BINZHOU TOPIGS NORSVIN BREEDING SWINE CO., LTD. BINHAI SWINE FARM BIOGAS RECOVERY AND UTILIZATION PROJECT

Document Prepared by Climate Bridge (Shanghai) Ltd.

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Project Title	Binzhou Topigs Norsvin Breeding Swine Co., Ltd. Binhai Swine Farm Biogas Recovery and Utilization Project
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1 PROJECT DETAILS

1.1 Summary Description of the Project

Binzhou Topigs Norsvin Breeding Swine Co., Ltd. Binhai Swine Farm Biogas Recovery and Utilization Project is located in Zhanhua District, Binzhou City, Shandong Province, P.R China. The project is owned and implemented by Binzhou Topigs Norsvin Breeding Swine Co., Ltd. Binhai Branch.

This project is to build an anaerobic animal manure treatment system to treat manure waste of breeding swine in the Binhai Breeding Swine Farm. The project uses the HDPE membrane enclosed anaerobic digesters to treat animal manure waste, and the biogas produced in this process will be recovered and utilized by the biogas heating system for heat supply during the heating period (October to April next year). During the non-heating period (May to September), the biogas will be burnt through the biogas flare system. The residual waste from the digesters will be handled aerobically to produce organic fertilizer at the project site.

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

The project is expected to avoid GHG emission of methane through recovery and destruction of biogas. For conservativeness, the emission reduction from the biogas heating system is not considered. The project is expected to achieve an annual emission reduction of 11,795 tCO_2e and a total emission reduction of 82,563 tCO_2e during the first 7-year renewable crediting period.

1.2 Sectoral Scope and Project Type

Sectoral Scope 13: Waste handling and disposal.

The project is not a grouped project.

1.3 Project Eligibility

The scope of the VCS Program includes:

1) The six Kyoto Protocol greenhouse gases: The project is expected to avoid Methane (CH_4) emissions from the anaerobic animal manure management system in the baseline scenario, which will be captured and destroyed in the project scenario.

2) Ozone-depleting substances: Not Applicable.

3) Project activities supported by a methodology approved under the VCS Program through the methodology approval process: Not Applicable.

4) Project activities supported by a methodology approved under a VCS approved GHG program, unless explicitly excluded under the terms of Verra approval: The applied methodology AMS-III.D (Version 21.0) of the project is methodology approved under CDM Program, which is a VCS approved GHG program.

5) Jurisdictional REDD+ programs and nested REDD+ projects as set out in the VCS Program document Jurisdictional and Nested REDD+ (JNR) Requirements: Not Applicable.

Furthermore, the project does not belong to the project activities excluded in Table 1 of VCS Standard 4.1.

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

1.4 Project Design

The project has been designed to be a single installation of an activity, not a grouped project.

1.5 Project Proponent

Organization name	Binzhou Topigs Norsvin Breeding Swine Co., Ltd. Binhai Branch
Contact person	Wang Geng
Title	Project Manager
Address	Huaquan Village, Binhai Town, Zhanhua District, Binzhou City, Shandong Province
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1.6 Other Entities Involved in the Project

Organization name	**Climate Bridge (shanghai) Ltd.**
Role in the project	Consultancy
Contact person	Zhiwen Gao
Title	General Manager
Address	Block B, Level 24, Jiangong Mansion, 33 Fushan Road, Pudong New Area, Shanghai, China 200120

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1.7 Ownership

The project owner of the project is Binzhou Topigs Norsvin Breeding Swine Co., Ltd. Binhai Branch. The project approval, approval of Environmental Impact Assessment (EIA), and the business license of the project owner are evidence for legislative right. Besides, the equipment purchasing contract and the construction contracts are the evidence for the ownership of the plant and equipment.

1.8 Project Start Date

05-08-2020 (operation start date).

1.9 Project Crediting Period

This project adopts a 7-year renewable crediting period, from 05-08-2020 to 04-08-2027 (both days included).

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	✓
Large project	

Year	Estimated GHG emission reductions or removals (tCO_2e)
05/08/2020~31/12/2020	4,814
01/01/2021~31/12/2021	11,795
01/01/2022~31/12/2022	11,795
01/01/2023~31/12/2023	11,795
01/01/2024~31/12/2024	11,795
01/01/2025~31/12/2025	11,795
01/01/2026~31/12/2026	11,795
01/01/2027~04/08/2027	6,979

Total estimated ERs	82,563
Total number of crediting years	7
Average annual ERs	11,795

1.11 Description of the Project Activity

This project is to build an anaerobic animal manure treatment system to treat manure waste of breeding swine in the Binhai Breeding Swine Farm. The project uses the HDPE membrane enclosed anaerobic digesters to treat animal manure waste, and the biogas produced in this process will be recovered and utilized by the biogas heating system for heat supply during the heating period (October to April next year). During the non-heating period (May to September), the biogas will be burnt through the biogas flare system. The residual waste from the digesters will be handled aerobically to produce organic fertilizer at the project site. The project is expected to avoid GHG emission of methane through recovery and destruction of biogas.

The key system involved in the project are as follows:

Anaerobic animal manure management system:

There're two HDPE membrane enclosed anaerobic digesters at the project site. The effective volume of each HDPE membrane enclosed anaerobic digester is 9,000m^3 (60m*70m*6m), thus the total effective volume is 18,000m^3. The ferment process takes place in the HDPE membrane enclosed anaerobic digesters under the temperature between 15 and 25 $^\circ$ C. To keep this temperature in the heating period, there are heating pipelines laying in the digesters which is powered by the biogas heating system. The project is expected to produce 828,154 m^3 biogas per year.

Biogas pre-treatment system:

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

Biogas heating system:

The project will install a biogas heating system. During the heating period, the recovery methane will be sent to biogas heating system for combustion and supply heat for the livestock farm and the HDPE membrane enclosed anaerobic digesters instead of emitting to atmosphere.

Biogas flare system:

The project will install a flare combustion system. During the non-heating period, the recovery methane will be sent to flare instead of emitting to atmosphere.

Wastewater treatment system

The outlet wastewater from the anaerobic digesters will be treated in an open tank. Wastewater treatment system will be handled aerobically and the treated wastewater will be used for nearby farm irrigation.

The Residual waste treatment system:

The digestate from the anaerobic will digesters be used as material to produce organic fertilizer. Hence proper conditions and procedures (not resulting in methane emissions) for digestate is ensured.

1.12 Project Location

This project locates in Huaquan Village, Binhai Town, Zhanhua District, Binzhou City, Shandong Province, P.R.China. The geographical coordinates for the project sites are east longitude 118°10′54″ and north latitude 37°52′43″.

