evapotranspiration to precipitation < 1). Therefore, MCF_j value of

[24] https://baike.baidu.com/item/%E5%9F%8E%E5%85%B3%E9%95%87/3468339

	67%will be applied.
Purpose of Data	project/baseline emission calculations
Comments	N/A

Data / Parameter	$MS\%_{BI,j}$
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 uncovered anaerobic lagoon is 100%.
Purpose of Data	Calculation of baseline emissions
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	The values in IPCC 2006 and US–EPA are compared and the lower value from IPCC 2006 is applied.
Purpose of Data	Calculation of Baseline emissions
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	The values in IPCC 2006 and US–EPA are compared and the lower value from IPCC 2006 is applied.
Purpose of Data	Used in project emission/baseline 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	Default value from IPCC2006 is 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	Default value from IPCC2006 is applied.
Purpose of Data	$NEX_{IPCC\ default}$ calculations
Comments	N/A

Data / Parameter	$NEX_{IPCC\ default}$

Data unit	kg N/ animal/year
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	$NEX_{LT,y}$ 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	table 10.22, chapter 10, volume 4 of 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied	$F_{gas\,MS,0,LT}$ =0.4 for Uncovered anaerobic lagoon in baseline (corresponding to the treatment method in Table 10.22 of IPCC2019 as Uncovered anaerobic lagoon); $F_{gas\,MS,1,LT}$ =0.85 for the homogenization treatment stage of this project (corresponding to the treatment method in Table 10.22 of

	IPCC2019 as Aerobic treatment__Forced aeration systems); $F_{gas\,MS,2,LT}$=0.6 for the aerobic composting stage of this project (corresponding to the treatment method in Table 10.22 of IPCC2019 as Composting_In Vessel); $F_{gas\,MS,3,LT}$=0.5 for the anaerobic digestion step of this project (corresponding to the treatment method in Table 10.22 of IPCC2019 as Anaerobic digester).
Justification of choice of data or description of measurement methods and procedures applied	The Table 10.21 in IPCC2019 is an updated version of the Table 10.21 in IPCC2016. Compared to the Table 10.21 in IPCC2006, the Table 10.21 in IPCC2019 provides more parameter values for various treatment methods, which is more applicable to the treatment steps in this project. The homogenization treatment step in this project involves storing manure in an underground pool, where it is stirred by a submersible stir rod. This stirring process effectively forces aeration of the manure, which remains in this stage for 30 days. While this stage bears similarities to the 'Aerobic treatment_Forced aeration systems' conditions outlined in the Table 10.22 of IPCC2019. Table 10.22 in the IPCC 2019 does not provide data for Aerobic treatment _Natural ventilation. Hence 0.85 remains the most conservative value among the two types of aerobic treatment presented in the table. The aerobic composting process of this project involves manure undergoing aerobic fermentation in a fermenter, which is mechanically overturned using a compulsory groove flip machine, and aerated through a pipeline at the bottom of the groove. Hence, this step resembles the 'Composting_In Vessel' treatment conditions in Table 10.22 of IPCC2019. As for the anaerobic digestion of the project, it employs the CSTR technology, allowing the manure to react at temperatures between 32 ℃ – 38 ℃. This is correspondent with 'Anaerobic digester' in

	Table 10.22 of IPCC2019.
Purpose of Data	Used in project/baseline emission calculations
Comments	N/A

Data / Parameter	$EF_{N_2O,D,j}$
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	$EF_{N_2O,D,0}$ =0 for Uncovered anaerobic lagoon in baseline (corresponding to the treatment method in Table 10.21 of IPCC2006 as Uncovered anaerobic lagoon) $EF_{N_2O,D,1}$ =0.01 for the homogenization treatment stage of this project (corresponding to the treatment method in Table 10.21 of IPCC2006 as Aerobic treatment__Natural aeration systems), $EF_{N_2O,D,2}$ =0.006 for the aerobic composting stage of this project (corresponding to the treatment method in Table 10.21 of IPCC2006 as Composting_In Vessel), $EF_{N_2O,D,3}$ =0 for the anaerobic digestion step of this project (corresponding to the treatment method in Table 10.21 of IPCC2006 as Anaerobic digester).
Justification of choice of data or description of measurement methods and procedures applied	The homogenization treatment step in this project involves storing manure in an underground pool, where it is stirred by a submersible stir rod. This stirring process effectively forces aeration of the manure, which remains in this stage for 30 days. While this stage bears similarities to the 'Aerobic treatment_Forced aeration systems' conditions outlined in the Table 10.21 of IPCC2006. However, from a conservative perspective, this project assigns the

	value corresponding to 'aerobic treatment_natural aeration systems' from Table 10.21 for the homogenization treatment step, which is 0.01. The aerobic composting process of this project involves manure undergoing aerobic fermentation in a fermenter, which is mechanically overturned using a compulsory groove flip machine, and aerated through a pipeline at the bottom of the groove. Hence, this step resembles the 'Composting_In Vessel' treatment conditions in Table 10.21 of IPCC2006. As for the anaerobic digestion of the project, it employs the CSTR technology, allowing the manure to react at temperatures between 32 ℃ – 38 ℃. This is correspondent with 'Anaerobic digester' in Table 10.21 of IPCC2006.
Purpose of Data	Used in project/baseline emission calculations
Comments	N/A

Data / Parameter	$EF_{N_2O,ID,}$
Data unit	kgN_2O–N/kg NH_3–N and NO_x–N
Description	Indirect N2O emission factor for N2O emissions from atmospheric deposition of nitrogen on soils and water surfaces
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	$EF_{CH_4,default}$
Data unit	t CH_4 leaked / t CH_4 produced
Description	Default emission factor for the fraction of CH_4 produced that leak from the anaerobic digester (fraction)
Source of data	Tool 14:" Project and leakage emissions from anaerobic digesters (version 02.0)"
Value applied	0.028
Justification of choice of data or description of measurement methods and procedures applied	Digesters with unlined concrete/ferrocement/brick masonry arched type gas holding section; monolithic fixed dome digesters, covered anaerobic lagoon
Purpose of Data	Calculation of project emissions
Comments	PE $CH_{4,y}$ 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 in section B.7 of PDD.

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 Annex 1 of methodology ACM0010 (version 08.0)

Value applied	$R_{VS,0}$ =85% for the Uncovered anaerobic lagoon in the baseline (one–cell of lagoon in Annex 1 of ACM0010) $R_{VS,1}$ =20%, for the homogenate (underfloor pit storage in Annex 1 of ACM0010) $R_{VS,2}$ =80% for the anaerobic–aerobic combined treatment (covered first cell of two cell lagoon in Annex 1 of ACM0010)
Justification of choice of data or description of measurement methods and procedures applied	For proposed project, before the treated manure is applied to the land, it undergoes two stages of pre–treatment and an anaerobic–aerobic combined treatment technology, the pre–treatment belong to underfloor pit storage in the Appendix 1 of applied methodology ACM0010 (version 08.0), so, the $R_{VS,n}$ is 20% which is the most conservative value. The anaerobic–aerobic combined treatment technology belongs to covered first cell of two cell lagoon in the Appendix 1 of applied methodology ACM0010 (version 08.0), so the $R_{VS,n}$ 80% which is the most conservative value. 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.
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
Description	Nitrogen reduction factor
Source of data	Refer to Annex 1 of methodology ACM0010 (version 08.0)

Value applied	$R_{N,0}$ =80% for the Uncovered anaerobic lagoon in the baseline (one–cell of lagoon in Annex 1 of ACM0010) $R_{N,1}$ =5%, for the homogenate (underfloor pit storage in Annex 1 of ACM0010) $R_{N,2}$ =25% for the anaerobic–aerobic combined treatment (covered first cell of two cell lagoon in Annex 1 of ACM0010)
Justification of choice of data or description of measurement methods and procedures applied	For proposed project, Before the treated manure is applied to the land, it undergoes two stages of pre–treatment and the an anaerobic–aerobic combined treatment technology, the pre–treatment belong to underfloor pit storage in the Appendix 1 of applied methodology ACM0010 (version 08.0), so, the $R_{N,n}$ is 5% which is the most conservative value. The anaerobic–aerobic combined treatment technology belongs to covered first cell of two cell lagoon in the Appendix 1 of applied methodology ACM0010 (version 08.0), so the $R_{N,n}$ is 25% which is the most conservative value. For proposed project, the baseline is uncovered anaerobic lagoon which similar to the anaerobic treatment of One–cell lagoon in the Appendix 1 of applied methodology ACM0010 (version 08.0), so, the $R_{N,n}$ is 80% which is the most conservative value.
Purpose of Data	Calculation of leakage emission
Comments	The most conservative value for the given technology must be used

Data / Parameter	$EF_1 EF_5 EF_4$
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 = 0.01 EF_4 =0.01 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
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/mineralised 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	According to paragraph 51 of the methodology ACM0010" GHG emission reductions from manure management systems

measurement methods and procedures applied	(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 $EF_{grid,OM,y}$: 0.8922 $EF_{grid,BM,y}$: 0.4407
Value applied	0.66645
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 project emission
Comments	N/A

6.2 Data and Parameters Monitored

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	The technicians in farms count the number of breeding swine and market swine and record in the financial system daily, and the record will be crosschecked by different technician through the yesterday number and the change with of which new imported animals are included and dead and discharge animals are excluded. in the end the record will checked by the manager of the swine farm monthly The annual average number of animals (NAA,LT) is calculated as an average of the daily stock of breeding swine and market swine in the farms without considering dead animals and discarded animals.
Frequency of monitoring/recording	Daily
Value applied	41935 heads of market swine and 5885 heads of breeding swine were used to ex-estimated. And this value is sourced from PER, which is the design scale of swine farms and it is also the maximum population of swine in the swine farms.
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 swine and market swine ,through the technician count and record the breeding swine and market swine. daily and the record will be saved in their financial system and will crosscheck by the different technician the next day and in the end the record will be verified by the manager monthly Therefore, the data of $N_{AA,LT}$ can be obtained through the financial system

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	79kg for market swine and 93 for breeding swine
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 can be used to estimate this variable, taking into account the following guidance: (a) To ensure representativeness, each defined livestock population will 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.
Purpose of data	Used for estimating $VS_{LT,y}$
Calculation method	/
Comments	/

Data / Parameter	n_{dy}
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 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 Project emission and leakages emission.
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	the maximum value will be applied during the monitoring period due to not monitored in operation period.
Frequency of monitoring/recording	Annually
Value applied	100% are used in the pre-calculation, which sourced from PER. 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 still 100%.
Monitoring equipment	/
QA/QC procedures to be applied	/

Purpose of data	Calculation of project 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. this parameter is not used in the calculation of emission reductions, but according to applied methodology ACM0010 (version08.0), this parameter needs to be monitored.
Frequency of monitoring/recording	Continuously by flow meters and reported cumulatively on weekly basis
Value applied	$482.59*10^4$ m^3 of biogas are expected to be generated by the project, which sourced from PER.
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, all the biogas generated will be captured for heat generation and burned through the flaring system if there is any surplus biogas, therefore the biogas generated from the anaerobic digestion, the amount of biogas utilized for heat generation and the amount of biogas burned 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 and procedures to be applied	Measured by electricity meters.
Frequency of monitoring/recording	Continuous measurement and at least monthly recording
Value applied	2680 MWh for ex ante estimation, which sourced from PER. During the monitoring period, the electricity consumption supplied by the gird company 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	Default value of 20% will be applied, which is conservative. According to the tool 05" Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0)
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	N/A
Purpose of data	Calculation of project emissions
Calculation method	N/A
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	Measured by flowmeter from project proponents
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 for Ex ante estimation and will be monitored in the monitoring period.
Monitoring equipment	Flowmeters
QA/QC procedures to be applied	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory for all projects applying large scale methodology(ies). Calibration and frequency of calibration is according to 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	Measured by gas analyzers from Project proponents
Description of measurement methods and procedures to be applied	Continuous gas analyser 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% in pre-estimated. In monitoring period. This value will be monitored by the gas analysers.
Monitoring equipment	Gas analyzers
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	Measured continuously by the biogas flow meters, since the flowmeters can monitor other parameter such as $V_{t,db}$, T_t and P_t simultaneously. And record hourly and saved automatically in

