FSW AMMS GHG MITIGATION PROJECT IN NANYANG CITY

Document Prepared by Shenzhen CTI International Certification Co., Ltd

Project Title	FSW AMMS GHG Mitigation Project in Nanyang City
Report Title	Joint Validation and 1st periodical VCS Verification report for FSW AMMS GHG Mitigation Project in Nanyang City
Version	1.1
Report ID	2022-0108
Verification Period	05-August-2020 to 30-June-2022
Client	Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd.
Pages	126
Date of Issue	27-September-2022
Prepared By	Shenzhen CTI International Certification Co., Ltd
Contact	Shenzhen CTI International Certification Co., Ltd F8-A CTI Building, No.4 LiuXianSan Road, Xin'an Street Bao'an District, Shen Zhen 518101, P. R. China Phone: +86-10-65580012

	https://www.cti-cert.org/ Contact: Ms. Lin Shunrong Email: linshunrong@cti-cert.com
Approved By	Zhou Lu
Work Carried Out By	Lin Wu (TL& verifier) Dai Qinghua (Technical Expert) Zhang Lei (TR)

Summary:

- *A description of the project*

The project activity developed in Nanyang City, Henan Province, P. R. China, is to install new animal waste management systems (AWMSs) by replace the current open anaerobic lagoons with 9 new closed anaerobic digesters to a group of 9 swine farms in project area, which will treat the manure and wastewater from the 9 swine farms to avoid methane emissions generated in the baseline uncovered anaerobic lagoons. The project activity involves implemented 9 sets of AWMSs in 9 existing swine farms involving 454,600 heads of market swine, 24,500 heads of breeding swine, it is estimated to produce 699,486 tons of manure and 3,847.173*$10^4$$m^3$ of biogas annually. The biogas produced is recovered and combusted for heat generation and used by swine farms, total heat production is estimated to be 769,433GJ. The project is expected to achieve 364,750 tCO_2e of emission reduction annually. The project started operation on 05-August-2020 with the VCS Ref. No. 2846.

- *A description of the validation and verification*

The approved CDM methodology ACM0010 "GHG emission reductions from manure management systems" (version 08.0) is applied to quantify the GHG removals achieved in this project. The calculation of the GHG emission reductions is carried out in a transparent and conservative manner. This project is being developed in conjunction with the validation and 1st periodic of verification.

- *The purpose and scope of validation and verification*

The validation objective is an independent assessment by a Third Party of a proposed project activity against all defined criteria set for the registration under the VCS. In order to confirm that the project activity, as documented, is sound reasonable and meets the identified criteria, the validation involves the assessment of: project conformance to VCS standards/programs, project conformance to the applied methodology, including the procedure for the demonstration of additionality specified in the methodology; and likelihood that methods and procedures set out in the project description will generate verifiable GHG data and information when implemented. Validation is a requirement and is seen as necessary to provide assurance to stakeholders of the quality of project and its intended generation of VCUs. Validation is part of the VCS project cycle and will finally result in a conclusion by the executing VVB whether a project activity is valid to be submitted for registration to VCS registry.

The objective of the verification is to have an independent review ex post determination by a VVB (Validation and Verification Body) of the monitored GHG emission reductions that have occurred as a result of the implementation of the project activity during a defined monitoring period.

- *The method and criteria used for validation and verification*

Validation and Verification is conducted using Shenzhen CTI International Certification Co., Ltd (CTI) procedures in line with the requirements specified in the latest version of the VCS Validation and Verification Manual and applying auditing techniques. The validation/verification team assessed the project activity's compliance against the VCS Standard Version 4.3, the selected CDM methodology and the joint project description and monitoring report. The project is eligible under Project Scope 1,

13 and 15. The validation/verification criteria followed the guidance documents provided by VCS included the following:

VCS Standard Version 4.3, VCS Program Guide Version 4.2 and the applied CDM methodology ACM0010 "GHG emission reductions from manure management systems" (version 08.0).

- *The number of findings raised during validation and verification*

In the course of the validation and verification, 22 Corrective Action Requests (CARs), 5 Clarification Requests (CLs) were raised and successfully closed. The assessment is included in the report.

- *Any uncertainties associated with the validation and verification*

There are no restrictions of uncertainty for both validation and verification.

- *Summary of the validation and verification conclusions*

Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd. has commissioned the Shenzhen CTI International Certification Co., Ltd to carry out the Verified Carbon Standard (VCS) validation joint with 1st periodical verification of the project, "FSW AMMS GHG Mitigation Project in Nanyang City" (VCS ID 2846) with regard to the relevant requirements of VCS Standard Version 4.3. CTI confirms all validation and verification activities including objectives, scope and criteria, level of assurance, project description, monitoring and monitoring report adhere to VCS Standard Version 4.3 and all associated updated as documented in this report, are complete.

CTI concludes that the project activity "FSW AMMS GHG Mitigation Project in Nanyang City" in China, as described in the final version of Joint-Project-Description-Monitoring-Report, meets all relevant requirements for VCS validation and verification activity and correctly applied the methodology ACM0010 Version 08.0. Hence CTI is able to certify that the GHG emission reductions from the project during the monitoring period from 05-August-2020 to 30-June-2022 were generated as 597,264 tCO_2e which can be claimed as VCUs.

CONTENTS

1 INTRODUCTION 6

1.1 Objective 6

1.2 Scope and Criteria 6

1.3 Level of Assurance 7

1.4 Summary Description of the Project 7

2 VALIDATION AND VERIFICATION PROCESS 9

2.1 Method and Criteria 9

2.2 Document Review 9

2.3 Interviews 10

2.4 Site Inspections 12

2.5 Resolution of Findings 13

2.5.1 Forward Action Requests 13

3 VALIDATION FINDINGS 14

3.1 Project Details 14

3.2 Participation under Other GHG Programs 20

3.3 Safeguards 20

3.4 Application of Methodology 23

3.5 Non-Permanence Risk Analysis 79

4 VERIFICATION FINDINGS 80

4.1 Accuracy of GHG Emission Reduction and Removal Calculations 80

4.2 Quality of Evidence to Determine GHG Emission Reductions and Removals 100

5 VALIDATION AND VERIFICATION CONCLUSION 101

APPENDIX 1: ABBREVIATIONS 103

APPENDIX 2: COMPETENCE OF TEAM MEMBERS AND TECHNICAL REVIEWERS 104

APPENDIX 3: DOCUMENTS REVIEWED OR REFERENCED 108

APPENDIX 4: CLARIFICATION REQUESTS, CORRECTIVE ACTION REQUESTS AND FORWARD ACTION REQUESTS 115

1 INTRODUCTION

1.1 Objective

Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd. has commissioned the Shenzhen CTI International Certification Co., Ltd to carry out the Verified Carbon Standard (VCS) validation joint with 1st periodical verification of the project for the monitoring period from 05-August-2020 to 30-June-2022 (both days included).

The objective of validation is an independent assessment by a Third Party of a proposed project activity against all defined criteria set for the registration under the VCS. In order to confirm that the project activity, as documented, is sound reasonable and meets the identified criteria, the validation involves the assessment of: project conformance to VCS standards/programs, project conformance to the applied methodology, including the procedure for the demonstration of additionality specified in the methodology; and likelihood that methods and procedures set out in the project description will generate verifiable GHG data and information when implemented. Validation is a requirement and is seen as necessary to provide assurance to stakeholders of the quality of project and its intended generation of VCUs. Validation is part of the VCS project cycle and will finally result in a conclusion by the executing VVB whether a project activity is valid to be submitted for registration to VCS registry.

The objective of verification is to have an independent review ex-post determination by a VVB of the monitored GHG emission reductions that have occurred as a result of the project activity implemented during a defined monitoring period. The evaluation is done against the requirements of the VCS Standard Version 4.3 based on the monitoring report. In order to confirm that the GHG emission reductions sound reasonable and meet the identified criteria, the verification involves the assessment of monitoring plan conformance to VCS rules and applied methodology. Verification is a requirement and is seen as necessary to provide assurance on the generation of VCUs.

1.2 Scope and Criteria

The validation scope is defined as an independent and objective review of the project description (PD) to validate that (a) the project design is actual, (b) the baseline scenario is correctly defined as per the applied methodology and relate tools, (c) the project is additional, (d) the monitoring plan can be implemented and is transparent and adequate and (e) all data and information used for ex-ante calculation of emission reductions is of projected and/or hypothetical nature. The Joint-PD-MR is reviewed against the criteria stated in VCS Standard Version 4.3/57/ and the approved baseline and monitoring methodology ACM0010 Version 08.0/45/. The validation was based on the requirements VCS Validation and Verification Manual and VCS Standard Version 4.3 applying auditing techniques. The validation is not meant to provide any consulting towards the project participants. However, stated requests for clarifications and/or corrective actions may have provided input for improvement of the project design.

The scope of the verification is to verify that: (a) the actual monitoring system and procedures are in compliance with the monitoring systems and procedures described in the monitoring plan; (b) the GHG emission reductions data and express a conclusion with a reasonable level of assurance about whether he reported GHG emission reductions data are free from material misstatement; (c) the reported GHG emissions data is sufficiently supported by evidence. Verification shall ensure that the reported GHG emission reductions are complete and accurate in accordance with the applicable VCS criteria in order to be certified. Verification is conducted using CTI procedures in line with the requirements specified in the VCS Program and ISO14064-3 requirements and applying auditing techniques. The VVB assessed and determined that the implementation and operation of the project activity, and steps to report GHG emission reductions comply with the VCS rules. The verification involved a document review of relevant documentation and interview with the project participants. Verification is not meant to provide any consultancy towards the project participants; however, stated request for clarifications and/or corrective actions may have provided input for improvement of the monitoring.

1.3 Level of Assurance

All GHG sinks, sources and GHG emissions equal to or greater than 1% of the total GHG assertions are considered. The project is expected to generated average GHG emission removal of 364,750 tCO_2eper year, and therefore can be considered as a large project per the VCS rules, in regards to its scale, subject to a 1% materiality threshold.

The assessment was conducted to provide a reasonable level of assurance of compliance against the defined audit criteria and materiality threshold within the audit scope. Based on the audit findings the validation and verification statement reasonably assure that the GHG assertion is materially correct and is a fair representation of the GHG data and information.

1.4 Summary Description of the Project

The project is implemented by Muyuan Foods Co., Ltd. which aims to install new Animal Manure Management Systems by replace the current open anaerobic lagoons with 9 new closed anaerobic digesters to a group of 9 existing swine farms in Nanyang City, Henan Province, which will treat the manure and wastewater from the 9 swine farms to avoid methane emissions generated in the baseline uncovered anaerobic lagoons. An Animal Manure Management System (AWMS) has been installed in each swine farm respectively which treat the manure and wastewater from the 9 existing swine farms. The raw materials such as pig manure and wastewater are collected into waste collecting tanks and then be separated first by Solid-liquid separators. the solid are treated in aerobic composting system, and the organic fertilizers are produced. The liquid is treated through anaerobic digestion and the biogas generated during the treatment process is captured for heat generation. If there is surplus biogas, then the biogas would be flared through the flaring system. After anaerobic digestion, the sludge produced from anaerobic digestion is treated through aerobic composting together with the separated solid, the effluent is used for agricultural irrigation. The generated heat is used for daily operation of AWMSs and the swine farms. The project implemented 9 sets of AWMSs in 9 existing swine farms involving 454,600 heads of market swine, 24,500 heads of breeding swine. Live swine are kept for 180 days in the farms before shipment and are estimated to produce 699,486 tons of manure and $3,847.173*10^4 m^3$ of biogas

annually. The biogas produced is recovered and combusted for heat generation and used for daily operation of AWMSs and the swine farms and the residual biogas (if any) will be flared, the total heat production is estimated to be annual 769,433GJ. For conservativeness, baseline emissions from heat generation are neglected. The sludge produced from anaerobic digestion are treated through aerobic composting together with the separated solid, the effluent is used for agriculture irrigation which has been confirmed by site inspection and checking the Project Evaluation Report (PER) of the project/5/.

The project activity enables 9 existing swine farms to use new AWMSs instead of the open anaerobic lagoons in baseline scenario to achieve the harmlessness and ecological utilization of the swine manure, finally generate the electricity to swine farms, which has been verified by on-site inspection, and checking the related documentations, interview with the project implementer.

The project is expected to avoid GHG emission of methane from anaerobic treatment of swine manure and wastewater through recovery and destruction of biogas. The estimated emission reduction from the project is 364,750 tCO_2e per year during the fixed 10-year crediting period from 05-August-2020 to 04-August-2030.

The project activity generates GHG emission reductions by avoid GHG emission of methane from anaerobic treatment of swine manure and wastewater. Thus the project generates GHG emission reductions and produces financial, social and environmental benefits. The project has resulted in the local sustainable development as described in Section 1 of the Joint-PD-MR/1/. The project applied to be registered as a VCS project activity and the 597,264 tCO_2e of emission reductions have been certified as verified carbon units (VCUs) for 1st monitoring period from 05-August-2020 to 30-June-2022.

2 VALIDATION AND VERIFICATION PROCESS

2.1 Method and Criteria

A project specific validation and verification plan was developed to guide the validation and verification auditing process to ensure efficiency and effectiveness.

The purpose of the validation and verification is to present a risk assessment for determining the nature and extent of validation and verification procedures necessary to ensure the risk of auditing error is reduces to a reasonable level. According to the ISO14064-3, the criteria are the policy, procedure or requirement used as reference against which evidence is compared. Therefore, validation of the project description and verification of the monitoring plan and the reported project results were measured for compliance against the following criteria:

- VCS Standard, v4.3/57/
- VCS Program Guide, v4.2/56/
- VCS Program Definitions, v4.2/55/
- VCS-Joint-Project-Description-Monitoring-Report-Template-v4.1/53/

The validation and verification process derived from all items in the validation and verification criteria stated above. Field inspection and techniques based on the project parameters, scope and best professional judgement of the validation and verification team in order to meet a reasonable level of assurance. The validation and verification consisted of the following three phase:

- Document review
- On-site assessment
- The resolution of outstanding issues and the issuance of the final joint validation and verification report and certification.

The validation and verification process derived from all items in the validation and verification criteria stated above. Field inspection and techniques based on the project parameters, scope and best professional judgement of the validation and verification team in order to meet a reasonable level of assurance.

There is no sampling approach utilized by PP and VVB during validation and verification.

2.2 Document Review

The VCS Joint-PD-MR/1/ of the project and supporting background documents related to the project implementation were reviewed. Documents review was conducted to ensure consistency with and identify any deviation from VCS program requirements. Desk review included an examination of the project design details, baseline scenario, additionality, ex ante and monitoring data and parameters, and quantification of GHG emission reductions.

Furthermore, the validation and verification team used additional documentation by third parties like host party legislation, technical reports referring to the project design details, baseline scenario, additionality, monitoring or to the basic conditions and technical data.

The references used in the course of this validation and verification are summarized in Appendix 3.

The validation and verification were performed basing on the documents check and site inspection/measurements, refer to the section 3 and 4 of this report for the validation and verification process detail and corresponding documents review.

2.3 Interviews

Describe the interview process and identify personnel, including their roles, who were interviewed and/or provided information additional to that provided in the Joint-PD-MR/1/ and any supporting documents.

The objective of the interview process was to solicit important information from personnel related to project and relevant to the validation and verification process. Onsite interviews and information discussions were conducted with representatives from project implementer/I1/, Operation Staffs of the AWMSs/I2/, local officers/I3/, local residents/I4/, representatives from each swine farm/I5/ and VCS consultant/I6/. The interviews were performed by the validation and verification team on-site (within the project area, in Nanyang City, Henan Province, P.R. China) and the following is a list of the main interviewees and subject.

No.	Interviewee			Date	Subject, Reference Number/ID	Team member
	Last name	First name	Affiliation			
1.	Lu /I1/	Chang	Muyuan Foods Co., Ltd. Environmental department / Project Manager	04-July-2022~06-July-2022	Discussion on project financials, project design and implementation, Main equipment, Technical parameters, Baseline, Additionality, Project boundary, Monitoring plan, Monitoring devices, SDG impacts, ER calculation, Local legislation to biogas	Lin Wu Dai Qinghua
2.	Hu/I2/	Xuqiang	Wolong 3rd farm/ AWMS operation staff	04-July-2022	Project implementation Treatment method Main equipment Biogas production Slurry General info of interviewee, name, gender, Age, Education, Location How to obtain this job?	Lin Wu Dai Qinghua
3.	Shen	Binguo	Sheqi 1st farm/ AWMS operation staff	04-July-2022		
4.	Ye	Xiaolong	Sheqi 2nd farm/ AWMS operation staff	04-July-2022		
5.	Xu	Yingling	Sheqi 3rd farm/ AWMS operation staff	05-July-2022		

6.	Cheng	Yongmao	Sheqi 7th farm/ AWMS operation staff	05-July-2022	What is the main work? Training provided, Salary level, if satisfied	
7.	Xiao	Shouzhi	Sheqi 9th farm/ AWMS operation staff	05-July-2022		
8.	Tang	Shaohua	Fangcheng 1st farm/AWMS operation staff	06-July-2022		
9.	Wang	Xiulan	Fangcheng 2nd farm/AWMS operation staff	06-July-2022		
10.	Peng	Dehui	Fangcheng 3rd farm/AWMS operation staff	06-July-2022		
11.	Ju/I5/	Xinchun	Wolong 3rd farm/ Swine farm staff	04-July-2022	Scenario before the project started, Swine genetic source on-farm record keeping Feed supplier Swine weight Sale of Swine Living dates of Swine Daily stock of animals in the farm, discounting dead and discarded animals	Lin Wu Dai Qinghua
12.	Pan	Junfang	Sheqi 1st farm/ Swine farm staff	04-July-2022		
13.	Huang	Yongkun	Sheqi 2nd farm/ Swine farm staff	04-July-2022		
14.	Zhao	Xihai	Sheqi 3rd farm/ Swine farm staff	05-July-2022		
15.	Lu	Baozhou	Sheqi 7th farm/ Swine farm staff	05-July-2022		
16.	Shao	Youping	Sheqi 9th farm/ Swine farm staff	05-July-2022		
17.	Zhou	Xiaofei	Fangcheng 1st farm/Swine farm staff	06-July-2022		
18.	Xu	Bin	Fangcheng 2nd farm/Swine farm staff	06-July-2022		
19.	Yu	Jianjun	Fangcheng 3rd farm/Swine farm staff	06-July-2022		
20.	Shen/ I4/	Zhixing	Local Stakeholders/ Residents	04-July-2022	Local Stakeholder Consultation issues, Local environment impact	Lin Wu Dai Qinghua
21.	Hu	Lidan		04-July-2022		
22.	He	Xiaomin		04-July-2022		
23.	Zeng	Wenqin		04-July-2022		
24.	Huang	Chunyun		04-July-2022		
25.	He	Shiqiang		04-July-2022		
26.	Wang	Haochang		05-July-2022		
27.	Yuan	Haiyang		05-July-2022		

28.	Cao	Changhu		05-July-2022		
29.	Jiang	Chusheng		05-July-2022		
30.	Liu	Zhongdon g		05-July-2022		
31.	Liu	Ruiming		05-July-2022		
32.	Peng	Liangwei		06-July-2022		
33.	Li	Fengjiao		06-July-2022		
34.	Feng	Guanghui		06-July-2022		
35.	Sun	Chunhong		06-July-2022		
36.	Zhu	Mengyua n		06-July-2022		
37.	Fan	Zhenhua		06-July-2022		
38.	Qu /I3/	Shengwu	Local officer/Wolong Branch of Nanyang Ecological Environment Bureau	04-July-2022	Baseline Scenario Local Stakeholder Consultation issues, SDG impacts, Inputs, Grievances mechanism, Local legislation to swine and biogas	Lin Wu Dai Qinghua
39.	Jiang	Xinshe	Local officer/Nanyang Bureau of Agriculture and Rural Affairs			
40.	Tu /I6/	Shulan	Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd./ Senior Manager	04-July-2022~06-July-2022	Ex-ante and monitoring parameters, JPM and ER, IRR, NPV editable issues	Lin Wu Dai Qinghua

2.4 Site Inspections

The joint validation and verification site inspection was conducted on 04-July-2022~06-July-2022. A ground inspection of the project was conducted during the site visit and the joint validation and VVB interviewed representatives as listed in section 2.3.

During the site inspection, the project site was inspected and documents evidence were checked, details as following table,

Duration of on-site inspection: 04-July-2022~06-July-2022				
No.	**Activity performed on-site**	**Site location**	**Date**	**Team member**
1.	Opening meeting	Office in Muyuan Foods Co., Ltd.	04-July-2022	Lin Wu

	Interview with PP, local officers, consultant representatives	in Nanyang City, Henan Province, P. R. China		Dai Qinghua
2	On-site inspection Interview with Operation Staffs of the AWMSs and representatives from each swine farm, local residents	Project Area in Nanyang City, Henan Province, P. R. China	04-July-2022~06-July-2022	Lin Wu Dai Qinghua
3	Documents check	Project Area in Nanyang City, Henan Province, P.R.China	04-July-2022~06-July-2022	Lin Wu Dai Qinghua
4	Finding Summary	Office in Muyuan Foods Co., Ltd. in Nanyang City, Henan Province, P. R. China	06-July-2022	Lin Wu Dai Qinghua
5	Close Meeting	Office in Muyuan Foods Co., Ltd. in Nanyang City, Henan Province, P. R. China	06-July-2022	Lin Wu Dai Qinghua

2.5 Resolution of Findings

Material discrepancies identified in the course of the validation and verification are addressed either as CARs, CLs or FARs.

A Corrective Action Request (CAR) is established where:

- The project participants have made mistakes that will influence the ability of the project activity to achieve real, measurable additional emission reductions;
- The VCS Standard Version 4.3 requirements have not been met;
- There is a risk that the emission reductions cannot be monitored or calculated.

A Clarification Request (CL) will be issued where information is insufficient, unclear or not transparent enough to establish whether a requirement is met.

A Forward Action Request (FAR) will be issued when certain issues related to project implementation should be reviewed during the next verification.

A detailed list of the CARs CLs and FAR raised and discussed in the course of this validation and verification is included in Appendix 4 of this report.

In the course of the validation 22 Corrective Action Requests (CARs), 5 Clarification Requests (CLs) were raised and successfully closed. The assessment is included in the report.

2.5.1 Forward Action Requests

This is the joint validation and 1st VCS verification, thus there is no FAR raised previously.

3 VALIDATION FINDINGS

3.1 Project Details

• Project type, technologies and measures implemented, and eligibility of the project

Type:

Through the onsite visit, interviewing the project developer and reviewing the project description/1/, it was confirmed that the project is to introduce new Animal Manure Management Systems by replace the current open anaerobic lagoons with 9 new closed anaerobic digesters to a group of 9 existing swine farms in Nanyang City, Henan Province, which will treat the manure and wastewater from the 9 swine farms to avoid methane emissions generated in the baseline uncovered anaerobic lagoons and the biogas produced is recovered and combusted for heat generation and used by swine farms in the project area in Nanyang City, Henan Province, P.R. China.

Therefore, it was confirmed that the sectoral scope is Scope 01: Energy industries (renewable - / non-renewable sources) and Scope 13 Waste handling and disposal as per the UNFCCC Standard "Applicability of sectoral scopes version 01.0"/58/ and Scope 15 as per para. A.1.2 in Appendix 1 of VCS standard (V4.3)/57/.

It was confirmed that the project is not a grouped project.

• Technologies and measures implemented:

The information and descriptions reported in section 1.1 of the VCS Joint-PD-MR/1/ have been checked.

The project is implemented by Muyuan Foods Co., Ltd. which aims to introduce new Animal Manure Management Systems by replace the current open anaerobic lagoons with 9 new closed anaerobic digesters to a group of 9 existing swine farms in Nanyang City, Henan Province, which will treat the manure and wastewater from the 9 swine farms to avoid methane emissions generated in the baseline uncovered anaerobic lagoons. An Animal Manure Management System (AWMS) has been installed in each swine farm respectively which treat the manure and wastewater from the 9 existing swine farms. The raw materials such as pig manure and wastewater are collected into waste collecting tanks and then be separated first by Solid-liquid separators. the solid are treated in aerobic composting system, and the organic fertilizers are produced. The liquid is treated through anaerobic digestion and the biogas generated during the treatment process is captured for heat generation. If there is surplus biogas, then the biogas would be flared through the flaring system. After anaerobic digestion, the sludge produced from anaerobic digestion is treated through aerobic composting together with the separated solid, the effluent is used for agricultural irrigation. The generated heat is used for daily operation of AWMSs and the swine farms. The project implemented 9 sets of AWMSs in 9 existing swine farms involving 454,600 heads of market swine, 24,500 heads of breeding swine. Live swine are kept for 180 days in the farms before shipment and are estimated to produce 699,486 tons of manure and $3,847.173*10^4 m^3$ of biogas annually. The biogas produced is recovered and combusted for heat generation and used for daily operation of AWMSs and the swine farms and the residual biogas (if any) will be flared, the total heat production is estimated to be annual 769,433GJ. For conservativeness, baseline emissions from heat

generation are neglected. The sludge produced from anaerobic digestion are treated through aerobic composting together with the separated solid, the effluent is used for agriculture irrigation which has been confirmed by site inspection and checking the Project Evaluation Report (PER) of the project/5/.

The technology is confirmed by site inspection and checking the PER/5/, General design and construction contract/10/, Equipment purchase contracts/9/, Technical agreement of main equipment/11/ and Technical flow chart/14/.

The project activity enables 9 existing swine farms to use new animal waste management systems instead of the open anaerobic lagoons in baseline scenario to achieve the harmlessness and ecological utilization of the swine manure, finally generate the electricity to swine farms, which has been verified by on-site inspection, and checking the related documentations, interview with the project implementer. The technology employed is environmentally safe and sound as well as state of the art. Via checking the Business License/4/of PP, General design and construction contract/10/ and Equipment purchase contracts/9/, it is verified that project owner invested in purchasing the AWMSs for all the farms and owned all the farms. By implementing the project, it has provided an opportunity for local community to generate steady and continual income for their livelihood.

The project is applicable to the applied CDM Methodology ACM0010 "GHG emission reductions from manure management systems" (Version 08.0)/45/.

The expected total emission reduction of the Project in the crediting periods of 10 years (from 05-August-2020 to 04-August-2030) is 3,647,500 tCO_2e, and the annual emission reduction is estimated to be 364,750 tCO_2e.

In conclusion, it is verified that the summary description of the project in section 1.1 is in line with the Joint-PD-MR template requirements and all the information has been provided and verified as correct.

- Eligibility of the project:

The PP has described and justified how the project is eligible under the scope of the VCS Program in Joint-PD-MR as per the section 2.1.1 of VCS Standard Version 4.3. The assessment is provided as below,

1. The project activity generates GHG emission reductions including CH_4 which belong to the six Kyoto Protocol greenhouse gases.
2. "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." Via checking the Joint-PD-MR/1/ of the project, it is verified that the project is implemented to introduce new Animal Manure Management Systems by replace the current open anaerobic lagoons with 9 new closed anaerobic digesters to a group of 9 existing swine farms in Nanyang City, Henan Province, China which will treat the manure and wastewater from the 9 swine farms to avoid methane emissions generated in the baseline uncovered anaerobic lagoons, and the additionality is verified as actual, thus there is no assumption of having generated GHG emissions primarily for the purpose of their subsequent reduction, removal or destruction for this project.
3. The VCS Program also excludes the following project activities under the circumstances indicated in Table 1 of section 2.1.1 of VCS Standard Version 4.3, via checking all the excluded project activities in the table, it is verified that this project type is not excluded by the scope of VCS program.

In conclusion, the project is eligible to the scope of the VCS Program.

• Project design, including eligibility criteria for grouped projects

The project activity involves the construction and operation 9 AWMSs in 9 swine farms in Nanyang City, Henan Province owned by Muyuan Foods Co., Ltd.. It has been designed to install one animal manure management system in each swine farm, and total 9 swine farms with 9 sets of AWMSs. Then the 9 AWMSs belongs to multiple project activity instances.

This project is not a grouped project.

• Project proponent and other entities involved in the project

The project proponent (Muyuan Foods Co., Ltd.), and the contact information reported in section 1.5 of the VCS Joint-PD-MR/1/ have been confirmed to be correct through checking the business license of the company/4/, General design and construction contract/10/, Equipment purchase contracts/9/, Approval of EIA/7/ and interviewing with the PP representative through the on-site visit/I1/.

The other entities involved in the Project (Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd.) and the contact information reported in section 1.6 of the VCS Joint-PD-MR have been confirmed to be correct through checking the business license of the Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd./4/and interviewing the representative of this company during the on-site visit/I6/.

• Ownership

The section 1.7 of the Joint-PD-MR has been checked, it is confirmed that the Project Proponent demonstrates that they have the legal right to control and operate project activity.