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

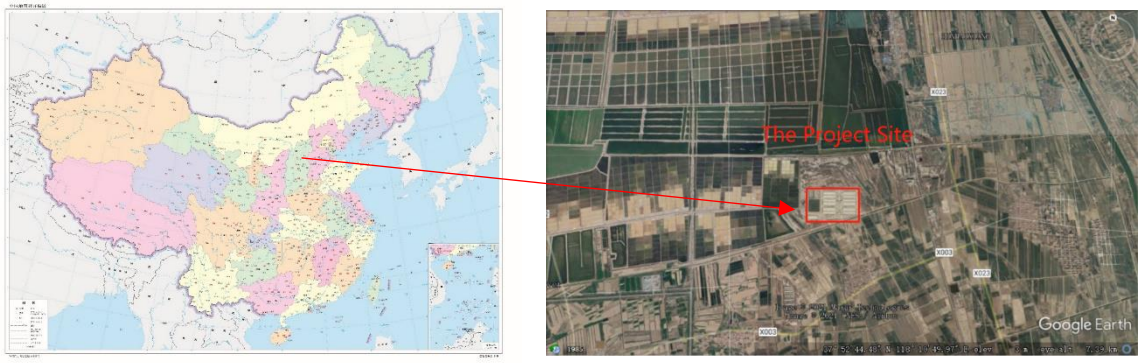

Figure 1-1 Location of the project

1.13 Conditions Prior to Project Initiation

The conditions existing prior to project initiation: the animal manure waste was left to decay in anaerobic manure management system (uncovered open lagoon) at the livestock farms and methane is emitted to the atmosphere directly without any methane recovery and destruction facility.

The conditions existing prior to project initiation is also the baseline scenario of the project.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

No.	Laws and Regulations	Compliance of the project

1	Environmental Protection Law of People's Republic of China	Article 49 "*The site selection, construction and management of livestock and poultry farms, breeding zones, designated slaughtering enterprises shall be in compliance with laws and regulations. Entities and individuals engaged in livestock poultry breeding and slaughtering shall take effective measures to dispose of manure and carcasses of livestock, sewage and other wastes in a scientific manner to prevent environmental pollution.*" The project is to build a centralized anaerobic animal manure treatment system, which is a commonly used method to prevent methane emission. And the digestate will be handle in the onsite organic fertilizer production plant. Both the methods will prevent environmental pollution. Therefore, this project is in compliance with "take effective measures to dispose of manure and carcasses of livestock, sewage and other wastes in a scientific manner to prevent environmental pollution".
2	Law of the People's Republic of China on the Prevention and Control of Solid Waste Pollution	Article 20 "*For large-scale livestock and poultry farming, livestock and poultry manure and other solid wastes produced during the farming process shall be promptly collected, stored, utilized or treated to avoid environmental pollution.*" The project is to build a centralized anaerobic animal manure treatment system, which is a commonly used method to collect and utilize animal manure. And the digestate will be handle at the onsite organic fertilizer production plant. Both the methods will prevent environmental pollution. The solid waste of the project would be classified into domestic garbage, industrial solid waste and hazardous waste and collected respectively and then sent to the relevant qualified entities for centralized treatment regularly. Therefore, this project is in compliance with "take effective measures to dispose of manure and carcasses of livestock, sewage and other wastes in a scientific manner to prevent environmental pollution".
3	Action plan for the resource utilization of	Section 2 article 4 "*Encourage and guide large-scale breeding farms to build necessary supporting facilities for manure treatment and utilization. Transform and upgrade*

	livestock and poultry manure	*existing infrastructure and equipment. Encourage the construction of centralized processing centers in intensive breeding areas and carry out specialized centralized processing."* The project is to build a centralized anaerobic animal manure treatment system, which is in compliance with this action plan.
4	Regulations on Environmental Protection in Shandong Province	Article 43 *"People's governments at all levels should promote green and low-carbon development, formulate policies and measures such as circular economy, clean production, comprehensive environmental management, and waste recycling, strengthen pollution control in key regions, key river basins, and key industries, and encourage and support pollution-free or low-pollution Industrial development, improve resource utilization efficiency, and reduce pollution emissions."* The project collects and utilize animal manure to produce methane for onsite power supply. During this process, the project improves resource utilization efficiency and reduces the pollution emissions, which is in compliance with the regulations.

The project has obtained the project approval and EIA approval from local government authorities: Environmental Protection Bureau of Zhanhua District, Binzhou City and Agriculture and Rural Affairs Bureau of Zhanhua District, Binzhou City. The two approvals well demonstrate that local government permits the construction of the project. Consequently, the project is compliance with laws, statutes and other regulatory frameworks.

1.15 Participation under Other GHG Programs

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

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

1.15.2 Projects Rejected by Other GHG Programs

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

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

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.

1.16.2 Other Forms of Environmental Credit

The project has not sought or received another form of GHG-related environmental credit.

1.17 Additional Information Relevant to the Project

Leakage Management

Not applicable.

Commercially Sensitive Information

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

Sustainable Development

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

Enhance the quality of water. The project will avoid waste of animals discharging into the farm and underground water system through capturing waste of animals. The project will enhance the quality of the water and improve the working environment of the workers of the livestock farm. Thus, the project will achieve SDG 6 Clean Water And Sanitation[1].

The project will provide new job opportunities and increase tax revenue, which will have a positive effect on the local economy. Thus, the project will achieve SDG 8 Decent Work and Economic Growth[2].

[1] https://sdgs.un.org/goals/goal6

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

Reduce CH_4 emission. The project will reduce CH_4 emissions from animal wastes through biogas digesters with methane capture and flare, which contributes to China's commitment to peak carbon dioxide emissions before 2030. Thus, the project will achieve SDG 13 Climate Action[3].

Protect the soil. The residual waste from the digesters of the project will be used to produce organic fertilizer, which will reduce the usage of fertilizer and pesticides, protect the quality of soils, and enhance the ecosystem's sustainable development. Thus, the project will achieve SDG 15 Life On Land[4].

Further Information

Not applicable.

2 SAFEGUARDS

2.1 No Net Harm

The Environmental Impact Assessment (EIA) of the project has been conducted, and EIA report has been approved by Environmental Protection Bureau of Zhanhua District, Binzhou City on 29-11-2018 (Approval No. "Zhanhuanzi [2018] No.76"). The EIA report has assessed every possible aspect of environmental impact of the project and recommended corresponding measures, where applicable. Meanwhile, the implementation of the project will improve local socio-economic development through creating career opportunities and paying taxes. The project will also contribute to the sustainable development of local community as described in section 1.17 above.

In conclusion, the project has no negative impacts on local environment and socio-economy. No net harm on local environment and social community has been detected for the project.

2.2 Local Stakeholder Consultation

Local Stakeholder Consultation during the project preparation stage:

The project owner collected comments from local stakeholders on the project activity. Survey questionnaires were distributed to relevant personnel of the livestock farms, local villagers, and

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

[4] https://sdgs.un.org/goals/goal15

government officials by the Project owner on 06/05/2019 The survey questionnaire was designed to assess the project's impacts on the local environment and social-economic development. The structure of the survey respondents is listed in Table 2-1 below.