applied	thefinancial system.
Frequency of monitoring/recording	Continuous measurement and the data can be obtained from this system and the monthly data was exported by the staff at the beginning of next month and then recorded in monthly operation report. Daily and monthly temperature was calculated based on the 24-hour average and daily average temperature.
Value applied	293.15K 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 will be monitored by the recordable electronic signal. The temperature T_t (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	Measured continuously by the biogas flow meters, since the flowmeters can monitor other parameter such as $V_{t,db}$, T_t and P_t simultaneously. And record hourly and saved automatically.
Frequency of monitoring/recording	Continuous measurement and the data can be obtained from this system and the monthly data was exported by the staff at the beginning of next month and then recorded in monthly operation report. Daily and monthly temperature was calculated based on the 24–hour average and daily average temperature.
Value applied	101.325 kPa for the pre–calculation for the density of CH_4 as the applied methodology ACM0010 (Version 08.0), in actual monitoring period, the temperature of the gaseous stream will be 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/m^3 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 of the gaseous stream in time interval t and pressure of the gaseous stream in time interval t.
Frequency of monitoring/recording	Pressure and temperature are measured continuously by the biogas flow meters –
Value applied	0.67 kg/m3 for ex–estimated. In monitoring period, this parameter will be 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	Calculated value according to the pressure and temperature
Purpose of data	Calculation of project emissions
Calculation method	*Calculation as Equation 20 and Equation 24 in JPM*
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	All the manure flew into AWMSs to be treated; no any manure will be discharged outside. Therefore, the value of this parameter is 100% or total MS%j in different treatment system is 100%.
Frequency of monitoring/recording	N/A
Value applied	In the ex-ante calculation of $PE_{N2O,y}$, $MS\%_1$, $MS\%_2$, $MS\%_3$ are respectively the proportions of the manure treated in the slurry treatment, aerobic composting, and anaerobic digestion steps, with values of 100%, 50%, and 50% respectively. In other ex-ante calculation processes, for conservative calculations, all values are taken as 100%, and the parameter notation is not differentiated, i.e., all $MS\%_j$ values are 100%. The values of $MS\%_2$ and $MS\%_3$ are based on the separation efficiency of the solid-liquid separation equipment in PER. In actual monitoring, because there is no relevant monitoring equipment installed at the project site, for conservative calculation, all $MS\%_j$ values in the calculation process of actual emission reductions are taken as 100%.
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	$B_{O,LT}$

Data unit	$m^3 CH_4$/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
Description of measurement methods and procedures to be applied	$B_{O,LT}$ can be measured as per ISO 11734:1995. As this parameter is not monitored in the actual operation. so, in the monitoring period 0.29 m3CH4/kg –dm is still applied. While the actual methane producing potential of the volatile solid generated by swine manure is 479.4ml/g VS according to the public literature[25], which is higher. Therefore 0.29 m3CH4/kg –dm applied in monitoring period is conservative.
Frequency of monitoring/recording	*Annually*
Value applied	$B_{O,LT}$ (Market swine) =0.29 $B_{O,LT}$ (Breeding swine) =0.29
Monitoring equipment	N/A
QA/QC procedures to be applied	The value is taken from IPCC 2006. The parameter value should be updated on latest available IPCC.
Purpose of data	Used in project emission/baseline calculations
Calculation method	N/A
Comments	N/A

Data / Parameter	$NEX_{LT,y}$

[25] http://www.doc88.com/p-9902182440715.html

Data unit	kg N/animal/year
Description	Annual average nitrogen excretion per head of a defined livestock population estimated as described in Appendix 2
Source of data	Calculated as the equation below: $NEX_{LT,y} = \frac{W_{site}}{W_{default}} * NEX_{IPCC\ default}$ While, NEXIPCC default calculated as equation 30 of the IPCC 2006, volume 4, chapter 10 $NEX_{LT,y} = N_{rate(T)} * TAM *$ /1000*365
Description of measurement methods and procedures to be applied	$W_{default}$, N_{rate} and TAM are default value from IPCC 2006. The measurement methods and procedures for Wsite, please refer to the monitoring parameter Wsite
Frequency of monitoring/recording	Annually
Value applied	NEXLT,y(Market swine) =12.1 NEXLT,y (Breeding swine) =8.14
Monitoring equipment	N/A
QA/QC procedures to be applied	The parameter is calculated as the equation in "Source of Data"from methodology ACM0010 Version 08 and the value of other parameter applied in the equation is taken from published sources (2006 IPCC). The value should be updated on latest available public data source. QA/QC procedure for Wsite, please refer to the monitoring parameter Wsite
Purpose of data	Used in project emission/baseline calculations
Calculation method	Calculated as the equation of "Source of Data".

Comments	N/A

Data / Parameter	Type
Data unit	/
Description	Type of barn and AWMS
Source of data	Project proponent
Description of measurement methods and procedures to be applied	The swine barn and AWMS layout and configuration are collected. Archive electronically during project plus 5 years..
Frequency of monitoring/recording	Once for each monitoring period
Value applied	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	After the first verification, only changes in the type of barn and AWMS will be reported.
Purpose of data	Confirm whether the implementation of project as design
Calculation method	N/A
Comments	N/A

Data / Parameter	T
Data unit	℃

Description	Annual average ambient temperature at project site
Source of data	Official public information
Description of measurement methods and procedures to be applied	The data published by Official public information can prove that the annual average ambient temperature at project site.
Frequency of monitoring/recording	monthly
Value applied	13.0 ˚C for ex-ante estimated
Monitoring equipment	N/A
QA/QC procedures to be applied	The actual Annual average ambient temperature at project site from Official public information during this monitoring period will be compared with the value of ex-ante estimated, i.e., 13.0 ˚C.
Purpose of data	Used in project emission/baseline calculations
Calculation method	N/A
Comments	N/A

6.3 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 Process

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:

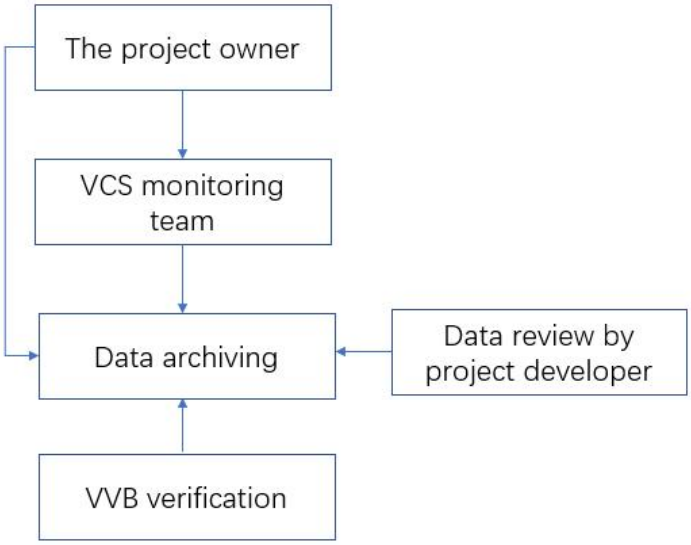

Figure 5–1 The Organization Structure of the Monitoring Team

Monitoring equipment and installation

Installation and configuration of monitoring equipment are shown as Figure 5–2. In order to ensure measurements with a low degree of uncertainty, the data monitoring 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.

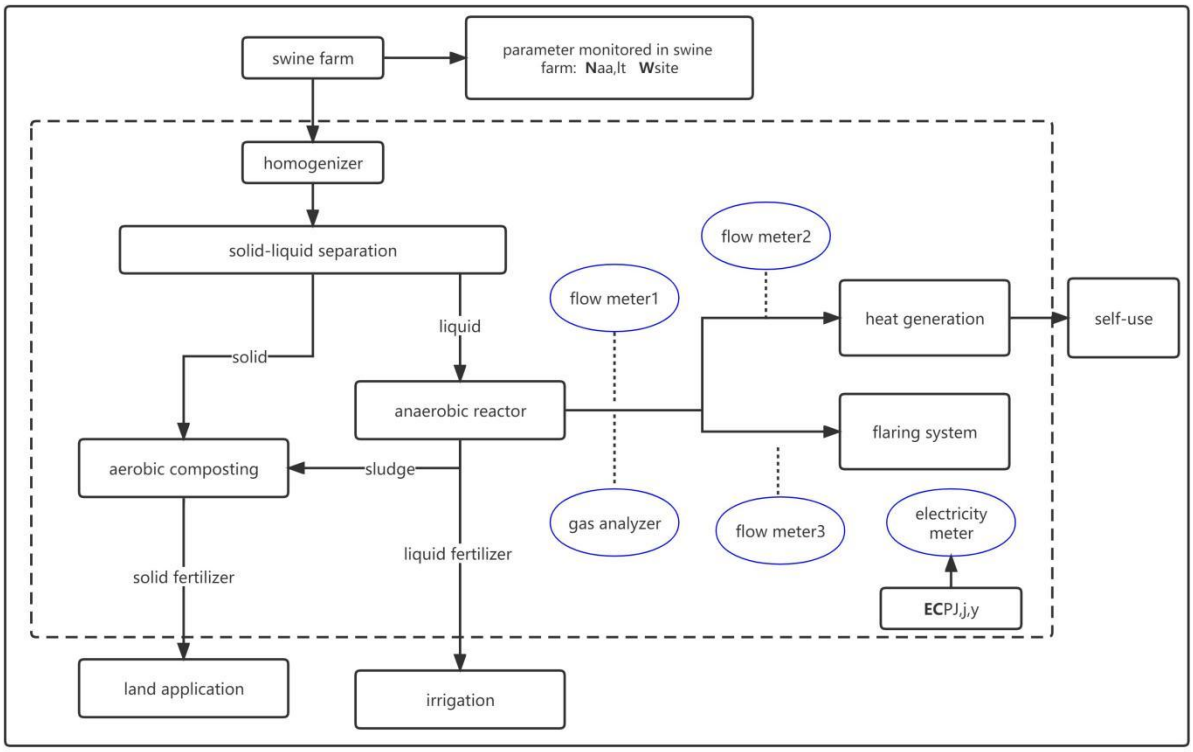

Figure 5–2 Installation and Configuration of Meters

Principle of Monitoring

All data from swine farm should be monitored and mentioned. The relevant monitoring instruments shall be carried out in accordance with industry requirements and manufacturer specifications, among which will be calibrated periodically as required. During the crediting period, if any changes or additions happened on the monitoring tools, a record should carry out in the monitoring report transparently, following the procedure for post registration changes.

Monitored Parameters

As per methodology, the monitoring parameters includes parameters for baseline emission, project emissions and leakage calculations. All provisions in the methodology and relevant tools shall apply, as described for each parameter in

Section 5.2. In this project, the parameters that should be monitored are concluded as follows:

item	Parameter to be monitored	Method to monitor/record
1.	$N_{AA,LT}$	Recorded daily by the technicians in swine farms.
2.	W_{site}	Conducted by sampling in the three age groups of Nursery phase, Growing phase and Mature phase in each swine farm at least one monthly. Please refer to "sample plan" below for details. Measured by the weight measurers in the end of each month and recorded by the technicians in farms.
3.	n_{dy}	Monitored by PP and sourced from data logged in each of the manure treatment plant.
4.	$EC_{PJ,j,y}$	Measured continuously by the meters installed in the farm and recorded monthly by the staff. The grid statement issued by the grid company can be cross-checked.
5.	$TDL_{j,y}$	Sourced from tool 05" Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (version 03.0)".

		This value will be renewed once the tool is updated.
6.	V_f	Continuously measurement by the biogas flowmeters (biogas flowmeter 1 installed at the outlet of the anaerobic digestion, biogas flowmeter 2 installed at the inlet of boiler and biogas flowmeter 3 installed in the inlet of flare and record hourly and saved automatically.
7.	$V_{t,db}$	Measured by the same flowmeters that monitor parameter V_f which can record daily and saved automatically since the flowmeters can monitor other parameter such as $V_{t,db}$, T_t and P_t simultaneously.
	$V_{i,t,db}$	Continuously measurement and record hourly by online gas analyser installed at the outlet of the anaerobic digester and saved automatically
8.	T_t	Measured by the same flowmeters that monitor parameter V_f which can record hourly and saved automatically since the flowmeters can monitor other parameter such as $V_{t,db}$, T_t and P_t simultaneously.
9.	P_t	Measured by the same flowmeters that monitor parameter V_f which can record hourly and saved automatically since the flowmeters can

		monitor other parameter such as $V_{t,db}$, T_t and P_t simultaneously.
10.	F_{Aer}	According to the methodology, F_{Aer} should be monitored annually. However, there is no volatile solids directed to aerobic treatment, therefore the value of F_{Aer} is applied as 100%, which is conservative
11.	$MS\%_j$	According to the methodology, $MS\%_j$ should be monitored annually. However, there is no equip installed in the project activity to monitor. Therefore, to be conservative, the value of this parameter in the emission reduction calculation is 100%.
12.	$B_{O,LT}$	Not monitored during this monitoring period since the value is taken from IPCC 2006, which is a published source.
13.	T	The data can be sourced from Official public information. During the monitoring period, corresponding MCF_j with lower annual average ambient temperature as per Appendix 3 of ACM0010(Version 08.0) will be used for calculation after comparing the actual value and the value of ex–ante estimated.
14.	$NEX_{LT,y}$	The parameter is calculated as the equation of

		option 2 in Appendix 2 of methodology ACM0010 Version 08.0 and the value of other parameter applied in the equation is taken from IPCC 2006, which is a published source. The parameter value will be updated on latest available public data source. While for parameter W_{site}, it is monitored during this MR, please refer to monitoring parameter W_{site}
15.	Type of barn and AWMS, Type	The swine farm and AWMS layout and configuration are collected, which can be prove the Type of barn and AWMS, and only changes in the type of barn and AWMS will be reported after the first verification

(2) Quality control and quality assurance procedures

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

Training

For all members involved in the project, necessary training 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.