Via checking the National legal approval to the Environmental Impact Assessment (EIA)/7/, Equipment purchase contracts/9/ and the business license of the Muyuan Foods Co., Ltd./4/, it is verified that PP has the legal right to control and operate the project activity. Thus, it is confirmed that the project owner has the ownership of the project.

• Project start date

The project start date is 05-August-2020 which is verified as the date on which the project began generating GHG emission reductions or removals as per the concept in VCS Standard Version 4.3.

Via checking the operation log/13/, it is verified that 05-August-2020 is the date when all the AWMSs had been put into operation, hence the start date is correct and in line with the VCS standard.

• Project crediting period

For the VCS crediting period, PP has chosen 10 years fixed crediting period started from 05-August-2020 to 04-August-2030 which is in line with the concept for crediting period in section 3.8.2 of the VCS Standard Version 4.3.

• Project scale and estimated GHG emission reductions or removals

The average annual ERs of the project are 364,750 tCO_2e, which is higher than the threshold of large-projects (300,000 tCO_2e per year). Therefore the project falls in the category of "Large Project" as per definition in VCS standard. And the estimated total Estimated GHG Emission Reductions or Removals during the 10 years of VCS fixed crediting period (05-August-2020 to 04-August-2030) is 3,647,500 tCO_2e.

• Project location

The project site is located at Henan Province, P. R. China. There are 9 subsidiary farms involved in the project. Details of the subsidiary farms' location are given in table 3-1 below:

Table 3-1: Project Location

Item	Project Location		
Host Country	China		
Region:	Nanyang City, Henan Province		
Geographical Coordinates			
Swine farm	**Detail Location**	**East longitude**	**North latitude**
Fangcheng 1st swine farm	Shudi Village, Bowang township, Fangcheng County, Nanyang City	33° 13′12.79″	112°43′9.48″
Fangcheng 2nd swine farm	Wuzhuang Village, Bowang township, Fangcheng County, Nanyang City	33° 11′41.96″	112°45′1.84″
Fangcheng 3rd swine farm	Wangminggao Village, Qinghe Township, Fangcheng County, Nanyang City	33° 14′16.46″	112°52′52.13″
Sheqi 1st swine farm	Koulouxin Village, Lidian Township, Sheqi County, Nanyang City	32° 54′19.01″	112°54′5.29″
Sheqi 2nd swine farm	Xuezhuang Village, Lidian Township, Sheqi County, Nanyang City	32° 55′2.21″	112°51′57.46″
Sheqi 3rd swine farm	Zhanglou Village, Mobei Township, Sheqi County, Nanyang City	33° 07′20.89″	113°01′4.30″
Sheqi 7th swine farm	Jiazhang Village, Xinglong Township, Sheqi County, Nanyang City	32° 56′45.49″	112°59′21.98″
Sheqi 9th swine farm	Liulaojia Village, Jinzhuang Township, Sheqi County, Nanyang City	32° 53′33.83″	112°48′35.50″
Wolong 3rd swine farm	Xiafanying Village, Luying Township, Wolong District, Nanyang City	32° 53′13.96″	112°27′15.12″

The project location has been clearly provided in section 1.12 of the JPM and the detailed coordinates of the 9 swine farms have been provided respectively which have also been verified by site inspection with GPS device and checking the map and the information is verified as correct.

• Conditions prior to project initiation

Via checking the Joint-PD-MR/1/, it is confirmed that the scenario existing prior to the implementation of the project is the animal manure waste was left to decay in anaerobic manure management system (uncovered open lagoon) at the 9 swine farms and methane is emitted to the atmosphere directly without any methane recovery and destruction facility. The baseline scenario is the same as the scenario existing prior to the implementation of the project activity, which has been confirmed during the site interview with PP and on-site checking the photo of baseline lagoon/27/. Thus it is verified that the baseline scenario is reasonable and correct.

And via site inspection and checking the related equipment purchase contracts/9/ and General design and construction contract/10/, it is verified that all the equipment involved in animal manure management systems covered by the project were newly built and there was no existing manure management system prior to the project activity hence no existing equipment in baseline scenario.

Therefore, the project is confirmed not to be implemented to generate GHG emissions for the purpose of their subsequent reduction, removal or destruction.

• Project compliance with applicable laws, statutes and other regulatory frameworks

The Joint-PD-MR has stated that the project is in the field of waste handling, this industry is confirmed as in line with the laws and regulations/75/ as listed in the Joint-PD-MR.

Also the project is legally approved by Local government by checking the EIA approval/7/, which means that the project is in line with the national and local laws and regulations based on the local expertise of the VVB. And as stated in the Joint-PD-MR/1/ and confirmed by interview with local officer/I2/, CTI verified that the project will be subject to regular inspection by local government during the implementation period to ensure continuous compliance.

In conclusion, the project complies with all relevant local, regional and national laws, statutes and regulatory frameworks in China.

• Participation under other GHG programs:

-Projects registered (or seeking registration) under other GHG program(s)

The project has neither been registered nor seeking registration under any other GHG programs which has been confirmed via checking the UNFCCC/60/, GS/62/, VCS/61/ and other GHG schemes' website. It is verified that the project is seeking registration only in VCS program/61/.

-Rejection by other GHG programs

The project has neither been rejected by any other GHG programs which has been confirmed via checking the UNFCCC/60/, GS/62/, VCS/61/ and other GHG schemes' website.

• Other forms of credit:

-Emissions trading programs and other binding limits

The project proponent is not part of any emission trading program which has been confirmed via checking the UNFCCC/60/, GS/62/, VCS/61/ and other GHG schemes' website. The net GHG emission reductions during this monitoring period from the project was not used for compliance with emission trading programs or to meet binding limits on GHG emissions. The project activity has not participated under any other GHG programs which has been confirmed via checking the UNFCCC/60/, GS/62/, VCS/61/ and other GHG schemes' website, it is verified that the implementation of the project is consistent with the description in the Joint-PD-MR and the monitoring system is fully functional to generate Verified Carbon Units (VCUs) without any double counting for this monitoring period from 05-August-2020 to 30-June-2022 which has been confirmed by checking the Declaration of no double counting and not involved in other GHG scheme/30/.

Besides, based on VVB's local expertise, China has a national emissions trading scheme only cover the high-emission industries, such as power generation sector that emitted at least 26,000 tons of CO_2e/year which has been verified in the public website/64/, and it is confirmed that the project activity is not included the mandatory emission control scheme and there is no emission cap enforced for the project owner by checking the enforced company list in public information/65/. Hence, it is confirmed that the emission reductions will not be double counted.

-Other forms of environmental credit sought or received and eligible to be sought or received

Via interview with the project developer/I1/ and based on above assessment, it is confirmed that the project has not created any other form of environmental credit.

•Sustainable development contributions

Via on-site inspection, checking the evidence provided as below and interview with the project implementer, CTI verified that the project contributes the sustainable development through the following aspects:

1. The project generated biogas during the treatment process are captured for heat generation are all used by the AWMSs and the 9 swine farms replace the coal-fired boiler (Goal 7 of UN SDG) – verified by checking the Daily operation record of each treatment plant/22/ and Emission Reduction Calculation sheet/2/, it is confirmed that $6{,}078.39*10^4 m^3$ of biogas is generated by the project during this monitoring period, which avoid the methane emitted to the atmosphere and provide clean energy by utilizing biogas, hence the contribution to this SDG has been confirmed and the provisions for monitoring and reporting this goal is verified as reasonable;
2. The project activity creates number of job opportunities (Goal 8 of UN SDG) – verified by interview with staffs and checking the Labor Contracts/31/ and monthly payroll/32/, it is confirmed that 18 job opportunities (9 females and 9 males) have been provided during this monitoring period, hence the contribution to this SDG has been confirmed and the provisions for monitoring and reporting this goal is verified as reasonable;
3. Sequester greenhouse gas and mitigate climate changes (Goal 13 of UN SDG) – 597,264 tCO_2e GHG emission reductions have been achieved, which is verified by checking the Emission Reduction Calculation sheet/2/, hence the contribution to this SDG has been confirmed and the provisions for monitoring and reporting this goal is verified as reasonable.

• Additional information relevant to the project, including:

-Leakage management for AFOLU projects

According to the methodology, the leakage involved in this project includes the leakage of anaerobic digestion in a digester 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. Via checking the ER calculation sheet/2/, CTI confirmed that the leakage has been included in the emission reductions calculation which is verified in line with the applied methodology/45/ and related tools. Refer to section 3.4.6 for detail assessment of the leakage.

-Commercially sensitive information

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

Based on above assessment and demonstration, it is concluded that the description in the project description is accurate, complete, and the nature of the project is actual and understandable, and it is confirmed that the project has been implemented as described in the project description via site inspection.

CL 01, CL 02, CAR 01, CAR 02, CAR 03 and CAR 04 were raised and successfully closed. Refer to Appendix 4 for detail assessment.

3.2 Participation under Other GHG Programs

The project has neither been registered nor seeking registration under any other GHG programs which has been confirmed via checking the UNFCCC/60/, GS/62/, VCS/61/ and other GHG schemes' website. It is verified that the project is seeking registration only in VCS program/61/.

3.3 Safeguards

3.3.1 No Net Harm

In China, an Environmental Impacts Assessment is required according to Chinese legislation. The EIA was designed by Nanyang Environmental Protection Research Institute Co., Ltd./6/ and approved by Nanyang Municipal Department of Ecology and Environment on 28-May-2019/7/. The analysis of the environmental impacts of the project activity is sufficiently described according to EIA report/6/. The assessment is as below,

It is considered that the environmental impacts and the relevant mitigation methods have been comprehensively described in Section 2.3 of Joint-PD-MR including the air pollution and wastewater, noise, and solid waste impact on the ecosystem and environment of local area in project site for both construction and operation period according to the EIA report/6/.

Associated with the review of EIA report/6/, there was no adverse effect on the air, water and solid waste, for the project subject to the implementation of pollution mitigation measures according to the EIA report/6/. There was also no any endangered species found in the project location.

As per the approval of EIA/7/, it stated that the inspectors from the local Environmental Protection Bureau have to carry out monitoring work for the environmental impact arisen from the project activity during project commissioning periodically. Via interview with the local officers from local Environmental Protection Bureau/I3/, CTI confirmed that they are satisfactory with the environmental protection and recovery work carried out by the project owner. The local Environmental Protection Bureau also did not receive any public comment on the project activity during this monitoring period.

During the on-site interview, the local residents/I3/ were interviewed if there was critical impact to their living environment. It is verified that the project activity does not cause adverse effect to their daily life.

Furthermore, via interview with local officer and stakeholders, it is confirmed that the implementation of the project will improve local socio-economic development through creating career opportunities.

In conclusion, there were some impacts on environment during the construction and operation periods which has been demonstrated in the Joint-PD-MR/1/ and EIA/6/, also the proper measurements have been carried out by project implementer to mitigate such impacts.

3.3.2 Local Stakeholder Consultation

Local stakeholder consultation prior the project started construction

A stakeholder survey was carried out by the project developer in November 2019 which was prior to the start date of the construction.

A stakeholder consultation questionnaire survey was conducted from 04-November-2019 to 09-November-2019. During the survey, total of 180 questionnaires were issued for this project, 20 copies for each project site, and 180 copies were collected. The stakeholders' background information, survey process, and final comments and response from PP were summarized and recorded in the Joint-PD-MR, Section 2.2.

Via checking the 180 filled questionnaires/28/, it is verified that most respondents knew or heard about the Project. Most of them are supportive of the project construction, and think the Project will bring more benefit than loss. And the survey shows that many local stakeholders think the Project will help improve the life of local people and promote local economic development without any adverse environmental impact and 100% of respondents support this project.

Finally, it is verified that no negative comments raised from local stakeholders by checking the 180 filled questionnaires/28/ and thus no need to change the project design based on the stakeholder inputs.

Mechanism for on-going communication and consultation during this monitoring period:

During the implementation stage of this monitoring period, via checking the local communication survey records/29/ and interview with the local officer/I2/ and local residents/I3/ during site visit, it is confirmed that the PP has conducted follow-up interviews and ongoing communication with local stakeholders to collect any comments or inputs to the project implementation. Based on the VVB's local expertise, CTI confirmed that the local government agencies and competent authorities will conduct spot checks on the implementation of the project from time to time as per the request from the local government's regulations.

Moreover, the project owner carried out a questionnaire survey for the local stakeholder to collect the relevant comments and suggestions from 26-September-2021 to 30-September-2021 during this 1st monitoring period, and project proponent put up public announcements at the villages near the project site about the survey including general information about the introduction of project, the date and the purpose of the questionnaire survey as well as the project proponent's phone number and email address from 06-September-2021 to 10-September-2021 which is confirmed by interview with the local stakeholders.

Via checking the 90 filled questionnaires/29/, interview with the local officer and local stakeholders during site visit, it is verified that nearly all the respondents believe that the Project will not have any negative environmental impact. It is verified that all local stakeholders who participated the survey were satisfied with the implementation of the project which has been confirmed by site interview with local stakeholders.

The local officers from Environment Protection Bureau/I3/ has confirmed that the project was under supervised and the implementation of the project is in line with the local environment protection regulations and EIA/6/. And via checking the 90 filled questionnaires/29/, it is confirmed that no other negative impacts considered by local stakeholder to their local life.

Via interview with the local officer/I3/ and local residents/I4/ during site visit, it is verified that there were no comments and issues from the local stakeholders during the implementation period and the project passed all the periodic spot checks by local government. Hence there is no need to change the project design based on the stakeholder inputs.

Furthermore, via site inspection, CTI confirmed that a grievance book was put at the entrance of each swine farm so that to collect the grievances or comments from local stakeholders anytime, and via checking all the books, CTI verified that there was no any grievances or comments received during this monitoring period.

CL 03 was raised and successfully closed. Refer to Appendix 4 for detail assessment.

3.3.3 Environmental Impact

In China, an Environmental Impacts Assessment is required according to Chinese legislation. The EIA was designed by Nanyang Environmental Protection Research Institute Co., Ltd./6/ and approved by Nanyang Municipal Department of Ecology and Environment on 28-May-2019/7/. The analysis of the environmental impacts of the project activity is sufficiently described according to EIA report/6/. The assessment is as below,

It is considered that the environmental impacts and the relevant mitigation methods have been comprehensively described in Section 2.3 of Joint-PD-MR including the air pollution and wastewater, noise, solid waste and impact on the ecosystem in local area of project site according to the EIA report/6/.

The environmental impacts of the project were sufficiently assessed by means of an Environmental Impact Assessment (EIA) study report according to the Chinese laws & regulations such as "Environmental Protection Law of P.R. China"/75/ and "Law of the People's Republic of China on the Environmental Impact Assessment"/75/. Every aspect of environmental impact has been considered in the EIA report with corresponding measures during project construction and operation.

During the construction period, via interview with the local officer from local Environmental Protection Bureau/I3/, it is confirmed that the potential environmental impacts have been sufficiently identified for the construction period, such as air pollution, wastewater, noise and solid waste etc. The conclusion of the analysis has been described in the Joint-PD-MR as per the EIA report/6/ and the related mitigation measures have been listed as per the approval of EIA report/7/. Due to the project has been implemented during the site inspection, it is confirmed that the impact during the construction period has been solved and no significant environmental impacts are expected from the project activity.

Associated with the review of EIA, there was no adverse effect on the ecology, air, water and solid waste, for the project subject to the implementation of pollution mitigation measures according to the EIA report. There was also no any endangered species found in the project location.

Via interview with the local officers from local Environmental Protection Bureau/I3/, it is confirmed that they are satisfactory with the environmental protection and recovery work carried out by the project owner. The Environmental Protection Bureau also did not receive any public comment on the project activity after the implementation of the project.

CL 04 was raised and successfully closed. Refer to Appendix 4 for detail assessment.

3.3.4 Public Comments

The project sought the registration with the VCS Program, according to VCS requirements the Project Description was submitted for public comment period. The project was allocated with VCS ID 2846. The public comment period started on 09-March-2022 and ended on 08-April-2022 (https://registry.verra.org/app/projectDetail/VCS/2846).

No comments (only one comment was received for the project, however, the comment section was left blank) were received during this period which has been verified by checking the dedicated website as above.

CAR 05 was raised and successfully closed. Refer to Appendix 4 for detail assessment.

3.3.5 AFOLU-Specific Safeguards

N/A

3.4 Application of Methodology

3.4.1 Title and Reference

The approved consolidated methodology applied in the project activity is ACM0010 – "GHG emission reductions from manure management systems" (version 08.0)/45/.

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

Tool 02 Combined tool to identify the baseline scenario and demonstrate additionality (Version 07.0)/46/

Tool 05 Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (Version 03.0)/47/

Tool 06 Project emissions from flaring (Version 04.0)/48/

Tool 08: Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version03.0)/49/

Tool 14: Project and leakage emissions from anaerobic digesters (Version 02.0)/50/

Tool 24 Common practice (Version 03.1)/51/

3.4.2 Applicability

Demonstration regarding the applicability of the methodology, and any tools selected by the project proponent as provided in below table.

Table 3-1 Assessment of Applicability conditions of ACM0010 (version 08.0).

No.	Applicability conditions	Validation Assessment	Conclusion
1	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.	Via site inspection and checking the PER/5/, related equipment purchase contracts/9/ and General design and construction contract/10/, CTI verified that this project activity is installing 9 sets of new animal waste management systems to treat the manure and wastewater from the 9 existing swine farms to avoid methane emissions generated in the baseline uncovered anaerobic lagoons. Hence this criteria is applicable for this project activity.	Applicable
2	This methodology is applicable to manure management on livestock farms where the existing anaerobic manure treatment system, within the project boundary, is replaced by one or a combination of more than one animal waste management systems (AWMSs) that result in less GHG emissions compared to the existing system. The methodology is also applicable to Greenfield facilities.	Via site inspection and checking the PER/5/, related equipment purchase contracts/9/ and General design and construction contract/10/, CTI verified that this project activity is installing 9 sets of new animal waste management systems to treat the manure and wastewater from the 9 existing swine farms to avoid methane emissions generated in the baseline uncovered anaerobic lagoons in 9 swine farms respectively that result in less GHG emissions compared to the existing system.	Applicable

No.	Applicability conditions	Validation Assessment	Conclusion
		9 swine farms were existed in the baseline with 9 old open lagoons and all animal waste management systems (AWMSs) are newly built in the project. Hence this criteria is applicable for this project activity.	
3	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) Via site inspection and checking the Licenses for production and operation of the breeding livestock and poultry/8/ for each swine farm, and furthermore via checking the public information of the project owner/67/ and based on the local expertise of validation team, CTI confirmed that the project owner is one of the national leading agricultural enterprise with the largest scale of swine farming in China, CTI confirmed that all the livestock population in the 9 swine farms within the project boundary is managed under confined conditions. (b) All the swine manure is dumped into open anaerobic lagoons and are not discharged into natural water resources. This is verified by checking the Licenses for production and operation of the breeding livestock and poultry/8/ and related "Regulations on Prevention and Control of Pollution from Livestock and Poultry Farming"/77/. (c) In the baseline scenario the depth of the open lagoons used for manure management under the baseline scenario is 3~5 meters higher than 1m. This is verified by checking the photo of baseline lagoon/27/ and verified by checking the national standard "Design code for wastewater stabilization ponds (GJJ/T54-93)"/34/. (d) The annual average temperature of baseline site where anaerobic manure treatment	Applicable

No.	Applicability conditions	Validation Assessment	Conclusion
		facility is located is 15°C which is higher than 5°C. This is verified by checking the public information of local temperature/68/. (e) In the baseline scenario the retention time of manure waste in the anaerobic lagoons is not less than 45 days, i.e. at least 60 days and not more than 90 days. This is verified by interview with chiefs and staffs of the swine farms. (f) The manure from project will be utilized to produce fertilizer after methane capture, hence there is no leakage of manure waste into ground water occurred which is confirmed by site inspection and checking the produced fertilizer. Furthermore, via site inspection of the anaerobic tanks, CTI confirmed that the anaerobic tanks are enclosed and have steel layer. Via checking the Technical agreement of anaerobic tank/11/, it is verified that the tanks are totally enclosed without any leak can be found, thus will not cause leakage of manure waste into ground water. Hence this criteria is applicable for this project activity.	
4	In addition, the applicability conditions included in the tools referred to below apply.	Refer to below assessments.	Applicable
Conclusion: Methodology ACM0010 (Version 08.0) is applicable to the project activity.			

In addition, the project meets the applicability conditions of the applied tools as follow table,

Table 3-2 Assessment of Applicability conditions of methodological tool

Tool	Criteria	Validation Assessment	Conclusion
(a) Tool 02 Combined tool to identify the baseline scenario and demonstrate additionality (Version 07.0)	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	The tool is applicable to all types of proposed project activities, and in section 15 of the applied methodology, it requires project proponents determine the most plausible baseline scenario through the use of	Applicable

Tool	Criteria	Validation Assessment	Conclusion
	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 "Combined tool to determine the baseline scenario and demonstrate additionality". Thus this tool is applicable to the project.	
Tool 05 Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (Version 03.0)	If emissions are calculated for electricity consumption, the tool is only applicable if one out of the following three scenarios applies to the sources of electricity consumption: (a) Scenario A: Electricity consumption from the grid. The electricity is purchased from the grid only, and either no captive power plant(s) is/are installed at the site of electricity consumption or, if any captive power plant exists on site, it is either not operating or it is not physically able to provide electricity to the electricity consumer; (b) Scenario B: Electricity consumption from (an) off-grid fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants are installed at the site of the electricity consumer and supply the consumer with electricity. The captive power plant(s) is/are not connected to the electricity grid; or (c) Scenario C: Electricity consumption from the grid and (a) fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants operate at the site of the electricity consumer. The captive power plant(s) can provide electricity to the electricity consumer. The captive power plant(s) is/are also connected to the electricity grid. Hence, the electricity consumer can be provided with	Via site inspection, it is confirmed that the electricity consumption of the project will be supplied by the CCPG (Central China Power Grid), which falls under scenario A. Therefore, emissions related to electricity consumption need to be calculated based on Tool 05.	Applicable

Tool	Criteria	Validation Assessment	Conclusion
	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.	N/A	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.	Via checking the ER calculation process, it is confirmed that Tool 05 is only used to calculate project emissions of electricity consumption supplied by CCPG. For conservativeness, baseline emissions of captive biogas heat generation system are ignored. Only CO_2 emissions will be accounted.	Applicable
Tool 06 Project emissions from flaring (Version 04.0)	This tool provides procedures to calculate project emissions from flaring of a residual gas. The tool is applicable to enclosed or open flares and project participants should document in the CDM-PDD the type of flare used in the project activity.	The project uses open flare system which has been confirmed by site inspection of the 9 open flares in 9 swine farms. Hence this criteria is applicable for this project activity.	Applicable
	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	Methane is the component with the highest concentration in the biogas (methane accounts for 60% of the biogas) flared in the project which has been	Applicable

Tool	Criteria	Validation Assessment	Conclusion
	(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).	confirmed by site inspection and checking the PER/5/. Hence this criteria is applicable for this project activity.	
	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 open flare, there shall be operating specifications provided by the manufacturer of the flare.	The project does not use auxiliary fuels which has been confirmed by site inspection of the project implementation and checking the PER/5/. Hence this criteria is applicable for this project activity.	Applicable
Tool 08 Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 03.0)	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.	Via site inspection, CTI confirmed the amount of biogas collected at the digester will be collected and monitored. Hence this criteria is applicable for this project activity.	Applicable
	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	It is confirmed that the biogas generated during the treatment process contains CH_4, H_2S, O_2, etc., hence the tool is used for determining the mass flow of a greenhouse gas. Hence this criteria is applicable for this project activity.	Applicable
	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) The tool is confirmed applied in the JPM. (b) The mass flow has been determined in the monitoring plan of the JPM. (c) The flow of the gaseous stream will be measured continuously as determined in the monitoring plan of the JPM. (d) The gaseous stream is dry and related equations have been used to calculate the mass flow of greenhouse gas. Hence this criteria is applicable for this project activity.	Applicable

Tool	Criteria	Validation Assessment	Conclusion
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.	Sources of project emissions including (a) and (c) which involved in the project implementation have been accounted by checking the ER calculation sheet/2/. Hence this criteria is applicable for this project activity.	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 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 which has been confirmed by site inspection of the project implementation and checking the PER/5/. By site inspection, CTI confirmed that there was no additional storage yard to store the sludge produced from anaerobic digestion. Therefore The leakage emissions associated with the anaerobic digester should not be taken into account for this project Hence this criteria is applicable for this project activity.	Applicable
	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,	N_2O emissions are neglected because these are minor emission sources via checking the applied methodology.	Applicable

Tool	Criteria	Validation Assessment	Conclusion
	piped distribution of the biogas, aerobic treatment of liquid digestate and land application of the digestate are neglected because these are minor emission sources or because they are accounted in the methodologies referring to this tool.		
Tool 24 Common practice (Version 03.1)	This methodological tool is applicable to project activities that apply the methodological tool "Tool for the demonstration and assessment of additionality", the methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality", or baseline and monitoring methodologies that use the common practice test for the demonstration of additionality.	As assessed above, the project applies the methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality" for the demonstration of additionality, the project can use the common practice test for the demonstration of additionality. Hence this criteria is applicable for this project activity.	Applicable
	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.	Via checking the applied methodology, CTI confirmed that the methodology defines approaches for the conduction of the common practice test that are same to those described in this methodological tool. Hence this criteria is applicable for this project activity.	Applicable
Conclusion: All the relevant methodological tools are applicable to the project activity.			

CAR 06, CAR 07 and CAR 08 were raised and successfully closed. Refer to Appendix 4 for detail assessment.

3.4.3 Project Boundary

The project boundary basically defines the physical and geographical boundary of the project facility and it is well defined in the Joint-PD-MR/1/ (section 3.3) according to ACM0010 GHG emission reductions from manure management systems (Version 08.0)/45/. The project boundary includes following,

Project boundary has been defined in the Joint-PD-MR according to the applied methodology ACM0010/45/ as the geographical extent of the project boundary includes the site of the AWMS(s), including the flare and heat generation equipment and the power source and considers the GHG

emissions that come from AWMSs, including the GHGs emissions from the anaerobic digestion, GHG emissions from sludge treatment by aerobic composting and GHG emissions from flaring system in 9 swine farms which is verified by checking the PER of the project/5/and on-site inspection.

Via site inspection and checking the PER/5/and the technical flow chart in the project site/14/, it is verified that project boundary is clearly defined in the Joint-PD-MR as per the methodology.

Emissions sources included in the project boundary have been appropriately included in the Joint-PD-MR. CH_4 and N_2O emissions due to emissions from the waste treatment processes is covered for baseline scenario and the project scenario has emissions due to on-site electricity use and CH_4 and N_2O emissions from the waste treatment processes.

It is concluded that the project boundary and selected sources are correctly justified for the project.

CAR 09 was raised and successfully closed. Refer to Appendix 4 for detail assessment.

3.4.4 Baseline Scenario

The PP has applied an approved baseline and methodology ACM0010, version 08.0 which is approved under CDM scheme.

The JPM applies the stepwise approach as given by section 5.2 of the ACM0010/45/ and "Combined tool to identify the baseline scenario and demonstrate additionality" (Version 07.0)/46/.

Step 1: Identification of alternative to the project activity consistent with current laws and regulations

Step 1a: Define alternative scenarios to the project activity

Due to the 9 swine farms were existed before the project implemented, hence according to the applied methodology, for existing facilities, for the baseline alternatives for managing the manure, PP has listed 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) which is confirmed consistent with the IPCC/39/, and possible combinations of animal manure management systems have been taken into account.

No further scenario is considered reasonable under the given context.

The alternatives are assessed by validation team as below

Alternatives	VVB Assessment
The manure is collected from the pasture/Range/Paddock	Via site inspection, CTI confirmed that swine in this project are bred in confined barns rather than pasture/range/paddock. This alternative is ruled out.
Daily spread: Manure removed from confinement and applied to pasture within 24 hours of excretion	Via site interview with chief and staffs in swine farms, CTI confirmed that it is not possible to remove the manure and apply on a daily basis for such large-scale swine farms, hence this alternative is not economically attractive. This alternative is ruled out.