Table 2-1 Structure of stakeholder survey

Item \ Distribution		Quantity	Percentage
Amount of stakeholders surveyed	Male	15	50%
	Female	15	50%
Age	<25	7	23%
	25-55	15	50%
	>55	8	27%
Education	Junior high school or below	9	30%
	Senior high school	15	50%
	College or above	6	20%
Occupation	Worker	14	47%
	Peasant	7	23%
	Management personnel	4	13%
	Civil servant	3	10%
	Unspecified	2	7%

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

Table 2-2 Summary of stakeholders' comments

No.	Questions	Attitude or Opinion	Amount	Percentage
1		Very much	24	80%

	Do you know about the project activity?	Heard of	2	7%
		Nothing	4	13%
2	Do you think the project will improve the current situation of livestock farms?	Yes	28	93%
		No	0	0%
		Don't know	2	7%
3	Do you think the project will improve the local employment situation?	Yes	24	80%
		No	0	0%
		Don't know	6	20%
4	Do you think the project will improve the local social community?	Yes	19	63%
		No	0	0%
		Don't know	11	37%
		No impact	1	3%
		Negative impact	0	0%
5	What is the most probable environmental impact do you think the project will cause after the construction finish? (Multiple choice)	None	22	73%
		Air pollution	0	0%
		Water pollution	0	0%
		Noise pollution	0	0%
		Harm to indigenous animals and plants	0	0%

		Don't know	8	27%
6	What is your attitude to the project activity?	Support	27	90%
		Against	0	0%
		Indifferent	3	10%

In general, local stakeholders are supportive of the project construction. The survey shows that most local stakeholders think the Project will help improve the life of local people and local social community without much adverse environmental impact. The survey shows that almost all the stakeholders are supportive of the proposed project, believing that the Project will provide more employment opportunities. Therefore, the implementation of the project is regarded as beneficial by most of the local stakeholders.

Local Stakeholder Consultation during the project implementation stage:

Communications with Local stakeholders are being carried out at periodic intervals. Key implementation schedules or changes of the project will be communicated to the local authority, who will inform the neighborhood committee and the residents, the comments and suggestions from residents will be collected by the local authority meanwhile. And the local government agencies and competent authorities will conduct spot checks on the implementation of the project from time to time and give suggestions on the involved rectification problems. There are no negative comments received for the project. In line with VCS requirements, all the processes have been implemented to receive comments from local stakeholders as well as communicate with them at periodic intervals.

2.3 Environmental Impact

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

1. Construction Phase

1.1 Air pollution

Construction dust and road dust during the construction has a certain effect on the surrounding areas of the construction site, these adverse effects are accidental, temporary, and partial, as long as to take effective measures and strengthen management, the scope of its influence is generally limited to the surrounding area of the construction site and will disappear along with the end of construction.

1.2 Wastewater

Wastewater during the construction period mainly includes construction wastewater and domestic sewage. The following measures are taken to prevent and control the pollution of construction wastewater: construct temporary diversion ditches on the construction site; Set up a sedimentation tank and reuse the washing water for construction machinery as much as possible after simple treatment of equipment and vehicles.

Domestic sewage is collected and pre-treatment in the on-site septic tank; then it is regularly cleared by the sanitation department.

1.3 Noise

The noise generated by the project construction has a slight impact on the surrounding sensitive points, and its pollution impact is localized and short-term. After adopting a reasonable construction organization method, its impact on the surrounding area can be reduced to the acceptable range.

1.4 Solid waste

During the construction period, a certain amount of construction waste and domestic waste from construction workers will be generated, of which part of the construction waste will be recycled, and the unusable waste will be handed over to the sanitation department for disposal. After the above measures are taken, the solid waste of the project will not cause pollution to the surrounding environment.

2. Operation Phase

2.1 Air pollution

The air pollution during the operation mainly includes the malodorous exhaust gas of the biogas flaring system and biogas heating system, which consists of NO_x, sulfur dioxide, H_2S, NH_3, and particulate matter. The malodorous exhaust gas is to be treated through biological purification equipment before being discharged into the biogas flaring system and biogas heating system. The emission of NO_x, sulfur dioxide, H_2S, NH_3, and particulate matter in all the exhaust gas by the project meets standard of " Malodorous Pollutants Emission Standards " (GB14554-93) and the standard of " Discharge standard of pollutants for livestock and poultry breeding " (DB37/534-2005).

2.2 Wastewater

The wastewater during operation is mainly biogas slurry from anaerobic digesters. Most biogas slurry will also be recycled in anaerobic digesters, and surplus biogas slurry will be treated in the wastewater treatment system and be used for nearby farm irrigation. No wastewater will be discharged into the environment. Therefore, the project activity has little effect on the surrounding ground water and surface water.

2.4 Solid waste

The solid waste of the project is mainly domestic garbage and digestate. Among them, the digestate from the anaerobic digesters will be used as material to produce organic fertilizer. The domestic garbage is collected respectively and then sent to the landfill site for landfill treatment by the sanitation department.

In conclusion, the environmental impact during the project construction will be temporary and not significant, and the environmental impact during the project operation will be minor. The project activity can reduce greenhouse gas emissions and environmental pollution caused by methane release and coal-fired power generation. The Project owner takes appropriate measures to minimize adverse environmental impacts.

2.4 Public Comments

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

2.5 AFOLU-Specific Safeguards

Not applicable.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

The project applies one small scale CDM methodology and two relevant tools:

The methodology:

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

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

The tool:

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

Project emissions from flaring (version 03.0);

Reference:

https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-14-v2.pdf

https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-06-v3.0.pdf

3.2 Applicability of Methodology

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

Table 3-1 Applicability of AMS-III.D

Clauses	Requirements of the AMS-III.D	Scenario of the project	Conclusion
1	This methodology covers project activities involving the replacement or modification of anaerobic animal manure management systems in livestock farms to achieve methane recovery and destruction by flaring/combustion or gainful use of the recovered methane. It also covers the treatment of manure collected from several farms in a centralized plant.	The project uses the HDPE membrane enclosed anaerobic digesters to treat animal manure waste. The project replaces existing anaerobic animal manure management systems (open lagoon) in livestock farms to achieve methane recovery and destruction by flaring.	Applicable
2	This methodology is only applicable under the following conditions:		
	a) The livestock population in the farm is managed under confined conditions	All the livestock population in the farms within the project boundary is managed under confined conditions.	Applicable
	b) Manure or the streams obtained after treatment are not discharged into natural water resources (e.g. river or estuaries), otherwise “AMS-III.H Methane recovery in wastewater treatment" shall be applied	As per the EIA report, manure or the streams obtained after treatment are not discharged into natural water resources (e.g. river or estuaries).	Applicable
	c) The annual average temperature of baseline site where anaerobic manure treatment facility is located is higher than 5°C	The annual average temperature of the baseline site where the anaerobic manure treatment facility is located is higher than 5°C.	Applicable
	d) In the baseline scenario the retention time of manure waste in the anaerobic treatment system is greater than one month, and if anaerobic lagoons are used in the baseline, their depths are at least 1 m	In the baseline scenario, the retention time of manure waste in the anaerobic lagoons is greater than one month, and their depths are at least 1 m.	Applicable
	e) No methane recovery and destruction by flaring or combustion for gainful use takes place in the baseline scenario	No methane recovery and destruction by flaring or combustion for gainful use takes place in the baseline scenario.	Applicable
	The project activity shall satisfy the following conditions:		