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.

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.

(3)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)[26]", 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 programs 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 09.0)", each defined livestock population should be classified into a minimum of three age categories; The three age categories of swine are classified according to the age in days, i.e. The three age categories of market swine are classified according to the age in days, i.e. Nursery phase with 30–60days, Growing phase with 60–110days and Mature phase with 110–150days.The three age categories of breeding swine are classified according to the age in days, i.e. Nursery phase with 30–70days, Growing phase with 70–220days and Mature phase with 220–310days. 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 Nursery phase, growing phase and mature phase in the swine farm at least one monthly.
Target population and	For the ex-calculation, A total of 47820 swine included in this project

[26] https://cdm.unfccc.int/filestorage/e/x/t/extfile-20210531160756474-Meth_Stan05.pdf/Meth_Stan05.pdf?t=T2x8cjBuZjFpfDDpBcoW32Nj3OQglkN4PmUs

sampling frame	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	As this project involved 1 swine farm and two types of swine i.e., Market swine and Breeding swine, and as per applied methodology, each defined livestock population should be classified into a minimum of three age categories, so the sampling method is Stratified random sampling. The specific sampling methods are as follows: For the sampling, PP should calculate the overall sample size based on the population of pigs in stock firstly. As the project involved only 1 swine farm, so the sample size in the swine farm should be determined based on the proportion of the farm. Similarly, the sample size of each age group of Market swine and Breeding swine in the farm were also calculated based on the proportion of the number of each age group of Market swine and Breeding swine to the total number of swine in the farm. After the sample size in each age group of Market swine and Breeding swine of this swine farm determined, the sample can be conducted. Since swine in different age are kept in the different pig houses, samples can be randomly selected from pig houses of this age group. After the samples are selected, the weight is measured by weight measurers and recorded in the weight record table.

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.

As per to statistical principles and sampling survey method, the sample size should be determined as follows:

$$n_1 = \frac{Z^2\sigma^2}{d^2} = \frac{Z^2(\sigma^2/X^2)}{d^2/X^2} = Z^2V^2/e^2$$

$$n_2 = n_1 N/(N + n_1)$$

$$n_3 = Bn_2$$

$$n_4 = n_3/r$$

$$n = n_4(110\%)$$

Where:

Z	the Z–statistic and the value taken is 1.96 (corresponding to 95% confidence level);
σ	the standard deviation;
d	the maximum error of estimate;
X	the mean value of samples;
V	the coefficient of variation, V=$\sigma/X \leq 1$ and its maximum value 1 is taken
e	the allowed relative sampling error (“precision”) and the value taken is 10%;
N	the total number of involved swine 47,820;
B	the survey design effect and the value taken is 1 because for stratification sampling the B value is less than or equal to 1;
r	the survey replies rate and the value taken is 100%;
110%	10% contingency was added to produce the final sample size;

$n_1, n_2, n_3, n_4 n$ the adjusted values after each step with n being the final number of samples to be taken. Actually, n_4 is the required number of samples based on calculation, 10% contingency was added to n_4 to produce n in this sampling.

For pre-calculation, since the total number of involved swine is 47,820, N in the calculation of sample size is 47,820, and the calculation result is as follows:

Z	V	e	N	B	r
1.96	1	0.1	47820	1	100%
n_1	Z^2V^2/e^2	384			
n_2	$n_1N/(N+n_1)$	381			
n_3	Bn_2	381			
n_4	n_3/r	381			
n	$n_4(110\%)$	419			

The calculation result of n is 419. Therefore, 419 samples should be sufficient to satisfy the desired confidence and precision.

As the applied value of 41,935 Market swine and 5,885 Breeding swine is the design stock scale, during the monitoring periods, the actual breeding scale of the farm is not exceeding the design value, so the sample size calculated from the design values can be used in the monitoring period and it is conservative.

Stratified sampling (with samples of 419) was used for the monitoring of the W_{site}. The specific sampling methods are as follows: For the sampling, PP should calculate the overall sample size based on the population of pigs in stock firstly. Since the project involved only one pig farm, the sample size should be determined in proportion to the number of pigs in that farm. Similarly, the sample size of market pigs for each age group and the number of breeding pigs on a farm are calculated in proportion to the number of pigs at each age. The number of market pigs and breeding pigs equals the total number of pigs on the farm.

Finally, 419 pig samples were selected for W_{site} monitoring, 367 samples for Market swine,52 samples for Breeding swine.

Sample number	breeding swine	market swine

Nursery phase	17	122
Growing phase	17	122
Mature phase	18	123
total	52	367

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.

Because the sampling activity is once a month, all the samples are changed in the next month. 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.

Procedures for Administering Data Collection and Minimizing Non-sampling Errors

During the monthly monitoring activities, the weight of the month's sample was recorded in the weight record table by the monitoring team member in the swine farms. Then average weight of a defined livestock population at the project site was calculated based on these data by the monitoring team member. The data is reviewed by the project developer and VVB.

If the recorded raw data on the monitoring form are reasonable and basically consistent with the actual growth state, the raw data is archived.If the data record is missing or damaged or the target animal was dead during the monitoring periods, the following makeup process shoule be conducted:

1) The general principle is that zero value is used for the missing or damaged data. This is most conservative approach. The monitoring personnel are 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 are required to strictly abide by the above conservative principle in data recording, i.e., use zero values for all the missing or damaged data.

2) 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 zero value for the missing or damaged data;

3) 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 zero value for the missing or damaged data;

4) If some data recorded are significantly higher than the normal range and inconsistent with normal growth, the monitoring personnel should ask for the reason. If the measurement is high due to the damage of weighing scales or other measurement equipment, zero value is used for that day's data. And need to calibrate and maintain the weighing scale or replace 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 is accepted for the monitoring report.

QA/QC Procedures

Before implementing the project, the members in monitoring team would be trained to comprehend the direct way of monitoring process. The training was conducted by the project proponent as well. If the data reported by the team member significantly

deviates from the normal range, the monitoring team should write down the reasons and report to the team leader, any action is forbidden before the permission. The monitoring team arranges research according to the attached tables. At the same time, when the verification group has any doubt with the result, they can arrange related research.

The project owner should enter all the measured data into the data sheet each month, using Excel to calculate the weighted mean value of average animal weight of a defined livestock population at the project site from all the sample, compared with the everyday normal growth state.

7 ACHIEVED GHG EMISSION REDUCTIONS AND REMOVALS

7.1 Data and Parameters Monitored

<table>
<tr><td>Data / Parameter</td><td>$N_{AA,LT}$</td></tr>
<tr><td>Data unit</td><td>Number</td></tr>
<tr><td>Description</td><td>Daily stock of animals in the farm, discounting dead and discarded animals</td></tr>
<tr><td>Value applied</td><td>Data source: Daily stock record of animals swine
<table>
<tr><td></td><td>Market Swine</td><td>Breeding Swine</td></tr>
<tr><td>01/06/2021-30/06/2021</td><td>37497</td><td>4769</td></tr>
</table></td></tr>
</table>

01/07/2021-31/07/2021	37798	4892
01/08/2021-31/08/2021	37726	4952
01/09/2021-30/09/2021	38969	4543
01/10/2021-31/10/2021	38053	3855
01/11/2021-30/11/2021	38131	4084
01/12/2021-31/12/2021	38841	3989
01/01/2022-31/01/2022	39566	4413
01/02/2022-28/02/2022	39726	4422
01/03/2022-31/03/2022	38229	4296
01/04/2022-30/04/2022	38497	5333
01/05/2022-31/05/2022	39222	4778
01/06/2022-30/06/2022	38997	5187
01/07/2022-31/07/2022	39052	4799
01/08/2022-31/08/2022	39300	5202
01/09/2022-30/09/2022	39368	5314
01/10/2022-31/10/2022	39498	6667
01/11/2022-30/11/2022	38883	6511

	01/12/2022-31/12/2022	38626	6716
	01/01/2023-31/01/2023	37962	6549

Comments	The project proponents monitor the population of breeding swine and market swine ,through the technician count and record the breeding swine and market swine. daily and the record will be saved in the ,financial system and will crosscheck by the different technician the next day and in the end the record will be verified by the manager monthly Therefore, the data of can be obtained through financial system

Data / Parameter	W_{site}
Data unit	kg
Description	Average animal weight of a defined livestock population at the project site

Value applied

	Market Swine	Breeding Swine
01/06/2021-30/06/2021	85.70	92.70
01/07/2021-31/07/2021	76.30	82.60
01/08/2021-31/08/2021	77.20	86.40
01/09/2021-30/09/2021	77.70	85.90
01/10/2021-31/10/2021	78.30	85.50
01/11/2021-30/11/2021	78.20	85.40
01/12/2021-31/12/2021	78.00	88.10
01/01/2022-31/01/2022	78.00	87.30

	01/02/2022-28/02/2022	78.20	86.00
	01/03/2022-31/03/2022	77.80	86.60
	01/04/2022-30/04/2022	78.20	84.90
	01/05/2022-31/05/2022	78.30	84.80
	01/06/2022-30/06/2022	77.90	85.90
	01/07/2022-31/07/2022	77.60	86.30
	01/08/2022-31/08/2022	77.70	86.50
	01/09/2022-30/09/2022	78.20	85.10
	01/10/2022-31/10/2022	77.80	87.00
	01/11/2022-30/11/2022	78.20	85.40
	01/12/2022-31/12/2022	77.80	88.00
	01/01/2023-31/01/2023	78.00	87.60

Comments

Measured by the weight measurers and record by the technical staff in farm monthly.

Weight measurers were calibrated on 02–May–2021, and 02–May–2022by officially accredited entity in compliance with JJG539–2016 “Verification Regulation of Digital Indicating Weighting Instruments” in China.

type	Series number	Calibration	Validity	Accuracy
XD01	XD01–550	20210502	1year	III
		20220502	1year	III

Data / Parameter	n_{dy}
Data unit	number
Description	Number of days treatment plant was operational in year y.

Value applied	

period	n_{dy}
01/06/2021-30/06/2021	30
01/07/2021-31/07/2021	31
01/08/2021-31/08/2021	31
01/09/2021-30/09/2021	30
01/10/2021-31/10/2021	31
01/11/2021-30/11/2021	30
01/12/2021-31/12/2021	31
01/01/2022-31/01/2022	31
01/02/2022-28/02/2022	28
01/03/2022-31/03/2022	31
01/04/2022-30/04/2022	30
01/05/2022-31/05/2022	31
01/06/2022-30/06/2022	30
01/07/2022-31/07/2022	31
01/08/2022-31/08/2022	31
01/09/2022-30/09/2022	30
01/10/2022-31/10/2022	31
01/11/2022-30/11/2022	30
01/12/2022-31/12/2022	31
01/01/2023-31/01/2023	31

Comments	The daily accumulated meter reading of flowmeters installed in the outlet of anaerobic digesters can be demonstrated that the AWMSs are actually running on a daily basis.

Data / Parameter	F_{Aer}
Data unit	Fraction
Description	Fraction of volatile solids directed to aerobic treatment
Value applied	100%
Comments	During this monitoring period, there is no equip install in the project activity to monitor the influent into anaerobic digestion and aerobic system, therefore the value of F_{Aer} is applied as 100%, which is conservative.