Solid Storage: The manure is disposed by solid storage.	Via site interview with chief and staffs in swine farms, CTI confirmed that solid storage is a storage method of manure, not a disposal method, and not suitable for such large-scale swine farms for using of a scraping and flushing approach to remove manure which has large volumes of water, hence this alternative is not economically attractive. This alternative is ruled out.
Dry lot	Via site interview with chief and staffs in swine farms, CTI confirmed that dry lot is a storage method of manure, not a disposal method, hence this alternative is not economically attractive. This alternative is ruled out.
The manure is disposed as liquid/slurry.	Via site interview with chief and staffs in swine farms, CTI confirmed that this method is a storage method of manure, not a disposal method, and not suitable for such large-scale swine farms, hence this alternative is not economically attractive. This alternative is ruled out.
Uncovered anaerobic lagoon	Via site interview with chief and staffs in swine farms and by checking the photo of baseline lagoon/27/, CTI confirmed that this is the scenario prior to the project implementation and it is a kind of harmless treatment of manure as per the "Technical specification for sanitation treatment of livestock and poultry manure"/76/ which means the animal waste that has been treated by uncovered anaerobic lagoon can satisfy the above regulations. So, the uncovered anaerobic lagoon is an alternative baseline scenario.
Pit storage below animal confinements, <1month	Via site interview with chief and staffs in swine farms, CTI confirmed that this method is a storage method of manure, not a disposal method, and not suitable for such large-scale swine farms which need a lot of labour work, hence this alternative is not economically attractive. This alternative is ruled out.
Pit storage below animal confinements, >1month	Via site interview with chief and staffs in swine farms, CTI confirmed that this method is a storage method of manure, not a disposal method, and not suitable for such large-scale swine farms and long time storage will generate the toxic fumes which may kill the pigs, hence this alternative is not realistic. This alternative is ruled out.
Anaerobic digester (Anaerobic digester-Aerobic Treatment system)	This is part of the project scenario, due to 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, this method is confirmed as one of the most advanced manure management systems, but need high investment. This alternative is realistic for this step.
Burned for fuel	Via site interview with chief and staffs in swine farms, CTI confirmed that this method is not suitable for such large-scale

	swine farms that generate too much dung and urine daily, which hard to dry and burned for fuel. This alternative is ruled out.
Cattle and Swine deep Bedding, <1month, Cattle and Swine deep Bedding, >1month	Via site interview with chief and staffs in swine farms, CTI confirmed that this method is a storage method of manure, not a disposal method, and not suitable for such large-scale swine farms as deep bedding is counter to achieving economies of scale associated with large animal counts, hence this alternative is not realistic. This alternative is ruled out.
Composting - In-vessel	Via site inspection, CTI confirmed that the manure in this project is in liquid with large volume of water, hence this alternative is not realistic. This alternative is ruled out.
Composting - Static pile	Via site inspection, CTI confirmed that the manure in this project is in liquid with large volume of water will consume a great deal of electricity for forced aeration as the large quantity of swine manure, hence this alternative is not economically attractive. This alternative is ruled out.
Composting - Intensive windrow	Via site inspection, CTI confirmed that the manure in this project is in liquid with large volume of water will consume a great deal of electricity for forced aeration as the large quantity of swine manure, hence this alternative is not economically attractive. This alternative is ruled out.
Composting – Passive windrow	Via site inspection, CTI confirmed that this method would take a long time and occupies a large area of land, even emits strong odors and GHGs during turning, hence this alternative is not economically attractive. This alternative is ruled out.
Poultry manure with litter	Via site inspection, CTI confirmed that only large-scale swine farm involved in the project, no Poultry farm.
Poultry manure without litter	Via site inspection, CTI confirmed that only large-scale swine farm involved in the project, no Poultry farm.
Aerobic treatment (Anaerobic Digester-Aerobic Treatment system)	Via site inspection, CTI confirmed that single aerobic treatment technique is not suitable for treating low concentration organic wastewater in wastewater. At present a combine Anaerobic Digester-Aerobic Treatment system is considered as 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 which has been demonstrated in the below step 3. Hence this alternative is not economically attractive. This alternative is ruled out.

Hence, based on above assessment, CTI confirmed that the remaining realistic and credible alternative scenarios for the new animal waste management system are

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 applicable laws and regulations

Via searching the public website with laws and regulations in Henan Province and China by CTI, it is confirmed that 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. And via checking the "Regulations on Prevention and Control of Pollution from Livestock and Poultry Farming"/77/ and "Technical specification for sanitation treatment of livestock and poultry manure"/76/, CTI confirmed that the manure is prohibited to discharge directly into environment without any treatment and the uncovered anaerobic lagoon is a kind of manure treatment method recognized by the state.

Besides, the "Specifications for the construction of manure resource utilization facilities for large-scale livestock and poultry farms (for trial implementation)"/78/ has been checked and CTI confirmed that anaerobic digester, aerobic treatment or other biological treatment techniques methods to dispose manure waste are encouraged by the state and not mandatory.

As assessed above, CTI confirmed that the above options of Scenario 6 and Scenario 8&17 are considered to follow all mandatory applicable legal and regulatory requirements which are verified based in validation team's local expertise. The outcome of Step 1b is same to Step 1a.

Step 2: Barrier analysis

Based on above assessments, it is concluded that both the two alternatives have no technology barriers, acceptability barriers and financial barriers.

Therefore, both alternatives come to Step 3.

Step 3: Investment analysis

The purpose of this step is to determine which one is economic attractive.

For each alternative, all cost and economic benefits attributable to the waste management scenario should be illustrated in a transparent and complete manner according to the Combined tool to identify the baseline scenario and demonstrate additionality (Version 07.0)/46/.

Via checking the calculation formula and calculation process of the value of NPV and IRR in the calculation sheet/3/, CTI confirmed that the formula and inputs values are correct and actual by checking the PER/5/and Economic Evaluation Method and Parameter of Construction Projects version 03/41/, thus CTI verified that the calculation results of the NPV for scenario 6 and scenario 8&17 are correct.

By comparing with the results, CTI confirmed that the NPV of the project activity is far more negative than that of the uncovered anaerobic lagoon.

Hence the uncovered anaerobic lagoon is the most attractive course of action and is considered to be the baseline scenario.

Furthermore, for the project scenario, PP has analyzed the IRR value to prove that only get revenues from VCUs, the IRR/3/ of the project activity is higher than the benchmark.

Via checking the calculation formula and calculation process of the value of IRR in the calculation sheet/3/, CTI confirmed that the formula and inputs values are correct and actual by checking the PER/5/and Economic Evaluation Method and Parameter of Construction Projects version 03/41/, thus CTI verified that the calculation results of the IRR for scenario 8&17 is correct and the final value of IRR of the project scenario without carbon revenue is 5.38% which is lower than the benchmark of 9.5%.

Benchmark of 9.5% is confirmed as reasonable by checking the "Notice on adjusting financial benchmark rate of return of construction projects in some industries" issued by NDRC and the ministry of housing and urban-rural development of PRC/42/, which define the financial benchmark of animal industry for Project IRR (after tax) is 9.5% for total investment.

And by checking the calculation process of the value of IRR in the calculation sheet/3/, CTI confirmed that the value of IRR of the project scenario with carbon revenue is increased to 10.69% which is higher than the benchmark of 9.5% and thus the proposed project is financially acceptable with carbon revenue.

A sensitivity analysis has been provided in the JPM and the calculation sheet/3/. The analysis is assessed as follow,

The sensitivity analysis was demonstrated through two manners:

a) Varying ± 10 % of three critical parameters (Total static investment, O&M cost and Annual Organic fertilizers sales). The selection is checked as in line with the requirements in Tool of Investment analysis (version 11.0)/52/ of "Only variables, including the total static investment, that constitute more than 20% of either total project costs or total project revenues should be subjected to reasonable variation", the Total static investment and Organic fertilizers sales are checked as constitutes more than 20% of total project costs. The total O&M throughout the project lifetime is checked as accounts for more than 20% of the project cost.

Via checking the sensitivity analysis for these three critical parameters as provided in JPM and the calculation sheet/3/, CTI verified that the IRR values are still lower than the benchmark by varying ±10% of three critical parameters.

b) Threshold analysis by varying the above three parameters to make the IRR reach the benchmark. The threshold analysis of each parameter is assessed individually by the validation team as below,

i. If the Total static investment decreases by 22.3%, the IRR reach the benchmark, however, via checking the price index of investment in fixed asset for China/71/, CTI confirmed that the price index was rising in the past years. Therefore, it is not likely to implement the project activity with the Total static investment reducing by 22.3% to make the project becomes economical attractive.

   In addition, due to the project has been operated during the joint audit process, via checking the Equipment (boilers, solid-liquid separators, flare systems and anaerobic tanks) purchase contracts/9/ and General design and construction contract/10/, CTI confirmed that the actual

investment costs of the project is about 118.98 Million RMB, which is higher than estimated value in PER (about 98 Million RMB)/5/. Therefore, CTI confirmed that the value in PER/5/ is reasonable and conservative.

ii. If the Annual organic fertilizers sales increases by 20.35%, the IRR reach the benchmark, however, via checking the PER/5/, CTI confirmed that the organic fertilizers are determined by the manure of the swine farm and fertilizer's price. And the population of livestocks and scale of the swine farm will stay stable in the future as confirmed by site inspection and interview with chiefs of farms, besides, sales of organic fertilizers are only a small part of the total organic fertilizers' generation and the price of organic fertilizers is determined by the raw material, production technology, the quality of organic fertilizer and so on. the organic fertilizers produced by the project belong to semi-finished Products (or called compost), which is harmless but not reaching the Chinese organic fertilizer standard. It can be directly applied to farmland or sold to commercial organic fertilizer plants for further processing. Via checking the sale agreement of organic fertilizer/25/, CTI confirmed that the organic fertilizer is sold to local agricultural company and local organic fertilizer plant with the fixed price i.e., 280 RMB/ton which is same to the estimated price in PER/5/. Hence it is not likely to increase of annual organic fertilizers generation by 20.35% to make the IRR reach the benchmark.

iii. If the O&M Costs decrease by 44.5%, the IRR reach the benchmark, however, via checking the PER/5/, CTI confirmed that O&M costs mainly consist of maintenance cost, salary & welfare, insurance of fixed assets, and other cost. Via checking the average monthly wage level in Henan Province/71/, CTI confirmed that the average monthly wage keeps increasing in past years. Besides, via checking the indices of purchasing price of raw material, power and fuel/71/, CTI confirmed that the price index was rising in the past years. Therefore, it is not likely to implement the project activity with the O&M cost reducing by 44.5% to make the IRR reach the benchmark.

In conclusion, the investment analysis concludes that the project IRR (after tax) will not reach the benchmark of 9.5% and the project activity is unlikely to be financially attractive. Threshold analysis is further proved this. The sensitivity analysis and threshold analysis were reproduced by the validation team and evaluated to be correct. Based above, it can confirm that the financial unattractiveness of the project is robust and thus the scenario 6 is the most economically attractive option and plausible baseline scenario.

Hence the scenario 6 is considered as baseline scenario which is "The manure is disposed in an uncovered anaerobic lagoon".

Based on the checking the data provided in Joint-PD-MR and above related assessment, it proves that the baseline scenario determined in the Joint-PD-MR is correct and reasonable. Therefore, baseline scenario is identified transparently for the project activity.

The assessment team has reviewed the Joint-PD-MR in line with the applied methodology and methodological tool and CTI confirmed that PP has correctly identified the baseline scenario.

CAR 10 was raised and successfully closed. Refer to Appendix 4 for detail assessment.

3.4.5 Additionality

By means of comparison of the Joint-PD-MR with "Combined tool to identify the baseline scenario and demonstrate additionality" (Version 07.0)/46/, the validation team has assessed the additionality demonstration in accordance with applicable methodology and tool.

Step 1-3 of the tool were already done in section B.4 of this Joint-PD-MR for selection of alternative 6 and 8&17 as assessed in above section 3.3.4.

Then for the demonstration of additionality, the below step is assessed,

Step 4 Common practice analysis

The common practice analysis was checked strictly followed Methodological tool "Common practice" (Version 03.1)/44/.

Step 1: calculate applicable capacity or output range as +/-50% of the design capacity or output of the proposed project activity

The project activity is to treat the manure from the swine farms, and 9 swine farms involving 454,600 heads of Market swine, 24,500 heads of breeding swine in stock are included, and are estimated to produce 699,486 tons of manure every year. So the range is the projects handle manure from 349,743 tons to 1,049,229 tons are considered as similar projects.

Step 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,

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

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

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

e) The capacity or output of the projects is within the applicable capacity or output range calculated in Step 1,

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.

Demonstration as follow,

a) The region selected for common practice of Henan Province is assessed as appropriate and reasonable. A province is the second administrative level of China after central Government and it is authorized to execute administrative examination and approval for construction projects considering local regulations based on local expertise of the validation team; also by considering differences of economic development level, population size, industrial structure, fundamental infrastructure, strategic planning etc, the investment environment of each province, and unique

geological conditions in Henan Province results in the different resource, thus region selected for common practice is Henan Province.

b) *Same measures is defined as: Methane formation avoidance*

c) *Same energy source/fuel and feedstock: biogas captured for heat generation and used in Swine Farm,*

d) *Treat manure waste and produce electricity technology,*

e) *Output range: handle manure from 349,743 tons to 1,049,229 tons annually*

f) *Commercial operation started before 05-August-2020.*

Thus, the Swine Farm Animal Manure Management System GHG Mitigation projects operated before 05-August-2020, handle manure from 349,743 tons to 1,049,229 tons annually in Henan province are determined similar projects.

The information source from Development and Reform Commission of Henan Province/72/ and other public information from Department of Agriculture and Rural affairs of Henan Province/73/ for the common practice analysis is available and checked by the audit team. The information used is evaluated to be credible.

Via the source, CTI confirmed that there are no similar projects identified in Henan Province based on the above criteria.

Step 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}.

There are no similar projects identified in Henan Province.

Hence N_{all}=0.

Step 4: within similar projects identified in Step 3, identify those that are different to the technology applied in the proposed project activity. Note their number N_{diff}.

Due to N_{all}=0, N_{all}=N_{diff}=0.

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

For this project, $F=1- N_{diff}/N_{all} =1-1=0$ and $N_{all}-N_{diff}=0$.

It can be concluded that the project is not a common practice.

In conclusion, the project meets the criteria and tool "Combined tool to identify the baseline scenario and demonstrate additionality (Version 07.0)", thus deemed as additional.

CAR 11 was raised and successfully closed. Refer to Appendix 4 for detail assessment.

3.4.6 Quantification of GHG Emission Reductions and Removals

For validation of the estimated GHG emission reductions in the Joint-PD-MR/1/ and ER calculation sheet/2/,

Further, the VVB has downloaded from the UNFCCC website the applicable version of the CDM methodology,

Via verify the Joint-PD-MR/1/, it is confirmed the calculation of ERs is done as per the applied methodology (ACM0010 ver. 08.0) with follow steps listed below.

Baseline emissions

Via checking the paragraph 26 of the applied methodology, the baseline emissions BE_y in a year y are calculated as:

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

Where:

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

1. Baseline CH_4 emissions ($BE_{CH4,\,y}$)

$$BE_{CH4,y} = GWP_{CH4} * D_{CH4} * \sum_{j,LT} (MCF_j * B_{0,LT} * N_{LT} * VS_{LT,y} * MS\%_{Bl,j}) \quad (2)$$

Where:

$BE_{CH4,\,y}$	=	Baseline CH_4 emissions in year y (t CO_2/yr)
GWP_{CH4}	=	Global Warming Potential (GWP) of CH_4 (t CO_2e/t CH_4)
D_{CH4}	=	Density of CH_4 (t/m³). 0.00067t/m³ at room temperature (20˚C) and 1am pressure.
MCF_j	=	Annual methane conversion factor (MCF) for the baseline *AWMS$_j$*. IPCC 2006 Guidance, table 10.17, chapter 10, volume 4.
$B_{0,LT}$	=	Maximum methane producing potential of the volatile solid generated by animal type *LT* (m³CH_4/kg -dm)
N_{LT}	=	Annual average number of animals of type LT for the year y (number)
$VS_{LT,y}$	=	Annual volatile solid excretions for livestock LT entering all AWMS on a dry matter weight basis (kg -dm/animal/yr)
$MS\%_{Bl,j}$	=	Fraction of manure handled in system j in the baseline. In this project, the baseline manure management system is uncovered anaerobic lagoon only. The amount of manure handled by the anaerobic lagoon is 100%. $MS\%_{Bl,j}$ =100%
LT	=	Type of livestock
j	=	Type of treatment system

Estimation of various variables and parameters for above equation:

(A) $VS_{LT,y}$

As per the methodology, there are four options to determine this value, via checking the options provided, CTI confirmed there is no published country specific data available based on the local expertise of audit team. The energy intake of the swine is not available, Option 2 can't be used. Option 3 utilizes the average weight of the swine, this data is available and therefore Option 3 is adopted by PP to calculate $VS_{LT,y}$.

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

$$VS_{LT,y} = \left(\frac{W_{site}}{W_{default}}\right) * VS_{default} * nd_y \quad (3)$$

Where:

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

(B) N_{LT}

As per the methodology, there are four options to determine this value, via checking the options provided, via site inspection, CTI confirmed that there are two types of swine in this project, i.e., Market swine and Breeding swine. For Market swine, since there is no way to trace the daily stock, so the Option 1 is adopted to calculate N_{LT} for Market swine. For Breeding swine, the PP can monitor the daily stock of breeding swine in a reliable way, discounting dead breeding swine and discarded them from the productive process from the daily stock. So, the Option 2 is adopted to calculate N_{LT} for Breeding swine.

Option 1:

$$N_{LT} = N_{da,LT} * \left(\frac{N_{p,LT}}{365}\right) \quad (4)$$

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:

$$N_{LT} = \frac{\sum_1^{365} N_{AA,LT}}{365} \quad (5)$$

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)

(C) $B_{0,LT}$

As per the applied methodology, 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)/39/.

CTI verified that 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 VS is applicable to the project due to project is located in Henan Province, China, Asia which is verified by checking the Table 10A-7 and 10A-8 of IPCC 2006 Guidelines for National Greenhouse Gas Inventories volume 4, chapter 10/39/.

(D) MCF_j

As per the applied methodology, the MCF_j values given in table 10.17, chapter 10, volume 4, IPCC 2006 Guidelines/39/ should be used. MCF_j values depend on the annual average temperature where the anaerobic manure treatment facility in the baseline existed.

i. For this project, the annual average temperature is confirmed as 15˚C/68/ and the value of 74% applied is verified as consistent with IPCC/39/.

ii. A conservativeness factor should be applied by multiplying MCF_j values (estimated as per above bullet) with a value of 0.94, to account for the 20% uncertainty in the MCF_j values as reported by IPCC 2006/39/.

2. Baseline NO_2 emissions ($BE_{NO2,y}$)

$$BE_{N2O,y} = GWP_{N2O} * CF_{N2O-N,N} * \frac{1}{1000} * \ (E_{N2O,D,y} + E_{N2O,ID,y}) \quad (6)$$

Where:

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

$$E_{N2O,D,y} = \sum_{j,LT} EF_{N2O,D,j} * NEX_{LT,y} * N_{LT} * MS\%_{Bl,j} \quad (7)$$

Where:

$E_{N2O,D,y}$	=	Direct N_2O emission in year *y* (kg N_2O-N/yr)
$EF_{N2O,D,j}$	=	Direct N_2O emission factor for the treatment system *j* of the manure management system (kg N_2O-N/kg N). (Estimated with site-specific, regional or national data if such

data is available, otherwise use default 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.

$NEX_{LT,y}$ = 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 4 and 5 (number)

N_{LT} = Annual Average number of animals of type LT for the year *y* estimated as per equation 4 and 5 (number)

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

Where:

$E_{N2O,ID,y}$ = Indirect N_2O emission in year *y* (kg N_2O-N/year)

$EF_{N2O,ID}$ = Indirect N_2O emission factor for N_2O emissions from atmospheric deposition of nitrogen on soils and water surfaces (kgN_2O-N/kg NH_3-N and NO_X-N). (Estimated with site-specific, regional or national data if such data is available. Otherwise, default values for EF_4 from table 11.3, chapter 11, volume 4 of IPCC 2006 Guidelines for National Greenhouse Gas Inventories

can be used). The site-specific, regional or national data are not available, so this project activity adopts default EF_4.

$NEX_{LT,y}$ = Annual average nitrogen excretion per head of a defined livestock population (kg N/animal/yr) estimated as described in Appendix 2

$MS\%_{Bl,j}$ = Fraction of manure handled in system *j* (fraction)

$F_{gasMS,j,LT}$ = Default values for nitrogen loss due to volatilisation of NH_3 and NO_X from manure management (fraction)

N_{LT} Annual Average number of animals of type LT for the year *y* estimated as per equation (4) or (5) (number)

Estimation of various variables and parameters for above equations:

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

As per the Appendix 2 of the applied methodology, two options provided, for this project, neither specific information on Portion of that N intake nor site-specific national or regional data is available. So, the Option 2 is adopted to calculate $NEX_{LT,y}$.

Option 2:

In the absence of availability of project specific information on protein intake, which should be justified in the Joint-PD-MR, 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:

$$NEX_{LT,y} = \frac{W_{site}}{W_{default}} * NEX_{IPCC\ default} \quad (9)$$

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)

Via checking the IPCC, it is confirmed that below equation is used for calculate $NEX_{IPCC\ default}$

$$NEX_{IPCC\ default} = N_{rate(T)} * \frac{TAM}{1000} * 365 \quad (10)$$

Where:

$N_{rate(T)}$	=	the default N excretion rate, kg N/ (1,000 kg animal mass)/ day, table 10.19, chapter 10, volume 4 of IPCC 2006 Guidelines
TAM	=	Typical animal mass for livestock in kg/animal

3. **Baseline CO_2 emission from electricity and/or heat used in the baseline**

$$BE_{elec/heat,y} = BE_{EC,y} + BE_{HG,y} \quad (11)$$

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)

Via site inspection and checking the baseline scenario evidence/27/, CTI confirmed that 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 used by the AWMSs and 9 swine farms. The heat generated will not be connected to another user. So, the baseline CO_2 emission from electricity and/or heat used in the baseline is 0, which is conservative.

Project Emissions

Based on the applied methodology, and via site inspection checking the project implementation, CTI confirmed that there are two stages involved in the manure treatment for the project activity: (1) anaerobic digester; (2) aerobic composting.

The Project emissions are estimated as follows:

$$PE_y = PE_{AD,y} + PE_{Aer,y} + PE_{N2O,y} + PE_{EC/FC,y} \quad (12)$$

Where:

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

i) $PE_{AD,y}$

$PE_{AD,y}$ is determined using the methodological tool "Project and leakage emissions from anaerobic digesters" (Version 02.0) as defined in the applied methodology, as per the tool

$$PE_{AD,y} = PE_{EC,y} + PE_{FC,y} + PE_{CH4,y} + PE_{flare,y} \quad (13)$$

Where:

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

a. $PE_{EC,y}$

The project emissions from electricity consumption is calculated according to the "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0).

$$PE_{EC,y} = \sum_{j,LT} EC_{PJ,J,y} * EF_{EF,j,y} * (1 + TDL_{j,y}) \quad (14)$$

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*

The electricity consumed by the project will provided from the regional power grid CCPG. So for ex ante calculation of $PE_{EC,y}$, it is assumed that the electricity consumed of the project activities comes from the CCPG is derived from PER.

During the monitoring period, the project emissions from electricity consumption will be calculated as above formular 14 in the case of the electricity consumed from the regional power grid CCPG. And the electricity consumption sourced from the grid company will be determined through the electricity meters measurement and cross-check with the grid statement.

b. $PE_{FC,y}$

Via site inspection, CTI confirmed that there are no fossil fuels involved in the project for anaerobic digestion process, hence $PE_{FC,y}$=0.

c. $PE_{flare,y}$

Via site inspection, it is confirmed that the residual gas stream will be flared by flaring, so the project emissions from flaring of biogas ($PE_{flare,y}$) shall be estimated using the tool 06 "Project emissions from flaring" (version 04.0)/48/

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

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

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

STEP 2: Determination of the flare efficiency;

STEP 3: Calculation of project emissions from flaring.

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

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

The following requirements apply:

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

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

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

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

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

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

Therefore, option A is adopted to calculate the mass flow of the residual biogas for flaring as per Too 08 "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0)/49/.

As per paragraph 23 of Tool 8:" Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 03.0)"/49/, the way to prove that the gaseous stream is dry needs to demonstrate that the temperature of the gaseous stream (T_t) is less than 60ºC (333.15 K) at the flow measurement point. For this project, the flowmeters installed in the outlet of the anaerobic tanks and the temperature of the anaerobic treatment unit of this project is designed as medium temperature i.e. 30~33 ºC. Therefore, the gas temperature measured by the flowmeter does not exceed 60 ºC, it can be demonstrated that the gaseous stream is dry.

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

$$F_{i,t} = V_{t,db} * \upsilon_{i,t,db} * \rho_{i,t} \quad (15)$$

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t} \quad (16)$$

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)

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" (version 03.0)/49/. The formulars are same to above (15) and (16).

Step 2: Determination of flare efficiency

Via site inspection, CTI confirmed that the open flares are applied

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

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

Step 3: Calculation of project emissions from flaring

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

$$PE_{flare,y} = GWP_{CH4,y} * \sum_{m=1}^{525600} F_{CH4,GR,m} * \left(1 - \eta_{flare,m}\right) * 10^{-3} \quad (17)$$

Where:

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

$F_{CH4,RG,m}$ will be determined as above assessment. So the Project emissions from flaring can be calculated by:

$$PE_{flare,y} = GWP_{CH4,y} * V_{t,db} * \upsilon_{i,t,db} * \rho_{i,t} * \left(1 - \eta_{flare,m}\right) * 10^{-3} \quad (18)$$

Where:

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

Via checking the project evaluation report/5/, it is confirmed as all the biogas generated in the AWMSs is collected for heat generation, so no biogas is flared in pre-calculation. While, in the monitoring period, the project emissions from flaring of biogas will be calculated according to the actual flaring mass flow of methane.

d. $PE_{CH4,y}$

The project emissions from methane from the anaerobic digester is calculated according to the tool "Project and leakage emissions from anaerobic digesters (Version 02.0)"/50/. According to the tool, 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:

$$PE_{CH4,y} = Q_{CH4,y} * EF_{CH4,default} * GWP_{CH4} \quad (19)$$

Where:

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

$Q_{CH4,y}$

Due to the project is a large scale, $Q_{CH4,y}$ was determined following step 1 and Option 1 of the applied tool. Below is the formula used for the calculation of $Q_{CH4,y}$.

Option1: Procedure using monitored data

$Q_{CH4,y}$ shall be measured using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0)/49/. When applying the tool, the following applies:

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

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

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

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

As per the tool, the mass flow of greenhouse gas i ($F_{i,t}$) is determined as follows:

$$F_{i,t} = V_{t,db} * \upsilon_{i,t,db} * \rho_{i,t} \quad (20)$$

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t} \quad (21)$$

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 final determined Project emission associated with the anaerobic digester for the project activity is **$PE_{AD,y} = PE_{EC,y} + PE_{CH4,y} + PE_{flare,y}$**

ii). $PE_{Aer,y}$

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.

$$PE_{Aer,y} = GWP_{CH4} * D_{CH4} * 0.001 * F_{Aer} * \left[\prod_{n=1}^{N}(1 - R_{VS,n})\right] * \sum_{j,LT}(B_{0,LT} * N_{LT} * VS_{LT,y} * MS\%_j) + PE_{sl,y} \quad (22)$$

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.

So,

$$PE_{Aer,y} = GWP_{CH4} * D_{CH4} * 0.001 * F_{Aer} * \left[\prod_{n=1}^{N}(1 - R_{VS,n})\right] * \sum_{j,LT}(B_{0,LT} * N_{LT} * VS_{LT,y} * MS\%_j) \quad (23)$$

Where:

GWP_{CH4}	=	Global Warming Potential (GWP) of CH_4 (t CO_2e/tCH_4)
$R_{VS,n}$	=	Fraction of volatile solid degraded in AWMS treatment method n of the N treatment steps prior to waste being treated (fraction)
D_{CH4}	=	Density of CH_4 (t/m³)
F_{Aer}	=	Fraction of volatile solid directed to aerobic system (fraction)
LT	=	Type of livestock
$B_{0,LT}$	=	Maximum methane producing potential of the volatile solid generated by animal type LT (m^3CH_4/kg dm)
$VS_{LT,y}$	=	Annual volatile solid excretion livestock type LT entering all AWMS on a dry matter weight basis in (kg -dm/animal/yr)
N_{LT}	=	Annual average number of animals of type LT for the year y (number) as estimated in equation above
$PE_{sl,y}$	=	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)

iii). $PE_{N2O,y}$

$$PE_{N2O,y} = GWP_{N2O} * CF_{N2O-N,N} * \frac{1}{1000} * (E_{N2O,D,y} + E_{N2O,ID,y}) \quad (24)$$

Where:

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

$E_{N2O,ID,y}$ = Indirect N_2O emission in year y (kg N_2O-N/year)

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

Option 1:

$$E_{N2O,D,y} = \sum_{j,LT} EF_{N2O,D,j} * NEX_{LT,y} * N_{LT} * MS\%_j \quad (25)$$

Where:

$E_{N2O,D,y}$ = Direct N_2O emission in year *y* (kg N_2O-N/yr)

$EF_{N2O,D,j}$ = Direct N_2O emission factor for the treatment system *j* of the manure management system (kg N_2O-N/kg N)

$NEX_{LT,y}$ = Annual average nitrogen excretion per head of a defined livestock population (kg N/animal/yr) estimated as described in appendix 2

$MS\%_j$ = Fraction of manure handled in system *j* (fraction)

N_{LT} = Annual Average number of animals of type LT for the year *y* estimated as per equation 4 and 5 (number)

$$E_{N2O,ID,y} = \sum_{j,LT} EF_{N2O,ID} * F_{gasMS,j,LT} * NEX_{LT,y} * N_{LT} * MS\%_j \quad (26)$$

Where:

$E_{N2O,ID,y}$ = Indirect N_2O emission in year *y* (kg N_2O-N/year)

$EF_{N2O,ID}$ = Indirect N_2O emission factor for N_2O emissions from atmospheric deposition of nitrogen on soils and water surfaces (kgN_2O-N/kg NH_3-N and NO_X-N)

$NEX_{LT,y}$ = Annual average nitrogen excretion per head of a defined livestock population (kg N/animal/yr) estimated as described in appendix 2

$MS\%_j$ = Fraction of manure handled in system *j* (fraction)

$F_{gasMS,j,LT}$ = Default values for nitrogen loss due to volatilisation of NH_3 and NO_X from manure management (fraction)

N_{LT} = Annual Average number of animals of type LT for the year *y* estimated as per equation 4 and 5 (number)

iv) $PE_{elec/heat}$

$$PE_{EC/FC,y} = PE_{EC,y} + \sum_{j} PE_{FC,j,y} \quad (27)$$

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).