3	(a) The residual waste from the animal manure management system shall be handled aerobically, otherwise the related emissions shall be taken into account as per relevant procedures of “AMS-III.AO Methane recovery through controlled anaerobic digestion". In the case of soil application, proper conditions and procedures (not resulting in methane emissions) must be ensured;	The residual waste from the animal manure management system of the project will be used to produce organic fertilizer, which is handled aerobically and will not result in methane emissions.	Applicable
	(b) Technical measures shall be used (including a flare for exigencies) to ensure that all biogas produced by the digester is used or flared;	During the heating period (October to April next year), biogas produced by the project are used directly to power the auxiliary equipment of the project’s animal manure treatment system and the organic fertilizer plant. And during the non-heating period, all biogas produced by the project is collected and flared.	Applicable
	(c) The storage time of the manure after removal from the animal barns, including transportation, should not exceed 45 days before being fed into the anaerobic digester. If the project proponent can demonstrate that the dry matter content of the manure when removed from the animal barns is larger than 20%, this time constraint will not apply.	The storage time of the manure after removal from the animal barns, including transportation will not exceed 45 days before being fed into the anaerobic digester.	Applicable
4	Projects that recover methane from landfills shall use “AMS-III.G Landfill methane recovery" and projects for wastewater treatment shall use AMS-III.H. Projects for composting of animal manure shall use “AMS-III.F Avoidance of methane emissions through composting". Project activities involving co-digestion of animal manure and other organic matters shall use the methodology “AMS-III.AO Methane recovery through controlled anaerobic digestion".	The project does not involve landfill methane recovery, wastewater treatment, composting animal manure, or co-digestion of animal manure and other organic matters.	Irrelevant

5	Utilization of the recovered biogas in one of the options detailed in AMS-III.H is also eligible under this methodology. The respective procedures in AMS-III.H shall be followed in this regard. If the recovered biogas is used to power auxiliary equipment of the project activity, it should be taken into account accordingly, using zero as its emission factor; however, energy used for such purposes is not eligible as an SSC CDM Type I project component.	The biogas recovered is used to power auxiliary equipment of the project activity during the heating period, zero is used as its emission factor, and this part of biogas is not eligible as an SSC CDM Type I project component, which means no emission reductions will be claimed for biogas utilization.	Applicable
6	New facilities (Greenfield projects) and project activities involving capacity additions compared to the baseline scenario are only eligible if they comply with the related and relevant requirements in the "General guidelines for SSC CDM methodologies".	The project is a Greenfield project. The emission reduction sourced from methane recovery is 11,795 tCO_2e/yr, which is lower than the threshold of 60,000 tCO_2e/yr. Therefore, the Project is in line with “General Guidelines to SSC CDM methodologies”	Applicable.
7	The requirements concerning demonstration of the remaining lifetime of the replaced equipment shall be met as described in the "General guidelines for SSC CDM methodologies".	The project is a Greenfield project, does not involve the replaced equipment. Therefore, this is irrelevant.	Irrelevant.
8	Measures are limited to those that result in aggregate emission reductions of less than or equal to 60 kt CO_2 equivalent annually from all Type III components of the project activity.	The emission reductions from the recovery and destruction of methane (Type III components of the project) are 11,795 tCO_2e/yr, which is less than 60 kt CO_2 equivalent.	Applicable.

In addition, the project meets the applicability conditions of the applied tool: Project and leakage emissions from anaerobic digesters (version 02.0) as follows:

Tool/Criteria	Applicability	Conclusion
This tool provides procedures to calculate project and leakage emissions associated with anaerobic digestion in an anaerobic digester. The tool is not applicable to other systems where waste may be	This project is to build an anaerobic animal manure treatment system to treat manure waste. It doesn’t involve other systems where	Applicable

decomposed anaerobically, for instances stockpiles, SWDS or unaerated lagoons.	waste may be decomposed anaerobically.	
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.	Source (c), (d) of project emissions have been accounted in this project.	Applicable.
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 does not involve composting or anaerobic storage.	Irrelevant.
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, the aerobic treatment of liquid digestate, and land application of the digestate are neglected because these are minor emission sources or because they are accounted in the methodologies referring to this tool.	As per the applied methodology, N_2O emissions are neglected because these are minor emission sources.	Applicable.

In addition, the project meets the applicability conditions of the applied tool: Project emissions from flaring (version 03.0) as follows:

Tool/Criteria	Applicability	Conclusion
This tool provides procedures to calculate project emissions from flaring of a residual gas. The tool is applicable to enclosed or open flares and project participants should document in the PD	The project will use an enclosed flaring system.	Applicable

the type of flare used in the project activity.		
This tool is applicable to the flaring of flammable greenhouse gases where: (a) Methane is the component with the highest concentration in the flammable residual gas; and (b) The source of the residual gas is coal mine methane or a gas from a biogenic source (e.g. biogas, landfill gas or wastewater treatment gas).	Methane is the component with the highest concentration in the biogas flared in the project.	Applicable
The tool is not applicable to the use of auxiliary fuels and therefore the residual gas must have sufficient flammable gas present to sustain combustion. For the case of an enclosed flare, there shall be operating specifications provided by the manufacturer of the flare.	The project does not use auxiliary fuels.	Applicable

3.3 Project Boundary

According to the methodology AMS-III.D, the project boundary includes the physical, geographical site(s) of (a) The livestock; (b) Animal manure management systems (including centralised manure treatment plant where applicable); (c) Facilities which recover and flare/combust or use methane.

Hence, the project boundary of the Binzhou Topigs Norsvin Breeding Swine Co., Ltd. Binhai Swine Farm Biogas Recovery and Utilization Project includes the physical and geographical sites of the livestock, the anaerobic animal manure management systems, the biogas flaring systems, wastewater treatment system, biogas heating system and residual waste treatment system.

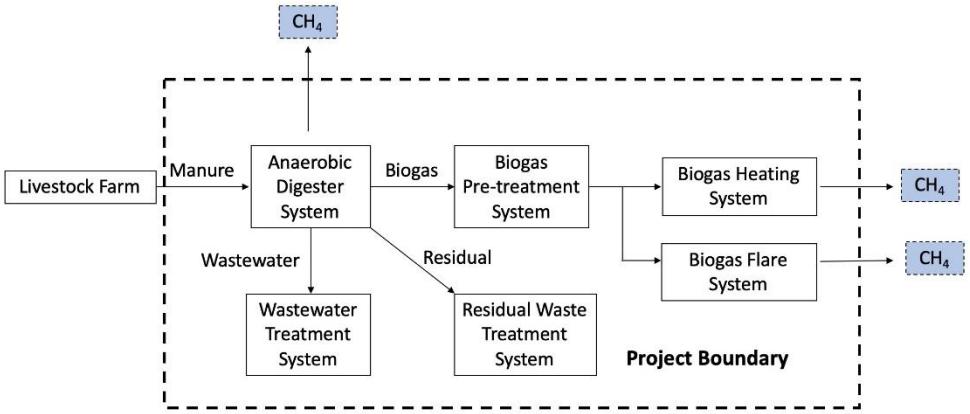

Figure 3-1 Project boundary of the project

Source		Gas	Included?	Justification/Explanation
Baseline	Direct emissions from the manure treatment processes	CO_2	No	Excluded for simplification.
		CH_4	Yes	The major source of emissions in the baseline
		N_2O	No	Excluded for simplification.
Project	Physical leakage of biogas in the manure management systems	CO_2	No	Excluded for simplification.
		CH_4	Yes	Main emission source.
		N_2O	No	Excluded for simplification.
	Emissions from flaring or combustion of the gas stream	CO_2	No	Excluded for simplification.
		CH_4	Yes	Main emission source.
		N_2O	No	Excluded for simplification.
	Emissions from the use of fossil fuels or electricity	CO_2	No	The project does not involve fossil fuels and electricity consumption, so Emission from the use of fossil fuels or electricity is not included.
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.
	Emissions from incremental transportation distances	CO_2	No	The project does not involve the transportation of manure.
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.