Data / Parameter	v_f
Data unit	m^3
Description	Biogas flow

Value applied

Period	Vf1(m^3) at outlet of the anaerobic digestion	Vf2(m^3) at the inlet of heating	Vf3(m^3) in inlet of flare system
01/06/2021-30/06/2021	352082	350759	-
01/07/2021-31/07/2021	352626	350826	-

01/08/2021-31/08/2021	352625	350921	-
01/09/2021-30/09/2021	356953	353462	-
01/10/2021-31/10/2021	356078	354927	-
01/11/2021-30/11/2021	357314	354533	-
01/12/2021-31/12/2021	357287	354788	-
01/01/2022-31/01/2022	356692	353483	-
01/02/2022-28/02/2022	356641	353247	-
01/03/2022-31/03/2022	356611	353336	-
01/04/2022-30/04/2022	355766	354222	-
01/05/2022-31/05/2022	355698	354848	-
01/06/2022-30/06/2022	357263	354317	-
01/07/2022-31/07/2022	356315	354469	-
01/08/2022-31/08/2022	355858	353734	-
01/09/2022-30/09/2022	356799	352924	-
01/10/2022-31/10/2022	355717	353625	-
01/11/2022-30/11/2022	355294	353584	-
01/12/2022-31/12/2022	355731	354172	-
01/01/2023-31/01/2023	356603	354940	-
total	7,115,953.00	7,071,117.00	-

Comments

Monitored continuously by flow meter 1, flowmeter 2 . Flow meter 1 was installed at the outlet of the anaerobic tank (where the biogas has been dewatered and desulfurized) to monitor the volumetric flow of biogas produced.. Flow meter 2 was installed at the inlet of the heating,Flow meter 3 was installed at the inlet of the flare system to monitor the volumetric flow of biogas destroyed by the flare.

Flow meters were calibrated on 02-May-2021 by an officially accredited entity in compliance with JJG1029-2007" Verification Regulation of Vortex-shedding Flowmeter" in China.

For this monitoring period, all the biogas produced is used for power generation, no surplus biogas for the flaring system.

The calibration information for flow meters are as follows:

	Type/ Accuracy	Series number	Calibration date	Validity	Accuracy
meter 1	YC105Q	S042104240157E	02/05/2021	2 years	0.5
meter 2	YC105Q	S042104240093E	02/05/2021	2 year	0.5
meter 3	FCTMF–C100	S042104210008E	02/05/2021	2 year	2.5

Data / Parameter	$EC_{PJ,j,y}$
Data unit	MWh
Description	Quantity of electricity consumed by the proposed project in year y

Value applied

01/06/2021–30/06/2021	208.56
01/07/2021–31/07/2021	253.40
01/08/2021–31/08/2021	208.80
01/09/2021–30/09/2021	231.66
01/10/2021–31/10/2021	342.70
01/11/2021–30/11/2021	399.10
01/12/2021–31/12/2021	427.76
01/01/2022–31/01/2022	559.52
01/02/2022–28/02/2022	517.64

01/03/2022–31/03/2022	388.72
01/04/2022–30/04/2022	297.28
01/05/2022–31/05/2022	342.84
01/06/2022–30/06/2022	411.28
01/07/2022–31/07/2022	458.80
01/08/2022–31/08/2022	497.08
01/09/2022–30/09/2022	357.92
01/10/2022–31/10/2022	417.40
01/11/2022–30/11/2022	501.08
01/12/2022–31/12/2022	616.52
01/01/2023–31/01/2023	629.24

Comments

Monitored continuously by electricity meter installed in the manure treatment plants. Power consumption data is recorded daily and summarized monthly and cross–checked with Grid Company Electricity Statement.Electricity meters were calibrated on 20–02–2021 by an officially accredited entity in compliance with JJG 596–2012: Electrical Meters for Measuring Alternating–current Electrical Energy.And during this monitoring period, most of the electricity consumed by the project came from the grid company

	Type/ Accuracy	Series number	Calibration date	Validity
meter 1	DTS1805/0.1level	57036703	20/02/2021	5 years

Data / Parameter	$TDL_{j,y}$

Data unit	/
Description	Average technical transmission and distribution losses for providing electricity to source *j* in year *y*
Value applied	20%
Comments	The value of this parameter sourced from Tool 05 "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0) and this tool is not updated in this monitoring period.

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

Value applied

Period	Average Vt,db (m^3 dry gas/h) monitored by flow meter 1	Average Vt,db (m^3 dry gas/h) monitored by flow meter 3
01/06/2021–30/06/2021	483.45	–
01/07/2021–31/07/2021	473.96	–
01/08/2021–31/08/2021	473.96	–
01/09/2021–30/09/2021	495.77	–
01/10/2021–31/10/2021	478.60	–
01/11/2021–30/11/2021	496.27	–

	01/12/2021–31/12/2021	480.22	–
	01/01/2022–31/01/2022	479.42	–
	01/02/2022–28/02/2022	530.72	–
	01/03/2022–31/03/2022	479.32	–
	01/04/2022–30/04/2022	494.12	–
	01/05/2022–31/05/2022	478.09	–
	01/06/2022–30/06/2022	496.20	–
	01/07/2022–31/07/2022	478.92	–
	01/08/2022–31/08/2022	478.30	–
	01/09/2022–30/09/2022	495.55	–
	01/10/2022–31/10/2022	478.11	–
	01/11/2022–30/11/2022	493.46	–
	01/12/2022–31/12/2022	478.13	–
	01/01/2023–31/01/2023	479.31	–
Comments	Monitored continuously by flow meter 1 and 3. The flow meters 1 was installed at the outlet of the anaerobic tank to monitor the volumetric flow of biogas produced. Flow meter 3 was installed at the entrance of the flare system to monitor the volumetric flow of biogas destroyed by the flare. The monitored data can be recorded hourly and saved automatically in the financial system . The data can be obtained from this system. Flow meters were calibrated on 02–May–2021 by an officially accredited entity in compliance with JJG1029–2007" Verification Regulation of Vortex–shedding Flowmeter" in China.		

	The calibration specifics information is listed in above table of monitored parameter “vf”.

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
Value applied	

Period	Average $V_{i,t,db}$
01/06/2021–30/06/2021	61.2
01/07/2021–31/07/2021	62.3
01/08/2021–31/08/2021	62.3
01/09/2021–30/09/2021	62.9
01/10/2021–31/10/2021	63.2
01/11/2021–30/11/2021	62.3
01/12/2021–31/12/2021	61.8
01/01/2022–31/01/2022	61.60
01/02/2022–28/02/2022	63.4
01/03/2022–31/03/2022	63.1
01/04/2022–30/04/2022	62.4
01/05/2022–31/05/2022	61.2
01/06/2022–30/06/2022	62.3

01/07/2022–31/07/2022	62.1
01/08/2022–31/08/2022	60.2
01/09/2022–30/09/2022	62.3
01/10/2022–31/10/2022	63.1
01/11/2022–30/11/2022	62.4
01/12/2022–31/12/2022	63.2
01/01/2023–31/01/2023	62.7

Comments

Measured continuously and record hourly by online gas analysers installed at the outlet of the anaerobic digesters and saved by the technician, Daily and Monthly CH_4 concentration was calculated based on the 24–hour average and daily average CH_4 concentration.

All the gas analysers were calibrated on 02–May–2021 by an officially accredited entity in compliance with JJG693–2011" Verification Regulation of Alarmer Detectors of Combustible Gas" in China. And the zero verification with an inert gas (N2) and one reading verification with a standard gas (single calibration gas) are implemented in the process of calibration, which is in accordance with JJG693–2011.

type	Series number	Calibration	Validity	Accuracy
PGAS–200	2008948194	20210502	1year	0.01%
		20220502	1year	

Data / Parameter	T_t
Data unit	K

Description	Temperature of the gaseous stream in time interval t

Value applied

Period	Average T_t(K)
01/06/2021–30/06/2021	297.15
01/07/2021–31/07/2021	299.45
01/08/2021–31/08/2021	299.35
01/09/2021–30/09/2021	298.95
01/10/2021–31/10/2021	297.65
01/11/2021–30/11/2021	299.35
01/12/2021–31/12/2021	298.25
01/01/2022–31/01/2022	299.85
01/02/2022–28/02/2022	297.35
01/03/2022–31/03/2022	297.45
01/04/2022–30/04/2022	298.15
01/05/2022–31/05/2022	299.45
01/06/2022–30/06/2022	297.15
01/07/2022–31/07/2022	299.95
01/08/2022–31/08/2022	298.25
01/09/2022–30/09/2022	299.15
01/10/2022–31/10/2022	297.25
01/11/2022–30/11/2022	298.25

	01/12/2022–31/12/2022 | 299.65 01/01/2023–31/01/2023 | 298.15
Comments	Measured continuously by the biogas flow meters, since the flowmeters can monitor other parameter such as $V_{t,db}$ Tt and Pt simultaneously. And record hourly and saved by the technician The readout of flowmeter was indicated degrees Celsius (°C). Therefore, the temperature Tt(K) is calculated as the equation T(K)=t(°C) +273.15. The data can be obtained from financial system. Daily and Monthly temperature was calculated based on the 24–hour average and daily average temperature. Flow meters were calibrated on 02–May–2021 by an officially accredited entity in compliance with JJG1029–2007" Verification Regulation of Vortex–shedding Flowmeter" in China. The calibration specifics information is listed in above table of monitored parameter "vf".

Data / Parameter	P_t
Data unit	Pa
Description	Pressure of the gaseous stream in time interval t
Source of data	Measured by instrument
Value applied	Period | Average P_t(pa) 01/06/2021–30/06/2021 | 101325 01/07/2021–31/07/2021 | 101325 01/08/2021–31/08/2021 | 101325 01/09/2021–30/09/2021 | 101325

	01/10/2021–31/10/2021	101325
	01/11/2021–30/11/2021	101325
	01/12/2021–31/12/2021	101325
	01/01/2022–31/01/2022	101325
	01/02/2022–28/02/2022	101325
	01/03/2022–31/03/2022	101325
	01/04/2022–30/04/2022	101325
	01/05/2022–31/05/2022	101325
	01/06/2022–30/06/2022	101325
	01/07/2022–31/07/2022	101325
	01/08/2022–31/08/2022	101325
	01/09/2022–30/09/2022	101325
	01/10/2022–31/10/2022	101325
	01/11/2022–30/11/2022	101325
	01/12/2022–31/12/2022	101325
	01/01/2023–31/01/2023	101325
Comments	Measured continuously by the biogas flow meters, since the flowmeters can monitor other parameter such as $V_{t,db}$, Tt and Pt simultaneously. The data can be obtained from financial system. Daily and Monthly pressure was calculated based on the 24–hour average and daily average pressure. Flow meters were calibrated on 02–May–2021 and by an officially accredited entity in compliance with JJG1029–2007" Verification Regulation of Vortex–shedding Flowmeter" in China. The calibration	

	specifics information is listed in above table of monitored parameter “vf”.

Data / Parameter	$\rho_{i,t}$
Data unit	kg gas i/m^3 gas i
Description	Density of greenhouse gas i in the gaseous stream in time interval t
Value applied	

Period	$\rho_{i,n}$(t/m3)
01/06/2021–30/06/2021	0.00066
01/07/2021–31/07/2021	0.00065
01/08/2021–31/08/2021	0.00065
01/09/2021–30/09/2021	0.00065
01/10/2021–31/10/2021	0.00066
01/11/2021–30/11/2021	0.00065
01/12/2021–31/12/2021	0.00066
01/01/2022–31/01/2022	0.00065
01/02/2022–28/02/2022	0.00066
01/03/2022–31/03/2022	0.00066
01/04/2022–30/04/2022	0.00066
01/05/2022–31/05/2022	0.00065
01/06/2022–30/06/2022	0.00066
01/07/2022–31/07/2022	0.00065

	01/08/2022–31/08/2022	0.00066
	01/09/2022–30/09/2022	0.00065
	01/10/2022–31/10/2022	0.00066
	01/11/2022–30/11/2022	0.00066
	01/12/2022–31/12/2022	0.00065
	01/01/2023–31/01/2023	0.00066
Comments	Calculated based on temperature of the gaseous stream in time interval t and pressure of the gaseous stream in time interval t using Equations (19) and (24). The monitoring result of Pressure and temperature are listed in the above two tables.	

Data / Parameter	$MS\%_j$
Data unit	Fraction
Description	Fraction of manure handled in system j in project activity
Value 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% or total $MS\%_j$ in different treatment system is 100%.
Comments	

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

Value applied	$B_{0,LT}$(Market swine)=0.29 $B_{0,LT}$(Breeding swine)=0.29
Comments	$B_{0,LT}$ can be measured as per ISO 11734:1995. As this parameter is not monitored in the actual operation. so, in the monitoring period 0.29 $m^3 CH_4$/kg–dm is still applied. While the actual methane producing potential of the volatile solid generated by swine manure is 479.4ml/g VS according to the public literature[27], which is higher. Therefore 0.29 m3CH_4/kg –dm applied in monitoring period is conservative.