Via site inspection, CTI confirmed there is no consumption of heat related to the anaerobic digester. Hence, these emissions should not be considered.

Besides, 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 $PE_{EC,y}$.

The same for the $PE_{FC,y}$, please refer to $PE_{FC,y}$ calculation in above.

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

Leakage

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

$$LE_y = \left(LE_{PJ,N2O,y} - LE_{BL,N2O,y}\right) + \left(LE_{PJ,CH4,y} - LE_{BL,CH4,y}\right) + LE_{AD,y} \quad (28)$$

Where:

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

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

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

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

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

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

$$LE_{BL,N2O,y} = GWP_{N2O} * CF_{N2O-N,N} * \frac{1}{1000} * (LE_{N2O,land,y} + LE_{N2O,runoff,y} + LE_{N2O,vol,y}) \quad (29)$$

$$LE_{N2O,land,y} = EF_1 * \prod_{n=1}^{N}(1 - R_{N,n}) * \sum_{LT} NEX_{LT,y} * N_{LT} \quad (30)$$

$$LE_{N2O,runoff,y} = EF_5 * F_{leach} * \prod_{n=1}^{N}(1 - R_{N,n}) * \sum_{LT} NEX_{LT,y} * N_{LT} \quad (31)$$

$$LE_{N2O,vol,y} = EF_4 * \prod_{n=1}^{N}(1 - R_{N,n}) * F_{gasm} * \sum_{LT} NEX_{LT,y} * N_{LT} \quad (32)$$

Where:

GWP_{N2O}	=	Global Warming Potential (GWP) for N_2O (t CO_2e/tN_2O)
$CF_{N2O-N,N}$	=	Conversion factor N_2O-N to N_2O (44/28)
$LE_{N2O,land,y}$	=	Leakage N_2O emissions from application of manure waste in year y (kg N_2O-N/year)
$LE_{N2O,runoff,y}$	=	Leakage N_2O emissions due to leaching and run-off in year y (kg N_2O-N/year)
$LE_{N2O,vol,y}$	=	Leakage N_2O emissions due to 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 4 and 5 (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)

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

$$LE_{PJ,N2O} = GWP_{N2O} * CF_{N2O-N,N} * \frac{1}{1000} * (LE_{N2O,land,y} + LE_{N2O,runoff,y} + LE_{N2O,vol,y}) \quad (33)$$

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

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

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

Where:

GWP_{N2O}	=	Global Warming Potential (GWP) for N_2O (t CO_2e/tN_2O)
$CF_{N2O-N,N}$	=	Conversion factor N_2O-N to N_2O (44/28)
$LE_{N2O,land,y}$	=	Leakage N_2O emissions from application of manure waste in year y (kg N_2O-N/year)
$LE_{N2O,runoff,y}$	=	Leakage N_2O emissions due to leaching and run-off in year y (kg N_2O-N/year)
$LE_{N2O,vol,y}$	=	Leakage N_2O emissions due to 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 4 and 5 (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)

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, $\prod_{n=1}^{N}(1 - R_{N,n}) * \sum_{LT} NEX_{LT,y} * N_{LT}$ does not need to be replaced 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:

$$LE_{BL,CH4,y} = GWP_{CH4} * D_{CH4} * MCF_d * \left[\prod_{n=1}^{N}(1 - R_{VS,n})\right] * \sum_{j,LT}(B_{0,LT} * N_{LT} * VS_{LT,y} * MS\%_j) \quad (37)$$

$$LE_{PJ,CH4,y} = GWP_{CH4} * D_{CH4} * MCF_d * \left[\prod_{n=1}^{N}(1 - R_{VS,n})\right] * \sum_{j,LT}(B_{0,LT} * N_{LT} * VS_{LT,y} * MS\%_j) \quad (38)$$

Where:

$LE_{BL,CH4,y}$	=	Leakage CH_4 emissions released during baseline scenario from land application of the treated manure in year *y* (t CO_2e/yr)
$LE_{PJ,CH4,y}$	=	Leakage CH_4 emissions released during project activity from land application of the treated manure in year *y* (t CO_2e/yr)
$R_{VS,n}$	=	Fraction of volatile solid degraded in AWMS treatment method *n* of the *N* treatment steps prior to sludge being treated
GWP_{CH4}	=	Global Warming Potential (GWP) of CH_4 (t CO_2e/tCH_4)
D_{CH4}	=	Density of CH_4 (t/m^3)
$B_{0,LT}$	=	Maximum methane producing potential of the volatile solid generated by animal type LT (m$^3CH_4$/kg dm)
N_{LT}	=	Annual average number of animals of type *LT* estimated as per equation 4 and 5, expressed (number)
$VS_{LT,y}$	=	Annual volatile solid excretions for livestock *LT* entering all AWMS on a dry matter weight basis (kg -dm/animal/yr)
$MS\%_j$	=	Fraction of manure handled in system *j* in the project activity (fraction)
MCF_d	=	Methane conversion factor (MCF_d) assumed to be equal to 1

iV) Estimation of leakage emissions associated with the anaerobic digester

$LE_{AD,y}$ is determined using the methodological tool "Project and leakage emissions from anaerobic digesters(Version 02.0)/43/.

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:

$$LE_{AD,y} = LE_{storage,y} + LE_{comp,y} \quad (39)$$

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)

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 heat generation or flared (if any). The Emissions from combustion is calculated in project emissions (if any). After anaerobic digestion, the fermented sludge is treated in aerobic composting system and organic fertilizer can be produced. Wastewater from the new animal waste management systems will be treated aerobically and then used for agriculture irrigation. So, the Estimation of leakage emissions associated with the anaerobic digester is 0. i.e., $LE_{AD,y}$ =0.

Emission reductions:

$$ER_y = BE_y - PE_y - LE_y \quad (40)$$

Where:

ER_y	Emission reductions in year y (t CO_2e/yr).
BE_y	Baseline emissions in year y (t CO_2e/yr).
PE_y	Project emissions in year y (t CO_2/yr).
LE_y	Leakage emissions in year y (t CO_2/yr)

Ex ante calculation of emission reductions

For Baseline Emission calculation, as per the equation as below

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

Based on above assessment, the ex ante baseline emissions can be calculated as follows:

Baseline Emissions: $BE_y = BE_{CH4,y} + BE_{N2O,y}$ =410,479 tCO_2e +6,832 tCO_2e =417,311 tCO_2e

All the ex ante determined values for each basic parameter for BE calculation is checked by CTI for both ex ante value for fixed parameters assessment as above and confirmed the ex ante value for monitored parameters as below. The values used for the ex ante baseline emissions calculation in both Joint-PD-MR/1/ and ER sheet/2/ is verified as correct.

Project Emissions

Based on above assessment, final PE_y calculation for the project activity is listed as below

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

Based on above assessment, the ex ante project emissions can be calculated as follows:

$PE_{AD,y} = PE_{EC,y} + PE_{CH4,y} + PE_{flare,y}$ =65 tCO_2e +21,651 tCO_2e +0 tCO_2e =21,716 tCO_2e

$PE_{Aer,y}$= 77 tCO_2e

$PE_{N2O,y}$= 12,385 tCO_2e

Project emission:

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

$= 21{,}716\ tCO_2e + 77\ tCO_2e + 12{,}385\ tCO_2e$

$= 34{,}179\ tCO_2e$

All the ex ante determined values for each basic parameter for PE calculation is checked by CTI for both ex ante value for fixed parameters assessment as above and confirmed the ex ante value for monitored parameters as below. The values used for the ex ante project emissions calculation in both Joint-PD-MR/1/ and ER sheet/2/ is verified as correct.

Leakage

Based on above assessment, final LE_y calculation for the project activity is listed as below

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

Based on above assessment, the ex ante leakage emissions can be calculated as follows:

$LE_{PJ,N2O,y} = 17{,}345\ tCO_2e$

$LE_{BL,N2O,y} = 4{,}868\ tCO_2e$

$LE_{PJ,CH4,y} = 94{,}419\ tCO_2e$

$LE_{BL,CH4,y} = 88{,}515\ tCO_2e$

Leakage emission:

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

$= (17{,}345tCO_2e - 4{,}868tCO_2e) + (94{,}419tCO_2e - 88{,}515tCO_2e)$

$= 18{,}382\ tCO_2e$

All the ex ante determined values for each basic parameter for LE calculation is checked by CTI for both ex ante value for fixed parameters assessment as above and confirmed the ex ante value for monitored parameters as below. The values used for the ex ante Leakage emissions calculation in both Joint-PD-MR/1/ and ER sheet/2/ is verified as correct.

Emission reductions

$ER_y = BE_y - PE_y - LE_y$

Based on the above assessment of the ex ante determined values, it is verified that the annual ex ante determined ERs calculated result is 364,750 tCO_2/yr.

The detail of emission reduction calculation is transparently discussed in the Joint-PD-MR/1/. The assessment team has checked the Joint-PD-MR/1/ and ER sheet/2/ for the detail calculation of all the particulars and found it to be correct.

In conclusion, based on above values for each parameter for determine the ex-ante of emission reduction calculation, the CTI verified that results in Joint-PD-MR are correct for the ex-ante ER values during the fixed 10 years crediting period.

The ER calculation sheet/2/ has been duly checked. Further it has been checked whether the results have been correctly calculated in Joint-PD-MR/1/ for determination of ex-ante ER. The VVB has further checked the Joint-PD-MR/1/ against the latest version of the applicable methodology for consistency.

CAR 12 was raised and successfully closed. Refer to Appendix 4 for detail assessment.

3.4.7 Methodology Deviations

There are no any methodology deviations applied to the project.

3.4.8 Monitoring Plan

1. Data and parameters available at validation

Please refer to the following tables for assessment of each parameter determined ex-ante only used to calculate the ex-ante emission reduction:

GWP_{CH4}	*Global Warming Potential of CH_4*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	IPCC Fifth Assessment Report (AR5)
Correct value provided?	Yes –28 tCO_2e/tCH_4 Derived from IPCC Fifth Assessment Report (AR5)/40/
Has this value been verified?	Confirmed as correct for ex ante determination. Via checking the 100-year values are adopted from Box 3.2, table 1, IPCC Fifth Assessment Report (AR5)/40/ and VCS Standard Version 4.3/57/, it is verified that the value is correct.
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

GWP_{N2O}	*Global Warming Potential of N_2O*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	IPCC Fifth Assessment Report (AR5)
Correct value provided?	Yes –265 tCO_2e/tN_2O Derived from IPCC Fifth Assessment Report (AR5)/40/
Has this value been verified?	Confirmed as correct for ex ante determination. Via checking the 100-year values are adopted from Box 3.2, table 1, IPCC Fifth Assessment Report (AR5)/40/ and VCS Standard Version 4.3/57/, it is verified that the value is correct.
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

D_{CH4}	*Density of CH_4*

Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	The value is given in the applied methodology ACM0010 (Version 08.0)/45/.
Correct value provided?	Yes –0.00067 t/m³ at room temperature 20℃ and 1 atm pressure
Has this value been verified?	Yes. Confirmed as correct for ex ante determination as per the applied methodology/45/
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

MCF_j	*Methane conversion factor for the baseline AWMSj*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	IPCC 2006 table 10.17, chapter 10, volume 4
Correct value provided?	Yes – 69.56%
Has this value been verified?	Yes. Confirmed as correct for ex ante determination as per the IPCC/39/. A conservativeness factor has been applied by multiplying MCF_j value with a value of 0.94, to account for the 20 per cent uncertainty in the MCFj values. For this project, the annual average temperature is 15˚C and the value of 74% is applied as reported by IPCC 2006/39/. Therefore, MCFj value of 69.56% is applied.
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

$MS\%_{Bl,j}$	*Fraction of manure handled in system j in the baseline*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	In this project, the baseline manure management system is uncovered anaerobic lagoon only. The amount of manure handled by the anaerobic lagoon is 100%.
Correct value provided?	Yes – 100%
Has this value been verified?	Yes. Confirmed as correct for ex ante determination. The PER/5/and baseline evidence/27/ is checked and confirmed.
Choice of data correctly justified?	Yes.
Measurement method correctly described?	N/A

$W_{default}$	*Default average animal weight of a defined population*

Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	IPCC 2006 table 10A-7 and 10A-8, chapter 10, volume 4/39/
Correct value provided?	Yes – $W_{default}$(Market swine)=28 kg $W_{default}$(Breeding swine)=28 kg
Has this value been verified?	Yes. Confirmed as correct for ex ante determination as per the IPCC/39/ and the values in IPCC 2006 and US-EPA are compared and the lower value from IPCC 2006 is applied.
Choice of data correctly justified?	Yes.
Measurement method correctly described?	N/A

$VS_{default}$	*Default value for the volatile solid excretion per day on a dry-matter basis for a defined livestock population*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	IPCC 2006 table 10A-7 and 10A-8, chapter 10, volume 4/39/
Correct value provided?	Yes – $VS_{default}$ (Market swine) =0.3 kg-dm/animal/day $VS_{default}$ (Breeding swine) =0.3 kg-dm/animal/day
Has this value been verified?	Yes. Confirmed as correct for ex ante determination as per the IPCC/39/ and the values in IPCC 2006 and US-EPA are compared and the lower value from IPCC 2006 is applied.
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

$NEX_{IPCC\ default}$	*Default value for the nitrogen excretion per head of a defined livestock population*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Calculated by the equation: $NEX_{IPCC\ default} = N_{rate(T)} * TAM/1000*365$
Correct value provided?	Yes – $NEX_{IPCC\ default}$ (Market swine) =4.29 kg N/ animal/year $NEX_{IPCC\ default}$ (Breeding swine) =2.45 kg N/ animal/year
Has this value been verified?	Yes. Confirmed as correct for ex ante determination according to the calculation equation, while $NEX_{IPCC\ default}$ is calculated as equation 10.30 in IPCC 2006 and $N_{rate(T)}$ and TAM are default value from IPCC 2006.
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

$N_{rate(T)}$	*Default N excretion rate*
Title in line with Methodology?	Yes

Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	IPCC 2006 table 10.19, chapter 10, volume 4 used for $NEX_{IPCC\ default}$ calculations as above equation
Correct value provided?	Yes – $N_{rate(T)}$ (Market swine) =0.42 kg N (1000 kg animal mass)$^{-1}$ day^{-1} $N_{rate(T)}$ (Breeding swine) =0.24 kg N (1000 kg animal mass)$^{-1}$ day^{-1}
Has this value been verified?	Yes. Confirmed as correct for ex ante determination as per the IPCC/39/
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

TAM	*Typical animal mass for livestock category*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	IPCC 2006 table 10A-7 and 10A-8, chapter 10, volume 4 used for $NEX_{IPCC\ default}$ calculations as above equation
Correct value provided?	Yes – TAM (Market swine) =28 kg animal^{-1} TAM (Breeding swine) =28 kg animal^{-1}
Has this value been verified?	Yes. Confirmed as correct for ex ante determination as per the IPCC/39/.
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

$F_{gas\ MS,j,LT}$	*Default values for nitrogen loss due to volatilisation of NH_3 and NO_X from manure management*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	IPCC 2006 table 10.22, chapter 10, volume 4 due to site specific data is unavailable
Correct value provided?	Yes – $F_{gasMS,j,LT}$, (anaerobic lagoon) : 40% $F_{gasMS,j,LT}$, (solid storage) : 45%
Has this value been verified?	Yes. Confirmed as correct for ex ante determination as per the IPCC/39/.
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

$EF_{N2O,D,j}$	*Direct N_2O emission factor for the treatment system j of the manure management system*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	IPCC 2006 table 10.21, chapter 10, volume 4 due to site specific data is unavailable

Correct value provided?	Yes – 0 Kg N_2O-N/kg N for anaerobic lagoon and digester 0.01 Kg N_2O-N/kg N for aerobic lagoon
Has this value been verified?	Yes. Confirmed as correct for ex ante determination as per the IPCC/39/.
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

$EF_{N2O,ID,j}$	*Indirect N_2O emission factor for the treatment system j of the manure management system*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	IPCC 2006 table 11.3, chapter 11, volume 4 due to site specific data is unavailable
Correct value provided?	Yes – 0.01 kgN_2O-N/kg NH_3-N and NO_X-N
Has this value been verified?	Yes. Confirmed as correct for ex ante determination as per the IPCC/39/.
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

$EF_{CH4,default}$	*Default emission factor for the fraction of CH_4 produced that leaks from the anaerobic digester (fraction)*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Tool 14: "Project and leakage emissions from anaerobic digesters (version 02.0)"/50/ for UASB (Upflow Anaerobic Sludge Blanket) type digesters
Correct value provided?	Yes – 0.05 t CH_4 leaked / t CH_4 produced
Has this value been verified?	Yes. Confirmed as correct for ex ante determination as per the tool/50/. Via checking the anaerobic digester purchase contract/9/, CTI confirmed that the UASB (Upflow Anaerobic Sludge Blanket) type digesters, floating gas holders with no external water seal are adopted to treat the manure anaerobically, therefore, the value of 0.05 t CH_4 leaked / t CH_4 produced is applied for this project. The information in the JPM is correct and actual which is identified by manufacturer information.
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

$R_{VS,n}$	*Default emission factor for the fraction of CH_4 produced that leaks from the anaerobic digester (fraction)*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes

Source clearly referenced? (appropriate?)	Appendix 1 of methodology ACM0010/45/
Correct value provided?	Yes – $R_{VS,n}$, aerobic treatment anaerobic digester: 20%, 80% for leakage N_2O emission released during project activity $R_{VS,n}$, one cell lagoon: 85% for leakage N_2O emission released during baseline scenario
Has this value been verified?	Yes. Confirmed as correct for ex ante determination as per the Appendix 1 of methodology ACM0010/45/. Via checking Appendix 1 of methodology ACM0010/45/, CTI confirmed that 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} 80% which is the most conservative value. Via checking Appendix 1 of methodology ACM0010/45/, CTI confirmed that 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.
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

$R_{N,n}$	*Nitrogen reduction factor*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Appendix 1 of methodology ACM0010/45/
Correct value provided?	Yes – $R_{N,n}$, anaerobic digester(project scenario): 5%, 25% $R_{N,n}$, uncovered anaerobic lagoon (baseline scenario): 80%
Has this value been verified?	Yes. Confirmed as correct for ex ante determination as per the Appendix 1 of methodology ACM0010/45/. Via checking Appendix 1 of methodology ACM0010/45/, CTI confirmed that 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. Via checking Appendix 1 of methodology ACM0010/45/, CTI confirmed that 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
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

EF_1, EF_4, EF_5	*Emission factor for N_2O emissions from N inputs; from N leaching and runoff; from atmospheric deposition of N on soils and water surfaces*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	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 due to site specific data is unavailable
Correct value provided?	Yes – EF_1 = 0.010 kg N_2O-N/kg N EF_4 =0.010 kg N_2O-N/(kg NH_3-N and NO_X-N EF_5 = 0.0075 kg N_2O-N/kg N
Has this value been verified?	Yes. Confirmed as correct for ex ante determination as per the IPCC/39/
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

F_{gasm}	Fraction of N lost due to volatilization
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Default values from table 11.3, chapter 11, volume 4 of IPCC 2006 guidelines due to site specific data is unavailable
Correct value provided?	Yes – 0.2
Has this value been verified?	Yes. Confirmed as correct for ex ante determination as per the IPCC/39/
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

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*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Default values from table 11.3, chapter 11, volume 4 of IPCC 2006 guidelines due to site specific data is unavailable
Correct value provided?	Yes – 0.3
Has this value been verified?	Yes. Confirmed as correct for ex ante determination as per the IPCC/39/
Choice of data correctly justified?	Yes

Measurement method correctly described?	N/A

MCF_d	*Methane conversion factor for leakage calculation*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Methodology ACM0010 (version 08.0)/45/
Correct value provided?	Yes – 1
Has this value been verified?	Yes. Confirmed as correct for ex ante determination as per the applied methodology/45/. Methane conversion factor for leakage calculation assumed to be equal 1.
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

$EF_{EF,j,y}$	*Emission factor for electricity generation*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Issued EF data of CCPG from China DNA/66/ as per the tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of heat generation"/47/
Correct value provided?	Yes –0.57205 tCO_2/MWh
Has this value been verified?	Yes. Confirmed as correct for ex ante determination as per the DNA data/66/
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

R_u	*Universal ideal gases constant*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 03.0)/49/
Correct value provided?	Yes –8,314 Pa.m^3/kmol.K
Has this value been verified?	Yes. Confirmed as correct for ex ante determination as per the applied Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 03.0)/49/
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

MM_i	*Molecular mass of greenhouse gas i*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes

Source clearly referenced? (appropriate?)	Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 03.0)/49/
Correct value provided?	Yes –16.04 kg/kmol for methane
Has this value been verified?	Yes. Confirmed as correct for ex ante determination as per the applied Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 03.0)/49/
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

$\eta_{flare,m}$	*Flare efficiency in minute m*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	"Project emissions from flaring (version 04.0)"/48/
Correct value provided?	Yes – 0% is the conservative value
Has this value been verified?	Yes. Confirmed as correct open flare as per the applied Project emissions from flaring (version 04.0)"/48/
Choice of data correctly justified?	Yes
Measurement method correctly described?	N/A

CAR 13 was raised and successfully closed. Refer to Appendix 4 for detail assessment.

2. Data and Parameters Monitored

The monitoring parameters required by the methodology and applicable tools for the project are summarized in the below table.

$N_{p,LT}$	*Number of animals of type LT produced annually for the year y*
Title in line with Methodology?	Yes
Ex-ante Value	454,600 heads of market swine
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes- $N_{p,LT}$ will be monitored by PP monthly by collected number of swine produced in each farm Each pig involved in this project has a unique electronic ear tag when was born, which is an electronic device dedicated to the identification and electronic management of animals, can track automatically. This electronic ear tag will be connected to the Data Collection System (DCS), which can store and read information. Therefore, the number of swine produced in the farm can be monitored through the auto tracking devices of electronic ear tag once pig slaughter monthly and obtained by the DCS. At the same time, the technicians in farms will record manually the number of swine produced in the farms monthly. Also, the number of monthly exported from the stock will also be recorded. The ex-ante value 454,600 heads of market swine is derived from Project evaluation report/5/.
Correct value provided?	Yes

Has this value been verified?	Yes - The ex-ante value 454,600 heads of market swine is derived from Project evaluation report/5/.
Choice of data correctly justified?	Yes
Measurement method correctly described?	Yes –Via site inspection of the Data Collection System (DCS), CTI confirmed that each pig has a unique electronic ear tag and has been connected to the Data Collection System (DCS) and the monitoring will be conducted as per the request in the Joint-PD-MR which in compliance with the applied methodology.
Monitoring frequency correctly described?	Monitored monthly - verified as per the applied methodology
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	Yes - The indirect information (sale records) will be crosschecked as per the request in the applied methodology.
Purpose of data?	BE, PE and LE calculation

$N_{da,LT}$	*Number of days animal of type LT is alive in the farm in the year y*
Title in line with Methodology?	Yes
Ex-ante Value	180 days
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes- $N_{da,LT}$ will be monitored by PP monthly. Each pig involved in this project has a unique electronic ear tag when was born, which is an electronic device dedicated to the identification and electronic management of animals. This electronic ear tag will be connected to the Data Collection System (DCS), which can store and read information. Therefore, the days of swine alive in the farm can be traced through the electronic ear tag by the technical staff in each farm and obtained by the DCS. The ex-ante value 180 days is derived from PER/5/.
Correct value provided?	Yes
Has this value been verified?	Yes - The ex-ante value 180 days is derived from PER/5/which is verified as consistent with the number of days for pigs to be slaughtered by existing large-scale breeding groups in China/63/.
Choice of data correctly justified?	Yes
Measurement method correctly described?	Yes –Via site inspection of the Data Collection System (DCS), CTI confirmed that each pig has a unique electronic ear tag and has been connected to the Data Collection System (DCS) and the monitoring will be conducted as per the request in the Joint-PD-MR which in compliance with the applied methodology.
Monitoring frequency correctly described?	Monitored monthly - verified as per the applied methodology
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	Yes - The indirect information (sale records) will be crosschecked as per the request in the applied methodology.
Purpose of data?	BE, PE and LE calculation

$N_{AA,LT}$	*Daily stock of animals in the farm, discounting dead and discarded animals*

Title in line with Methodology?	Yes
Ex-ante Value	24,500 heads of Breeding swine
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes- $N_{AA,LT}$ will be monitored by PP daily. Each pig involved in this project has a unique electronic ear tag when was born, which is an electronic device dedicated to the identification and electronic management of animals. This electronic ear tag will be connected to the Data Collection System (DCS), which can store and read information. The technicians in farms monitor and record the number of breeding swine through the auto tracking devices of electronic ear tag daily, of which new imported animals are included and dead and discharge animals are excluded. The annual average number of animals ($N_{AA,LT}$) is calculated as an average of the daily stock of breeding swine in the farms without considering dead animals and discarded animals. The ex-ante value of 24,500 heads Breeding swine is derived from PER/5/.
Correct value provided?	Yes
Has this value been verified?	Yes - The ex-ante value of 24,500 heads Breeding swine is derived from PER/5/
Choice of data correctly justified?	Yes
Measurement method correctly described?	Yes –Via site inspection of the Data Collection System (DCS), CTI confirmed that each pig has a unique electronic ear tag and has been connected to the Data Collection System (DCS) and the monitoring will be conducted as per the request in the Joint-PD-MR which in compliance with the applied methodology.
Monitoring frequency correctly described?	Monitored monthly - verified as per the applied methodology
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	Yes - The PP monitor the population of breeding swine through the auto tracking device, which is connected to the Data Collection System (DCS). Therefore, the data of $N_{AA,LT}$ can be obtained through DCS.
Purpose of data?	BE, PE and LE calculation

W_{site}	*Average animal weight of a defined livestock population at the project site*
Title in line with Methodology?	Yes
Ex-ante Value	56.0kg for market swine and 93.0kg for breeding swine
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes- W_{site} will be monitored by PP monthly. Sampling procedures will be used to estimate this variable following guidance as provided in the methodology. The ex-ante value 56.0kg for market swine and 93.0kg for breeding swine are derived from PER/5/.
Correct value provided?	Yes
Has this value been verified?	Yes - The ex-ante value 56.0kg for market swine and 93.0kg for breeding swine are derived from PER/5/.
Choice of data correctly justified?	Yes

Measurement method correctly described?	Yes –The Joint-PD-MR has described the system of random sampling taking into account stratification of each livestock population into a minimum of three weight categories as per the request in the applied methodology/45/.
Monitoring frequency correctly described?	Monitored monthly - verified as per the applied methodology
Monitoring equipment correctly described?	Yes - weight measurer
QA/QC procedure correctly described?	Yes - 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. The weight measurer will be calibrated according to the national regulation.
Purpose of data?	Used for estimating $VS_{LT,y}$

F_{Aer}	*Fraction of volatile solids directed to aerobic treatment*
Title in line with Methodology?	Yes
Ex-ante Value	100%
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes- As this parameter is not monitored in the actual operation. so in the monitoring period, the value of this parameter in the emission reduction calculation is 100% which is confirmed as conservative. The ex-ante value 100% is derived from PER/5/.
Correct value provided?	Yes
Has this value been verified?	Yes - The ex-ante value 100% is derived from PER/5/.
Choice of data correctly justified?	Yes
Measurement method correctly described?	Yes – As this parameter is not monitored in the actual operation. so in the monitoring period, the value of this parameter in the emission reduction calculation is 100% which is confirmed as conservative.
Monitoring frequency correctly described?	Annually - verified as per the applied methodology
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	Yes - The value of this parameter in the emission reduction calculation is 100%, which is conservative.
Purpose of data?	PE calculation

n_{dy}	*Number of days treatment plant was operational in year y*
Title in line with Methodology?	Yes
Ex-ante Value	365 days
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes- n_{dy} will be monitored by PP daily. The ex-ante value 365 days is total days for a year
Correct value provided?	Yes
Has this value been verified?	Yes - The ex-ante value 365 days is confirmed as reasonable due to it is expected that the treatment plant operated everyday.
Choice of data correctly justified?	Yes

Measurement method correctly described?	Yes –The number of of days treatment plant was operational will be recorded manually by the responsible staff.
Monitoring frequency correctly described?	Daily - verified as per the applied methodology
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	Yes - Production record sheet from the DCS system can be crosscheck that the treatment plant is operational.
Purpose of data?	BE calculation

v_f	*Biogas flow*
Title in line with Methodology?	Yes
Ex-ante Value	3,847.173*10^4m^3
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes- v_f will be monitored by flow meters continuously and reported cumulatively on weekly basis by PP. The ex-ante value 3,847.173*10^4m^3 of biogas are expected to be generated by the project annually is derived from PER/5/
Correct value provided?	Yes
Has this value been verified?	Yes - The ex-ante value 3,847.173*10^4m^3 of biogas are expected to be generated by the project annually is derived from PER/5/
Choice of data correctly justified?	Yes
Measurement method correctly described?	Yes –The biogas flow will be measured at four points. For the proposed project, based on the site inspection, it is confirmed that all the biogas generated are used for heat generation and the residual gas is sent to flare system, therefore the biogas generated from the anaerobic digestion, the amount of biogas used for heat generation and the amount of biogas burned will be monitored through the flow meters.
Monitoring frequency correctly described?	Continuously by flow meter and reported cumulatively on weekly basis - verified as per the applied methodology
Monitoring equipment correctly described?	Yes - flow meters
QA/QC procedure correctly described?	Yes - The calibration of flow meters, including the frequency of calibration, should be done in accordance with national standards or requirements.
Purpose of data?	PE and LE calculation

$EC_{PJ,j,y}$	*Quantity of electricity consumed by the proposed project in year y*
Title in line with Methodology?	Yes
Ex-ante Value	95.82 MWh
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes- $EC_{PJ,j,y}$ will be monitored by electricity meters continuously and at least monthly recording by PP. The ex-ante value is 95.82 MWh electricity consumed by the proposed project will be imported from the grid derived from PER/5/.
Correct value provided?	Yes

Has this value been verified?	Yes - The ex-ante value is 95.82 MWh is confirmed as reasonable.
Choice of data correctly justified?	Yes
Measurement method correctly described?	Yes –The electricity consumption will be measured by electricity meters. The electricity consumption supplied by the gird company, then the value will be determined by the electricity meters monitoring and cross-check with the grid statement.
Monitoring frequency correctly described?	Continuous measurement and at least monthly recording - verified as per the applied methodology
Monitoring equipment correctly described?	Yes - electricity meters
QA/QC procedure correctly described?	Yes - The calibration of electricity meters, including the frequency of calibration, should be done in accordance with national standards or requirements
Purpose of data?	PE calculation

$TDL_{j,y}$	*Average technical transmission and distribution losses for providing electricity to source j in year y*
Title in line with Methodology?	Yes
Ex-ante Value	20%
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes- value is derived from "Baseline, project and/or leakage emissions from electricity consumption and monitoring of heat generation" (version 03.0)/47/
Correct value provided?	Yes
Has this value been verified?	Yes – default value of 20% is used, which is conservative
Choice of data correctly justified?	Yes
Measurement method correctly described?	Yes – value is derived from "Baseline, project and/or leakage emissions from electricity consumption and monitoring of heat generation" (version 03.0)/47/
Monitoring frequency correctly described?	Value will change once the tool is updated - verified as per the tool
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	N/A
Purpose of data?	PE calculation

$V_{t,db}$	*Volumetric flow of the gaseous stream in time interval t on a dry basis*
Title in line with Methodology?	Yes
Ex-ante Value	See ER sheet
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes- $V_{t,db}$ will be monitored by flowmeters continuously. The ex-ante value was estimated according to the amount of manure.
Correct value provided?	Yes
Has this value been verified?	Yes - The ex-ante value was estimated according to the amount of manure.