Source		Gas	Included?	Justification/Explanation
	Emissions from the storage of manure	CO_2	No	Excluded for simplification.
		CH_4	No	The storage time of the manure after removal from the animal barns, is within 24 hours before being fed into the anaerobic digester, hence Emissions from the storage of manure are not accounted for.
		N_2O	No	Excluded for simplification.

3.4 Baseline Scenario

As per para. 17 of AMS-III.D, the baseline scenario is the situation where, in the absence of the project activity, animal manure is left to decay anaerobically within the project boundary and methane is emitted to the atmosphere.

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

3.5 Additionality

As per para. 15-16 of applied methodology AMS-III.D, project activities may demonstrate the additionality by showing that there is no regulation in the host country, applicable to the project site, that requires the collection and destruction of methane from livestock manure. If so, it is not required to apply the "Guidelines on the demonstration of additionality of small-scale project activities".

The regulations relative to the project in China are identified as below.

a) Environmental Protection Law of People's Republic of China;

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

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

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

e) Discharge standard of pollutants for livestock and poultry breeding (GB/T18596);

f) The technical standard of pollution prevention for livestock and poultry breeding (HJ/T81).

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

3.6 Methodology Deviations

Not applicable.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

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

(a) Using the amount of the waste or raw material that would decay anaerobically in the absence of the project activity, with the most recent IPCC Tier 2 approach (please refer to the chapter 'Emissions from Livestock and Manure Management' under the volume 'Agriculture, Forestry and other Land use' of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories). For this calculation, information about the characteristics of the manure and of the management systems in the baseline is required. Manure characteristics include the amount of volatile solids (VS) produced by the livestock and the maximum amount of methane that can be potentially produced from that manure (B_o);

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

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

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

Where:

BE_y	=	Baseline emissions in year y (t CO_2e)
GWP_{CH4}	=	Global Warming Potential (GWP) of CH_4 applicable to the crediting period (tCO_2e/tCH_4)
D_{CH4}	=	CH_4 density (0. 67kg/m^3 at room temperature (20°C) and 1 atm pressure)

UF_b	=	Model correction factor to account for model uncertainties (0.94)
LT	=	Index for all types of livestock
j	=	Index for animal manure management system
MCF_j	=	Annual methane conversion factor (MCF) for the baseline animal manure management system j
$B_{0,LT}$	=	Maximum methane producing potential of the volatile solid generated for animal type LT (m^3CH_4/kg-dm)
$N_{LT,y}$	=	Annual average number of animals of type LT in year y (numbers)
$VS_{LT,y}$	=	Volatile solids production/excretion per animal of livestock LT in year y (on a dry matter weight basis, kg-dm/animal/year)
$MS\%_{Bl,j}$	=	Fraction of manure handled in baseline animal manure management system j

a) The maximum methane-producing capacity of the manure ($B_{o,LT}$) varies by species and diet. The preferred method to obtain $B_{o,LT}$ measurement values is to use data from country-specific published sources, measured with a standardised method ($B_{o,LT}$ shall be based on total as-excreted VS). These values shall be compared to IPCC default values and any significant differences shall be explained. If country specific B_o values are not available, default values from tables 10 A-4 to 10 A-9 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10 can be used, provided that the project participants assess the suitability of those data to the specific situation of the treatment site.

b) VS are the organic material in livestock manure and consist of both biodegradable and non-biodegradable fractions. For the calculations the total VS excreted by each animal species is required.

If country specific VS values are not available IPCC default values from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 10 table 10 A-4 to 10 A-9 can be used provided that the project participants assess the suitability of those data to the specific situation of the treatment site particularly with reference to feed intake levels;

c) $B_{o,LT}$ values applicable to developed countries can be used provided the following four conditions are satisfied:

i. The genetic source of the livestock originates from an Annex I Party;

ii. The farm uses formulated feed rations (FFR) which are optimized for the various animal(s), stage of growth, category, weight gain/productivity and/or genetics;

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

iv. The project specific animal weights are more similar to developed country IPCC default values.

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

e) The annual average number of animals ($N_{LT,y}$) is determined as follows:

$$N_{LT,y} = N_{da,y} \times (\frac{N_{p,y}}{365}) \quad (2)$$

Where:

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

4.2 Project Emissions

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

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

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

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

(d) CO_2 emissions from incremental transportation distances ($PE_{transp,y}$);

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

$$PE_y = PE_{PL,y} + PE_{flare,y} + PE_{power,y} + PE_{transp,y} + PE_{storage,y} \quad (3)$$

Where:

PE_y	=	Project emissions in year *y* (tCO_2e)
$PE_{PL,y}$	=	Emissions due to physical leakage of biogas in year *y* (tCO_2e)
$PE_{flare,y}$	=	Emissions from flaring or combustion of the biogas stream in the year *y* (tCO_2e)

$PE_{power,y}$ = Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year *y* (tCO_2e)

$PE_{transp,y}$ = Emissions from incremental transportation in the year *y* (tCO_2e), as per relevant paragraph in AMS-III.AO

$PE_{storage,y}$ = Emissions from the storage of manure (tCO_2e)

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

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

$$PE_{PL,y} = 0.10 \times GWP_{CH4} \times D_{CH4} \times \sum_{j,LT} B_{0,LT} \times N_{LT,y} \times VS_{LT,y} \times MS\%_{i,y} \quad (4)$$

Where:

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

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

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

As per "Project emissions from flaring" (version 03.0)", Emissions from flaring ($PE_{flare,y}$) should be calculated as follows:

$$PE_{flare,y} = GWP_{CH4} \times \sum_{m=1}^{525600} F_{CH4,RG,m} \times (1 - \eta_{flare,m}) \times 10^{-3} \quad (5)$$

Where:

$F_{CH4,RG,m}$ = Mass flow of methane in the residual gas in the minute m (kg)

$\eta_{flare,m}$ = Flare efficiency in minute m

For the Mass flow of methane in the residual gas ($FC_{H4,RG,m}$), $\sum_{m=1}^{525600} F_{CH4,RG,m}$ is equal to the quantity of methane produced in the anaerobic digester in year y,

$$\sum_{m=1}^{525600} F_{CH4,RG,m} = Q_{CH4,y} \quad (6)$$

Where:

$Q_{CH4,y}$ = Quantity of methane produced in the anaerobic digester in year y (tCH_4)

And for $Q_{CH4,y}$ could be calculated based on the amount of biogas collected at the digester outlet in a year.

$$Q_{CH4,y} = Q_{biogas,y} \times f_{CH4,default} \times \rho_{CH4} \quad (7)$$

Where:

$Q_{biogas,y}$	=	Amount of biogas collected at the digester outlet in year y (Nm^3biogas),
$f_{CH4,default}$	=	Default value for the fraction of methane in the biogas (m^3CH_4/m^3biogas)
ρ_{CH4}	=	Density of methane at normal conditions ($kgCH_4/Nm^3CH_4$)

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

Project emissions from electricity and fossil fuel consumption are determined by following the methodological tool "Project and leakage emissions from anaerobic digesters" (version 02.0), where $PE_{Power,y}$ is the sum of $PE_{EC,y}$ and $PE_{FC,y}$ in the tool.