Data / Parameter	$NEX_{LT,y}$
Data unit	kg N/animal/year
Description	Annual average nitrogen excretion per head of a defined livestock population estimated as described in Appendix 2

Value applied

	Market Swine	Breeding Swine
01/06/2021–30/06/2021	1.07	0.66
01/07/2021–31/07/2021	0.98	0.62
01/08/2021–31/08/2021	0.99	0.65
01/09/2021–30/09/2021	0.97	0.61
01/10/2021–31/10/2021	1.01	0.64
01/11/2021–30/11/2021	0.98	0.61

[27] http://www.doc88.com/p–9902182440715.html

	01/12/2021–31/12/2021	1.00	0.66
	01/01/2022–31/01/2022	1.00	0.65
	01/02/2022–28/02/2022	0.92	0.58
	01/03/2022–31/03/2022	1.00	0.65
	01/04/2022–30/04/2022	0.98	0.61
	01/05/2022–31/05/2022	1.01	0.64
	01/06/2022–30/06/2022	0.97	0.61
	01/07/2022–31/07/2022	1.00	0.65
	01/08/2022–31/08/2022	1.00	0.65
	01/09/2022–30/09/2022	0.98	0.61
	01/10/2022–31/10/2022	1.00	0.65
	01/11/2022–30/11/2022	0.98	0.61
	01/12/2022–31/12/2022	1.00	0.66
	01/01/2023–31/01/2023	1.00	0.66

Comments	The parameter is calculated as the equation of option 2 in Appendix 2 of methodology ACM0010 Version 08 and the value of other parameter applied in the equation is taken from published sources (2006 IPCC). $NEX_{IPCC\ default}$ is fixed ex-ante as described in Section 5.1 of JPM. For W_{site}, please refer to the monitoring parameter W_{site}

Data / Parameter	Type

Data unit	/
Description	Type of barn and AWMS
Value applied	N/A
Comments	After the first verification, only changes in the type of barn and AWMS will be reported. This monitoring is the first monitoring period and in this monitoring period, the swine barn and AWMS layout and configuration are consistent with the design which is approved by the official government.

Data / Parameter	T
Data unit	℃
Description	Annual average ambient temperature at project site
Value applied	**Period** | T (℃) 01/07/2021–31/12/2021 | 13.0 01/01/2022–31/12/2022 | 13.0 01/01/2023–31/01/2023 | N/A
Comments	The temperature in 2020 and 2021 is sourced respectively from Gansu Meteorological Administration and Gansu Province Bureau of Statistics.[28] Liaoning Meteorological Administration and Gansu Province Bureau of Statistics is Official institutions. Therefore, the data is creditable. While only 1 months are included for the period from 01–January–2023 to 31–January–2023 and the monthly average temperature is not available from official public information. Furthermore, the

[28] https://baike.baidu.com/item/%E5%9F%8E%E5%85%B3%E9%95%87/3468339

	temperature in these 1 months cannot represent the annual average temperature of the whole year. So, the Annual average ambient temperature at project site of 2022 applied the lower ex-ante estimated value i.e. 13°C, which is more conservative. MCF value is still 71% with the temperature of 13°C as per Appendix 3 of ACM0010(Version 08.0). Then multiplying MCF values with a value of 0.94, so 67% of (71%*0.94) is used for calculation during this monitoring period, which is consistent with the valued of ex-ante.

7.2 Baseline Emissions

As described in methodology ACM0010 (version 8.0) mentioned above, the baseline scenario is the continuation of the current practice, the baseline emissions are calculated as follows:

$$BE_y = BE_{CH4,y} + BE_{N2O,y} + BE_{elec/heat,y}$$

As described in section 5.1 the baseline scenario of this project is uncovered anaerobic lagoon, and no heat used in the baseline, only minor electricity will be used, so the emission can be excluded for simplification. In addition, the biogas generated during the treatment process in this project will be captured for heat generation and all the heat generated from this project will be used by the daily operation of AWMS and the swine farms. The heat generated is not connected to another user. So, the baseline CO2 emission from electricity and/or heat used in the baseline is 0, which is conservative. So,$BE_y = BE_{CH4,y} + BE_{N2O,y}$.

During this monitoring period, the basic monitoring data values used in the calculation of baseline emissions and the calculation results are shown in the Table 6-1 and Table 6-2.

Table 7-1 the basic monitoring data values used in the calculation of baseline emissions

	N_{LT}		W_{site} (kg)		n_{dy} (day)	$VS_{LT,y}$ (kg–dm/ animal/year)		$NEX_{IPCCdefault}$ kg N/animal/year)		$NEX_{LT,y}$	
	Market Swine	Breeding Swine	Market Swine	Breeding Swine		Market Swine	Breeding Swine	Market Swine	Breeding Swine	Market Swine	Breeding Swine
01/06/2021–30/06/2021	37497	4769	85.70	92.70	30	27.55	29.80	0.35	0.20	1.07	0.66
01/07/2021–31/07/2021	37798	4892	76.30	82.60	31	25.34	27.44	0.36	0.21	0.98	0.62
01/08/2021–31/08/2021	37726	4952	77.20	86.40	31	25.64	28.70	0.36	0.21	0.99	0.65
01/09/2021–30/09/2021	38969	4543	77.70	85.90	30	24.98	27.61	0.35	0.20	0.97	0.61
01/10/2021–31/10/2021	38053	3855	78.30	85.50	31	26.01	28.40	0.36	0.21	1.01	0.64
01/11/2021–30/11/2021	38131	4084	78.20	85.40	30	25.14	27.45	0.35	0.20	0.98	0.61
01/12/2021–31/12/2021	38841	3989	78.00	88.10	31	25.91	29.26	0.36	0.21	1.00	0.66
01/01/2022–31/01/2022	39566	4413	78.00	87.30	31	25.91	29.00	0.36	0.21	1.00	0.65
01/02/2022–28/02/2022	39726	4422	78.20	86.00	28	23.46	25.80	0.33	0.19	0.92	0.58

01/03/2022–31/03/2022	38229	4296	77.80	86.60	31	25.84	28.76	0.36	0.21	1.00	0.65
01/04/2022–30/04/2022	38497	5333	78.20	84.90	30	25.14	27.29	0.35	0.20	0.98	0.61
01/05/2022–31/05/2022	39222	4778	78.30	84.80	31	26.01	28.17	0.36	0.21	1.01	0.64
01/06/2022–30/06/2022	38997	5187	77.90	85.90	30	25.04	27.61	0.35	0.20	0.97	0.61
01/07/2022–31/07/2022	39052	4799	77.60	86.30	31	25.77	28.66	0.36	0.21	1.00	0.65
01/08/2022–31/08/2022	39300	5202	77.70	86.50	31	25.81	28.73	0.36	0.21	1.00	0.65
01/09/2022–30/09/2022	39368	5314	78.20	85.10	30	25.14	27.35	0.35	0.20	0.98	0.61
01/10/2022–31/10/2022	39498	6667	77.80	87.00	31	25.84	28.90	0.36	0.21	1.00	0.65
01/11/2022–30/11/2022	38883	6511	78.20	85.40	30	25.14	27.45	0.35	0.20	0.98	0.61
01/12/2022–31/12/2022	38626	6716	77.80	88.00	31	25.84	29.23	0.36	0.21	1.00	0.66
01/01/2023–31/01/2023	37962	6549	78.00	87.60	31	25.91	29.10	0.36	0.21	1.00	0.66

Table 7-2 The calculation result of BEy

Parameter	Value		Unit
species	Market Swine	Breeding Swine	
GWP_{CH_4}	27.9	27.9	tCO_2/tCH_4
DCH_4	0.00067	0.00067	t/m^3
MCF_j	0.71	0.71	%
Conservative Factor	0.94	0.94	/
MCF_j with cons. Factor	0.67	0.67	/
$B_{O,LT}$	0.29	0.29	$m^3\ CH_4$ /kg_dm
N_{LT}	Refer to Table 6-1		
W_{site}	Refer to Table 6-1		
$W_{default}$	28	28	kg
$VS_{default}$	0.3	0.3	Kg-dm/animal/day
$VS_{LT,y}$	Refer to Table 6-1		kg-dm/animal/yr
$MS\%_{BI,j}$	100%	100%	%
n_{dy}	Refer to Table 6-1		days
$BE_{CH_4,y}$ from 01/06/2022-31/12/2022	**28,217**		tCO_2e
$BE_{CH_4,y}$ from 01/01/2022-31/12/2022	**49,778**		tCO_2e
$BE_{CH_4,y}$ from 01/01/2023-31/01/2023	**4,264**		tCO_2e
$BE_{CH_4,y}$ in the monitoring period	**82,259**		tCO_2e
$EF_{N_2O,D,j}$	0	0	kg N_2O-N/kg N
$EF_{N_2O,ID}$	0.01	0.01	kg N_2O-N/kg N
$N_{rate(T)}$	0.42	0.24	kg N/1000kg animal mass/day

$NEX_{IPCCdefault}$	Refer to Table 6–1		
$NEX_{LT,y}$	Refer to Table 6–1		
TAM	28.0	28.0	kg
$F_{gassMS,j,LT}$	0.4	0.4	
GWP_{N_2O}	273	273	tCO2/t N_2O
$CF_{N_2O-N,N}$	44/28	44/28	Conversion Factor N_2O–N to N_2O
$BE_{N_2O,y}$ from 01/06/2022–31/12/2022	**491**		tCO_2e
$BE_{N_2O,y}$ from 01/01/2022–31/12/2022	**861**		tCO_2e
$BE_{N_2O,y}$ from 01/01/2023–31/01/2023	**72**		tCO_2e
$BE_{N_2O,y}$ in the monitoring period	**1,424**		**tCO_2e**

Baseline Emissions: $\boldsymbol{BE_{CH_4,y}}$ + $\boldsymbol{BE_{N_2O,y}}$ =82259 tCO_2e +1424 tCO_2e =83683 tCO_2e

7.3 Project Emissions

As described in Section 5.2, project emissions can be calculated by Equation 15。

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

For $PE_{AD,y}$, 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 by $PE_{AD,y} = PE_{EC,y} + PE_{FC,y} + PE_{CH4,y} + PE_{flare,y}$.

As 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 is calculated together.

All thermal energy used by the project is supplied by the new installed boilers, which is utilizing biogas generated during the treatment process in this project for heat generation. No other thermal energy from outside source is used for the project. And 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 residual gas is sent to flare system (if any) and project emissions from flaring of biogas ($PE_{flare,y}$) shall be estimated using the tool "Project emissions from flaring". For this monitoring period, there is no residual gas to be flared, so $PE_{flare,y}$=0.

In summary, the Project emissions associated with the anaerobic digester in year y (tCO_2e) is the Project emissions of methane from the anaerobic digester in year y (tCO_2e). i.e., $PE_{AD,y} = PE_{EC,y} + PE_{CH4,y}$

Table 7-3 the calculation result of $PE_{EC,y}$

Period	$EC_{PJ,j,y}(MWh$	$EF_{EF,j,y}(tCO_2/MWh)$	$TDL_{j,y}$	$PE_{EC,y}(tCO_2e)$
01/06/2021–30/06/2021	208.56	0.66645	20%	167
01/07/2021–31/07/2021	253.40	0.66645	20%	203
01/08/2021–31/08/2021	208.80	0.66645	20%	167
01/09/2021–30/09/2021	231.66	0.66645	20%	186
01/10/2021–	342.70	0.66645	20%	275

31/10/2021				
01/11/2021–30/11/2021	399.10	0.66645	20%	320
01/12/2021–31/12/2021	427.76	0.66645	20%	343
01/01/2022–31/01/2022	559.52	0.66645	20%	448
01/02/2022–28/02/2022	517.64	0.66645	20%	414
01/03/2022–31/03/2022	388.72	0.66645	20%	311
01/04/2022–30/04/2022	297.28	0.66645	20%	238
01/05/2022–31/05/2022	342.84	0.66645	20%	275
01/06/2022–30/06/2022	411.28	0.66645	20%	329
01/07/2022–31/07/2022	458.80	0.66645	20%	367
01/08/2022–31/08/2022	497.08	0.66645	20%	398
01/09/2022–30/09/2022	357.92	0.66645	20%	287
01/10/2022–31/10/2022	417.40	0.66645	20%	334
01/11/2022–30/11/2022	501.08	0.66645	20%	401
01/12/2022–31/12/2022	616.52	0.66645	20%	494
01/01/2023–31/01/2023	629.24	0.66645	20%	504