Choice of data correctly justified?	Yes
Measurement method correctly described?	Yes –monitored by flowmeters continuously. Volumetric flow measurement should always refer to the actual pressure and temperature.
Monitoring frequency correctly described?	Continuous measurement - verified as per the applied methodology
Monitoring equipment correctly described?	Yes - flow meters
QA/QC procedure correctly described?	Yes - The periodic calibration against a primary device provided by an independent accredited laboratory is mandatory, the calibration and frequency of calibration should be in accordance with manufacturer's specifications.
Purpose of data?	PE calculation

$V_{i,t,db}$	*Volumetric fraction of greenhouse gas i in a time interval t on a dry basis*
Title in line with Methodology?	Yes
Ex-ante Value	See ER sheet
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes- $V_{i,t,db}$ will be monitored by gas analyzers continuously. The ex-ante value was derived from Project evaluation report/5/.
Correct value provided?	Yes
Has this value been verified?	Yes - The ex-ante value was derived from Project evaluation report/5/.
Choice of data correctly justified?	Yes
Measurement method correctly described?	Yes –monitored by gas analyzers continuously. Continuous gas analysers operating in dry-basis. Volumetric flow measurement should always refer to the actual pressure and temperature.
Monitoring frequency correctly described?	Continuous measurement - verified as per the applied methodology
Monitoring equipment correctly described?	Yes - gas analyzers
QA/QC procedure correctly described?	Yes - 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?	PE calculation

T_t	*Temperature of the gaseous stream in time interval t*
Title in line with Methodology?	Yes
Ex-ante Value	293.15 K
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes- T_t will be monitored by recordable electronic signal continuously. The temperature T_t(K) is calculated as the equation T(K)=t(°C) +273.15 The ex-ante value was estimated according to the applied methodology/45/.
Correct value provided?	Yes

Has this value been verified?	Yes - The ex-ante value was estimated according to the applied methodology/45/.
Choice of data correctly justified?	Yes
Measurement method correctly described?	Yes –monitored by recordable electronic signal continuously. Instruments with recordable electronic signal (analogical or digital) are required. Examples include thermocouples, thermo resistance, etc 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)
Monitoring frequency correctly described?	Continuous unless differently specified in the underlying methodology - verified as per the applied methodology
Monitoring equipment correctly described?	Yes - Instruments with recordable electronic signal (analogical or digital)
QA/QC procedure correctly described?	Yes - 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?	PE calculation

P_t	*Pressure of the gaseous stream in time interval t*
Title in line with Methodology?	Yes
Ex-ante Value	101.325 kPa
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes- P_t will be monitored by recordable electronic signal continuously. The ex-ante value was estimated according to the applied methodology/45/.
Correct value provided?	Yes
Has this value been verified?	Yes - The ex-ante value was estimated according to the applied methodology/45/.
Choice of data correctly justified?	Yes
Measurement method correctly described?	Yes –monitored by recordable electronic signal continuously. Instruments with recordable electronic signal (analogical or digital) are required. Examples include pressure transducers, etc. 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)
Monitoring frequency correctly described?	Continuous unless differently specified in the underlying methodology - verified as per the applied methodology
Monitoring equipment correctly described?	Yes - Instruments with recordable electronic signal (analogical or digital)
QA/QC procedure correctly described?	Yes - 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?	PE calculation

$\rho_{i,t}$	*Density of greenhouse gas i in the gaseous stream in time interval t*
Title in line with Methodology?	Yes
Ex-ante Value	0.67 kg/m^3
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes- The actual value will be calculated based on temperature of the gaseous stream in time interval t and pressure of the gaseous stream in time interval t. The ex-ante value is derived from applied methodology.
Correct value provided?	Yes
Has this value been verified?	Yes - The ex-ante value was estimated according to the applied methodology/45/.
Choice of data correctly justified?	Yes
Measurement method correctly described?	Yes –The actual value 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 frequency correctly described?	Pressure and temperature are measured continuously - verified as per the applied methodology
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	Yes - Calculated value according to the pressure and temperature
Purpose of data?	PE calculation

MS%$_j$	*Fraction of manure handled in system j in project activity*
Title in line with Methodology?	Yes
Ex-ante Value	100%
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes- All the manure flew into AWMSs to be treated; no any manure will be discharged outside. Therefore, the value of this parameter is 100%. The value used is 100% for ex-ante determination for conservative.
Correct value provided?	Yes
Has this value been verified?	Yes - The value used is 100% for ex-ante determination for conservative.
Choice of data correctly justified?	Yes
Measurement method correctly described?	Yes – Since the treatment process of this project is an anaerobic-aerobic combined treatment technology and as this parameter is not monitored in the actual operation. so, in the monitoring period, to be conservative, the value of this parameter applied in the emission reduction calculation in the two phases are both 100%.
Monitoring frequency correctly described?	Annually - verified as per the applied methodology
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	Yes - 100% is the maximum value and conservative.

Purpose of data?	PE calculation

$B_{0,LT}$	*Maximum methane producing potential of the volatile solid generated by animal type LT*
Title in line with Methodology?	Yes
Ex-ante Value	$B_{0,LT}$ (Market swine) =0.29 $B_{0,LT}$ (Breeding swine) =0.29
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes- $B_{0,LT}$ can be measured as per ISO 11734:1995. As this parameter is not monitored in the actual operation. So, in the monitoring period, ex-ante determined values are still applied which is verified as conservative. The value used is derived from Table 10A-7 and 10A-8 of IPCC 2006 Guidelines for National Greenhouse Gas Inventories volume 4, chapter 10, the maximum methane producing potential ($B_{0,LT}$) for Market swine and Breeding swine in Asia region in IPCC/39/.
Correct value provided?	Yes
Has this value been verified?	Yes - While the actual methane producing potential of the volatile solid generated by swine manure is 479.4ml/g VS via checking the public literature/69/, which is higher. Therefore 0.29 m^3CH_4/kg -dm applied is conservative.
Choice of data correctly justified?	Yes
Measurement method correctly described?	Yes –As this parameter is not monitored in the actual operation. So, in the monitoring period, ex-ante determined values are still applied which is verified as conservative
Monitoring frequency correctly described?	Annually - verified as per the applied methodology
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	Yes – The values will be updated based on latest available data from IPCC
Purpose of data?	BE, PE calculation

$NEX_{LT,y}$	*Annual average nitrogen excretion per head of a defined livestock population estimated as described in Appendix 2*
Title in line with Methodology?	Yes
Ex-ante Value	$NEX_{LT,y}$(Market swine) =8.58 $NEX_{LT,y}$ (Breeding swine) =8.15
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes - the value is calculated as the equation of option 2 in Appendix 2: $NEX_{LT,y} = \frac{W_{site}}{W_{default}} * NEX_{IPCC\ default}$ While, $NEX_{IPCC\ default}$ calculated as equation 30 of the IPCC 2006, volume 4, chapter 10 $NEX_{IPCC\ default} = N_{rate(T)} * TAM/1000*365$
Correct value provided?	Yes
Has this value been verified?	Yes - the value is calculated as the equation of option 2 in Appendix 2 of methodology ACM0010 Version 08
Choice of data correctly justified?	Yes

Measurement method correctly described?	Yes –$W_{default}$, $N_{rate(T)}$ and TAM are default value from IPCC 2006. The measurement methods and procedures for W_{site}, please refer to the monitoring parameter W_{site}
Monitoring frequency correctly described?	Annually - verified as per the applied methodology
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	Yes –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). The value should be updated on latest available public data source. QA/QC procedure for W_{site}, please refer to the monitoring parameter W_{site}
Purpose of data?	BE, PE calculation

Type	*Type of barn and AWMS*
Title in line with Methodology?	Yes
Ex-ante Value	N/A
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes- Type will be monitored by PP. The swine barn and AWMS layout and configuration are collected for check if the type changed.
Correct value provided?	Yes
Has this value been verified?	Yes - Due to the project has been approved by government, it will not be changed during the implementation periods, hence the Type of barn and AWMS will not be changed.
Choice of data correctly justified?	Yes
Measurement method correctly described?	Yes –The swine barn and AWMS layout and configuration are collected for check if the type changed.
Monitoring frequency correctly described?	Once for each monitoring period - verified as per the applied methodology
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	Yes –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

T	*Annual average ambient temperature at project site*
Title in line with Methodology?	Yes
Ex-ante Value	15°C
Data unit correctly expressed?	Yes
Appropriate description?	Yes
Source clearly referenced? (appropriate?)	Yes- This parameter will be monitored monthly by checking the annual average ambient temperature at project site from public website monthly. The value used is 15°C for ex-ante determination which is derived from public website/68/.
Correct value provided?	Yes

Has this value been verified?	Yes - This parameter will be monitored monthly by checking the annual average ambient temperature at project site from public website monthly.
Choice of data correctly justified?	Yes
Measurement method correctly described?	Yes –Data sourced from Official public information
Monitoring frequency correctly described?	Monthly- verified as per the applied methodology
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	Yes –The actual temperature during the monitoring period will be compared with the value of ex-ante estimated, i.e., 15 °C, and to be conservative, 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.
Purpose of data?	Used to select the annual MCF_j from IPCC 2006 Guidelines

3. Monitoring plan

The VVB has checked the monitoring plan of the Joint-PD-MR against the applied methodology.

The monitoring plan in the Joint-PD-MR has been designed to comply with the latest applicable version of the methodology (ACM0010 version 08.0).

The validation team evaluated the feasibility and sufficiency of the monitoring plan. The key components of the monitoring plan are as follows.

Monitoring framework:

The Joint-PD-MR contains a diagram illustrating the Organization Structure of the Monitoring Team to be implemented by the project owner in order to implement the project activity. The VCS monitoring team will be responsible for the monitoring of all the parameters to be monitored. And all the data will be reviewed by the project developer and VVB. The organizational structure is considered sufficient to fulfil the monitoring requirements of the methodology and to ensure that emission reductions can be verified.

Monitoring equipment and installation:

Measurement instruments are described in the monitoring plan as subject to appropriate national standards with respect to installation, accuracy and calibration interval. Main instruments flow meters, electricity meters, weight measurers, gas analyzers are used to monitor related parameters as assessed in the above tables of monitored parameters.

This equipment setup is considered sufficient to carry out the monitoring requirements of the methodology, and the appropriate national standards will be followed.

Principle of Monitoring:

Listed as above table for each monitored value and assessed by VVB.

Parameters to be monitored:

Listed as above tables and assessed by VVB accordingly.

Quality assurance and quality control procedures:

The Joint-PD-MR contains sufficient description on how quality will be controlled and assured in the monitoring of emission reductions.

Training:

Training will be provided to relevant personnel.

Data management:

All data collected as part of monitoring plan will be archived electronically on hard disks and be kept at least 2 years after the end of the last crediting period.

Corrective actions:

In case of nonconformities would be observed, a corrective action plan will be established and the whole VCS monitoring team will follow recognized standard data evaluation methods to guarantee that the data is reliable and accurate.

Sample Plan:

Sample plan is designed by PP for monitoring the parameter W_{site} which is confirmed in line with the requirement for this parameter monitoring in the applied methodology. The sample plan is designed according to the Standard of "Sampling and surveys for CDM project activities and programmes of activities (Version 09.0)"/43/.

The sample plan including the below designs,

a. To ensure representativeness, each defined livestock population should be classified into a minimum of three age categories - *verified as in line with the applied methodology*

b. For each defined livestock population, a minimum of one monthly sample per age category should be taken - *verified as in line with the applied methodology*

c. PP will use 95/10 confidence/precision as the criteria for the reliability of sampling efforts - *verified as in line with the standard of "Sampling and surveys for CDM project activities and programmes of activities (Version 09.0)" and applied methodology*

Via site inspection and interview with chiefs of farms and PP, CTI confirmed that the monitoring activities of the W_{site} will be conducted in the three age groups of Nursery phase, Growing phase and Mature phase (Nursery phase with 30-60 days, Growing phase with 60-130 days and Mature phase with 130-180 days. The three age categories of breeding swine are classified according to the age in days, i.e. Nursery phase with 30-70 days, Growing phase with 70-220 days and Mature phase with 220-310 days) in each swine farm at least one monthly which is verified as in line with the above requirements.

Via checking the request of applied methodology, it stated "The PDD should describe the system of

random sampling taking into account stratification of each livestock population into a minimum of three weight categories as described above". Via site inspection, it is confirmed that for 9 swine farms involved, all the swine farms including market swine and breeding swine in stock. Due to 9 swine farms have two types of 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 chosen as Stratified random sampling which is confirmed as applicable to the project situation.

Hence, based on this, PP designed the sampling method as Stratified random sampling in 9 swine farms and divide the swine from each into at least 3 age groups, which is verified by CTI as correct and reasonable and in line with the request of applied methodology/45/.

The method of calculation of sample size is checked by CTI, it is confirmed that the calculation process is in compliance with the Appendix 6 of the Guideline of the "Sampling and surveys for CDM project activities and programmes of activities (Version 04.0)"/44/ and PP will use 95/10 confidence/precision as the criteria for the reliability of sampling efforts which is confirmed in line with Standard of "Sampling and surveys for CDM project activities and programmes of activities (Version 09.0)"/43/.

The implementation of sample plan including monitoring, data recording and collection, QA/QC procedure, emergency procedure is stated by PP which is confirmed as actual and reasonable by site inspection and interview with the chief of farms and monitoring team. The one monthly monitoring activity of the samples will be completed in the 9 swine farms during each monitoring periods. The monitoring forms will be filled out daily by the Breeders in the 9 swine farms to record the animal weight of the samples. All the samples will be changed at the beginning of next monitoring periods which is confirmed as conservative and more representative.

CAR 14, CAR 15 and CAR 16 were raised and successfully closed. Refer to Appendix 4 for detail assessment.

3.5 Non-Permanence Risk Analysis

N/A

4 VERIFICATION FINDINGS

4.1 Project Implementation Status

Through the onsite visit, interviewing the project developer and reviewing the project description in Joint-PD-MR/1/, it was confirmed that the project installed new Animal Manure Management Systems by replace the current open anaerobic lagoons with 9 new closed anaerobic digesters to a group of 9 existing swine farms in Nanyang City, Henan Province, which will treat the manure and wastewater from the 9 swine farms to avoid methane emissions generated in the baseline uncovered anaerobic lagoons.

By means of an in-depth review of the Joint-PD-MR and the checks carried out during the on-site visit, an assessment has been carried out whether the project has been implemented and operated in line with the Joint-PD-MR and whether all physical features of the project are in place. The following has been checked: implemented technology, project equipment as well as monitoring equipment.

The verifier has performed a site visit to check the project equipment and interview with staffs from AWMSs and swine farms, in addition by all the provided evidence, it is found that the project implemented 9 sets of AWMSs in 9 existing swine farms involving 454,600 heads of market swine, 24,500 heads of breeding swine. Live pigs are kept for 180 days in the farms before shipment and are estimated to produce 699,486 tons of manure and 3,847.173*$10^4 m^3$ of biogas annually. All these 9 existing swine farms were put into operation before the implementation of this project since year 2015 which is verified by checking the Licenses for production and operation of the breeding livestock and poultry/8/ for each swine farm.

The project started construction on 01-December-2019 (for Fangcheng 1st farm) which has been confirmed by checking the General design and construction contract/10/, and started first commissioning on 09-July-2020 and all the farms were put into operation on the same day on 05-August-2020 which has been confirmed by checking the operation log of the project/13/ and statement of all the AWMSs started construction and operation/12/. The factors and parameters used during this monitoring period to arrive at the emission reduction calculations are transparently described in the Joint-PD-MR/1/.

During this monitoring period (05-August-2020~30-June-2022), there were total 410,250 heads of market swine, monthly average of 22,170 heads of breeding swine in 9 swine farms. Live pigs are kept for 180 days in the farms before shipment and produce 6,078.39*$10^4 m^3$ of biogas.

The actual operations during the 1st monitoring period are found in accordance with the descriptions provided in the Joint-PD-MR. There is no deviation / change evidenced during this monitoring period and there were no delays compared to information in approved project.

This verification covers the period from 05-August-2020 to 30-June-2022 (including both days). 597,264 tCO_2e emission reductions are claimed as VCUs during this monitoring period.

CAR 17 was raised and successfully closed. Refer to Appendix 4 for detail assessment.

4.2 Accuracy of GHG Emission Reduction and Removal Calculations

1. Assessment of Data and parameters available at validation

Via checking the Joint-PD-MR/1/, it is confirmed that all the ex-ante data and parameters are same to the Joint-PD-MR which is verified as correct. Refer to section 3.4.8 for the detail assessment of ex-ante parameters.

2. Assessment of Data and parameters monitored

During the verification all relevant monitoring parameters (as listed in chapter 3.4.8 of this report) have been verified with regard to the

(i) appropriateness of the applied measurement / determination method,

(ii) the correctness of the values applied for ER calculation,

(iii) the accuracy, and applied QA/QC measures.

The monitoring results as well as the verification procedure are described parameter-wise in the below tables,

$N_{p,LT}$	*Number of animals of type LT produced annually for the year y*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes – Number
Appropriate description?	Yes
Monitored Value?	1,585,525 heads of market pigs
Correct value provided?	Yes
Source clearly referenced? (appropriate?)	Yes– Values of Monitoring parameter of $N_{p,LT}$ were derived from Production record of Market swine issued by PP/17/ for this monitoring period.
Choice of data correctly justified?	Yes –The measuring and reporting frequency are in line with the monitoring plan and applied methodology/45/.
Measurement method and procedures correctly described?	Yes –Data were recorded by technicians in farms each month and sourced from the data logged in each swine farm which has been confirmed by site inspection and checking the Production record of Market swine issued by PP/17/. Via site inspection, it is confirmed that each pig involved in this project has a unique electronic ear tag when was born, which is an electronic device dedicated to the identification and electronic management of animals, can track automatically. This electronic ear tag can be connected to the Data Collection System (DCS), which can store and read information. Through this method, the number of swine produced in the farm can be monitored through the auto tracking devices of electronic ear tag once pig slaughter monthly and obtained by the DCS which has been verified as effective by site inspection of the electronic ear tag and Data Collection System (DCS). Each farm control and record the numbers strictly due to the pigs production and sale are the commercial sources of farms. Hence, the recorded data are confirmed as reasonable and reliable. Above mentioned evidences were provided to the VVB during site verification. Via comparing the data in Joint-PD-MR with the evidence, CTI verified that the data in Joint-PD-MR is correct.
Calculation method?	N/A
Monitoring frequency correctly described?	Monitored monthly
Monitoring equipment correctly described?	N/A

QA/QC procedure correctly described?	Yes- The Production record of Market swine/17/ is cross-checked with the monthly Sale Records of Market swine/20/ of each farm. Via comparing with both sources, it is verified that the calculated N_{LT} is 410,250 (1,585,525 *180days/365days*12months/22.871 months) heads. However, according to the number of market pigs produced annually of each farm, the N_{LT} calculated is rounded to an integer as 410,250 heads. While via checking the monthly Sale Records of Market swine/20/ of each farm, CTI confirmed that total 1,585,525 head of marketing swine is produced and sold into the market which is consistent with the value from Monthly production record of market swine. According to the conservative principle, the 410,250 heads was applied in the calculations of emission reductions in MR, therefore, $N_{p,LT}$ is reasonable and credible.
Purpose of data?	BE, PE, LE calculation
Comments?	N/A

$N_{da,LT}$	*Number of days animal of type LT is alive in the farm in the year y*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes – days
Appropriate description?	Yes
Monitored Value?	180
Correct value provided?	Yes
Source clearly referenced? (appropriate?)	Yes–Values of Monitoring parameter of $N_{da,LT}$ were derived from Production record of Market swine issued by PP/17/ for this monitoring period.
Choice of data correctly justified?	Yes –The measuring and reporting frequency are in line with the monitoring plan and applied methodology/45/.
Measurement method and procedures correctly described?	Yes –Data were recorded by technicians in farms each month and sourced from the data logged in each swine farm which has been confirmed by site inspection and checking the Production record of Market swine issued by PP/17/. Via site inspection, it is confirmed that each pig involved in this project has a unique electronic ear tag when was born, which is an electronic device dedicated to the identification and electronic management of animals, can track automatically. This electronic ear tag can be connected to the Data Collection System (DCS), which can store and read information. Through this method, the days of swine alive can be traced by the technical staffs using DCS in each farm, so it is confirmed that the recorded dates are reasonable and reliable. Above mentioned evidences were provided to the verification team during site verification. Via comparing the data in Joint-PD-MR with the evidence, CTI verified that the data in Joint-PD-MR is correct.
Calculation method?	N/A
Monitoring frequency correctly described?	Monitored monthly
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	Yes- The Production record of Market swine/17/ is cross-checked with the sale records of Market swine/20/. Via comparing with both sources, it is verified that the days of swine alive in the farm is 180 days then for sale.