$$PE_{power} = PE_{EC,y} + PE_{FC,y} \quad (8)$$

Where:

$PE_{EC,y}$	=	Project emissions from electricity consumption associated with the anaerobic digester in year y (tCO_2)
$PE_{FC,y}$	=	Project emissions from fossil fuel consumption associated with the anaerobic digester in year y (tCO_2)

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

As per the methodological tool "Project and leakage emissions from anaerobic digesters" (version 02.0), project emissions from electricity consumption associated with the anaerobic digester are calculated as follows:

$$PE_{EC,y} = Q_{CH4,y} \times F_{EC,default} \times EF_{EL,default} \quad (9)$$

Where:

$F_{EC,default}$	=	Default factor for the electricity consumption associated with the anaerobic digester per ton of methane generated (MWh/tCH_4)
$EF_{EL,default}$	=	Default emission factor for the electricity consumed in year y (tCO_2/MWh)

As per the methodological tool "Project and leakage emissions from anaerobic digesters" (version 02.0), $F_{EC,default}$ for covered anaerobic lagoons (gravity fed) / conventional digesters is 0. This project uses the HDPE membrane enclosed anaerobic digesters, which is a commonly used kind

of covered anaerobic lagoons, so the $F_{EC,default}$ in this project is 0. Therefore, $PE_{EC,y}$ in this project is 0.

In summary, $PE_{Power,y}$ is 0 in this project.

4. Emissions from incremental transportation in the year y

The project will transfer the manure within the livestock farm, and won't involve road and rail transportation. Therefore, $PE_{transp,y}$ is not included in the project emission.

5. Emissions from the storage of manure

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

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

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

As per the FSR of the project, all animal manure will be collected several times a day and delivered to the anaerobic digesters systems immediately. Therefore, the storage time of the manure before being fed into the anaerobic digester is less than 24 hours, hence emissions from the storage of manure are not accounted for, $PE_{storage,y}$ = 0 tCO_2e.

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

$$PE_y = PE_{PL,y} + PE_{flare,y} + PE_{power,y} = PE_{PL,y} + PE_{flare,y} + PE_{EC,y} \quad (10)$$

4.3 Leakage

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

Digestate from the anaerobic digesters of the project will be used to produce organic fertilizer when digestate is removed from the digesters. Digestate will not be stored under anaerobic conditions. In addition, the project does not involve composting of digestate. Therefore, leakage emissions of the project associated with the anaerobic digester is not accounted for.

4.4 Net GHG Emission Reductions and Removals

The emission reductions achieved by the project activity will be determined ex-post through direct measurement of the amount of methane flared. It is likely that the project activity involves manure treatment steps with higher methane conversion factors (MCF) than the MCF for the manure treatment systems used in the baseline situation, therefore the emission reductions

achieved by the project activity are limited to the ex-post calculated baseline emissions minus the project emissions using the actual monitored data for the project activity (i.e. $N_{LT,y}$, $MS\%_{i,y}$, as well as $VS_{LT,y}$ in cases where adjusted values for animal weight are used). The emission reductions achieved in any year are the lowest value of the following:

$$ER_{y,ex\ post} = min\left[\left(BE_{y,ex\ post} - PE_{y,ex\ post}\right), \left(MD_y - PE_{power,y,ex\ post}\right)\right] \quad (11)$$

Where:

$ER_{y,ex\ post}$	=	Emission reductions achieved by the project activity based on monitored values for year *y* (tCO_2e)
$BE_{y,ex\ post}$	=	Baseline emissions calculated using equation 1. For projects using option in paragraph 错误!未找到引用源。 using ex post monitored values of $N_{LT,y}$ and if applicable $VS_{LT,y}$. For projects using option in paragraph 错误!未找到引用源。, the ex post monitored values for $Q_{manure,j,LT,y}$ and $SVS_{j,LT,y}$ are used
$PE_{y,ex\ post}$	=	Project emissions calculated using equation 11 using ex post monitored values of $N_{LT,y}$, $MS\%_{i,y}$, and if applicable $VS_{LT,y}$
MD_y	=	Methane captured and destroyed or used gainfully by the project activity in year *y* (tCO_2e)
$PE_{power,y,ex\ post}$	=	Emissions from the use of fossil fuel or electricity for the operation of the installed facilities based on monitored values in the year *y* (tCO_2e)

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

$$\mathrm{MD_y} = \mathrm{BG_{burnt,y}} \times \mathrm{w_{CH4,y}} \times \mathrm{D_{CH4}} \times \mathrm{FE} \times \mathrm{GWP_{CH4}} \quad (12)$$

Where:

$\mathrm{BG_{burnt,y}}$	=	Biogas flared or combusted in year y (m^3)
$\mathrm{w_{CH4,y}}$	=	Methane content in biogas in the year y (volume fraction)
FE	=	Flare efficiency in the year y (fraction), which is equal to $\eta_{flare,m}$

Ex-ante calculation of GHG emission reductions

1. Calculation of baseline emissions:

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

Parameter	Value	Data sources
GWP_{CH4}	28 tCO_{2e}/tCH_4	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
D_{CH4}	0.67 kg/m^3	AMS-III.D
UF_b	0.94	AMS-III.D

MCF_j	71%	Table 10.17 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 10
$B_{o,LT}$	Breeding Swine:0.45 m^3CH_4/kg-VS	Table 10A-8 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 10
$VS_{default}$	Breeding Swine: 0.46 kg/hd/day	Table 10A-8 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 10
$MS\%_{BI,j}$	100%	Feasibility Study Report of the project
nd_y	365 days	Feasibility Study Report of the project
$N_{da,y}$	Adult breeding Swine: 365 days	Feasibility Study Report of the project
$N_{p,y}$	Adult breeding Swine: 15,150	Feasibility Study Report of the project

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

Parameter	Adult Breeding Swine	Unit
GWP_{CH4}	28	tCO_2e/tCH_4
D_{CH4}	0.67	kg/m^3
UF_b	0.94	/
MCF_j	71%	/
$B_{0,LT}$	0.45	m^3 CH_4/kg-dm
$N_{LT,y}$	15,150	/
$VS_{LT,y}$	167.90	kg-dm/(animal*year)
$MS\%_{BI,j}$	100%	/
$BE_{y,i}$	**14,331**	**t CO_2e**

So, the ex-ante calculated baseline emissions (BE_y) is 14,331 tCO_2e.