Table 7-4 the calculation result of $PE_{CH_4,y}$

Period	GWP_{CH_4} (tCO_2 /tCH_4)	$EF_{CH_4,default}$ (tCH_4 leaked /tCH_4 produced	$Q_{CH_4,y}$ (tCH_4	$PE_{CH_4,y}$ (tCO_2e
01/06/2021–30/06/2021	27.9	0.028	140.60	110
01/07/2021–31/07/2021	27.9	0.028	142.80	112
01/08/2021–31/08/2021	27.9	0.028	142.80	112
01/09/2021–30/09/2021	27.9	0.028	145.94	115
01/10/2021–31/10/2021	27.9	0.028	148.53	117
01/11/2021–30/11/2021	27.9	0.028	144.69	114
01/12/2021–31/12/2021	27.9	0.028	145.73	114
01/01/2022–31/01/2022	27.9	0.028	142.82	112
01/02/2022–28/02/2022	27.9	0.028	149.23	117
01/03/2022–31/03/2022	27.9	0.028	148.51	117
01/04/2022–30/04/2022	27.9	0.028	146.52	115
01/05/2022–31/05/2022	27.9	0.028	141.50	111
01/06/2022–30/06/2022	27.9	0.028	146.90	115
01/07/2022–31/07/2022	27.9	0.028	143.83	113
01/08/2022–31/08/2022	27.9	0.028	141.39	111

01/09/2022–30/09/2022	27.9	0.028	144.49	113
01/10/2022–31/10/2022	27.9	0.028	148.14	116
01/11/2022–30/11/2022	27.9	0.028	146.32	115
01/12/2022–31/12/2022	27.9	0.028	146.13	115
01/01/2023–31/01/2023	27.9	0.028	147.57	116

Table 7-5 the calculation result of $PE_{AD,y}$

Period	$PE_{EC,y}$ (tCO_2e)	$PE_{CH4,y}$ (tCO_2e)	$PE_{AD,y}$ (tCO_2e)
01/06/2021–31/12/2021	**1,657**	**794**	**2,451**
01/01/2022–31/12/2022	**4,291**	**1,370**	**5,661**
01/01/2023–31/01/2023	**503**	**116**	**619**
1st monitoring period	**6,451**	**2,280**	**8,731**

$PE_{AD,y} = PE_{EC,y} + PE_{CH4,y}$=6451+2280=8731

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

The project CH_4 emissions from aerobic AWMS treatment is calculated using Equation 25 described in above section 5.2. The specific calculation results are shown in Table 6–6.

Table 7-6 the calculation result of $PE_{Aer,y}$

Parameter	Value		Unit
species	Market Swine	Breeding Swine	
GWP_{CH_4}	27.9	27.9	tCO_2/tCH_4
D_{CH_4}	0.00067	0.00067	t/m^3
F_{Aer}	1	1	/
$1-R_{VS,1}$	0.8	0.8	/
$B_{O,LT}$	0.29	0.29	m^3 CH_4 /kg VS
N_{LT}	Refer to Table 6–1		
$VS_{LT,y}$	Refer to Table 6–1		
$MS\%_j$	1	1	/
$PE_{Aer,y}$ from 01/06/2021–31/12/2021	**34**		tCO_2e
$PE_{Aer,y}$ from 01/01/2022–31/12/2022	**60**		tCO_2e
$PE_{Aer,y}$ from 01/01/2023–31/01/2023	**5**		tCO_2e
$\boldsymbol{PE_{Aer,y}}$ **in this monitoring period**	**99**		$\boldsymbol{tCO_2e}$

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

The project N_2O emissions in year y can be calculated using Equation 26–28 described in above section 5.2. The specific calculation result is shown in Table 7–7.

Table 7-7 the calculation result of $PE_{N_2O,y}$

Parameter	Value		Unit
species	Market Swine	Breeding Swine	
$EF_{N_2O,D,1}$ (Hom)	0.01	0.01	kg N_2O –N/kg N

$NEX_{LT,y}$	Refer to Table 6-1		
N_{LT}	Refer to Table 6-1		
$MS\%_j$	1	1	/
$E_{N_2O,D,y}$ from 01/06/2021–31/12/2021	**2867.18**		kg N_2O –N/year
$E_{N_2O,D,y}$ from 01/01/2022–31/12/2022	**5028.54**		kg N_2O –N/year
$E_{N_2O,D,y}$ from 01/01/2023–31/01/2023	**422.84**		kg N_2O –N/year
$E_{N_2O,D,y}$ in this monitoring period	**8,318.56**		kg N_2O –N/year
$E_{N_2O,ID}$	0.01	0.01	kg N_2O –N/kg N
$F_{gassMS,1,LT}$(hom)	0.85	0.85	/
$NEX_{LT,y}$	Refer to Table 6-1		
N_{LT}	Refer to Table 6-1		
$MS\%_j$	1	1	/
GWP_{N_2O}	**273**		tCO_2/tN_2O
$E_{N_2O,ID,y}$ from 01/06/2021–31/12/2021	**2,437.11**		kg N_2O –N/year
$E_{N_2O,ID,y}$ from 01/01/2022–31/12/2022	**4,274.26**		kg N_2O –N/year
$E_{N_2O,ID,y}$ from 01/01/2023–31/01/2023	**359.42**		kg N_2O –N/year
$E_{N_2O,ID,y}$ in this monitoring period	**7,070.79**		kg N_2O –N/year

Parameter	**Value**		**Unit**
species	**Market Swine**	**Breeding Swine**	
$EF_{N_2O,D,3}$ (AD)	0.0	0.0	kg N_2O –N/kg N
1-RN,1[29]	95%	95%	/
$NEX_{LT,y}$	Refer to Table 6-1		

[29] It is only used to calculate PE-AD and PE-AER, not PE-HOM. Please refer to page P71

N_{LT}	Refer to Table 6–1		
$MS\%_j$	1	1	/
$E_{N_2O,D,y}$ from 01/06/2021–31/12/2021	**0**		kg N_2O –N/year
$E_{N_2O,D,y}$ from 01/01/2022–31/12/2022	**0**		kg N_2O –N/year
$E_{N_2O,D,y}$ from 01/01/2023–31/01/2023	**0**		kg N_2O –N/year
$E_{N_2O,D,y}$ in this monitoring period	**0**		kg N_2O –N/year
$E_{N_2O,ID,j}$(AD)	0.01	0.01	kg N_2O –N/kg N
$F_{gassMS,j,LT}$(AD)	0.5	0.5	/
$NEX_{LT,y}$	Refer to Table 6–1		
N_{LT}	Refer to Table 6–1		
$MS\%_j$	1	1	/
GWP_{N_2O}	**273**		tCO_2/tN_2O
$E_{N_2O,ID,y}$ from 01/06/2021–31/12/2021	**1,361.91**		kg N_2O –N/year
$E_{N_2O,ID,y}$ from 01/01/2022–31/12/2022	**2,388.57**		kg N_2O –N/year
$E_{N_2O,ID,y}$ from 01/01/2023–31/01/2023	**200.85**		kg N_2O –N/year
$E_{N_2O,ID,y}$ in this monitoring period	**3,951.33**		kg N_2O –N/year

Parameter	**Value**		**Unit**
species	**Market Swine**	**Breeding Swine**	
$EF_{N_2O,D,2}$ (COM)	0.006	0.006	kg N_2O –N/kg N
1-RN,1[30]	95%	95%	/
$NEX_{LT,y}$	Refer to Table 6–1		
N_{LT}	Refer to Table 6–1		

[30] It is only used to calculate PE-AD and PE-AER, not PE-HOM. Please refer to page P71

$MS\%_j$	1	1	/
$E_{N_2O,D,y}$ from 01/06/2021–31/12/2021	**1,634.29**		kg N_2O –N/year
$E_{N_2O,D,y}$ from 01/01/2022–31/12/2022	**2,866.28**		kg N_2O –N/year
$E_{N_2O,D,y}$ from 01/01/2023–31/01/2023	**241.02**		kg N_2O –N/year
$E_{N_2O,D,y}$ in this monitoring period	**4,741.59**		kg N_2O –N/year
$E_{N_2O,ID}$	0.01	0.01	kg N_2O –N/kg N
$F_{gassMS,2,LT}$(COM)	0.6	0.6	/
$NEX_{LT,y}$	Refer to Table 6–1		
N_{LT}	Refer to Table 6–1		
$MS\%_j$	1	1	/
GWP_{N_2O}	**273**		tCO_2/tN_2O
$E_{N_2O,ID,y}$ from 01/06/2021–31/12/2021	**1,634.29**		kg N_2O –N/year
$E_{N_2O,ID,y}$ from 01/01/2022–31/12/2022	**2,866.28**		kg N_2O –N/year
$E_{N_2O,ID,y}$ from 01/01/2023–31/01/2023	**241.02**		kg N_2O –N/year
$E_{N_2O,ID,y}$ in this monitoring period	**4,741.59**		kg N_2O –N/year

01/06/2021-31/12/2021	**4,263**	tCO_2e

01/01/2022-31/12/2022	**7,475**	tCO_2e
01/01/2023-31/01/2023	**629**	tCO_2e

$PE_{N2O,y}=GWP_{N20}*(44/28)*1/1000*(E_{N2O,D,y}+E_{N2O,ID,y})$ =	**12,367**	tCO_2e

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

These emissions should only be considered for consumption of electricity or heat that is not related to the anaerobic digester. As described in 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 $PE_{EC,y}$.

No fossil fuel was consumed in process that is not related to the anaerobic digester, so

$$PE_{FC} = 0$$

Therefore, $PE_{elec/heat}$ that is not related to the anaerobic digester , $PE_{elec/heat}$=0.

In summary, the project emission of the proposed project in this monitoring period are summarized in Table 6–8.

Table 7-8 the calculation result of project emissions in this monitoring period

Period	$PE_{AD,y}$ (tCO_2e)	$PE_{Aer,y}$ (tCO_2e)	$PE_{N_2O,y}$ (tCO_2e)	PE_y (tCO_2e)
01/06/2021–31/12/2021	**2,451**	**34**	**4,263**	**6,748**

01/01/2022–31/12/2022	**5,661**	**60**	**7,475**	**13,196**
01/01/2023–31/01/2023	**619**	**5**	**629**	**1,253**
1st monitoring period	**8,731**	**99**	**12,367**	**21,197**

7.4 Leakage

As described in section 5.3, Leakage emissions can be calculated by Equation 44:

$$LE_y = (LE_{PJ,N_2O,y} - LE_{BL,N_2O,y}) + (LE_{PJ,CH4,y} - LE_{BL,CH4,y}) + LE_{AD,y}$$

Also, as described in section 5.3, The leakage emissions associated with the anaerobic digester ($LE_{AD,y}$) depend on how the digestate is managed. For this project, the anaerobic digestion process of this project is carried out in a fully enclosed system. The biogas generated during the treatment process is captured for power generation or flared (if any). The Emissions from combustion are calculated in project emissions (if any). After anaerobic digestion, the fermented sludge is treated in aerobic composting system, which are used as fertilizer. Wastewater from the new animal waste management systems is 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. Therefore, the

$$LE_y = (LE_{PJ,N_2O,y} - LE_{BL,N_2O,y}) + (LE_{PJ,CH4,y} - LE_{BL,CH4,y})$$

The LE_y can be calculated by Equation 29–38 described in section 5.3 and the specific calculation and the result are shown in table 7–9. The calculation result of leakage emission is shown in table 7–10.