	Furthermore, the number of days is verified as consistent with the number of days for pigs to be slaughtered by existing large-scale breeding groups in China/63/. Hence it is verified that the days in MR is correct and actual.
Purpose of data?	BE, PE, LE calculation
Comments?	N/A

$N_{AA,LT}$	*Daily stock of animals in the farm, discounting dead and discarded animals*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes –Number
Appropriate description?	Yes
Monitored Value?	Refer to ER sheet/2/
Correct value provided?	Yes
Source clearly referenced? (appropriate?)	Yes–Values of Monitoring parameter of $N_{AA,LT}$ were derived from Daily Breeding Pig stock record issued by PP/21/ for this monitoring period.
Choice of data correctly justified?	Yes – The measuring and reporting frequency are in line with the monitoring plan and applied methodology/45/.
Measurement method and procedures correctly described?	Yes –This parameter is monitored daily through the auto tracking devices of electronic ear tag. Data were recorded by technicians in farms each day and sourced from the data logged in each swine farm which has been confirmed by site inspection and checking the Breeding Pig stock record issued by PP/21/ of each farm. Via site inspection, it is confirmed that each pig involved in this project has a unique electronic ear tag when was born, which is an electronic device dedicated to the identification and electronic management of animals, can track automatically. This electronic ear tag can be connected to the Data Collection System (DCS), which can store and read information. Through this method, the daily stock number of animals from the first day of monitoring period can be recorded, and this record data including the new imported animal and discounting dead and discharge animals which can be traced and recorded by the technical staffs using DCS in each farm, so it is confirmed that the recorded dates are reasonable and reliable. The annual average number of animals ($N_{AA,LT}$) was calculated as an average of the daily stock of breeding swine in the farms without considering dead animals and discarded animals. Above mentioned evidences were provided to the verification team during site verification. Via comparing the data in Joint-PD-MR with the evidence, CTI verified that the data in Joint-PD-MR is correct.
Calculation method?	N/A
Monitoring frequency correctly described?	Monitored daily
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	N/A as the data from DCS
Purpose of data?	BE, PE and LE calculation
Comments?	-

W_{site}	*Average animal weight of a defined livestock population at the project site*

Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes – kg
Appropriate description?	Yes
Monitored Value?	Refer to values provided in ER sheet/2/
Correct value provided?	Yes
Source clearly referenced? (appropriate?)	Yes–Values of Monitoring parameter of W_{site} were derived from Weight records issued by PP/18/ for this monitoring period.
Choice of data correctly justified?	Yes – The measuring and reporting frequency are in line with the monitoring plan and applied methodology/45/.
Measurement method and procedures correctly described?	Yes – For monitoring this parameter, a sampling method has been used by PP following the applied methodology. Sample plan is designed for monitoring the parameter W_{site} which is confirmed in line with the requirement for this parameter monitoring in the applied methodology. The sample plan is designed according to the Standard of "Sampling and surveys for CDM project activities and programmes of activities (Version 09.0)"/43/. For this monitoring period, as per the sample plan in the JPM, below methods have been taken by PP to carry out the sampling, a. To determine the total population - Calculate the overall sample size based on the population of pigs in stock firstly– the Production record of Market swine/17/ have been checked and the total population of pigs determined are verified as correct and actual; b. To determine the sample size for each farm - The project involved 9 swine farms (all swine farms including market swine and breeding swine), then the sample size in each swine farm is adjusted based on the proportion of the number of each farm in the total number of 9 swine farms– the calculation sheet of sample size/19/ is checked as correct and actual; c. To determine the sample size of each age group - The sample size of each age group of Market swine and Breeding swine in a farm is 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 two kinds of farms– the calculation sheet of sample size/19/ is checked as correct and actual; d. To ensure representativeness, each defined livestock population has been classified into a minimum of three age categories including Nursery phase, Growing phase and Mature phase – the monthly records of animal weight of a defined livestock population of three age categories/18/ have been checked and the three age categories determined are verified as in line with the JPM and applied methodology e. After the sample size in each age group of Market swine and Breeding swine of each swine farm determined, the sample is conducted in every swine farm. Since swine in different age are kept in the different pig houses, samples can be randomly selected from pig houses of this age group – the samples choosing method is checked as correct and actual; f. For each defined livestock population, a minimum of one monthly sample per age category has been taken - the monthly records of animal weight of a defined livestock population of three age categories/18/ have been checked and one monthly sample per age category determined for each defined livestock population are verified as in line with the JPM and applied

<table>
<tr><td></td><td>methodology
g. If the same samples are taken the following month, then new samples will be taken, this will be done every month until the end of the monitoring period - the monthly records of animal weight of a defined livestock population of three age categories/18/ have been checked and confirmed that the samples are not same for each month.
PP uses 95/10 confidence/precision as the criteria for the reliability of sampling efforts - verified as in line with the standard of “Sampling and surveys for CDM project activities and programmes of activities (Version 09.0)” and applied methodology
Via site inspection and interview with chiefs of farms, CTI confirmed that the monitoring activities of the W_{site} have been conducted in the three age groups of Nursery phase, Growing phase and Mature phase in each swine farm at least one monthly which is verified as in line with the above requirements and the 95/10 confidence/precision is confirmed as used by PP as the criteria for the reliability of sampling efforts.
The one monthly monitoring activity of the samples have been completed in the 9 swine farms during this monitoring period. The monitoring forms have been filled out by the Breeders in the 9 swine farms to record the animal weight of the samples/18/.
The implementation of sampling method and process including monitoring, data recording and collection, QA/QC procedure, emergency procedure is stated by PP which is confirmed as actual and reasonable by site inspection and interview with the chief of farms and monitoring team.
Via checking the sampling method by reviewing the Weight records issued by PP/18/ and interview with technicians as stated in the MR, CTI verified that the sampling and recording method is in line with the monitoring plan and applied methodology/45/.
Above mentioned evidences were provided to the verification team during site verification. Via comparing the data in MR with the evidence, CTI verified that the data in MR is correct.</td></tr>
<tr><td>Calculation method?</td><td>N/A</td></tr>
<tr><td>Monitoring frequency correctly described?</td><td>Monitored monthly</td></tr>
<tr><td>Monitoring equipment correctly described?</td><td>9 weight measurers installed at all swine farm
Accuracy: III level
Type: XK3190-A12+E
The calibration information and validity is listed as below table
<table>
<tr><th>Farm</th><th>Serial No.</th><th>Calibrated Date</th><th>Validity</th></tr>
<tr><td>Fangcheng 1st farm</td><td>2018012014</td><td rowspan="9">24-June-2020
11-June-2021
08-June-2022</td><td rowspan="9">23-June-2021
10-June-2022
07-June-2023</td></tr>
<tr><td>Fangcheng 2nd farm</td><td>2018012019</td></tr>
<tr><td>Fangcheng 3rd farm</td><td>2018012026</td></tr>
<tr><td>Sheqi 1st farm</td><td>2016041235</td></tr>
<tr><td>Sheqi 2nd farm</td><td>2018012042</td></tr>
<tr><td>Sheqi 3rd farm</td><td>2018012049</td></tr>
<tr><td>Sheqi 7th farm</td><td>2018012053</td></tr>
<tr><td>Sheqi 9th farm</td><td>2018012058</td></tr>
<tr><td>Wolong 3rd farm</td><td>2015061309</td></tr>
</table></td></tr>
<tr><td>QA/QC procedure correctly described?</td><td>Yes - The above calibration information has been confirmed by checking the calibration reports/15/ which has been conducted by</td></tr>
</table>

	qualified parties/16/ in compliance with JJG539-2016 "Verification Regulation of Digital Indicating Weighting Instruments" in China/38/.
Purpose of data?	Used for estimating $VS_{LT,y}$
Comments?	-

F_{Aer}	*Fraction of volatile solids directed to aerobic treatment*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes – Fraction
Appropriate description?	Yes
Monitored Value?	100%
Correct value provided?	Yes
Source clearly referenced? (appropriate?)	Yes– the value of F_{Aer} is applied as 100%, which is conservative.
Choice of data correctly justified?	Yes – the measuring and reporting frequency are in line with the monitoring plan and applied methodology/45/.
Measurement method and procedures correctly described?	Yes –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.
Calculation method?	N/A
Monitoring frequency correctly described?	Annually
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	N/A
Purpose of data?	PE calculation
Comments?	N/A

n_{dy}	*Number of days treatment plant was operational in year y*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes –number
Appropriate description?	Yes
Monitored Value?	695 days
Correct value provided?	Yes
Source clearly referenced? (appropriate?)	Yes–Monitoring parameter of n_{dy} was derived from Daily operation record of each treatment plant/22/.
Choice of data correctly justified?	Yes – the measuring and reporting frequency are in line with the monitoring plan and applied methodology/45/.
Measurement method and procedures correctly described?	Yes –PP record the actual number of days of each treatment plant that was operational daily. Finally, the Daily operation record of each treatment plant during this monitoring period were summarized by all the daily record. Via checking the Daily operation record of each treatment plant/22/ and interview with monitoring staff and PP, CTI verified that the method is in line with the monitoring plan and applied methodology/45/
Calculation method?	N/A
Monitoring frequency correctly described?	Measured Daily
Monitoring equipment correctly described?	N/A

QA/QC procedure correctly described?	Yes - Daily operation record of each treatment plant/22/ is cross-checked with the production record from DCS system/17/, CTI verified that each treatment plant was operational in 695 days during this monitoring period.
Purpose of data?	BE calculation
Comments?	-

v_f	*Biogas flow*
Title in line with Methodology?	Yes
Data unit correctly expressed?	m^3
Appropriate description?	Yes
Monitored Value?	Refer to Joint-PD-MR
Correct value provided?	Yes
Source clearly referenced? (appropriate?)	Yes–Monitoring parameter of v_f was derived from Daily operation record/22/ saved automatically in the Data Collection System (DCS).
Choice of data correctly justified?	Yes
Measurement method and procedures correctly described?	Yes –The biogas flow data were measured by the flow meters installed at each treatment plant (total 27 flow meters 1,2,3), flow meters 1 are installed at outlet of the anaerobic digestion, flow meters 2 are installed at the inlet of boiler and flow meters 3 are installed at the inlet of flare system which have been verified as correct and actual by site inspection. The flowmeters monitored data continuously, record hourly and saved automatically in the Data Collection System (DCS). The data can be obtained from Data Collection System (DCS) and the monthly data was exported by the staff at the beginning of next month and then recorded in daily operation record, then summarized as the monthly biogas production, biogas flow to the boiler and biogas flow to flare system is the sum of the daily output. Via checking the measuring method by reviewing the Daily operation record/19/ and interview with monitoring staff, CTI verified that the method is in line with the applied methodology.
Calculation method?	N/A
Monitoring frequency correctly described?	Continuously by flow meters and reported cumulatively on weekly basis
Monitoring equipment correctly described?	9 flow meters 1,2,3 installed at each treatment plant Total 27 flow meters Accuracy: 1.5 level Type: LUGB For each flow meter, the calibration information and validity is listed as below table Flow meter 1

Farm	Serial No.	Calibrated Date	Validity
Fangcheng 1st farm	20191120147	06-July-2020 30-June-2022	05-July-2022 29-June-2024
Fangcheng 2nd farm	20191214102		
Fangcheng 3rd farm	20191016056		
Sheqi 1st farm	20191024126		
Sheqi 2nd farm	20190921024		
Sheqi 3rd farm	20190816112		
Sheqi 7th farm	20191221034		
Sheqi 9th farm	20191106097		
Wolong 3rd farm	20190915124		

Flow meter 2

	<table><tr><th>Farm</th><th>Serial No.</th><th>Calibrated Date</th><th>Validity</th></tr><tr><td>Fangcheng 1st farm</td><td>20191120151</td><td rowspan="9">06-July-2020 30-June-2022</td><td rowspan="9">05-July-2022 29-June-2024</td></tr><tr><td>Fangcheng 2nd farm</td><td>20191214107</td></tr><tr><td>Fangcheng 3rd farm</td><td>20191016061</td></tr><tr><td>Sheqi 1st farm</td><td>20191024130</td></tr><tr><td>Sheqi 2nd farm</td><td>20190921030</td></tr><tr><td>Sheqi 3rd farm</td><td>20190816115</td></tr><tr><td>Sheqi 7th farm</td><td>20191221039</td></tr><tr><td>Sheqi 9th farm</td><td>20191106102</td></tr><tr><td>Wolong 3rd farm</td><td>20190915129</td></tr></table> Flow meter 3 <table><tr><th>Farm</th><th>Serial No.</th><th>Calibrated Date</th><th>Validity</th></tr><tr><td>Fangcheng 1st farm</td><td>20191120157</td><td rowspan="9">06-July-2020 30-June-2022</td><td rowspan="9">05-July-2022 29-June-2024</td></tr><tr><td>Fangcheng 2nd farm</td><td>20191214109</td></tr><tr><td>Fangcheng 3rd farm</td><td>20191016064</td></tr><tr><td>Sheqi 1st farm</td><td>20191024135</td></tr><tr><td>Sheqi 2nd farm</td><td>20190921038</td></tr><tr><td>Sheqi 3rd farm</td><td>20190816119</td></tr><tr><td>Sheqi 7th farm</td><td>20191221042</td></tr><tr><td>Sheqi 9th farm</td><td>20191106108</td></tr><tr><td>Wolong 3rd farm</td><td>20190915135</td></tr></table>
QA/QC procedure correctly described?	Yes - The above calibration information has been confirmed by checking the calibration reports/15/ which has been conducted by qualified parties/16/. Via checking the calibration reports/15/, CTI confirmed that all the flow meters are calibrated based on JJG1029-2007-Verification Regulation of Vortex-shedding Flowmeter/36/. And based on the validity as above table, CTI confirmed that the installed monitoring equipment has been duly calibrated for this entire monitoring period.
Purpose of data?	PE and LE calculation
Comments?	For this monitoring period, all the biogas produced is used for heat generation, no surplus biogas for the flaring system.

$EC_{PJ,j,y}$	*Quantity of electricity consumed by the proposed project in year y*
Title in line with Methodology?	Yes
Data unit correctly expressed?	MWh
Appropriate description?	Yes
Monitored Value?	4,631.5896
Correct value provided?	Yes
Source clearly referenced? (appropriate?)	Yes– Value derived from Daily report of electricity/23/
Choice of data correctly justified?	Yes - the measuring and reporting frequency are in line with the monitoring plan and applied methodology/45/.
Measurement method and procedures correctly described?	Yes –The electricity consumptions were measured by the electricity meter 1 installed at each treatment plant (total 7 meters). Monitoring staff read the readings of electricity daily and recorded meter reading data into Daily report of electricity/23/ which includes the electricity consumption of the treatment plant daily, and then the electricity consumption is calculated for each month. Via checking the measuring method by reviewing the Daily operation record/23/ and interview with monitoring staff, CTI verified that the method is in line with the monitoring plan and applied tool/47/.
Calculation method?	N/A

<table>
<tr><td>Monitoring frequency correctly described?</td><td>Continuous measurement and daily recording</td></tr>
<tr><td>Monitoring equipment correctly described?</td><td>9 Electricity meters installed at each treatment plant
Accuracy: 1.0
Type: DTS634
For each electricity meter, the calibration information and validity is listed as below table
<table>
<tr><th>Farm</th><th>Serial No.</th><th>Calibrated Date</th><th>Validity</th></tr>
<tr><td>Fangcheng 1st farm</td><td>20180662422430</td><td rowspan="9">02-July-2020</td><td rowspan="9">01-July-2025</td></tr>
<tr><td>Fangcheng 2nd farm</td><td>20180662422433</td></tr>
<tr><td>Fangcheng 3rd farm</td><td>20180662422439</td></tr>
<tr><td>Sheqi 1st farm</td><td>20180662422442</td></tr>
<tr><td>Sheqi 2nd farm</td><td>20180662422446</td></tr>
<tr><td>Sheqi 3rd farm</td><td>20180662422449</td></tr>
<tr><td>Sheqi 7th farm</td><td>20180662422451</td></tr>
<tr><td>Sheqi 9th farm</td><td>20180662422457</td></tr>
<tr><td>Wolong 3rd farm</td><td>20180662422459</td></tr>
</table></td></tr>
<tr><td>QA/QC procedure correctly described?</td><td>Yes – The above calibration information has been confirmed by checking the calibration reports/15/ which has been conducted by qualified parties/16/.
Via checking the calibration reports/15/, CTI confirmed that all the electricity meters are calibrated based on JJG 596-2012 Electrical Meters for Measuring Alternating-current Electrical Energy/35/. And based on this regulation, if the electricity meters can be used normally, recalibration is not required. The validity is five years.
And based on the validity as above table, CTI confirmed that the installed monitoring equipment has been duly calibrated for this entire monitoring period.
The electricity data is cross-checked with Grid Company Electricity Statement/24/.</td></tr>
<tr><td>Purpose of data?</td><td>PE calculation</td></tr>
<tr><td>Comments?</td><td>During this monitoring period, the electricity consumption of AWMSs were sourced from the grid company.
Via checking the Daily report of electricity/23/ comparing with Grid Company Electricity Statement/24/, it is confirmed that the electricity consumed from power grid company is consistent.</td></tr>
</table>

$TDL_{j,y}$	*Average technical transmission and distribution losses for providing electricity to source j in year y*
Title in line with Methodology?	Yes
Data unit correctly expressed?	%
Appropriate description?	Yes
Monitored Value?	20
Correct value provided?	Yes
Source clearly referenced? (appropriate?)	Yes– Value is derived from Tool 05 “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (version 03.0)/47/
Choice of data correctly justified?	Yes - the measuring and reporting frequency are in line with the monitoring plan and applied tool/47/

Measurement method and procedures correctly described?	Yes –As per the tool of Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (Version 03.0)/47/, CTI confirmed that different values applied to different scenarios. For the project, the electricity consumption was derived from the power grid. Hence, scenario A: Electricity consumption from the grid is applied to this situation. For this situation, a default value of 20% is used for $TDL_{j,y}$ in line with the tool/47/ and it is confirmed that this value is the maximum value as per Methodology tool 05 Version 03.0 and conservative. Via checking the Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (Version 03.0)/47/, CTI confirmed that the data in MR is correct.
Calculation method?	N/A
Monitoring frequency correctly described?	Changed once the tool is updated.
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	N/A, as the value is derived from tool.
Purpose of data?	PE calculation
Comments?	-

$V_{t,db}$	*Volumetric flow of the gaseous stream in time interval t on a dry basis*
Title in line with Methodology?	Yes
Data unit correctly expressed?	m^3 dry gas/h
Appropriate description?	Yes
Monitored Value?	Refer to values in ER sheet/2/
Correct value provided?	Yes
Source clearly referenced? (appropriate?)	Yes– Value is derived from Daily operation record/22/ saved automatically in the Data Collection System (DCS)
Choice of data correctly justified?	Yes - the measuring and reporting frequency are in line with the monitoring plan and applied methodology/45/.
Measurement method and procedures correctly described?	Yes – The volumetric flow of the gaseous stream data was measured by the flow meters installed at each treatment plant (total 18 flow meters 1,3), flow meters 1 are installed at outlet of the anaerobic digestion and flow meters 3 are installed at the inlet of flare system which have been verified as correct and actual by site inspection. The flowmeters monitored data continuously, record hourly and saved automatically in the Data Collection System (DCS). CTI confirmed that the measurement method is actual and the gaseous stream is defined as dry according to the Tool 8:" Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 03.0)"/49/. Hence the monitoring parameter $V_{t,db}$ does not need to be calculated based on the wet basis flow plus water concentration. The data can be obtained from Data Collection System (DCS) and the monthly data was exported by the staff at the beginning of next month and then recorded in daily operation record. Daily biogas flow is equal to the cumulative value of 24 hours, and monthly biogas flow can be accumulated on daily basis.

	Via checking the measuring method by reviewing the Daily operation record/22/ and interview with monitoring staff, CTI verified that the method is in line with the tool and applied methodology.
Calculation method?	N/A
Monitoring frequency correctly described?	Continuously measurement
Monitoring equipment correctly described?	Refer to information for 18 flow meters (1,3) above
QA/QC procedure correctly described?	Yes - The above calibration information has been confirmed by checking the calibration reports/15/ which has been conducted by qualified parties/16/. Via checking the calibration reports/15/, CTI confirmed that all the flow meters are calibrated based on JJG1029-2007-Verification Regulation of Vortex-shedding Flowmeter/36/. And based on the validity as above table, CTI confirmed that the installed monitoring equipment has been duly calibrated for this entire monitoring period.
Purpose of data?	PE calculation
Comments?	-

$V_{i,t,db}$	*Volumetric fraction of greenhouse gas i in a time interval t on a dry basis*
Title in line with Methodology?	Yes
Data unit correctly expressed?	m^3 gas i/m^3 dry gas
Appropriate description?	Yes
Monitored Value?	Refer to values in ER sheet/2/
Correct value provided?	Yes
Source clearly referenced? (appropriate?)	Yes– Value is derived from Daily operation record/22/.
Choice of data correctly justified?	Yes - the measuring and reporting frequency are in line with the monitoring plan and applied methodology/45/.
Measurement method and procedures correctly described?	Yes –The data are measured continuously and record hourly by online gas analysers installed at the outlet of the anaerobic digesters and saved automatically in the DCS. The data can be obtained from DCS and the monthly data was exported by the staff at the beginning of next month. Daily and Monthly CH_4 concentration was calculated based on the 24-hour average and daily average CH_4 concentration and recorded finally in the Daily operation record/22/. Via checking the measuring method by reviewing the Daily operation record/22/ as stated in the MR and interview with monitoring staff, CTI verified that the method is in line with the applied methodology.
Calculation method?	N/A
Monitoring frequency correctly described?	Continuous measurement
Monitoring equipment correctly described?	Gas analyzers installed at each treatment plant Total 9 gas analyzers Accuracy: ±1% Type: Gasboard-9060 For each gas analyzer, the calibration information and validity is listed as below table

Farm	Serial No.	Calibrated Date	Validity
Fangcheng 1st farm	2014234	30-June-2020	
Fangcheng 2nd farm	2014238		

	Fangcheng 3rd farm	2014240	18-June-2021 15-June-2022	29-June-2021 17-June-2022 14-June-2023
	Sheqi 1st farm	2014248		
	Sheqi 2nd farm	2014251		
	Sheqi 3rd farm	2014254		
	Sheqi 7th farm	2014258		
	Sheqi 9th farm	2014263		
	Wolong 3rd farm	2014267		
QA/QC procedure correctly described?	Yes - The above calibration information has been confirmed by checking the calibration reports/15/ which has been conducted by qualified parties/16/. Via checking the calibration reports/15/, CTI confirmed that all the gas analyzers are calibrated based on JJG693-2011 (Verification Regulation of Alarmer Detectors of Combustible Gas)/37/. And based on this regulation, the validity is one year. 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). And the zero verification with an inert gas (N_2) and one reading verification with a standard gas (single calibration gas) are implemented in the process of calibration, which is confirmed as in accordance with JJG693-2011/37/. All calibration gases are confirmed as from Shanghai Shenkai Gases Technology Co. Ltd, which is a qualified reference materials manufacturer issued by the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China on 16-April-2007/16/. And based on the validity as above table, CTI confirmed that the installed monitoring equipment has been duly calibrated for this entire monitoring period.			
Purpose of data?	PE calculation			
Comments?	-			

T_t	*Temperature of the gaseous stream in time interval t*
Title in line with Methodology?	Yes
Data unit correctly expressed?	K
Appropriate description?	Yes
Monitored Value?	Refer to values in ER sheet/2/
Correct value provided?	Yes
Source clearly referenced? (appropriate?)	Yes– Value is derived from Daily operation record/22/.
Choice of data correctly justified?	Yes - the measuring and reporting frequency are in line with the monitoring plan and applied methodology/45/.
Measurement method and procedures correctly described?	Yes – The temperature of the gaseous stream data was measured by the flow meters installed at each treatment plant (total 27 flow meters 1,2,3), flow meters 1 are installed at outlet of the anaerobic digestion, flow meters 2 are installed at the inlet of boiler and flow meters 3 are installed at the inlet of flare system, and record hourly and saved automatically in the DCS system. which have been verified as correct and actual by site inspection. Via site inspection and checking the manufacture specification of the flow meter/26/, it is confirmed that the flow meter has the function to measure the temperature with recordable electronic signal (digital).

	The data are monitored continuously, record hourly and saved automatically in the DCS. The data for this monitoring period have been obtained from DCS and the monthly data was exported by the staff at the beginning of next month. Daily and Monthly temperature was calculated based on the 24-hour average and daily average temperature. The readout of flowmeter was indicated degrees Celsius(°C). Therefore, the temperature T_t(K) is calculated as the equation T(K)=t(°C)+273.15 Via checking the measuring method by reviewing the Daily operation record/22/ as stated in the MR and interview with monitoring staff, CTI verified that the method is in line with the applied methodology.
Calculation method?	N/A
Monitoring frequency correctly described?	Continuously measurement
Monitoring equipment correctly described?	Refer to information for 27 flow meters above
QA/QC procedure correctly described?	Yes - The above calibration information has been confirmed by checking the calibration reports/15/ which has been conducted by qualified parties/16/. Via checking the calibration reports/15/, CTI confirmed that all the flow meters are calibrated based on JJG1029-2007-Verification Regulation of Vortex-shedding Flowmeter/36/. And based on the validity as above table, CTI confirmed that the installed monitoring equipment has been duly calibrated for this entire monitoring period.
Purpose of data?	PE calculation
Comments?	-

P_t	*Pressure of the gaseous stream in time interval t*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Pa
Appropriate description?	Yes
Monitored Value?	Refer to values in ER sheet/2/
Correct value provided?	Yes
Source clearly referenced? (appropriate?)	Yes– Value is derived from Daily operation record/22/.
Choice of data correctly justified?	Yes - the measuring and reporting frequency are in line with the monitoring plan and applied methodology/45/.
Measurement method and procedures correctly described?	Yes –The pressure of the gaseous stream data was measured by the flow meters installed at each treatment plant (total 27 flow meters 1,2,3), flow meters 1 are installed at outlet of the anaerobic digestion, flow meters 2 are installed at the inlet of boiler and flow meters 3 are installed at the inlet of flare system, and record hourly and saved automatically in the DCS system which have been verified as correct and actual by site inspection. Via site inspection and checking the manufacture specification of the flow meter/26/, it is confirmed that the flow meter has the function to measure the pressure with recordable electronic signal (digital). The data are monitored continuously, record hourly and saved automatically in the DCS. The data for this monitoring period have been obtained from DCS and the monthly data was exported by the

	staff at the beginning of next month. Daily and Monthly pressure was calculated based on the 24-hour average and daily average pressure. Via checking the measuring method by reviewing the Daily operation record/22/ as stated in the MR and interview with monitoring staff, CTI verified that the method is in line with the applied methodology.
Calculation method?	N/A
Monitoring frequency correctly described?	Continuously measurement
Monitoring equipment correctly described?	Refer to information for 27 flow meters above
QA/QC procedure correctly described?	Yes - The above calibration information has been confirmed by checking the calibration reports/15/ which has been conducted by qualified parties/16/. Via checking the calibration reports/15/, CTI confirmed that all the flow meters are calibrated based on JJG1029-2007-Verification Regulation of Vortex-shedding Flowmeter/36/. And based on the validity as above table, CTI confirmed that the installed monitoring equipment has been duly calibrated for this entire monitoring period.
Purpose of data?	PE calculation
Comments?	-

$\rho_{i,t}$	*Density of greenhouse gas i in the gaseous stream in time interval t*
Title in line with Methodology?	Yes
Data unit correctly expressed?	kg gas i/m³ gas i
Appropriate description?	Yes
Monitored Value?	Refer to values in ER sheet/2/
Correct value provided?	Yes
Source clearly referenced? (appropriate?)	Yes– Calculated based on temperature of the gaseous stream in time interval t and pressure of the gaseous stream in time interval t.
Choice of data correctly justified?	Yes - the calculation methods are in line with the monitoring plan and applied methodology/45/.
Measurement method and procedures correctly described?	Yes –Calculated based on temperature of the gaseous stream in time interval t and pressure of the gaseous stream in time interval t. The monitoring result of Pressure and temperature are listed in the above two tables.
Calculation method?	Calculated based on temperature of the gaseous stream in time interval t and pressure of the gaseous stream in time interval t.
Monitoring frequency correctly described?	N/A
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	N/A
Purpose of data?	PE calculation
Comments?	-

MS%j	*Fraction of manure handled in system j in project activity*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Fraction
Appropriate description?	Yes
Monitored Value?	100%
Correct value provided?	Yes

Source clearly referenced? (appropriate?)	Yes–As no monitoring was conducted in the project activity to monitor the fraction of manure handled, hence using 100% as conservative.
Choice of data correctly justified?	Yes
Measurement method and procedures correctly described?	Yes –As this parameter is not monitored during this monitoring period. so, to be conservative, the value of this parameter in the emission reduction calculation is 100%. All the manure flew into AWMSs to be treated; no any manure will be discharged outside. Therefore, the value of this parameter is 100%
Calculation method?	N/A
Monitoring frequency correctly described?	Annually
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	N/A
Purpose of data?	PE calculation
Comments?	-

$B_{0,LT}$	*Maximum methane producing potential of the volatile solid generated by animal type LT*
Title in line with Methodology?	Yes
Data unit correctly expressed?	m^3CH_4/kg -dm
Appropriate description?	Yes
Monitored Value?	$B_{0,LT}$ (Market swine) =0.29 $B_{0,LT}$ (Breeding swine) =0.29
Correct value provided?	Yes
Source clearly referenced? (appropriate?)	Yes– Value is derived from Table 10A-7 and 10A-8 of IPCC 2006 Guidelines for National Greenhouse Gas Inventories volume 4, chapter10/39/
Choice of data correctly justified?	Yes - the measuring and reporting frequency are in line with the monitoring plan and applied methodology/45/.
Measurement method and procedures correctly described?	Yes –As no monitoring was conducted in the project activity to monitor the value, so, 0.29 m^3CH_4/kg -dm is still applied. The actual methane producing potential of the volatile solid generated by swine manure is 479.4ml/g VS via checking the public literature/69/, which is higher than JPM value, therefore 0.29 m^3CH_4/kg -dm applied in monitoring period is conservative.
Calculation method?	N/A
Monitoring frequency correctly described?	Annually
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	Yes – The values will be updated based on latest available data from IPCC
Purpose of data?	BE, PE calculation
Comments?	-

$NEX_{LT,y}$	*Annual average nitrogen excretion per head of a defined livestock population estimated as described in Appendix 2*
Title in line with Methodology?	Yes
Data unit correctly expressed?	Yes
Appropriate description?	Yes

Monitored Value?	Refer to values in ER sheet/2/
Correct value provided?	Yes
Source clearly referenced? (appropriate?)	Yes–the value is calculated as the equation of option 2 in Appendix 2: $NEX_{LT,y} = \frac{W_{site}}{W_{default}} * NEX_{IPCC\ default}$ While, $NEX_{IPCC\ default}$ calculated as equation 30 of the IPCC 2006, volume 4, chapter 10 $NEX_{IPCC\ default} = N_{rate(T)} * TAM/1000*365$
Choice of data correctly justified?	Yes - the calculation is in line with the monitoring plan and applied methodology/45/.
Measurement method and procedures correctly described?	Yes –$W_{default}$, $N_{rate(T)}$ and TAM are default value from IPCC 2006. The measurement methods and procedures for W_{site}, please refer to the monitoring parameter W_{site}
Calculation method?	$NEX_{LT,y} = \frac{W_{site}}{W_{default}} * NEX_{IPCC\ default}$
Monitoring frequency correctly described?	Annually - verified as per the applied methodology
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	Yes - 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). The value should be updated on latest available public data source. QA/QC procedure for W_{site}, please refer to the monitoring parameter W_{site}
Purpose of data?	BE, PE calculation
Comments?	-

Type	*Type of barn and AWMS*
Title in line with Methodology?	Yes
Data unit correctly expressed?	-
Appropriate description?	Yes
Monitored Value?	-
Correct value provided?	Yes
Source clearly referenced? (appropriate?)	Yes– Value is derived from layout and configuration are collected to confirm whether the implementation of project as design
Choice of data correctly justified?	Yes - the measuring and reporting frequency are in line with the monitoring plan and applied methodology/45/.
Measurement method and procedures correctly described?	Yes –This monitoring is the first monitoring period and in this monitoring period, the swine barn and AWMS layout and configuration/14/ are consistent with the design which is approved by the official government/7/.
Calculation method?	N/A
Monitoring frequency correctly described?	After the first verification, only changes in the type of barn and AWMS will be reported.
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	Yes - Due to the project has been approved by government, it will not be changed during the implementation periods, hence the Type of barn and AWMS will not be changed, hence type will not be monitored

	due to all the other parameters monitored can determine if the project type has been changed or not.
Purpose of data?	BE calculation
Comments?	-

T	*Annual average ambient temperature at project site*
Title in line with Methodology?	Yes
Data unit correctly expressed?	°C
Appropriate description?	Yes
Monitored Value?	2020: 15.9 2021: 15.9 2022: N/A
Correct value provided?	Yes
Source clearly referenced? (appropriate?)	Yes– Value is derived from Henan Province Bureau of Statistics/70/.
Choice of data correctly justified?	Yes - the measuring and reporting frequency are in line with the monitoring plan and applied methodology/45/.
Measurement method and procedures correctly described?	Yes –This parameter monitored monthly by checking the annual average ambient temperature at project site from public website monthly. The parameter value should be updated upon the changes occur in the monitoring period.
Calculation method?	N/A
Monitoring frequency correctly described?	Annually
Monitoring equipment correctly described?	N/A
QA/QC procedure correctly described?	Yes - Cross-Check with the value of ex-ante estimated, i.e., 15°C. MCF value is 74% with the lower temperature of 15°C by comparing with the ex-ante value and year 2020 and year 2021 monitored values as per Appendix 3 of ACM0010 (Version 08.0). Then multiplying MCF values with a value of 0.94, so 69.56% of MCF_j is used for calculation during in this monitoring period. For year 2022, due to the year not ended and the temperature in first 6 months cannot represent the annual average temperature of the whole year, hence MCFj of 69.56% is still applied for the period from 01-January-2022 to 30-June-2022, which is the same with the value in 2021. Via comparing with the ex-ante value, CTI confirmed that MCFj of 69.56% is applied in this monitoring period consistent with the value for ex-ante calculation.
Purpose of data?	Used to select the annual MCF_j from IPCC 2006 Guidelines
Comments?	-

CAR 25, CAR 26 and CAR 27 were raised and successfully closed. Refer to Appendix 4 for detail assessment.