2. Calculation of project emissions

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

Parameter	Value	Data sources

GWP_{CH4}	28 tCO_{2e}/tCH_4	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
D_{CH4}	0.67 kg/m^3	AMS-III.D
$B_{o,LT}$	Breeding Swine:0.45 $m^3CH_4/kg\text{-}VS$	Table 10A-8 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 10
$VS_{default}$	Breeding Swine: 0.46 kg/hd/day	Table 10A-8 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 10
$MS\%_{i,y}$	100%	AMS-III.D
nd_y	365 days	Feasibility Study Report of the project
$N_{da,y}$	Adult breeding Swine: 365 days	Feasibility Study Report of the project
$N_{p,y}$	Adult breeding Swine: 15,150	Feasibility Study Report of the project
$Q_{biogas,y}$	Heating Period: 483,090 m^3 Non-heating Period: 345,064 m^3	Feasibility Study Report of the project
$f_{CH4,default}$	0.6	"Tool to Project and leakage emissions from anaerobic digesters"
$\eta_{flare,m}$	Heating Period: 1 Non-heating Period: 0.9	AMS-III.D
$F_{EC,default}$	0	"Tool to Project and leakage emissions from anaerobic digesters"

$EF_{EL,default}$	1.3	"Tool to calculate baseline, project and/or leakage emissions from electricity consumption"

2.1 Emissions due to physical leakage of biogas in year y

As described in 4.2, project emissions from physical leakage of biogas are calculated as follow:

Table 4-4 Ex-ante calculate Physical leakage of biogas ($PE_{PL,y}$)

Parameter	Adult Breeding Swine	Unit
GWP_{CH4}	28	tCO_2e/tCH_4
D_{CH4}	0.67	kg/m^3
$B_{0,LT}$	0.45	m^3 CH_4/kg-dm
$N_{LT,y}$	15,150	/
$VS_{LT,y}$	167.900	kg-dm/(animal*year)
$MS\%_{BI,j}$	100%	/
$PE_{PL,y}$	**2,147**	**t CO_2e**

So, the ex-ante calculated result of the project's Physical leakage of biogas is 2,147 tCO_2e.

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

As described in 4.2, the emissions from flaring or combustion of the biogas stream shall ex-ante calculated as follow:

Table 4-5 Ex-ante calculate emissions from flaring or combustion of the biogas stream

Parameter	Heating Period	Non-heating Period	Unit
GWP_{CH4}	28	28	tCO_2e/tCH_4
D_{CH4}	0.67	0.67	kg/m^3
Biogas Produce Quantity	483,090	345,064	m^3
$f_{CH4,default}$	0.6	0.6	/
Efficiency	1	0.9	/
$PE_{flare,y}$	**0**	**388**	**t CO_2e**
$PE_{flare,y}$	**388**		**t CO_2e**

So, the ex-ante calculated result of the project's emissions from flaring or combustion of the biogas stream is 388 tCO_2e.

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

As described in 4.2, the emissions from the use of fossil fuel or electricity for the operation of the installed facilities ($PE_{power,y}$) is 0 tCO_2e.

2.4 Emissions from incremental transportation in the year y

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

2.5 Emissions from the storage of manure

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

So, the ex-ante estimated project emission shall calculate as far equation (11):

$PE_y = PE_{PL,y} + PE_{flare,y}$= 2,147 tCO_2e + 388 tCO_2e = 2,536 tCO_2e

3. Calculation of leakage

As described above, leakage is 0.

4. Calculation of emission reductions

Emission reductions of the project can be calculated as following equation (13):

$ER_y = BE_y - PE_y - LE_y = BE_y - PE_y$ (13)

Annual emission reductions of the project can be calculated as follows:

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
05/08/2020 to 31/12/2020	5,850	1,036	0	4,814
01/01/2021 to 31/12/2021	14,331	2,536	0	11,795
01/01/2022 to 31/12/2022	14,331	2,536	0	11,795
01/01/2023 to 31/12/2023	14,331	2,536	0	11,795
01/01/2024 to 31/12/2024	14,331	2,536	0	11,795
01/01/2025 to 31/12/2025	14,331	2,536	0	11,795
01/01/2026 to 31/12/2026	14,331	2,536	0	11,795
01/01/2027 to 04/08/2027	8,480	1,501	0	6,979

Total	100,316	17,753	0	82,563

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	GWP_{CH4}
Data unit	tCO_2e/tCH_4
Description	Global Warming Potential (GWP) of CH_4 applicable to the crediting period
Source of data	IPCC
Value applied	28
Justification of choice of data or description of measurement methods and procedures applied	Default value of 28 from IPCC Fifth Assessment Report (AR5). Shall be updated according to any future revision to VCS standard by VERRA.
Purpose of Data	Calculation of baseline emissions and project emissions
Comments	-

Data / Parameter	D_{CH4}
Data unit	kg/m^3
Description	CH4 density
Source of data	AMS-III.D
Value applied	0.67 (at 20 °C and 1 atm pressure)
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline emissions and project emissions
Comments	-

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

Data / Parameter	MCF_j
Data unit	-
Description	Annual methane conversion factor (MCF) for the baseline animal manure management system j
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied	71%
Justification of choice of data or description of measurement methods and procedures applied	No country or regional specific value is available. Default value from table 10.17 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 10 is applied. The annual average temperature of baseline site where anaerobic manure treatment facility is located is around 13°C [5], the corresponding annual methane conversion factor (MCF) is 71%.
Purpose of Data	Calculation of baseline emissions and project emissions
Comments	-

Data / Parameter	$B_{0,LT}$
Data unit	$m^3 CH_4/kg\text{-}VS$

[5] http://www.weather.com.cn/cityintro/101121101.shtml

Description	Maximum methane producing potential of the volatile solid generated for animal type LT
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied	Animal type: Adult breeding Swine; $B_{O,LT}$: 0.450
Justification of choice of data or description of measurement methods and procedures applied	No country or regional specific value is available. Default values from tables 10 A-4 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10 are applied. Bo values applicable to developed countries are used for the project as the following conditions are satisfied: (i) According to the animal purchase contract, the genetic source of dairy cow originates from Australia and the genetic source of market swine originates from UK; (ii) The farm uses formulated feed rations (FFR) which are optimized for the various animal(s), stage of growth, category, weight gain/productivity and/or genetics; (iii) The use of FFR can be validated through on-farm record keeping; (iv) The project specific animal weights are more similar to developed country IPCC default values as per on-farm record keeping
Purpose of Data	Calculation of baseline emissions and project emissions
Comments	-

Data / Parameter	$VS_{default}$
Data unit	kg/hd/day
Description	Default value for the volatile solid excretion rate per day on a dry-matter basis for a defined livestock population
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied	Animal type: Adult breeding Swine; $VS_{default}$: 0.46
Justification of choice of data or description of measurement methods and procedures applied	According to animals' genetic region" and type, Default values from table 10 A-8 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10 are applied.

	The genetic source for all types of swine is from UK and Denmark, as defined as West Europe and the average weight of breeding swine is 200kg.
Purpose of Data	Calculation of baseline emissions and project emissions
Comments	-

Data / Parameter	$MS\%_{BI,j}$
Data unit	-
Description	Fraction of manure handled in baseline animal manure management system j
Source of data	FSR
Value applied	100%
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline emissions and project emissions
Comments	-

Data / Parameter	$f_{CH4,default}$
Data unit	-
Description	Default value for the fraction of methane in the biogas
Source of data	Tool to Project and leakage emissions from anaerobic digesters
Value applied	0.6
Justification of choice of data or description of measurement methods and procedures applied	There are two different procedures to determine the quantity of methane produced in the digester in year y ($Q_{CH4,y}$). For small scale projects, project participants may choose between Option 1 or Option 2. ● Option 1: Procedure using monitored data ● Option 2: Procedure using a default value Use this default value for Option 2 of the step "Determination of the quantity of methane produced in the digester"

Purpose of Data	Calculate the quantity of methane produced in the digester in year y
Comments	-

5.2 Data and Parameters Monitored

Data / Parameter	$MS\%_{i,y}$
Data unit	-
Description	Fraction of manure handled in system i in year y
Source of data	AMS-III.D
Description of measurement methods and procedures to be applied	The project does not involve sequential manure management system, hence all manure would be handled in system i, 100% is applied for $MS\%_{i,y}$
Frequency of monitoring/recording	-
Value applied	100%
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of baseline emissions and project emissions
Calculation method	-
Comments	-

Data / Parameter	$N_{p,y}$
Data unit	Number
Description	Number of animals produced annually of type LT for the year y
Source of data	Ex-ante values are sourced from the FSR of the project. Ex-post values are from the operation records.
Description of measurement methods and procedures to be applied	The number of breeding swine on the farm will be recorded monthly in the operation records.