Table 7-9 the calculation result of LE_y

Parameter	Value	Unit

species	Market Swine	Breeding Swine	
$NEX_{LT,y}$	Refer to Table 6–1		
N_{LT}	Refer to Table 6–1		
$R_{N,0}$	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}	0.3	0.3	/
F_{gasm}	0.2	0.2	/
GWP_{N_2O}	273	273	tCO_2/tN_2O
$LE_{N_2O,land,y}$ from 01/06/2021–31/12/2021	573		kg N_2O–N/year
$LE_{N_2O,land,y}$ from 01/01/2022–31/12/2022	1,006		kg N_2O–N/year
$LE_{N_2O,land,y}$ from 01/01/2023–31/01/2023	85		kg N_2O–N/year
$LE_{N_2O,land,y}$ **in this monitoring period**	**1,664**		**tCO_2e**
$LE_{N_2O,runoff,y}$from 01/06/2021–31/12/2021	129		kg N_2O–N/year
$LE_{N_2O,runoff,y}$rom 01/01/2022–31/12/2022	226		kg N_2O–N/year
$LE_{N_2O,runoff,y}$from 01/01/2023–31/01/2023	19		kg N_2O–N/year
$LE_{N_2O,runoff,y}$**n this monitoring**	**374**		kg N_2O–N/year

period			
$LE_{N_2O,vol,y}$ from 01/06/2021–31/12/2021	115		kg N_2O–N/year
$LE_{N_2O,vol,y}$ from 01/01/2022–31/12/2022	201		kg N_2O–N/year
$LE_{N_2O,vol,y}$ from 01/01/2023–31/01/2023	17		kg N_2O–N/year
$LE_{N_2O,vol,y}$ in this monitoring period	**333**		kg N_2O–N/year
$LE_{BL,N_2O,y}$ from 01/06/2021–31/12/2021	350		tCO_2e
$LE_{BL,N_2O,y}$ from 01/01/2022–31/12/2022	614		tCO_2e
$LE_{BL,N_2O,y}$ from 01/01/2023–31/01/2023	51		tCO_2e
$LE_{BL,N_2O,y}$ in this monitoring period	**1,015**		tCO_2e
$NEX_{LT,y}$	Refer to Table 6–1		
N_{LT}	Refer to Table 6–1		
$R_{N,1}$	5%	5%	/
$R_{N,2}$	25%	25%	/
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}	0.3	0.3	/
F_{gasm}	0.2	0.2	/
$LE_{N_2O,land,y}$ from 01/06/2021–	**2,043**		kg N_2O–N/year

31/12/2021		
$LE_{N_2O,land,y}$ from 01/01/2022–31/12/2022	**3,583**	kg N_2O–N/year
$LE_{N_2O,land,y}$ from 01/01/2023–31/01/2023	**301**	kg N_2O–N/year
$LE_{N_2O,land,y}$ in this monitoring period	**5,927**	kg N_2O–N/year
$LE_{N_2O,runoff,y}$ from 01/06/2021–31/12/2021	**460**	kg N_2O–N/year
$LE_{N_2O,runoff,y}$ from 01/01/2022–31/12/2022	**806**	kg N_2O–N/year
$LE_{N_2O,runoff,y}$ from 01/01/2023–31/01/2023	**68**	kg N_2O–N/year
$LE_{N_2O,runoff,y}$ in this monitoring period	**1,334**	kg N_2O–N/year
$LE_{N_2O,vol,y}$ from 01/06/2021–31/12/2021	409	kg N_2O–N/year
$LE_{N_2O,vol,y}$ from 01/01/2022–31/12/2022	717	kg N_2O–N/year
$LE_{N_2O,vol,y}$ from 01/01/2023–31/01/2023	60	kg N_2O–N/year
$LE_{N2O,vol,y}$ in this monitoring period	**1,186**	kg N_2O–N/year
$LE_{PJ,N2O}$from 01/06/2021–31/12/2021	1,250	tCO_2e
$LE_{PJ,N2O}$ from 01/01/2022–31/12/2022	2,191	tCO_2e
$LE_{PJ,N2O}$ from 01/01/2023–31/01/2023	185	tCO_2e

$LE_{PJ,N2O}$ in this monitoring period	**3,626**		tCO_2e
GWP_{CH_4}	27.9	27.9	tCO_2/tCH_4
D_{CH_4}	0.00067	0.00067	t/m^3
MCF_{jd}	1	1	/
N_{LT}	Refer to Table 6–1		
$VS_{LT,y}$	Refer to Table 6–1		
$B_{O,LT}$	0.29	0.29	m^3 CH_4 /kg VS
$R_{VS,0}$	85%	85%	/
$MS\%_j$	100%	100%	/
$LE_{BL,CH_4,y}$ from 01/06/2021–31/12/2021	6,310		tCO_2e
$LE_{BL,CH_4,y}$ from 01/01/2022–31/12/2022	11,131		tCO_2e
$LE_{BL,CH_4,y}$ from 01/01/2023–31/01/2023	953		tCO_2e
$LE_{BL,CH_4,y}$ in this monitoring period	**18,394**		tCO_2e
GWP_{CH_4}	27.9		tCO_2/tCH_4
D_{CH_4}	0.00067		t/m^3
MCF_{jd}	1		
N_{LT}	Refer to Table 6–1		
$VS_{LT,y}$	Refer to Table 6–1		
$B_{O,LT}$	0.29		m^3 CH_4 /kg VS
$R_{VS,1}$	20%		20%
$R_{VS,2}$	80%		80%

$MS\%_j$	100%	100%
$LE_{PJ,CH_4,y}$ from 01/06/2021–31/12/2021	**6,745**	tCO_2e
$LE_{PJ,CH_4,y}$ from 01/01/2022–31/12/2022	**11,900**	tCO_2e
$LE_{PJ,CH_4,y}$ from 01/01/2023–31/01/2023	**1,020**	tCO_2e
$LE_{PJ,CH_4,y}$ in this monitoring period	**19,665**	**tCO_2e**

Table 7-10 The calculation result of leakage emission

period	$LE_{PJ,CH4,y}$	$LE_{BL,CH4,y}$	$LE_{PJ,N_2O,y}$	$LE_{BL,N_2O,y}$	LE_y
01/06/2021–31/12/2021	**6,745**	**6,310**	**1,250**	**350**	**1,335**
01/01/2022–31/12/2022	**11,900**	**11,131**	**2,191**	**614**	**2,346**
01/01/2023–31/01/2023	**1,020**	**953**	**185**	**51**	**201**
1st monitoring period	**19,665**	**18,394**	**3,626**	**1,015**	**3,882**

7.5 Net GHG Emission Reductions and Removal

As per paragraph 54 in applied methodology ACM0010 (Version08.0): Furthermore, if the actual methane captured from anaerobic digesters in project activity is lower than ($BE_{CH_4,y} - PE_{AD,y}$), then ($BE_{CH_4,y} - PE_{AD,y}$) is replaced by actual methane captured $Q_{CH_4,y}$.

Biogas captured during monitoring period is 7,111,953.00 m^3, which equals to 81034 tCO_2e that emission from methane production[31]. Baseline methane emission (BECH4,y) in this monitoring period is 82259 tCO_2e. project emissions associated with anaerobic digester in this monitoring period is ($PE_{AD,y}$) is 8731tCO_2e. Actual

[31] Biogas captured during this monitoring period is 7,111,953.00m^3. The quality of methane is 2,904.44 tCH_4, which can be calculated by the amount of biogas, the density of biogas and the content of methane in this monitoring period. Then the quality of methane multiplied by the global warming potential of CH4 i.e. 27.9 tCO_2/tCH_4.is the result of 81,034 tCO_2e. Please refer ER sheet, tab " monitoring results" for detail calculation process and final results.

methane captured from anaerobic digesters is higher than the difference of $BE_{CH_{4,y}}$ and $PE_{AD,y}$. Therefore, the equation ($BE_{CH_{4,y}} - PE_{AD,y}$) can be used to calculate emission reduction. So, the Net GHG Emission Reductions and Removals can be calculated using Equation 44 in section 5.4. The Net GHG Emission Reductions and Removals in this monitoring period is shown in following table.

The monitoring period of this project is from 01–June–2021 to 31–January–2023, which lasts 20 months. The estimated emission reduction annually is 42,656 tCO2e based on the ex–ante situation. However, the actual amount of emission reduction is about 35,772[32] tCO2e. The difference actually arises from the weight and the quantity of market swine and the breeding swine. Under the circumstances of ex–ante, the estimated number of market swine is 41,935 and the number of breeding swine is 5885, and the estimated weight of market swine is 79 kg and the weight of breeding swine is 93 kg. While the actual annual average number of market swine during the project operationis 38697, the number of breeding swine is 5064, the actual annual average weight of market swine was 78 kg and the weight of breeding swine was 86 kg. Therefore, the ex–post emission reduction is lower than that of ex–ante emission.

[32] 58,604 tCO_2e/20*12=35,772ttCO_2e, there are 20 months in the first monitoring period.

Year	Baseline emissions or removals (tCO2e)	Project emissions or removals (tCO2e)	Leakage emissions (tCO2e)	Net GHG emission reductions or removals (tCO2e)
01/06/2021 – 31/12/2021	28,708	6,748	1,335	20,625
01/01/2022 – 31/12/2022	50,639	13,196	2,346	35,097
01/01/2023 – 31/01/2023	4,336	1,253	201	2,882
Total	83,683	21,197	3,882	58,604

APPENDIX 1: <EVIDENCE OF ACHIEVED SDGS>

Supporting evidence for contribution to SDG 13.0 Tons of greenhouse gas emissions avoided or removed

The project design document has estimated that 42,656 tCO2e emission reductions will be produced annually. This is the 1st monitoring period, which is covering from 01–06–2021 to 31–01–2023 and the emission reductions of first monitoring period is 59,620 tCO2e. please see Section 6 of JPM for details

Year	Baseline emissions or removals (tCO2e)	Project emissions or removals (tCO2e)	Leakage emissions (tCO2e)	Net GHG emission reductions or removals (tCO2e)
01/06/2021 –31/12/2021	28,708	6,748	1,335	20,625
01/01/2022 _ 31/12/2022	50,639	13,196	2,346	35,097
01/01/2023 _ 31/01/2023	4,336	1,253	201	2,882
Total	83,683	21,197	3,882	58,604

Supporting evidence for contribution to SDG 7.2 Renewable energy share in the total final energy consumption

The project design document has estimated that482.59×10^{4} m^{3} of biogas are expected to be

generated annually. This is the 1st monitoring period, which is covering from 01–June–2021 to

31–January–2023, and during this monitoring period 7,111,953.00 m3 of biogas is generated by the project.

徽县兴疆牧歌沼气计量数据

日期	沼气产生记录（m^3）	燃烧利用沼气（m^3）
01/06/2021-30/06/2021	348082	345759
01/07/2021-31/07/2021	352626	350826
01/08/2021-31/08/2021	352625	350921
01/09/2021-30/09/2021	356953	353462
01/10/2021-31/10/2021	356078	354927
01/11/2021-30/11/2021	357314	354533
01/12/2021-31/12/2021	357287	354788
01/01/2022-31/01/2022	356692	353483
01/02/2022-28/02/2022	356641	353247
01/03/2022-31/03/2022	356611	353336
01/04/2022-30/04/2022	355766	354222
01/05/2022-31/05/2022	355698	354848
01/06/2022-30/06/2022	357263	354317
01/07/2022-31/07/2022	356315	354469
01/08/2022-31/08/2022	355858	353734
01/09/2022-30/09/2022	356799	352924
01/10/2022-31/10/2022	355717	353625
01/11/2022-30/11/2022	355294	353584
01/12/2022-31/12/2022	355731	354172
01/01/2023-31/01/2023	356603	354940
总计	7,111,953.00	7,066,117.00

Supporting evidence for contribution to SDG 8.3 Proportion of informal employment in nonagriculture employment by sex

The project activity generates permanent job opportunities for 8 persons including 4 females

and 4 males during the operation period. During this monitoring period, total 10 jobs for local

people were created (including 4 females and 6 males) by the project.

徽县兴疆牧歌粪污处理人员				
序号	姓名	员工编号	性别	岗位
1	李德强	20200910002	男	管理岗
2	田佳兴	20200910001	男	管理岗
3	邱婷婷	20210506002	女	行政财务岗
4	勾小玲	20210112001	女	环保专员
5	吴爱爱	20220101001	女	环保专员
6	年志成	20210317001	男	环保专员
7	柏建平	20211011001	男	环保专员
8	程蕾	20211012001	女	环保专员
9	雷小明	20220811451	男	环保专员
10	张春平	20210628001	男	环保专员

APPENDIX 2: < INVESTMENT ANALYSIS >

During the previous version, the heat generated from burning biogas was mainly used to heat the pigsty, which are under different financial departments from AWMS. Now, when analyzing the benefits of biogas heating in terms of coal savings which are not make revenue for the AWMS directly, it is also necessary to take into account the additional costs incurred by the pigsty due to the use of biogas heating. Therefore, the costs related to the pigsty additional expenses need to be included in the cost.

The additional costs included the extra investment (ie the extra pipeline pump) and the extra annual cost (ie, more disinfection patrol maintenance)due to AWMS

The extra investment can be proved by the equipment contract (3,015,000) which shows the extra pipeline /pump/bracket , the extra annual cost was supported by the contract and purchase record .

The cost incurred by additional inspection (288,000 yuan/year):

Because the use of biogas boilers increases the risk of heating facilities, the swine farm arranges three people per year to conduct inspections on the corresponding equipment. Due to the need for night shifts and the need for certain professional knowledge to respond to emergencies, as well as the need to stay inside the pig farm for a long time,they cannot leave without authorization, except for special circumstances, based on the above and the analysis of the talent market, only those with a monthly salary of over 8,000 can find people who match the needs.

The additional inspection includes below:

Ensure the safe and stable operation of pigsties and biogas facilities: Additional regular inspections can detect and resolve potential safety hazards in a timely manner, avoiding damage or malfunction of the facilities and ensuring uninterrupted biogas supply.

Extending the service life of heating and cooling facilities: Regular inspections will inform t maintenance engineer fortimely repairs and maintenance, effectively extending the life of the facilities and reducing the cost of replacing equipment.

Ensure the safety of employees and surrounding residents: Conduct regular inspections of biogas facilities and heating facilities to ensure that the equipment is in good working condition, avoid accidents, and protect the lives and property of employees and surrounding residents.

The cost incurred by additional disinfection (200,000 yuan/year):

Because the production and utilization of manure and biogas have increased adverse effects on the heating area, the swine farm requires additional disinfection every year to eliminate these adverse effects. The pig farm has signed a contract for the purchase of disinfectants, and based on the sales organization's estimates and employee psychological needs, it will cost 200,000 yuan per year.

The additional disinfection includes blow:

Preventing harmful bacteria and viruses from harming the pigsty during the fermentation process of feces: disinfection is an important part of epidemic prevention in pig farms, which can effectively kill bacteria and viruses and ensure the health of the pig herd.

Reduce odors and pollution: Disinfection can inhibit the growth and reproduction of harmful microorganisms, thereby reducing the production of odors and pollution and improving the environment of the pigsty.

Compliance with environmental protection requirements: Regular disinfection can ensure the hygiene and safety of pig farm feces treatment facilities, meet environmental protection requirements, and avoid polluting the surrounding environment of the pigsty.

The cost incurred by additional equipment maintenance: (550,000 yuan/year)

Due to the production and use of biogas, the damage to heating equipment is greater than that of using coal for heating. Therefore, more frequent maintenance is required to ensure normal heating usage and the safety of the swine farm. The swine farm has signed a maintenance contract with a total contract price of 550,000 yuan.

Ensuring the normal operation of biogas heating and heat exchange equipment: Equipment maintenance is a key step in ensuring the stable operation of biogas equipment, allowing for the timely detection and resolution of equipment malfunctions or potential problems, ensuring the stability of biogas supply.

Improve the service life of biogas heating and heat exchange equipment: Regular equipment maintenance can extend the service life of equipment and reduce the cost of replacing equipment.

Improve the production efficiency of biogas heating and heat exchange equipment: Equipment maintenance can ensure the stable operation of biogas equipment, improve production efficiency, and thus reduce production costs.

All the generated biogas (4,825,900m^3/a)contain 60% CH_4(NCV_{CH4} =35.9MJ/m^3(AMS–III.D.(version 21.0)) will be burned at the boiler (combustion efficiency η =90%) ,so there will be 93,554,897.40 MJ heating energy generated, the generated heat will save 3547t coal($NCV_{coal=}$29.307MJ/kg[33]) (combustion efficiency η =90%)annually, which will make revenue 1,479,099 CNY (coal price 417 CNY /t [34])

HG = VF × $V_{i,t,db}$× NCV_{CH4}× η =4,825,900m^3×60%×35.9MJ/m^3×90%= 93,554,897.40 MJ

$M_{coal\ saved}$ =HG / （ η_{boiler} ×NCV_{coal} ） =93,554,897.40 MJ/ （ 90%×29.307MJ/kg ） ×0.001=3547t

Coats and benefits	1	2	3-15	16
Cash inflow		3,255,946	3,255,946	3,534,446
Revenues from fertilizers sales		1,776,847	1,776,847	1,776,847
Revenues from coal saving		1,479,099	1,479,099	1,479,099
Fixed assets residue value	0	0	0	278,500
Cash outflow	5,800,000	2,643,721	2,643,721	2,643,721

[33] https://www.zhaibian.com/baike/22460085495136523540.html

[34] http://www.coalresource.com/news/4620134/info

Construction investment	5,800,000	0	0	0
O&M cost		2,693,188	2,693,188	2,693,188
Stamp tax[35]	0	533	533	533
Net cash flow (after tax)[36]	**5.42%**			
NPV	**-1212255.08**			

The NPV of both the project activity and the uncovered anaerobic lagoon are negative, and the NPV of the project activity is far more negative than that of the uncovered anaerobic lagoon, which means the cost of the project activity without VCS revenues is much higher than the uncovered anaerobic lagoon. So the uncovered anaerobic lagoon is the most attractive course of action and is considered to be the baseline scenario.

The anaerobic digester system is considered to be one of the most advanced manure management systems in the world. High costs involved in the investment compared to other available systems are required to implement such technology. Additionally, the investment required to generate heat from biogas is still too high and the cost is much higher than prices in the market, so the IRR of the project activity is lower than the average level and it is difficult for the project proponents to get loans from the banks. Only the project proponents can prove that they can get revenues from VCS Standard certification, it can attract the banks to provide loans for this project. For

[35] This project is only subject to stamp tax in China.

[36] http://www.chinatax.gov.cn/n810341/n810765/n812171/n812710/c1192026/content.html

these reasons, without the revenues, PP is willing to adopt other manure management systems of lower costs which will lead to more GHG emissions.

The comparison of economic attractiveness is carried out by applying Step 3 Investment analysis of Tool 02" Combined tool to identify the baseline scenario and demonstrate additionality (Version 07.0)". The compared alternatives are Scenario 6: "The manure is disposed of in an uncovered anaerobic lagoon"; and Scenario 8&17: Anaerobic Digester Treatment i.e., the proposed project activity not being registered as a VCS project activity.

Sub-step 3a. Determine appropriate analysis method

Three analysis methods are suggested in the "Tools for the demonstration and assessment of additionality" (Version 07.0.0). They are simple cost analysis (the option I), investment comparison analysis (option II), and benchmark analysis (option III).

The investment comparison analysis method (option II) applies to projects whose alternatives are also investment projects. Only on such a basis, comparison analysis can be conducted. The alternative baseline scenario of the proposed project doesn't belong to investment projects. Therefore, option II is not an appropriate method.

The proposed project will use the benchmark analysis method (option III) based on the consideration that benchmark, Project IRR is available.

Sub-step 3b. Benchmark Analysis Method (Option III)

According to the "Financial benchmark rate of return of construction projects" issued by NDRC, the financial benchmark of the animal industry for Project IRR (after tax) is 9.5% for the total investment.

Sub-step 3c: Calculation and comparison of financial indicators

(c) Basic parameters

Annual organic fertilizers sales	5226.02 t	Project Evaluation Report
price of organic fertilizers	340 RMB/t	Project Evaluation Report
Annual coal saved	3547t	All the generated biogas (4,825,900m3/a)contain 60% CH4(NCVCH4 =35.9MJ/m3(AMS-III.D.(version 21.0)) will be burned at the boiler (combustion efficiencyη=90%) ,so there will be 93,554,897.40 MJ heating energy generated, the generated heat will save 3547t
price of coal	417 RMB/t	Gansu Development and Reform Commission[37]
Total static investment(with coal saving)	580*10⁴RMB	Project Evaluation Report
O&M cost	269.32 *10⁴RMB	Project Evaluation Report
Operation period	15 years	Project Evaluation Report
Emission reduction	42,640tCO2e	Calculated
VCU Price	CNY 10/ton	Expected

[37] http://www.coalresource.com/news/4620134/info

According to the above summary, with the benefit from saving coal, the extra expense (ie extra patrol or pipeline) based on the coal saving must be taken in consideration ,In accordance with the feasibility study report (FSR) of the project, the basic parameters for calculation of the financial indicator are shown as Table 3-1:

	1	**2**	**3~15**	**16**
Cash inflow (without VCU)		3,255,946	3,255,946	3,534,446
Cash inflow (with VCU)		3,682,346	3,682,346	3,960,846
Revenues from fertilizers sales		1,776,847	1,776,847	1,776,847
Revenues from coal saving		1,479,099	1,479,099	1,479,099
Revenue from VCU		426,400	426,400	426,400
Salvage value recovery		0	0	278,500
Cash outflow (without VCU)	5,800,000	2,643,721	2,643,721	2,643,721
Cash outflow (with VCU)	5,800,000	2,908,587	2,908,587	2,908,587
total investment (with coal saving)	2,785,000	0	0	0
extra equipment (ie extra pipeline)	3,015,000	0	0	0
Working capital investment	0	0	0	0
O&M cost		2,693,188	2,693,188	2,693,188
Stamp tax[38]		533	533	533
Adjustment of income tax (without		0	0	0

[38] According to the National Taxation Bureau of China ,this kind of project does not need to Pay income tax http://www.chinatax.gov.cn/n810341/n810765/n812171/n812710/c1192026/content.html

VCU)				
Adjustment of income tax (with VCU)		214,866	214,866	214,866
Net cash flow (without VCU)	–5,800,000	562,225	562,225	840,725
Net cash flow (with VCU)	–5,800,000	773,759	773,759	1,052,259
IRR (without VCU) after tax	5.42%			
IRR (with VCU) after tax	10.45%			
NPV (without VCU)	–1212255.08			
NPV (with VCU)	300004.16			

(d) 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 5.42%, lower than the benchmark IRR of 9.5%[39]which is latest version published by the China Development and Reform Commission set for the project associated with Animal husbandry constructed after 2013 still valid for the project, and the proposed project is financially unacceptable because of its low profitability. While considering such income, the IRR of the proposed project is 10.45%, higher than the benchmark, and the proposed project is financially acceptable

[39] https://www.ndrc.gov.cn/fggz/gdzctz/tzfg/201907/W020191104862129391071.pdf

Sub-step 3d: 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 fertilizers sales 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:

*Static total investment

*Annual fertilizers production

*Annual fertilizer price

*Annual coal saved

*Annual coal price

*Annual O&M cost

The variation range of –10%~10% which was employed in the Project Design Report and prevailing in China was used. The results of sensitivity analysis of the three parameters of the proposed project are shown in the following table:

Interval of variation	**90%**	**95%**	**100%**	**105%**	**110%**
Static total investment	7.00%	6.18%	5.42%	4.71%	4.06%

Annual fertilizers production	0.72%	3.17%	5.42%	7.53%	9.52%
Annual fertilizer price	0.72%	3.17%	5.42%	7.53%	9.52%
Annual coal saved	1.57%	3.56%	5.42%	7.18%	8.86%
Annual coal price	1.57%	3.56%	5.42%	7.18%	8.86%
Annual O&M cost	11.73%	8.69%	5.42%	1.78%	–2.46%

The sensitivity analysis was further conducted, and the project IRR (after tax) could reach the benchmark of 9.5% if one of the following conditions can be achieved:

Static total investment	decrease 22.89%
Annual fertilizers production	increase 9.94%
Annual fertilizer price	increase 9.94%
Annual coal saved	increase 11.94%
Annual coal price	Increase11.94%
Annual O&M cost	decrease6.30%

Since all the data used for the investment analysis was sourced from the PER, which was completed by an authorized entity. Therefore, the data used in the investment analysis are believed to be reliable and credible and none of the above conditions can be achieved:

Total static investment decreasing 22.89%: 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. In addition, the project was put into operation.. As a result, the IRR cannot increase through the change of equipment cost.

Annual fertilizers production increasing 9.94%: The fertilizers are determined by the manure of the swine farm. The number of production of the fertilizers is the maximum number ,because the number of market swine and breeding swine will not exceed the 41935 and 5885, herefore, the increase of annual fertilizers production to threshold is impossible to achieve.

Annual fertilizer price increasing 9.94%: the price is set with the agreement to help the local farmer instead of making much benefit from them, if the price increase, the farmer will buy the chemical fertilizer from the market which can be more convenient, the chemical fertilizer is not as friendly to the environment as organic fertilizer, so it is impossible for the price increase the 9.94%. Therefore, the increase of annual fertilizer price to threshold is impossible to achieve.

Annual coal saved increasing 11.94%

The annual coal saved is estimated as the maximum biogas production and the heat utilized for the swine farm as per the FSR and it is not likely to increase the amount of coal saved during the operation due to the capacity of biogas generation of the project activity. For the IRR to reach the benchmark.

the coal price increasing 11.94%

Gansu province have energy policies that are linked to coal prices. If coal prices increasing 11.94%, it may affect the implementation and adjustment of these policies. For example, the government may have difficulty accurately estimating future coal demand and corresponding subsidy amounts, resulting in poor policy effectiveness.

For users of coal. If coal prices increasing 8.42%, it may lead to higher product prices in the power, chemical, and other industries, which in turn affects the interests of ordinary consumers

Therefore, in order to maintain the stability of the energy market, ensure the implementation of energy policies, and protect the interests of users, the coal price cannot increase 11.94%

O&M cost decreasing 6.30%: However, the decrease of it is not likely to occur. Based on the Chinese Statistic Yearbook, the fluctuations of indices of the purchasing price of raw material, power, and fuel are insignificant over the last ten years and the annual average wages in Gansu Province have been constantly growing over the 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 decrease of 6.30% in 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 a 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 summary, the NPV of both the project activity and the uncovered anaerobic lagoon are negative and the NPV of the project activity is far more negative than that of the uncovered anaerobic lagoon which means the cost of the project activity without VCS revenues is much higher than the uncovered anaerobic lagoon, so, the uncovered anaerobic lagoon is the most attractive course of action and is considered to be the baseline scenario.