3. Assessment of GHG emission reductions Quantity

Calculation of baseline GHG emissions or removals

According to the methodology and above all the formulars listed in section 3.4.6, baseline emissions are calculated using the following formula:

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

The values monitored during monitoring survey are transparently shown in the Section 6.1 of Joint-PD-MR. During onsite, CTI cross-checked these values in detail using various supporting records and documents. Refer to the above section 3.4.8 of this report for ex-ante and above section 4.1 for ex-post parameters' assessment.

The Baseline Emissions during this monitoring period is summarized as below,

Date	$BE_{CH4,y}$ (tCO_2e/yr)	$BE_{N2O,y}$ (tCO_2e/yr)	BE_y (tCO_2e/yr)
05-August-2020~31-December-2020	149,397	2,492	151,889
01-January-2021~31-December-2021	364,843	6,082	370,925
01-January-2022~30-June-2022	181,261	3,021	184,282
05-August-2020~30-June-2022	**695,501**	**11,595**	**707,096**

Total Baseline emissions of the 1st monitoring period is thus verified as **707,096** tCO_2e.

In conclusion, the calculations of baseline GHG emissions have been carried out in accordance with the formulae and methods described in the registered monitoring plan, the applied methodology and, where applicable, the applied standardized baseline. Any assumptions used in emission calculations have been justified. Appropriate emission factors, GWP and other reference values have been correctly applied. No errors, miscalculations, omissions, misstatements or incomplete information has been identified. It can be confirmed that the baseline calculation is overall correct.

Calculation of project GHG emissions or actual net GHG removals by sinks

According to the methodology, the project emissions are calculated using the following formula:

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

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

The values monitored during monitoring survey are transparently shown in the Section 6.1 of Joint-PD-MR. During onsite, CTI cross-checked these values in detail using various supporting records and documents. Refer to the above section 3.4.8 of this report for ex-ante and above section 4.1 for ex-post parameters' assessment.

So $PE_{AD,y}$ during this monitoring period is calculated as below table

Date	$PE_{EC,y}$ (tCO_2e)	$PE_{CH4,y}$ (tCO_2e)	$PE_{AD,y}$ (tCO_2e)
05-August-2020~31-December-2020	691	6,979	7,670
01-January-2021~31-December-2021	1,659	17,459	19,118
01-January-2022~30-June-2022	830	8,662	9,492
05-August-2020~30-June-2022	**3,180**	**33,100**	**36,280**

So Project Emissions during this monitoring period is calculated as below table

Date	$PE_{AD,y}$ (tCO_2e)	$PE_{Aer,y}$ (tCO_2e)	$PE_{N2O,y}$ (tCO_2e)	PE_y (tCO_2e)

05-August-2020~31-December-2020	7,670	43	9,044	16,758
01-January-2021~31-December-2021	19,118	105	22,064	41,287
01-January-2022~30-June-2022	9,492	52	10,962	20,506
05-August-2020~30-June-2022	**36,280**	**200**	**42,069**	**78,551**

In conclusion, the calculations of project GHG emissions have been carried out in accordance with the formulae and methods described in the registered monitoring plan, the applied methodology and, where applicable, the applied standardized project. Any assumptions used in emission calculations have been justified. Appropriate emission factors, GWP and other reference values have been correctly applied. No errors, miscalculations, omissions, misstatements or incomplete information has been identified. It can be confirmed that the project calculation is overall correct.

Calculation of leakage GHG emissions

According to the methodology, the leakage emissions are calculated using the following formula:

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

The values monitored during monitoring survey are transparently shown in the Section 6.1 of Joint-PD-MR. During onsite, CTI cross-checked these values in detail using various supporting records and documents. Refer to the above section 3.4.8 of this report for ex-ante and above section 4.1 for ex-post parameters' assessment.

So Leakage Emissions during this monitoring period is calculated as below table

Date	$LE_{PJ,CH4,y}$ (tCO_2e)	$LE_{BL,CH4,y}$ (tCO_2e)	$LE_{BL,N2O,y}$ (tCO_2e)	$LE_{PJ,N2O,y}$ (tCO_2e)	LE_y (tCO_2e/yr)
05-August-2020~31-December-2020	34,371	32,212	1,770	6,332	**6,721**
01-January-2021~31-December-2021	83,937	78,665	4,316	15,455	**16,411**
01-January-2022~30-June-2022	41,699	39,081	2,146	7,677	**8,149**
05-August-2020~30-June-2022	**160,007**	**149,958**	**8,232**	**29,464**	**31,281**

In conclusion, the calculations of leakage GHG emissions have been carried out in accordance with the formulae and methods described in the registered monitoring plan, the applied methodology and, where applicable, the applied standardized project. Any assumptions used in emission calculations have been justified. Appropriate emission factors, GWP and other reference values have been correctly applied. No errors, miscalculations, omissions, misstatements or incomplete information has been identified. It can be confirmed that the project calculation is overall correct.

Summary of calculation of GHG emission reductions or net anthropogenic GHG removals by sinks

The VVB has checked the Joint-PD-MR includes a summary table of the emission reductions calculation.

Summary of emission reductions during the monitoring period,

$$ER_y = BE_y - PE_y - LE_y$$

Furthermore, as per the applied methodology, if the actual methane captured from anaerobic digesters in project activity is lower than ($BE_{CH4,y}$ - $PE_{AD,y}$), then ($BE_{CH4,y}$ - $PE_{AD,y}$) is replaced by actual methane captured $Q_{CH4,y}$.

Biogas captured during monitoring period is 6,078.39*10^4 m^3, which equals to 661,957 tCO_2e that emission from methane production. Baseline methane emission ($BE_{CH4,y}$) is 695,501 tCO_2e. The project emissions associated with anaerobic digester is ($PE_{AD,y}$) is 36,280 tCO_2e. Actual methane captured from anaerobic digesters is higher than the difference of $BE_{CH4,y}$ and $PE_{AD,y}$. Therefore, the equation ($BE_{CH4,y}$ - $PE_{AD,y}$) can be used to calculate emission reduction.

Hence, the emission reductions during this monitoring period from 2020 to 2022 are summarized in the table below

Parameters / Period	Baseline Emissions BE_y	Project Emissions PE_y	Leakage Emissions LE_y	Net GHG emission reductions or removals ER
	(tCO_2e)	(tCO_2e)	(tCO_2e)	(tCO_2e)
05-August-2020~31-December-2020	151,889	16,758	6,721	**128,410**
01-January-2021~31-December-2021	370,925	41,287	16,411	**313,227**
01-January-2022~30-June-2022	184,282	20,506	8,149	**155,627**
05-August-2020~30-June-2022	**707,096**	**78,551**	**31,281**	**597,264**

All the figures as per the monitoring report were cross-checked by the VVB against basic monitored data. Refer to section 4.4.1 and 4.4.2 of this report for assessment details.

CL 05 was raised and successfully closed. Refer to Appendix 4 for detail assessment.

4.3 Quality of Evidence to Determine GHG Emission Reductions and Removals

Refer to section 4.1 above for the detail assessment of each monitoring parameters and Appendix 3 for the supporting evidence used to determine the GHG emission reductions.

For each reported data, the evidence is provided and verified as sufficient and quality is appropriate. Also, the cross-checks have been performed on the reported data with different source of evidence. The information flow from data generation and aggregation, to recording, calculation and final transposition into the monitoring report has been assessed by VVB in section 4.1 for each parameter and also the calibration have been conducted as per the frequency of monitoring equipment defined in the Joint-PD-MR.

Therefore, it is concluded that the evidence provided are verified as sufficient and quality is appropriate and thus the evidence can be used to determine the GHG emission reductions and removals for this monitoring period.

5 VALIDATION AND VERIFICATION CONCLUSION

Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd. has commissioned the CTI to carry out the Verified Carbon Standard (VCS) joint validation and 1st periodic verification of the project activity FSW AMMS GHG Mitigation Project in Nanyang City (VCS ID 2846), for the monitoring period from 05-August-2020 to 30-June-2022, with regard to the relevant requirements for VCS Standard Version 4.3.

Based on the reviewing the documented evidence and by an on-site assessment, CTI can confirm that:

- the baseline scenario is correctly defined as per the applied methodology and relate tools;
- the project is additional;
- all data and information used for ex-ante calculation of emission reductions is of projected and/or hypothetical nature;
- the monitoring plan in the validated Joint-PD-MR is as per the applied baseline and monitoring methodology.
- the project has been implemented and operated as per the VCS Joint-PD-MR;
- the project complies with the validation and verification criteria for projects set out in VCS Standard Version 4.3;
- the monitoring report and other supporting documents provided are complete and verifiable and in accordance with the applicable VCS requirement and ACM0010 (version 08.0);
- the monitoring is in place as per the applied baseline and monitoring methodology ACM0010 (version 08.0);
- the monitoring complies with the monitoring plan in the validated Joint-PD-MR;

It is certified that the GHG emission reductions from the project during the monitoring period amount as follows:

Verification period: From 05-August-2020 to 30-June-2022

Verified GHG emission reductions and removals in the above verification period by vintage is

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
05-August-2020~31-December-2020	151,889	16,758	6,721	**128,410**
01-January-2021~31-December-2021	370,925	41,287	16,411	**313,227**
01-January-2022~30-June-2022	184,282	20,506	8,149	**155,627**
05-August-2020~30-June-2022	**707,096**	**78,551**	**31,281**	**597,264**

Lin Wu

CTI

Verification Team Leader

27-September-2022

Zhou Lu

CTI

Final Approval

27-September-2022

APPENDIX 1: ABBREVIATIONS

Abbreviations	Full texts
AWMS	Animal Waste Management System
BE	Baseline Emission
CAR	Corrective Action Request
CCER	China Certified Emission Reduction
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CL	Clarification Request
CO_2	Carbon dioxide
CP	Crediting Period
DNA	Designated National Authority
EB	Executive Board
EIA	Environmental Impact Assessment
ER	Emission Reduction
ETS	Emission Trading Scheme
FAR	Forward Action Request
PER	Project Evaluation Report
GHG	Green House Gas
GS	Gold Standard
GSC/GSP	Global Stakeholder Consultation Process
IPCC	Intergovernmental Panel on Climate Change
JPM	Joint-PD-MR
KP	Kyoto Protocol
LSC	Local Stakeholder Consultation
MoV	Means of Validation
MP	Monitoring Plan
ODA	Official Development Assistance
PA	Project Activity
PE	Project Emission
PP	Project Participant
PS	Project Standard
QC/QA	Quality control/Quality assurance
CCPG	Central China Power Grid
SD	Sustainable Development
SDG	Sustainable Development Goals
tCO_2e	Tonnes of Carbon di oxide equivalent
UNFCCC	United Nations Framework Convention on Climate Change
VVS	Validation and Verification Standard
VCS	Verified Carbon Standard
VCSA	Verified Carbon Standard Association
VCU	Verified Carbon Unit
VVB	Validation/Verification Body

APPENDIX 2: COMPETENCE OF TEAM MEMBERS AND TECHNICAL REVIEWERS

Mr. Lei ZHANG

Satisfies the requirements of competence management system of CTI Certification, and is hereby appointed as:

Qualification						
Status	GHG Auditor	Validator	Verifier	Team Leader	Technical Reviewer	Technical Expert
Date	√	√	√	√	√	√

Scope	Technical Area
SS 1: Energy industries (renewable/non-renewable sources)	TA 1.1: Thermal energy generation
	TA 1.2: Energy generation from renewable energy sources
SS 4: Manufacturing industries	TA 4.1: Cement and lime production
SS 13: Waste handling and disposal	TA 13.1: Solid waste and wastewater

This appointment is valid for 3 years from its date of approval below and is bound by internal requirements of management system of the Certification Body of CTI.

Approved by: Wu Lin

Wu LIN

Technical Competent Manager

Shenzhen, 01/01/2021

Mr. Qinghua DAI

Satisfies the requirements of competence management system of CTI Certification, and is hereby appointed as:

Qualification						
Status	GHG Auditor	Validator	Verifier	Team Leader	Technical Reviewer	Technical Expert
Date	-	-	-	-	-	√

Scope	Technical Area
SS 13: Waste handling and disposal	TA 13.2: Manure
SS 15: Agriculture	TA 15.1: Agriculture

This appointment is valid for 3 years from its date of approval below and is bound by internal requirements of management system of the Certification Body of CTI.

Approved by: Wu Lin

Wu LIN

Technical Competent Manager

Shenzhen, 01/01/2021

Mr. Wu LIN

Satisfies the requirements of competence management system of CTI Certification, and is hereby appointed as:

Qualification						
Status	GHG Auditor	Validator	Verifier	Team Leader	Technical Reviewer	Technical Expert
Date	√	√	√	√	√	√

Scope	Technical Area
SS 1: Energy industries (renewable/non-renewable sources)	TA 1.1: Thermal energy generation
	TA 1.2: Energy generation from renewable energy sources
SS 2: Energy distribution	TA 2.1: Electricity distribution
SS 3: Energy demand	TA 3.1: Energy demand
SS 4: Manufacturing industries	TA 4.1: Cement and lime production
SS 5: Chemical industry	TA 5.1: Chemical industry
	TA 5.2: Caprolactam, nitric and adipic acid
SS 10: Fugitive emissions from fuels (solid, oil and gas)	TA 10.1: Fugitive emissions from oil and gas
SS 11: Fugitive emissions from production and consumption of halocarbons and sulphur hexafluoride	TA 11.1: Emissions of fluorinated gases
	TA 11.2: Refrigerant gas production
SS 12: Solvents use	TA 12.1: Chemical industry
SS 13: Waste handling and disposal	TA 13.1: Solid waste and wastewater
	TA 13.2: Manure

This appointment is valid for 3 years from its date of approval below and is bound by internal requirements of management system of the Certification Body of CTI.

Approved by:

Lu ZHOU

General Manager

Shenzhen, 01/01/2021

APPENDIX 3: DOCUMENTS REVIEWED OR REFERENCED

No.	Author	Title	References to the document	Provider
1.	PP	Joint-PD-MR of "FSW AMMS GHG Mitigation Project in Nanyang City"	- Draft Version No. 01, dated 03-July-2022 - Final Version No. 02, dated 22-July-2022 - Final Version No. 03, dated 27-September-2022	PP
2.	PP	Emission Reduction Calculation spreadsheet of "FSW AMMS GHG Mitigation Project in Nanyang City" – Ex-ante calculation	- Draft Version No. 01, dated 03-July-2022 - Final Version No. 02, dated 22-July-2022	PP
		Emission Reduction Calculation spreadsheet of "FSW AMMS GHG Mitigation Project in Nanyang City" – related to 1st monitoring period	- Draft Version No. 01, dated 03-July-2022 - Final Version No. 02, dated 22-July-2022	PP
3.	PP	NPV and IRR calculation sheet	- Draft Version No. 01, dated 03-July-2022 - Final Version No. 02, dated 22-July-2022	PP
4.	Local Administrative Examination and Approval Bureau	Business License of PP	Business License of Muyuan Foods Co., Ltd. and Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd.	PP
5.	Henan Tutian New Energy Technology Co., Ltd.	Project Evaluation Report	Issued on 16-May-2019	PP
6.	Nanyang Environmental Protection Research Institute Co., Ltd.	Environment Impact Assessment (EIA)	Issued in January 2019	PP
7.	Nanyang Municipal Department of Ecology and Environment	EIA approval	Issued on 28-May-2019	PP
8.	Local County Agriculture	Licenses for production and operation	Licenses for production and operation of the breeding	PP

	and Rural Affairs		livestock and poultry of 9 swine farms	
9.	PP and manufacturers	Equipment purchase contracts	Equipment purchase contracts of all the involved main equipment including biogas boiler, solid-liquid separators, anaerobic tanks etc.	PP
10.	PP and Henan Guanyu Environmental Protection Technology Co., Ltd.	General design and construction contract	Signed on 08-November-2019	PP
11.	Manufacturers	Technical agreement	Technical agreement of main equipment	PP
12.	PP	Statement	Statement of time for all the AWMSs started construction and operation	PP
13.	PP	Operation log of the project	Operation log of the 9 AWMSs plants	PP
14.	PP	Technical flow charts	Technical flow charts in the project site of 9 AWMSs	PP
15.	Henan Institute of Metrology	Calibration Reports	- Calibration Reports to all the electricity meters with validity covering this monitoring period	PP
			- Calibration Reports to all the Weight measurers with validity covering this monitoring period	
			- Calibration Reports to all the gas analysers with validity covering this monitoring period	
			- Calibration Reports to all the flow meters with validity covering this monitoring period	
16.	General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China	Certificate of Metrological Authorization/CMA/	Certificate of Metrological Authorization of Henan Institute of Metrology issued on 06-November-2017 valid to 05-November-2022 Certificate of Metrological Authorization of Shanghai Shenkai Gases Technology Co. Ltd issued on 16-April-2007	PP
17.	PP	Production record of Market swine	Production record of Market swine of each farm covering this monitoring period	PP

18.	PP	Records of animal weight	Monthly records of animal weight of a defined livestock population of three age categories	PP
19.	PP	Calculation sheet of sample size	Calculation sheet of sample size for monitoring W_{site}	PP
20.	PP	Sale Records of Market swine	Monthly Sale Records of Market swine of each farm covering this monitoring period	PP
21.	PP	Breeding Pig stock record	Breeding Pig stock record of each farm covering this monitoring period	PP
22.	PP	Daily operation record	Daily operation record of each treatment plant covering this monitoring period	PP
23.	PP	Daily report of electricity	Daily report of electricity imported issued by PP for this monitoring period	PP
24.	State Grid Nanyang Power Supply Company	Grid Company Electricity Statement	Grid Company Electricity Statement issued by grid company for this monitoring period	PP
25.	Project Owner and Nanyang Jingu Biotechnology Co., Ltd.	Sale agreement of organic fertilizer	Sale agreement of organic fertilizer dated 28-July-2020	PP
26.	Shanghai Shangyi Company	Manufacture specification	Manufacture specification of the flow meter	PP
27.	PP	Photo of baseline lagoon	Photo of baseline lagoons of 9 swine farms	PP
28.	PP	Local Stakeholder Consultation Records prior to the construction start date	Local stakeholder consultation process evidences: - 180 filled questionnaires by attendance in the Meeting	PP
29.	PP	Local Stakeholder Consultation Records during 1st monitoring period	Local stakeholder consultation process evidences: 90 filled questionnaires by attendance in the Meeting	PP
30.	PP	Declaration of no double counting and not involved in other GHG scheme	Issued on 10-March-2021	PP
31.	PP and employees	Labor contracts	Labor contracts signed with employees for implementation of this project	PP
32.	PP	Pay rolls	Monthly salary slips for employees	PP
33.	PP	Technical Training Records	Technical Training Records of project 1. Training Records in this monitoring period 2. Training register list	PP

34.	National Standard	GJJ/T54-93	Design code for wastewater stabilization ponds	Public Website
35.	National Standard	JJG 596-2012	Electrical Meters for Measuring Alternating-current Electrical Energy	Public website
36.	National Standard	JJG1029-2007	Verification Regulation of Vortex-shedding Flowmeter	Public website
37.	National Standard	JJG693-2011	Verification Regulation of Alarmer Detectors of Combustible Gas	Public Website
38.	National Standard	JJG539-2016	Digital Indicator Scale Verification Regulations	Public Website
39.	IPCC	IPCC	2006 IPCC Guidelines for National Greenhouse Gas Inventories	Public Website
40.	IPCC	IPCC Fifth Assessment Report	IPCC Fifth Assessment Report	Public Website
41.	National Development and Reform Commission and Ministry of Construction	Economic Evaluation Method and Parameter of Construction Projects	Version 03	Public Website
42.	NDRC and the ministry of housing and urban-rural development of PRC	Notice on adjusting financial benchmark rate	Notice on adjusting financial benchmark rate of return of construction projects in some industries	Public Website
43.	UNFCCC	Standard of Sampling and surveys	Standard of "Sampling and surveys for CDM project activities and programmes of activities (Version 09.0)"	UNFCCC website
44.	UNFCCC	Guideline of Sampling and surveys	Guideline of the "Sampling and surveys for CDM project activities and programmes of activities (Version 04.0)"	UNFCCC website
45.	UNFCCC	CDM Approved Methodology ACM0010	"GHG emission reductions from manure management systems" (Version 08.0)	UNFCCC website
46.	UNFCCC	Methodological tool	Combined tool to identify the baseline scenario and demonstrate additionality (Version 07.0)	UNFCCC website
47.	UNFCCC	Methodological tool	Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (Version 3.0)	UNFCCC website
48.	UNFCCC	Methodological tool	Project emissions from flaring (Version 04.0)	UNFCCC website

49.	UNFCCC	Methodological tool	Tool to determine the mass flow of a greenhouse gas in a gaseous stream (Version 07.0)	UNFCCC website
50.	UNFCCC	Methodological tool	Project and leakage emissions from anaerobic digesters (Version 02.0)	UNFCCC website
51.	UNFCCC	Methodological tool	Common practice (Version 03.1)	UNFCCC website
52.	UNFCCC	Methodological tool	Investment analysis (version 11.0)	UNFCCC website
53.	VERRA	Template	VCS-Joint-Project-Description-Monitoring-Report-Template-v4.1	VCS website
54.	VERRA	Registration and Issuance Process	Registration and Issuance Process version 4.2	VCS website
55.	VERRA	VCS Program Definitions	VCS Program Definitions, v4.2	VCS website
56.	VERRA	VCS Program Guide	VCS Program Guide, v4.2	VCS website
57.	VERRA	VCS Standard	VCS Standard Version 4.3	VCS website
58.	UNFCCC	CDM Standard	Applicability of sectoral scopes version 01.0	Public Website
59.	China CER platform	CCER	http://cdm.ccchina.org.cn/ccer.aspx	Public Website
60.	UNFCCC	UNFCCC website	https://cdm.unfccc.int	UNFCCC website
61.	VERRA	VCS	https://verra.org/project/vcs-program/	VCS website
62.	GS	GS	http://globalgoals.goldstandard.org/	GS website
63.	Public Info	Days for pigs to be slaughtered	Number of days for pigs to be slaughtered by existing large-scale breeding groups in China https://zhuanlan.zhihu.com/p/38676811 http://finance.people.com.cn/n1/2017/1121/c1004-29658996.html	Website
64.	Ministry of Ecology and Environment of China	China cap & trade scheme	http://www.mee.gov.cn/xxgk2018/xxgk/xxgk02/202101/t20210105_816131.html	Public Website
65.	Ministry of Ecology and Environment of China	Enforced company list	http://mee.gov.cn/xxgk2018/xxgk/xxgk03/202012/W020201230736907682380.pdf	Public Website
66.	Ministry of Ecology and Environment of the People's Republic of China	Baseline emission factor of China	2019 China regional power grid carbon dioxide baseline emission factor OM calculation instructions http://www.mee.gov.cn/ywgz/ydqhbh/wsqtkz/202012/t20201229_815386.shtml	Public Website
67.	Public Website	Public information of the project owner	http://www.muyuanfoods.com/	Public Website

68.	Henan Government	Public information of local temperature	http://www.weather.com.cn/cityintro/101180701.shtml http://www.weather.com.cn/cityintro/101181601.shtml	Public Website
69.	Public Website	Public literature of methane producing potential of the volatile solid generated by swine manure	http://www.doc88.com/p-9902182440715.html	Public Website
70.	Henan Province Bureau of Statistics	Public information of local temperature for this monitoring period	https://oss.henan.gov.cn/sbgt-wztipt/attachment/hntjj/hntj/lib/tjnj/2021nj/zk/indexch.htm https://tjj.henan.gov.cn/2022/03-10/2412169.html	Public info
71.	Public Website	Price index of investment in fixed asset	http://www.stats.gov.cn/	Public Website
72.	Public Website	Development and Reform Commission of Henan Province	https://fgw.henan.gov.cn/	Public Website
73.	Public Website	Department of Agriculture and rural affairs of Henan Province	https://nynct.henan.gov.cn/	Public Website
74.	VVB	Site Visit Photo	Photo taken by VVB during site visit including main equipment in AWMSs, swine farms, monitoring devices, etc.	N/A
75.	National Government	Law&Regulation	1. Farmland Irrigation Water Quality Standard (GB5084-2005); 2. Odor Pollutant Discharge Standard (GB14554-93); 3. Comprehensive Emission Standards for Air Polluted Areas (GB16297-1996); 4. Boiler Air Pollutant Emission Standard (GB13271-2014); 5. Environmental Noise Emission Standard for Industrial Enterprise Boundary (GB12348-2008) 6. Environmental Protection Law of P.R. China 7. Law of the People's Republic of China on the Environmental Impact Assessment	Public Website
76.	National Standard	GB-T 36195	Technical specification for sanitation treatment of livestock and poultry manure https://oss.baigongbao.com/2020/12/14/MRyhTKQcWC.pdf	Public Website
77.	Chine State Council	Regulations on Prevention and Control of Pollution from Livestock and Poultry Farming	http://politics.people.com.cn/n/2013/1126/c1001-23662445.html	Public Website

78.	Ministry of Agriculture and Rural Affairs of China	Specifications for the construction of manure resource utilization facilities for large-scale livestock and poultry farms (for trial implementation)	http://www.moa.gov.cn/gk/tzgg_1/tfw/201801/t20180111_6134801.htm	Public Website

APPENDIX 4: CLARIFICATION REQUESTS, CORRECTIVE ACTION REQUESTS AND FORWARD ACTION REQUESTS

Table 1.Remaining FAR from validation and/or previous verification

FAR ID	N/A	Section no.		Date:
Description of FAR				
Project participant response				Date:
Documentation provided by project participant				
VVB assessment				Date:

Table 2.CL from this verification

CL ID	01	Section no.	1.8	Date : 11/07/2022
Description of CL				
PP stated that the project has been put into operation on 05-August-2020, however, there are total 9 AWMSs installed in 9 swine farms, if all the AWMSs started operation on this day or only the first AWMS is not clarified.				
Project participant response				Date : 22/07/2022
The commissioning date of all the AWMSs is different, but the AWMSs had been put into operation on 05-August-2020. Thus, the project start date is 05-August-2020. The date for AWMS in 9 swine farms is described in Section 1.11 of JPM.				
Documentation provided by project participant				
/1/- version 2.0 /13/ /12/				
VVB assessment				Date: 23/07/2022
The revised Joint-PD-MR is checked, CTI confirmed that the clarification has been added, all the farms were put into operation on the same day on 05-August-2020 which has been confirmed by checking the operation log of the project/13/ and statement of all the AWMSs started construction and operation/12/. CL 01 is closed.				