Frequency of monitoring/recording	Monthly.
Value applied	Adult breeding Swine: 15,150
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	To calculate the annual average number of animals ($N_{LT,y}$)
Calculation method	-
Comments	-

Data / Parameter	$N_{da,y}$
Data unit	Day
Description	Number of days animal is alive in the farm in the year y
Source of data	Ex-ante values are sourced from the FSR of the project. Ex-post values are from the operation records.
Description of measurement methods and procedures to be applied	To collect the alive days of breeding swine in the livestock farms, the number of alive days of swine on the livestock farm will be recorded monthly in the operation records.
Frequency of monitoring/recording	Monthly
Value applied	Adult breeding Swine: 365 days
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	To calculate the annual average number of animals ($N_{LT,y}$)
Calculation method	-
Comments	-

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

Data / Parameter	FE ($\eta_{flare,m}$)
Data unit	%
Description	The flare efficiency
Source of data	Project emissions from flaring (version 03.0)
Description of measurement methods and procedures to be applied	As per para.22 of the applied methodology, if the recovered biogas is combusted for electrical/thermal energy production or for other gainful use, the methane destruction efficiency can be considered as 100%. As for flaring, the project uses enclosed flares, and the project chose option A of Project emissions from flaring (version 03.0) for the determination of flare efficiency. The flare efficiency of the

	project is determined as 90% since the project meets the following two conditions when in operating: • The temperature of the flare and the flow rate of the residual gas to the flare is within the manufacturer's specification for the flare; and • The flame is detected in minute m. The project proponent chooses to apply 100% and 90% for heating period and non-heating period, this is conservative.
Frequency of monitoring/recording	-
Value applied	Heating period: 100% Non-heating period: 90%
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of emission reductions
Calculation method	-
Comments	-

Data / Parameter	$w_{CH4,y}$
Data unit	%
Description	Methane content in biogas in the year y
Source of data	AMS-III.D default value
Description of measurement methods and procedures to be applied	Default value of 60% is applied as per AMS-III.D
Frequency of monitoring/recording	-
Value applied	60%
Monitoring equipment	-
QA/QC procedures to be applied	-

Purpose of data	Calculation of emission reductions
Calculation method	-
Comments	-

Data / Parameter	$BG_{burnt,y}$
Data unit	m^3
Description	Biogas flared in year y
Source of data	Records by project participants
Description of measurement methods and procedures to be applied	The amount of biogas recovered and flared or used gainfully shall be monitored ex post, using flow meters. Continuously measured by flow meter with temperature sensor and pressure sensor. The meter readings will be automatically converted to value at room temperature (20 °C) and 1 atm pressure.
Frequency of monitoring/recording	Monthly, based on continuous flow measurement with accumulated daily accumulated volume recording.
Value applied	Monitored ex-post
Monitoring equipment	Flow meter
QA/QC procedures to be applied	-
Purpose of data	Calculation of emission reductions
Calculation method	-
Comments	-

5.3 Monitoring Plan

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

(A) Monitoring structure

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

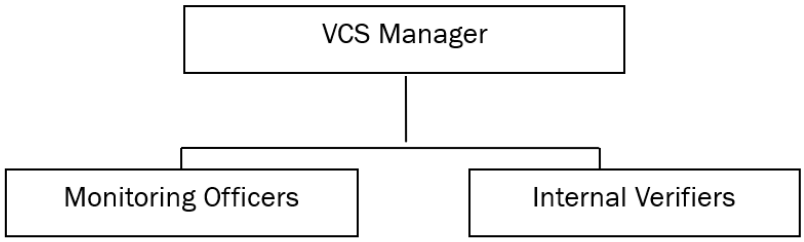

Figure 5-1 Operation and management structure of the project

(B) Data and parameters to be monitored

Data and parameters to be monitored are listed below.

Figure 5-2 shows the positions of the monitoring instruments.

Table 5-1 list the corresponding parameters monitored:

Table 5-1 Data and parameters to be monitored

Equipment No.	Parameter to be Monitored	Description
E1	$BG_{burnt,y}$	Biogas flared or combusted in year y is continuously measured by flow meter installed at the outlet of biogas purification system. The meter readings will be automatically converted to value at room temperature (20 °C) and 1 atm pressure
These two parameters do not require monitoring equipment, hence not shown in Figure 5-2 below	$w_{CH4,y}$	Methane content in biogas in the year y applies a default value of 60%, no monitoring equipment is required.
	FE	The flare efficiency applies the default value of 90%. No monitoring equipment is required.

/	$N_{p,y}$	The number of swine produced in the farm will be recorded manually by the responsible staff.
/	$N_{da,y}$	The number of alive days of swine on the livestock farm will be recorded manually by the responsible staff.
/	nd_y	The actual number of days the treatment plant was operationally used in the monitoring periods will be monitored and recorded by staff.

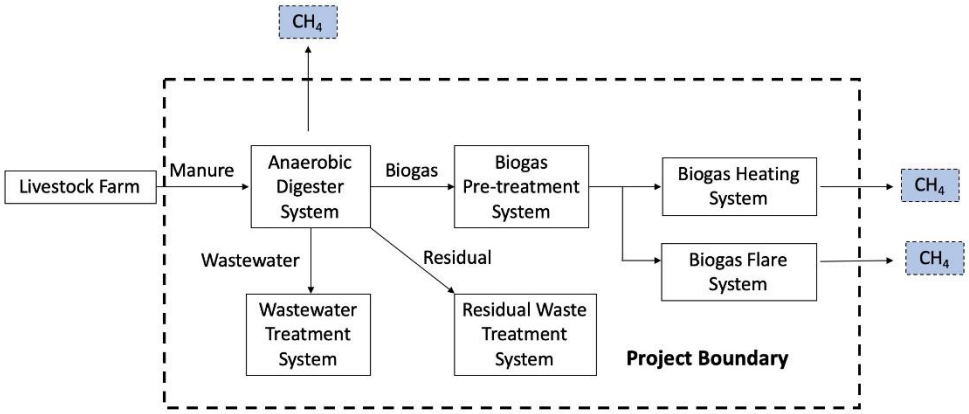

Figure 5-2 Project monitoring diagram

(C) Data collection

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

(D) Quality assurance

All metering equipment for monitoring will be chosen in accordance with VCS requirements and will be calibrated regularly for accuracy by qualified party according to the national regulations. To assist in future verifications, the project owner will preserve the calibration records, along with the data files of project monitoring.

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

The installation of flow meters will fulfill the national standard (MT448-2008). All the meters will be checked and maintained periodically.

(E) Data file management

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