CL ID	02	Section no.	1.16.1	Date : 11/07/2022
Description of CL				
PP is not to clarify that how to avoid double counting of the project by considering China has a national emissions trading scheme.				
Project participant response				Date : 22/07/2022
The project proponent is not part of any emission trading program. The Project does not reduce GHG emissions from activities that are included in an emissions trading program or any other mechanism that includes GHG allowance trading. There is a cap & trade scheme in China. However, China's national emissions trading scheme (ETS), which is at its very early stage, only includes 2,225 fossil fuel-fired power plants in the power sector, and the project proponent is not included in the list. China's ETS is expected to include all companies with annual GHG emissions greater than 26,000 tCO2e in				

eight emission-intensive industries including power generation, petrochemicals, chemicals, building materials, non-ferrous metals, papermaking, steel and aviation. As the annual GHG emissions of the project proponent will not be greater than 26,000 tCO_2e, it will not be included in the national ETS; no emission cap will be enforced on the project proponent, nor can it participate in carbon transactions in the national ETS. Therefore, the net GHG emission reductions from the Project will not be used for compliance with emission trading programs or to meet binding limits on GHG emissions. In addition, the project owner has signed the Declaration of No Double Counting Statement and Declaration of neither been registered and rejected nor seeking registration under any other GHG programs and not participating in other environment credits, other GHG programs other than VCS.
Documentation provided by project participant
/1/- version 2.0 /30/
VVB assessment **Date:** 23/07/2022
The revised Joint-PD-MR is checked, CTI confirmed that the clarification has been added. The project proponent is not part of any emission trading program which has been confirmed via checking the UNFCCC/60/, GS/62/, VCS/61/ and other GHG schemes' website. The net GHG emission reductions during this monitoring period from the project was not used for compliance with emission trading programs or to meet binding limits on GHG emissions. The project activity has not participated under any other GHG programs which has been confirmed via checking the UNFCCC/60/, GS/62/, VCS/61/ and other GHG schemes' website, it is verified that the implementation of the project is consistent with the description in the Joint-PD-MR and the monitoring system is fully functional to generate Verified Carbon Units (VCUs) without any double counting for this monitoring period from 05-August-2020 to 30-June-2022. Besides, based on VVB's local expertise, China has a national emissions trading scheme only cover the high-emission industries, such as power generation sector that emitted at least 26,000 tons of CO_2e/year which has been verified in the public website/64/, and it is confirmed that the project activity is not included the mandatory emission control scheme and there is no emission cap enforced for the project owner by checking the enforced company list in public information/65/. Besides, the "Declaration of No Double Counting and not involved in other GHG scheme"/30/ have been checked, CTI verified that PP promised not to double counting the project in any other scheme. Hence, it is confirmed that the emission reductions will not be double counted. CL 02 is closed.

CL ID	03	**Section no.**	2.2	**Date :** 11/07/2022
Description of CL				
In section 2.2, 1. The category of the participants attended the stakeholder consultation meeting is not clarified. 2. The questions and answers of the stakeholder consultation meeting are not clarified. 3. The actual local stakeholder consultation process for this monitoring period is not clarified.				
Project participant response				**Date :** 22/07/2022
1. The category of the participants attended the stakeholder consultation meeting have been added in section 2.2, please refer to table 2-1. 2.The questions and answers of the questionnaires distributed to the stakeholders have been summarized in table 2-2 in this JPM. 3.The actual local stakeholder consultation process for this monitoring period have been added in section 2.2, which including the invitation method, the consultation method, the survey date and the survey result, please refer section 2.2.				
Documentation provided by project participant				
/1/- version 2.0 /28/ /29/ /6/				
VVB assessment				**Date:** 23/07/2022

1. The revised Joint-PD-MR is checked, CTI confirmed that category of the participants attended the stakeholder consultation meeting has been clarified which is confirmed as correct by checking the filled questionnaires/28/. 2. The revised Joint-PD-MR is checked, CTI confirmed that the questions and answers of the stakeholder consultation meeting has been clarified which is confirmed as correct by checking the filled questionnaires/28/. 3. The revised Joint-PD-MR is checked, CTI confirmed that the actual local stakeholder consultation process for this monitoring period has been clarified which is confirmed as correct by checking the filled questionnaires/29/. Refer to section 3.3.2 of this report for detail assessment. CL 03 is closed.

CL ID	04	Section no.	2.3	Date : 11/07/2022
Description of CL				
The demonstration of environmental impact from the project is not in line with the EIA which analyzed all the potential impacts for both construction and operation period.				
Project participant response				Date : 22/07/2022
The demonstration of environmental impact from the project including construction and operation period is added in JPM.				
Documentation provided by project participant				
/1/- version 2.0 /6/				
VVB assessment				Date: 23/07/2022
The revised Joint-PD-MR is checked, CTI confirmed that environmental impacts which analyzed for both construction and operation period is added which is verified as correct and actual by checking the EIA/6/. CL 04 is closed.				

CL ID	05	Section no.	6.5	Date : 11/07/2022
Description of CL				
PP stated in section 6.5 that Biogas captured during monitoring period is 6,078.39*$10^4 m^3$, which equals to 661,957 tCO_2e, however, how to derive the value of 661,957 tCO_2e based on 6,078.39*$10^4 m^3$ is not clarified.				
Project participant response				Date : 22/07/2022
Biogas captured during this monitoring period is 6,078.39*$10^4 m^3$. The quality of methane is 23,641.33tCH_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 CH_4 i.e. 28tCO_2/tCH_4 is the result of 661,957 tCO_{2e}. Please refer ER sheet, tab "monitoring results" for detail calculation process and final results.				
Documentation provided by project participant				
/1/- version 2.0				
VVB assessment				Date: 23/07/2022
The revised Joint-PD-MR is checked, via checking the ER sheet, CTI confirmed that the value is correctly calculated based on amount of biogas, the density of biogas and the content of methane in this monitoring period, thus the final result of 661,957 tCO_2e is verified as reasonable and credible. CL 05 is closed.				

Table 3.CAR from this verification

CAR ID	01	Section no.	1.1	Date : 11/07/2022
Description of CAR				
1. PP is requested to use the latest version of VCS-Joint-Project-Description-Monitoring-Report-Template to finish the project report.				

2. PP is requested to provide the status of the swine farms, if existed in baseline or not. 3. The expected biogas production is missing. 4. Total ER value for fixed crediting period is missing. 5. Actual ER value achieved during the 1st monitoring period is missing.	
Project participant response	**Date :** 22/07/2022
1. The latest version of VCS-Joint-Project-Description-Monitoring-Report-Template is applied for this project. 2. the swine farms involving this project are existing, which has added in Section 1.1. 3. the expected biogas production by the project is added in Section 1.1. 4. Total ER value for the 10-year fixed crediting period has been added in Section 1.1. 5. This monitoring period for the project is 05-August-2020 to 30-June-2022, which is the first monitoring period. The total emission reductions achieved in this monitoring period is 597,264 tCO_2e.	
Documentation provided by project participant	
/1/- version 2.0 /5/	
VVB assessment	**Date:** 23/07/2022
1. The revised Joint-PD-MR is checked, CTI confirmed that the latest version of VCS-Joint-Project-Description-Monitoring-Report-Template, version 4.1/53/ has been used by PP for completing the project which is verified as correct. 2. The revised Joint-PD-MR is checked, CTI confirmed that the status of the swine farms has been provided as existing which is confirmed as actual via site inspection and checking the PER/5/. 3. The revised Joint-PD-MR is checked, CTI confirmed that the expected biogas production has been added which is confirmed as correct by checking the PER/5/. 4. The revised Joint-PD-MR is checked, CTI confirmed that the value of total ER value for 1st crediting period is added which is verified as correct by checking the ER sheet/2/. 5. The revised Joint-PD-MR is checked, CTI confirmed that the Actual ER value achieved during the 1st monitoring period is provided which is verified as correct by checking the ER sheet/2/. CAR 01 is closed.	

CAR ID	02	**Section no.**	1.3	**Date :** 11/07/2022
Description of CAR				
1. The VCS Standard version used in Joint-PD-MR should be updated to the latest version. 2. The analysis of the project eligibility is not in line with the requirement of the VCS Standard section 2.1.1.				
Project participant response				**Date :** 22/07/2022
1. the version of VCS standard used in Joint-PD-MR has been updated to Version 4.3. 2. the analysis of the project eligibility has been modified to in line with the requirement of the VCS standard version 4.3 section 2.1.1, please refer to Section 1.3 in the JPM.				
Documentation provided by project participant				
/1/- version 2.0				
VVB assessment				**Date:** 23/07/2022
1. The revised Joint-PD-MR is checked, CTI confirmed that the VCS Standard has been updated to version 4.3 in the whole Joint-PD-MR which has been verified in line with the VCS Standard Version 4.3/57/. 2. The revised Joint-PD-MR is checked, CTI confirmed that the analysis has been updated according to the VCS Standard Version 4.3 section 2.1.1. Refer to section 3.1 of this report for detail assessment. CAR 02 is closed.				

CAR ID	03	**Section no.**	1.12	**Date :** 11/07/2022
Description of CAR				
PP is requested to provide separate map which can show detail location of each farm.				

Project participant response	Date : 22/07/2022
The map is added in section 1.12 of JPM to show detail location of each swine farm.	
Documentation provided by project participant	
/1/- version 2.0	
VVB assessment	**Date:** 23/07/2022
The revised Joint-PD-MR is checked, CTI confirmed that a separate map which can show detail location of each farm has been supplemented, which is verified as correct by site inspection with GPS device. CAR 03 is closed.	

CAR ID	04	Section no.	1.17	Date : 11/07/2022
Description of CAR				
1. The section 1.17 is not in line with the latest JPM template request. 2. PP is requested to demonstrate that a project contributes to at least three SDGs by the end of the first monitoring period, and in each subsequent monitoring period as per the section 3.16 of VCS Standard. 3. As per the JPM template, evidence of the project's SD contributions shall be provided as appendices to this report, however, the evidence of the project's SD contributions is missing in Appendices of JPM.				
Project participant response				Date : 22/07/2022
1. The section 1.17 is revised as the requirement of the latest JPM Template. 2. For SDG13, in this monitoring period from 05-August-2020 to 30-June-2022, the total amount of GHGs emission reductions are 597,264 tCO_2e. For SDG7, total 6,078.39*$10^4 m^3$ of biogas is generated by the project from 05-August-2020 to 30-June-2022. For SDG 8, in this monitoring period from 05-August-2020 to 30-June-2022, total 18 full-time jobs for local people were created (including 9 females and 9 males). 3. Evidence of the project's SD contributions is added into appendix of JPM				
Documentation provided by project participant				
/1/- version 2.0				
VVB assessment				**Date:** 23/07/2022
1. The revised Joint-PD-MR is checked, CTI confirmed that section 1.17 has been updated to the Sustainable Development Contributions which is verified in line with the template. 2. The revised Joint-PD-MR is checked, CTI confirmed that actual project contributes to three SDGs by the end of the first monitoring period has been specified and verified as in line with the section 3.16 of VCS Standard Version 4.3/57/. 3. The revised Joint-PD-MR is checked, CTI confirmed that the related evidence has been added into Appendix 1 of the JPM which is consistent with the evidence shown to VVB during site visit. Refer to section 3.1 of this report for detail assessment. CAR 04 is closed.				

CAR ID	05	Section no.	2.4	Date : 11/07/2022
Description of CAR				
The actual information of public comments from VCS GSC is not specified.				
Project participant response				Date : 22/07/2022
The Project (VCS ID: 2846) was open for public comments for a month from 09-March-2022 to 08-April-2022 on the website of Verra Registry. Only one comment was received for the project, however, the comment section was left blank. Therefore, no comment needs to be responded for the project.				
Documentation provided by project participant				
/1/- version 2.0				
VVB assessment				**Date:** 23/07/2022
The revised Joint-PD-MR is checked, CTI confirmed that the information has been added. The project sought the registration with the VCS Program, according to VCS requirements the Project Description was submitted for public comment period. The project was allocated with VCS ID 2846.				

The public comment period started on 09-March-2022 and ended on 08-April-2022 (https://registry.verra.org/app/projectDetail/VCS/2846). No comments were received (only one comment was received for the project, however, the comment section was left blank) during this period which has been verified by checking the dedicated website as above. CAR 05 is closed.

CAR ID	06	Section no.	3.2	Date : 11/07/2022
Description of CAR				
For the applicability to the methodology, the demonstration of the project to applicable to criteria 1 is not correct as the project does not generate electricity.				
Project participant response				Date : 22/07/2022
There is a typo. For the project, the biogas captured is used for heat generation, which is corrected in JPM.				
Documentation provided by project participant				
/1/- version 2.0				
VVB assessment				Date: 23/07/2022
The revised Joint-PD-MR is checked, CTI confirmed that the typo information has been updated accordingly. Refer to section 3.4.2 of this report for detail assessment. CAR 06 is closed.				

CAR ID	07	Section no.	3.2	Date : 11/07/2022
Description of CAR				
For the applicability to the methodology, the demonstration of the project to applicable to criteria 3 is not correct and in line with the request from the methodology.				
Project participant response				Date : 22/07/2022
The demonstration of the project to applicable to criteria 3 have been modified by PP, please refer to section 3.2.				
Documentation provided by project participant				
/1/- version 2.0				
VVB assessment				Date: 23/07/2022
The revised Joint-PD-MR is checked, CTI confirmed that the demonstration has been updated accordingly. Refer to section 3.4.2 of this report for detail assessment. CAR 07 is closed.				

CAR ID	08	Section no.	3.2	Date : 11/07/2022
Description of CAR				
For the applicability to the Tool 14, demonstration of the project generate electricity is not correct.				
Project participant response				Date : 22/07/2022
There is a typo. For the project, the biogas captured is used for heat generation, which is corrected in JPM.				
Documentation provided by project participant				
/1/- version 2.0 /9/				
VVB assessment				Date: 23/07/2022
The revised Joint-PD-MR is checked, CTI confirmed that the typo information has been updated accordingly. Refer to section 3.4.2 of this report for detail assessment. CAR 08 is closed.				

CAR ID	09	Section no.	3.3	Date : 11/07/2022

Description of CAR	
1. The project boundary is not correctly defined according to the applied methodology. 2. The chart of project boundary of the project is not correctly related to the project implementation.	
Project participant response	**Date :** 22/07/2022
1. 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 AWMS, including the GHG emissions from the anaerobic digesters, GHG emissions from the heat generation equipment, GHG emissions from sludge treatment by aerobic composting and GHG emissions from flaring system in 9 swine farms. 2. the chart of project boundary of the project has been corrected, please refer to the figure 3-2.	
Documentation provided by project participant	
/1/- version 2.0 /9/	
VVB assessment	**Date:** 23/07/2022
1. The revised Joint-PD-MR is checked, CTI confirmed that the project boundary has been re-defined which is verified in line with the applied methodology. 2. The revised Joint-PD-MR is checked, CTI confirmed that the chart of project boundary of the project is updated to in line with the actual project implementation. Refer to section 3.4.3 of this report for detail assessment. CAR 09 is closed.	

CAR ID	10	Section no.	3.4	Date : 11/07/2022
Description of CAR				
The investment analysis including sensitivity analysis and threshold analysis for scenario 6 is not completed, the cross-check descriptions are missing.				
Project participant response				**Date :** 22/07/2022
Sensitivity analysis and threshold analysis for scenario 6 is revised to be complete, please refer Section 3.4.				
Documentation provided by project participant				
/1/- version 2.0				
VVB assessment				**Date:** 23/07/2022
The revised Joint-PD-MR is checked, CTI confirmed that investment analysis including sensitivity analysis and threshold analysis for scenario 6 has been further specified. Refer to section 3.4.4 of this report for detail assessment. CAR 10 is closed.				

CAR ID	11	Section no.	3.5	Date : 11/07/2022
Description of CAR				
For common practice justification, 1. Methodological tool: "common practice (version 03.1)" is not listed. 2. The justification for Sub-step 4a.2 is not complete. The similar projects is not correctly defined.				
Project participant response				**Date :** 22/07/2022
1. Methodological tool: "common practice (version 03.1)" has been added in the section 3.5. 2. the justification for Sub-step 4a.2 have been described complete, and the similar project is defined as: the project belonging to "Methane formation avoidance" with treatment of manure operated before 05-August-2020, that can handle manure from 349,743 tons to 1,049,229 tons annually in Henan Province is the similar project as the project activity.				
Documentation provided by project participant				
/1/- version 2.0				
VVB assessment				**Date:** 23/07/2022

1. The revised Joint-PD-MR is checked, CTI confirmed that the "common practice (version 03.1)" has been used for demonstrate the common practice. 2. The revised Joint-PD-MR is checked, CTI confirmed that each item for Sub-step 4a.2 has been analysed accordingly as per the tool. Refer to section 3.4.5 of this report for detail assessment. CAR 11 is closed.

CAR ID	12	Section no.	4.2	Date : 11/07/2022
Description of CAR				
In section 4.2, 1. Determination of project emissions of fossil fuel combustion is missing. 2. The ex-ante determination of project emissions from flaring is not correct.				
Project participant response				Date : 22/07/2022
1.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 description about this is added in Section 4.2. 2. As all the biogas generated in the AWMSs is collected for heat generation, so no biogas is flared in pre-calculation. In the monitoring period, the project emissions from flaring of biogas should be calculated according to the actual situation.				
Documentation provided by project participant				
/1/- version 2.0 /5/				
VVB assessment				Date: 23/07/2022
1. The revised Joint-PD-MR is checked, CTI confirmed that the information has been added. During site inspection, CTI confirmed that no fossil fuel is used for the project, therefore $PE_{FC,y}$=0. 2. The revised Joint-PD-MR is checked, CTI confirmed that the information has been added. Via checking the project evaluation report/5/, it is confirmed as all the biogas generated in the AWMSs is collected for heat generation, so no biogas is flared in pre-calculation. While, in the monitoring period, the project emissions from flaring of biogas will be calculated according to the actual flaring mass flow of methane. CAR 12 is closed.				

CAR ID	13	Section no.	5.1	Date : 11/07/2022
Description of CAR				
1. For parameter GWP_{CH4}, the source of data is not accurate. 2. For parameter GWP_{N2O}, the source of data is not accurate.				
Project participant response				Date : 22/07/2022
1.the parameter GWP_{CH4} sourced from IPCC Fifth Assessment Report, which is revised in JPM. 2. parameter GWP_{N2O} sourced from IPCC Fifth Assessment Report, which is revised in JPM.				
Documentation provided by project participant				
/1/- version 2.0				
VVB assessment				Date: 23/07/2022
1. The revised Joint-PD-MR is checked, CTI confirmed that the source of data has been updated to be correct and accurate. 2. The revised Joint-PD-MR is checked, CTI confirmed that the source of data has been updated to be correct and accurate. Refer to section 3.4.8 of this report for detail assessment. CAR 13 is closed.				

CAR ID	14	Section no.	5.2	Date : 11/07/2022
Description of CAR				
For parameter W_{site}, the calibration request for the monitoring device is missing.				
Project participant response				Date : 22/07/2022

The weight measurer will be calibrated annually to ensure the reliability of the parameter, which is added in JPM.
Documentation provided by project participant
/1/- version 2.0 /38/
VVB assessment **Date:** 23/07/2022
The revised Joint-PD-MR is checked, CTI confirmed that the calibration request for weight measurer has been added which is verified in line with the JJG539-2016 "Verification Regulation of Digital Indicating Weighting Instruments" in China/38/. Refer to section 3.4.8 of this report for detail assessment. CAR 14 is closed.

CAR ID	15	**Section no.**	5.2	**Date :** 11/07/2022
Description of CAR				
For Parameters T, QA/QC procedure is not reasonable due to the cross check should not be the data source itself.				
Project participant response				**Date :** 22/07/2022
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., 15°. In the monitoring period, to be conservative, corresponding MCFj with lower annual average ambient temperature as per Appendix 3 of ACM0010 (Version08.0) will be used for calculation after comparing the actual value and the value of ex-ante estimated.				
Documentation provided by project participant				
/1/- version 2.0				
VVB assessment				**Date:** 23/07/2022
The revised Joint-PD-MR is checked, CTI confirmed that the cross-check method has been updated and verified as reasonable. CAR 15 is closed.				

CAR ID	16	**Section no.**	5.3	**Date :** 11/07/2022
Description of CAR				
The monitoring system figure is not correct due to the project technical process is not completed, revision is requested.				
Project participant response				**Date :** 22/07/2022
The monitoring system figure in Section 5.3 is corrected according the project technical process.				
Documentation provided by project participant				
/1/- version 2.0				
VVB assessment				**Date:** 23/07/2022
The revised Joint-PD-MR is checked, CTI confirmed that monitoring system figure is updated accordingly which is verified as correct with actual location of installed monitoring devices and actual project technical process. CAR 16 is closed.				

CAR ID	17	**Section no.**	1.11	**Date :** 11/07/2022
Description of CAR				
1. The actual status of the 9 existing swine farms is missing. 2. Baseline scenario is missing. 3. The description of project technology is not provided. 4. The Process flow diagram of the project activity is not correct. 5. The description of heat generation is missing. 6. The description of flare system and technical parameters of flares is missing. 7. The actual status of the project during this monitoring period is missing. 8. The time for project started construction, commissioning and operation is missing for 9 AWMSs.				

Project participant response	Date : 22/07/2022
1.The actual status of the 9 existing swine farms have been added in section 1.11. 2.The description of baseline scenario has been added in section 1.11. 3.The description of project technology have been added in section 1.11 4.The Process flow diagram of the project activity has been corrected by PP 5. The biogas just produced by the anaerobic fermentation system is a mixed gas containing saturated steam. In addition to CH_4 and CO_2, it also contains H_2S and suspended particulate impurities. Therefore, desulfurization and purification treatments are required. Biogas collected from the fully enclosed anaerobic pond is purified by biogas purification device firstly, then the biogas is sent to boilers for heat generation. The heat generated is used by the AWMS and the 9 swine farms. Surplus biogas would be flared (if any). This has been added in the "Comprehensive utilization of biogas" in section 1.11 6.The purified biogas can enter to boilers for heat generation. The heat generated is used by the AWMS and the 9 swine farms. Surplus biogas would be flared (if any). this has been added in "Comprehensive utilization of biogas" in section 1.11 7. For this monitoring period covering 695days, total 410,250 heads of market swine, 22,170 heads of breeding swine are included in these 9 swine farms and total 6,078.39*104m^3 of biogas are produced. 8. The time for project started construction, commissioning and operation have been added to table 1-2 in section 1.11.	
Documentation provided by project participant	
/1/- version 2.0	
VVB assessment	**Date:** 23/07/2022
1. The revised Joint-PD-MR is checked, CTI confirmed that actual status of the 9 existing swine farms is added. 2. The revised Joint-PD-MR is checked, CTI confirmed that baseline scenario is added. 3. The revised Joint-PD-MR is checked, CTI confirmed that description of project technology is added. 4. The revised Joint-PD-MR is checked, CTI confirmed that Process flow diagram of the project activity is updated to be correct and in line with the actual status of the project. 5. The revised Joint-PD-MR is checked, CTI confirmed that description of heat generation is added. 6. The revised Joint-PD-MR is checked, CTI confirmed that description of flare system and technical parameters of flares is added. 7. The revised Joint-PD-MR is checked, CTI confirmed that actual status of the project during this monitoring period is added. 8. The revised Joint-PD-MR is checked, CTI confirmed that time for project started construction, commissioning and operation for all 9 AWMSs is added. Refer to section 4.2 of this report for detail assessment. CAR 17 is closed.	

CAR ID	18	Section no.	6.1	Date : 11/07/2022
Description of CAR				
For parameter $N_{p,LT}$, the cross-check method and checking result is not justified clearly.				
Project participant response				**Date :** 22/07/2022
For the monitoring period 05-August-2020~30-June-2022, it is 22.871months. therefore, the annual swine produced can be averaged according to the total quantity of swine produced during this monitoring period. Based on the Equation 5, the calculated N_{LT} is 410,250 heads ((1,585,525 heads/22.871months*12months) *180days/365days). However, according to the number of market pigs produced annually of each farm, the N_{LT} calculated by Equation 5 is rounded to an integer as 410,250 heads. According to the conservative principle, the 410,250 heads was applied in the calculations of emission reductions in MR. $N_{p,LT}$ has been crosschecked through the monthly sale records of 9 swine farms during this monitoring period and according to the monthly sale records of 9 swine farms, total 1,585,525 heads of marketing swine is produced and sold into the market, which is consistent with the value from Monthly production record of market swine.				

Therefore, $N_{p,LT}$ is reasonable and credible.	
Documentation provided by project participant	
/1/- version 2.0	
VVB assessment	**Date:** 23/07/2022
The revised Joint-PD-MR is checked, CTI confirmed that cross-check method and checking result are specified with details. Refer to section 4.2 of this report for detail assessment. CAR 18 is closed.	

CAR ID	19	**Section no.**	6.1	**Date :** 11/07/2022
Description of CAR				
For parameter $N_{da,LT}$, the monitoring result is not elaborated.				
Project participant response				**Date :** 22/07/2022
During this monitoring period, a certain number of market swine are slaughtered in each farm every month and the number of days market swine alive in the farm is 180 days as per monthly production record of marketing swine. Also this parameter needs to be monitored every month, therefore, the number of days of the market swine alive in the farm is 180 days. Furthermore, the number of days the animal alive in the farm is crosschecked through the monthly sale records of 9 swine farms during this monitoring period. and it can be concluded that the data is consistent.				
Documentation provided by project participant				
/1/- version 2.0				
VVB assessment				**Date:** 23/07/2022
The revised Joint-PD-MR is checked, CTI confirmed that monitoring result has been not elaborated. Refer to section 4.2 of this report for detail assessment. CAR 19 is closed.				

CAR ID	20	**Section no.**	6.1	**Date :** 11/07/2022
Description of CAR				
For parameter v_f 1. The location of three flow meters for each farm is missing. 2. The serial No. is not corresponding with meter No. of three flow meters.				
Project participant response				**Date :** 22/07/2022
1. the location of three flowmeters in included in Section 6.1. 2. the No. of three flow meters is revised to be corresponding with the serial No.				
Documentation provided by project participant				
/1/- version 2.0 /15/				
VVB assessment				**Date:** 23/07/2022
1. The revised Joint-PD-MR is checked, CTI confirmed that the location of three flow meters for each farm is added. 2. The revised Joint-PD-MR is checked, CTI confirmed that the serial No. is correctly corresponding with meter No. confirmed by checking the certificate of calibration/15/. Refer to section 4.2 of this report for detail assessment. CAR 20 is closed.				

CAR ID	21	**Section no.**	6.1	**Date :** 11/07/2022
Description of CAR				
For monitoring parameter $V_{t,db}$, 1. The monitoring result by flow meter 3 is not provided. 2. The flow meters' location is missing.				
Project participant response				**Date :** 22/07/2022
1. The result of $V_{t,db}$ monitored by flowmeter 3 is added. 2. The location of flowmeter is included.				

Documentation provided by project participant	
/1/- version 2.0	
VVB assessment	**Date:** 23/07/2022
1. The revised Joint-PD-MR is checked, CTI confirmed that the monitoring result monitored by flow meter 3 is added which is confirmed as correct due to there was no residual gas flared for this monitoring period. 2. The revised Joint-PD-MR is checked, CTI confirmed that the location has been added which is confirmed in line with the site inspection. Refer to section 4.2 of this report for detail assessment. CAR 21 is closed.	

CAR ID	22	Section no.	6.1	Date : 11/07/2022
Description of CAR				
For monitoring parameter T, 1. The cross-check method is not in line with the monitoring plan. 2. Why the MCFj of 69.56% is applied in this monitoring period is not clearly specified.				
Project participant response				Date : 22/07/2022
1.The actual temperature will be compared to the value of ex-ante estimated, i.e., 15 °C. and in the monitoring period, to be conservative, corresponding MCF value with lower annual average ambient temperature as per Appendix 3 of ACM0010(Version08.0) will be used for calculation after comparing the actual value and the value of ex-ante estimated. 2.The temperature in 2020 and 2021 is sourced respectively from Henan Meteorological Administration and Henan Province Bureau of Statistics. Henan Meteorological Administration and Henan Province Bureau of Statistics is Official institutions. Therefore, the data is creditable. While only 6 months are included for the period from 01-January-2022 - 30-June-2022 and the monthly average temperature is not available from official public information. Furthermore, the temperature in these 6 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. 15°C, which is more conservative. MCF value is still 74% with the temperature of 15°C and 15.9°C as per Appendix 3 of ACM0010(Version 08.0). Then multiplying MCF values with a value of 0.94, so 69.56% of MCF_j (74%*0.94) is used for calculation during this monitoring period, which is consistent with the valued of ex-ante.				
Documentation provided by project participant				
/1/- version 2.0				
VVB assessment				Date: 23/07/2022
1. The revised Joint-PD-MR is checked, CTI confirmed that the cross-check method has been updated in line with the monitoring plan. 2. The revised Joint-PD-MR is checked, CTI confirmed that the value is correctly used. Refer to section 4.2 of this report for detail assessment. CAR 22 is closed.				

Table 4.FAR from this verification

FAR ID	N/A	Section No.	-	Date: -
Description of FAR				
Project participant response				Date: -
Documentation provided by project participant				
VVB assessment				Date: