HUOSHENGYUAN COMPOSTING PROJECT IN MIANYANG CITY

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1 PROJECT DETAILS

1.1 Summary Description of the Project

Huoshengyuan Composting Project in Mianyang City (hereafter referred to as the project) installs a set of organic fertilizer production lines with an annual capacity of 50,000 tons to treat manure (cow and swine manure) from livestock farms and biomass waste residue, i.e. straw, in Santai County, Mianyang City, Sichuan Province, China. The project is invested and owned by Sichuan Huoshengyuan Biotechnology Co., Ltd. The purpose of the project activity is to avoid methane emissions through controlled aerobic treatment by composting of manure and biomass waste residue.

In absence of the project, all manure waste produced was left to decay in uncovered anaerobic lagoons, which is the most economic, viable and reasonable for livestock farm owners and the biomass waste residue had been left to decay anaerobically in a solid waste disposal site (SWDS).

This project was designed to treat the cow, swine manure and biomass waste residue (straw) to produce organic fertilizer. This project comprises of fermentation system and fertilizer production system. It is estimated that approximately 117,000 tonnes of manure and 32,000 tonnes of biomass waste residue can be treated annually, therefore total 149,000 tonnes of waste can be composted aerobically for this project. A portion of the organic fertilizer obtained is sold to the local government for improving the quality of local high-standard farmland, and another portion is sold to local farmers, farmer cooperatives and businesses. The construction start date of the project is 6 August 2019 and was put into operation on 1 January 2022.

The project activity will reduce of GHG in the atmosphere through avoiding methane emissions from controlled aerobic treatment by composting of manure and biomass residue. It is estimated that 58,686 tCO_2e emission reductions will be generated annually and total emission reductions are 586,856 tCO_2e in the 10 years' fixing crediting period.

1.2 Sectoral Scope and Project Type

The project falls into sectoral scope 13: Waste handling and disposal and 15: Livestock and manure management. The project is not AFOLU project and is not a grouped project.

The project type of this project belongs to Type III "Other project activities not included in Type I or Type II that result in GHG emission reductions not exceeding 60 kt CO_2e per year in any year of the crediting period", which is defined in para. 119 of CDM document "CDM project standard for project activities" (version 03.0).

1.3 Project Eligibility

As per section 2.1.1 of VCS Standard (version 4.5), the scope of the VCS Program includes:

1) The six Kyoto Protocol greenhouse gases: The project activity treats organic wastes for fertilizer through controlled aerobic treatment by composting of manure and biomass waste residue which can avoid methane (CH_4) emissions from uncovered anaerobic lagoons and anaerobically in a solid waste disposal site (SWDS) in the baseline scenario. Thus, the project applicable to this scope.

2) Ozone-depleting substances: Not Applicable.

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

4) Project activities supported by a methodology approved under a VCS approved GHG program, unless explicitly excluded (see the Verra website for exclusions): The applied methodology AMSIII.F (Version 12.0) of the project are methodologies approved under CDM Program, which is a VCS approved GHG program.

5) Jurisdictional REDD+ programs and nested REDD+ projects as set out in the VCS Program document Jurisdictional and Nested REDD+ (JNR) Requirements: Not Applicable. Furthermore, the project does not belong to the project activities excluded in Table 1 of VCS Standard 4.5. Therefore, the proposed project activity is eligible under the scope of the VCS Program.

1.4 Project Design

☒ The project includes a single location or installation only

☐ The project includes multiple locations or project activity instances, but is not being developed as a grouped project

☐ The project is a grouped project

Eligibility Criteria

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

1.5 Project Proponent

Organization name	Sichuan Huoshengyuan Biotechnology Co., Ltd.
Contact person	Xiaoyong Pang

Title	Project Manager
Address	Huayuan Town, Santai County, Mianyang City, Sichuan Province
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Organization name	Xi'an Carbon Neutral Environmental Technology Co., Ltd.
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Title	Project Manager
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1.6 Other Entities Involved in the Project

Organization name	/
Role in the project	/
Contact person	/
Title	/
Address	/
Telephone	/
Email	/

1.7 Ownership

The project owner of the project is *Sichuan Huoshengyuan Biotechnology Co., Ltd.* who has the legal right to control and operate the project activity. The business license, Recordation Certificate of Project, Fertilizer Registration Certificate, approval of Environmental Impact Assessment (EIA) and the equipment purchasing contract are evidence for the ownership of the project and carbon credits generated.

1.8 Project Start Date

As per section 3.8 of *VCS Standard* (Version 4.5), the project start date of a non-AFOLU project is the date on which the project began generating GHG emission reductions or removals. The project activity is a non-AFOLU project, and it has been put into operation on 1 January 2022 Thus, the project start date is 1 January 2022.

1.9 Project Crediting Period

This project adopts fixed crediting periods of 10 years. The crediting period is 10 years 0 month from 1 January 2022 to 31 December 2031 (both days included).

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project	√
Large project	

Year			Estimated GHG emission reductions or removals (tCO_2e)
1-Jan-2022	-	31-Dec-2022	52,554
1-Jan-2023	-	31-Dec-2023	53,990
1-Jan-2024	-	31-Dec-2024	55,397
1-Jan-2025	-	31-Dec-2025	56,777
1-Jan-2026	-	31-Dec-2026	58,129
1-Jan-2027	-	31-Dec-2027	59,454
1-Jan-2028	-	31-Dec-2028	60,754
1-Jan-2029	-	31-Dec-2029	62,027
1-Jan-2030	-	31-Dec-2030	63,275
1-Jan-2031	-	31-Dec-2031	64,499
Total estimated ERs			**586,856**
Total number of crediting years			10
Average annual ERs			**58,686**

1.11 Description of the Project Activity

The project activity is designed to install a set of organic fertilizers production lines to treat the manure from cow, swine farms and the biomass waste residue (straw) in Santai County, Mianyang City to produce organic fertilizer. This project comprises of fermentation system and fertilizer production system. This project uses microbial aerobic fermentation technology, which follows a step-by-step method as given below:

A. Fermentation system

1. Main fermentation - The project has 15 fermentation grooves (specification is 20m × 6m), in the operation process, 15 fermentation grooves are used at the same time, every day, cow and swine manure, crushed straw, fermentation bacterium mixed into the fermentation grooves after using semi-permeable membrane cover on, through the intelligent control system to aeration in the fermentation grooves for aerobic fermentation, after 10 days, the amount of material in this pile moisture content of about 52%.

2. Secondary fermentation - The coarse material after fermentation is transferred to the aging workshop by conveyor belt, the aging temperature is room temperature, the aging time is 20~30d, and the semi-finished product after aging enters the subsequent production line for further processing.

B. Fertilizer production system

3. Further processing processes - **Crushing and sieving**: The mixed materials are transferred to the crusher and sieving machine through the belt, in which the materials that meet the requirements of the particle size into the granulation process, and the materials that do not meet the requirements of the particle size are re-entered into the crusher for crushing. **Granulation, drying, cooling, packaging**: The material enters the granulation process for shaping, and after granulation, it enters the drying process, and the temperature is generally controlled at 120℃. After drying, the materials are sent to the cooling machine for cooling, and the cooled semi-finished products are screened and then enter the packing line for packaging.

The process flow diagram of this project activity is shown in Figure 1-1.

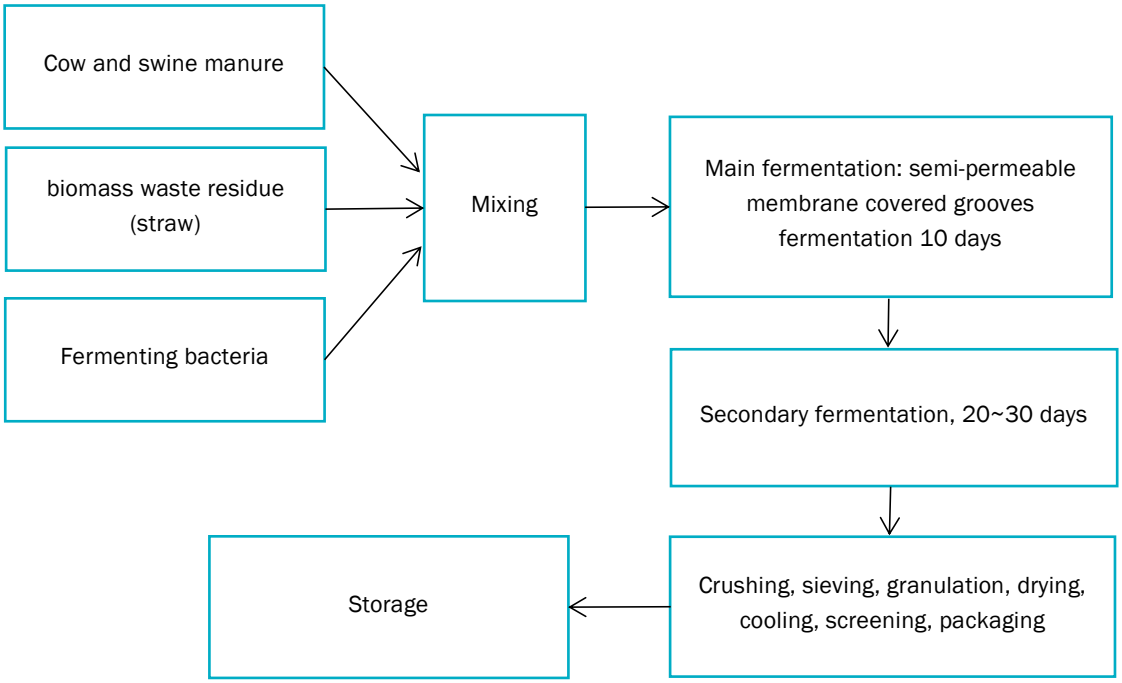

Figure 1-1 Process flow diagram of the project activity

In this project, the prepared raw materials will be put into the fermentation grooves covered by the semi-permeable membrane and the main fermentation will be carried out through the airflow membrane system. Therefore, the main equipment of this project is airflow membrane and aeration system and its main technical parameters are shown in the following table.

Table1-1 The main technical parameters of airflow membrane

Parameter	Value
Equipment name	Sweeper patented imported airflow membrane
Size	25m*8.4m
Tear strength	≥1500N
Unit weight	≥500g/m^2
Water-absorbing quality	≤10%
Vapor permeability	≥5000g/m^2/24h

Table1-2 The main technical parameters of aeration system

Parameter	Value
Equipment name	High pressure positive blower
Power	5.5kw
Wind pressure	≥3000Pa
Blowing rate	≥2000m^3/h

1.12 Project Location

The project located in, Huayuan Town, Santai County, Mianyang City, Sichuan Province, China. The centre coordinates of the project site are 104°57′33.95″E, 31°17′28.77″N.

中国地图

审图号：GS(2019)1696号　　自然资源部 监制

分省（区、市）地图—四川省

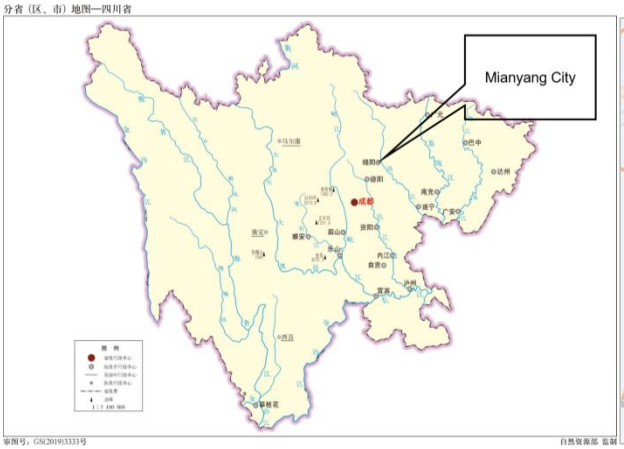

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Figure 1-2 the location of the project activity

1.13 Conditions Prior to Project Initiation

The project is a Greenfield project. In the absence of the project, the cow and swine manure was left to decay in uncovered anaerobic lagoons, which is the most economic, viable and reasonable for livestock farm owners and the biomass waste residue (straw) had been left to decay anaerobically in a solid waste disposal site (SWDS). The baseline scenario is the same as the conditions existing prior to the project initiation. Refer section 3.4 of the PD for detailed baseline scenario.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

According to Recordation Certificate of Project and the approval of EIA of the project, the project complies with all Chinese relevant laws and regulations. Mainly include:

1. Environmental Protection Law of the People's Republic of China.

2. Administrative Licensing Law of the People's Republic of China.

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

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

The project has obtained Recordation Certificate of Project issued by Bureau of Development and Reform of Santai County, Mianyang City, also, the project has obtained the EIA approval

from Mianyang Santai Ecological Environment Bureau. The approvals well demonstrate that local government permits the construction of the project. Consequently, the project is compliance with laws, status and other regulatory frameworks.

1.15 Participation under Other GHG Programs

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

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

1.15.2 Projects Rejected by Other GHG Programs

The project activity is not participating in other environment credits, other GHG programs and has not been rejected by any other GHG Programs.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

Does the project reduce GHG emissions from activities that are included in an emissions trading program or any other mechanism that includes GHG allowance trading?

☐ Yes ☒ No

The project proponent is not part of any emission trading program. 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. The project activity has not participated under any other GHG programs.

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 tCO_2e in eight emission intensive industries including power generation, petrochemicals, chemicals, building materials, non-ferrous metals, paper making, 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.

1.16.2 Other Forms of Environmental Credit

Has the project sought or received another form of GHG-related credit, including renewable energy certificates?

☐ Yes ☒ No

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

Supply Chain (Scope 3) Emissions

The project is reduced the manure from cow, swine farms and the biomass waste residue (straw) , which reduces GHG emission reductions by avoiding GHG emission of methane from the uncovered open lagoon and SWDS. Therefore, the project's GHG emission reductions or removals are not in a supply chain, and thus the Supply Chain (Scope3) Emissions are not applicable.

1.17 Sustainable Development Contributions

The project activity implemented by the project owner can contribute to sustainable development as defined by and tracked against the United Nations Sustainable Development Goals (SDGs). The specific analysis is as follows:

SDG8 Decent Work and Economic Growth

Temporary and permanent job opportunities are created for locals during the construction and operation period of the project. So, the impact parameter of the proposed project on SDG8 is the number of full-time jobs created. After completion, 40 jobs will be created directly,which has obvious social benefits.

SDG12 Responsible consumption and production

The project activity is designed to install a set of organic fertilizers production lines to treat the manure from the cow, swine farms and biomass waste residue (straw), so the organic fertilizers will be produced, which are sold as organic fertilizer. It is estimated that approximately 117,000 tonnes of manure and 32,000 tonnes of biomass waste residue can be treated annually, and the annual organic fertilizer production is 50,000 tonnes.

SDG13 Climate Action

Prior to the implementation of the project, the animal manure waste was left to decay in uncovered open lagoon at the livestock farms and the biomass waste residue was left to decay

in the SWDS, where the methane is emitted to the atmosphere directly without any methane recovery and destruction facility. The project activity will reduce of GHG in the atmosphere through avoiding methane emissions from aerobic treatment of the waste. So, the impact parameter of the proposed project on SDG13 is the amount of GHGs emission reductions. It is estimated that 58,686 tCO_2e emission reductions can be produced annually.

1.18 Additional Information Relevant to the Project

Leakage Management

Not applicable. The project is greenfield project and all equipment applied is new, it does not involve the equipment transferred from another activity or if the existing equipment is transferred to another activity as per section 5.5 of the methodology. And the compost won't be subjected to anaerobic storage, not disposed of in an SWDS. Therefore, leakage emission is not taken into account for the project activity.

Commercially Sensitive Information

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

Further Information

Not applicable.

2 SAFEGUARDS

2.1 No Net Harm

The Environmental Impact Assessment (EIA) Report for the Project has been approved by ecological environment Bureau of Santai County, Mianyang City. Every aspect of environmental impact has been considered in the EIA report with corresponding measures during project development, the construction of the project is in line with national policies and no net harm has been detected. For specific analysis, see section 2.3 below. Meanwhile, the implementation of the project will improve local social economic development through creating career opportunities.

2.2 Local Stakeholder Consultation

The project owner collected comments from local stakeholders about the project activity. Survey questionnaires were distributed to local residents and government officials by the project owner on 1-July-2019.

The survey questionnaire was designed to assess the project's impacts on the local environment and social economic development. The structure of the survey respondents is listed in Table 2-1 below.

Table 2-1 Structure of stakeholder survey

Items		Amount
Gender stakeholders surveyed	Male	18
	female	12
Age	<25	10
	25-55	17
	>55	3
Education	Junior high school or below	6
	Senior high school	13
	College or above	11
Occupation	Worker	10
	Farmer	12
	Management personnel	5
	Civil servant	3

Totally, 30 questionnaires were sent, and 30 responses were collected. Comments from these questionnaires are summarized in Table 2-2 below.

Table 2-2 Summary of stakeholders' comments on the project

No	Question	Response	Amount
1	Do you know about the project activity?	Very much	22
		A little	7
		Not at all	1
2	What do you think is the impact of the implementation of this project on the local environment?	Reduce odor	20
		Improve water quality	6
		Reduce waste pollution	4
		none	0
3	What impact do you think the implementation of this project will have	improve the quality of surrounding environment	23

	on your life?	providing employment opportunities	4
		use of fertilizer as below market price	3
4	What do you think is the impact of the proposed project on local employment?	Positive	30
		Negative	0
		None	0
5	Do you think the proposed project will benefit the local economy?	Yes	29
		No	1
		No idea	0
6	In general, what is your attitude towards the Project construction?	Supportive	30
		Against	0
		Indifferent	0
7	Do you think other regions should also vigorously promote this type of project?	Yes	30
		No	0
		No idea	0

In general, local stakeholders are supportive of the project construction and operation. The survey shows that a majority of local stakeholders think the project will help improve the life of local people without much adverse environmental impact. The survey shows that almost the stakeholders are supportive to the proposed project, believing that the project will provide more employment opportunities and will improve villagers' income. Therefore, the implementation of the project is regarded as beneficial by most of the local stakeholders.

2.3 Environmental Impact

EIA of the Project has been approved by ecological environment Bureau of Santai County, Mianyang City. A short summary of the environmental impacts is presented below.

1. Strictly implement all environmental protection measures during the construction period

Control and reduce construction dust pollution in accordance with the relevant regulations of the State and Sichuan Province on air pollution prevention and control and the requirements set forth in the report form. Reasonable arrangement of construction time, control of construction noise, to ensure that noise does not disturb the public. The construction flushing wastewater is recycled after oil separation and precipitation. During the construction period, your unit shall control and reduce the construction dust pollution in accordance with the relevant regulations of the state and Sichuan Province on air pollution prevention and control and the requirements set forth in the report form. Reasonable arrangement of construction time, control of construction noise, ensure that live sewage utilization has facilities for treatment. The construction waste slag shall be promptly removed and transported to the site

designated by the local competent department for better construction, and shall not be dumped and stacked at will. After collection, the household waste shall be disposed of by the sanitation department. Do a good job of soil and water conservation in accordance with relevant requirements.

2. Strictly implement water pollution prevention and control measures during the operation period

Implement various wastewater pollution prevention and control measures: build rainwater interceptor trenches around the factory, improve the construction of "rain and pollution diversion" and "pollution diversion" pipe networks in the factory, and pre-dispose domestic sewage and ground washing wastewater through septic tanks.

3. Strictly implement air pollution prevention and control measures during the operation period

Implement all kinds of wastewater pollution prevention and application: the evil gas (NH_3 and H_2S) produced during the fermentation process and the emission of the gas must meet the emission limit requirements in the "Discharge Standard for Malodorous Pollutants" (GB14554-93). After the disposal of the dust generated from the straw crushing and screening process in the raw material workshop of the project by the air collecting army + cloth bag dust collector, the exhaust gas must meet the secondary standard of the Comprehensive Emission Standard of Air Pollutants (GB16297-1996) and the requirements of the unorganized emission limit; The baked degree gas (SO_2, NOX and smoke generation) produced in the drying process is disposed of by gravity sedimentation + alkali spray measures, and discharged through 15m high exhaust gas, and the exhaust gas emission must meet the standard limit requirements of the "Industrial Furnace dense Air Pollutant Emission Standard" (GB9078-1996). At the same time, according to the requirements of the report form, the boundary of the organic fertilizer plant is the starting point, and the health protection distance is set up with an extension of 100 meters. There are no sensitive buildings such as concentrated residential areas within this range.

4. Strictly implement the operation period noise pollution prevention measures

Strengthen internal management, grinder, mixer, granulator and other high-noise equipment, must optimize the layout, and take sound insulation, vibration and other measures, the factory boundary noise value must meet the "industrial enterprise factory boundary environmental noise emission standard" (GB12348-2008) 2 standard limits.

5. Strict implementation of solid waste disposal measures during the operation period

In strict accordance with the requirements of the report form, implement the prevention and control measures of solid waste pollution. The damaged semi-permeable membrane and waste packaging bags generated during the operation of the project are sold to the waste collection station. Waste pharmaceutical bottles shall be recycled by the original manufacturer. Domestic waste shall be uniformly removed, transported and disposed of by the sanitation department.

6. Implementing measures to prevent and control groundwater pollution

The project shall adopt zoning anti-seepage, and reliable and effective anti-seepage measures shall be taken in membrane fermentation yard, mixing workshop, organic fertilizer processing workshop, biological bacteria truck, septic tank, and other areas. Anti-seepage measures shall meet the requirements of anti-seepage technology in the Technical Guidelines for Environmental Impact Assessment Groundwater Environment (HJ610-2016). During the operation period, we should strengthen the daily overhaul, maintenance and management of the above key impermeable areas to avoid polluting groundwater and soil.

7. Strictly implement environmental risk prevention measures

The project shall implement safety production, strengthen material transport, storage and use measures. Improve the enterprise environmental risk emergency plan, strengthen the operation and maintenance management of various environmental protection facilities, and equip key equipment and spare parts with enough spare parts to ensure their stable and normal operation and avoid accidental emissions.

2.4 Public Comments

The project will be open for public comment on the VERRA website. The project shall be listed, and comments shall be incorporated later.

2.5 AFOLU-Specific Safeguards

The project is not an AFOLU project. Thus this section is not applicable to the project.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

The following methodology is applicable to the project activity.

AMS-III.F Avoidance of methane emissions through composting (Version 12.0)

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

For the baseline manure emissions, AMS-III.F (Version 12.0) refers to "AMS-III.D: Methane recovery in animal manure management systems" (Version 21.0)

Tool 03: " Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion (version 03.0)"

Tool 04: "Emissions from solid waste disposal sites (version 08.1)"

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

Tool 13: "Project and leakage emissions from composting" (Version 02.0)

Tool 21: "Demonstration of additionality of small-scale project activities" (Version 13.1)

For more detail information about the methodology and tools, please reference to the following link:

https://cdm.unfccc.int/methodologies/DB/NZ83KB7YHBIA7HL2U1PCNAOCHPUQYX

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

3.2 Applicability of Methodology

Justification for the ch shown in the following table:

AMS-III.F Avoidance of methane emissions through composting, version 12.0	
Applicability Criteria	**Justification**
1. This methodology is applicable to the composting of the organic fraction of municipal solid waste and biomass waste from agricultural or agro-industrial activities including manure.	The proposed project is designed to treat the cow, swine manure and biomass waste residue (straw) to produce the organic fertilizers through aerobic composting.
2. This methodology includes construction and expansion of treatment facilities as well as activities that increase capacity utilization at an existing facility. For project activities that increase capacity utilization at existing facilities, project participant(s) shall demonstrate that special efforts are made to increase the capacity utilization, that the existing facility meets all applicable laws and regulations, and that the existing facility is not included in a separate CDM project activity. The special efforts should be identified and described.	Not applicable. The project is a new facility and does not involve expansion of any existing facility.
3. This methodology is also applicable for co-composting wastewater and solid biomass waste, where wastewater would otherwise have been treated in an anaerobic wastewater treatment system without biogas recovery. The wastewater in the project scenario is used as a source of moisture and/or nutrients to the biological treatment process e.g., composting of empty fruit bunches (EFB), a residue from palm oil production, with the addition of palm oil mill	Not applicable. The project does not involve co–composting wastewater and solid biomass waste.

effluent (POME) which is the wastewater co-produced from palm oil production.	
4. In case of co-composting, if it cannot be demonstrated that the organic matter would otherwise been left to decay anaerobically, baseline emissions related to such organic matter shall be accounted for as zero, whereas project emissions shall be calculated according to the procedures presented in this methodology for all co-composted substrates.	Not applicable. This project activity does not involve co-composting
5. The location and characteristics of the disposal site of the biomass, animal manure and co-composting wastewater in the baseline condition shall be known, in such a way as to allow the estimation of its methane emissions, using the provisions of AMS-III.G, AMS-III.E (concerning stockpile), AMS-III.D "Methane recovery in animal manure management systems" or AMS-III.H respectively.	The location and characteristics of the disposal site of the animal manure and biomass in the baseline condition are well known[1]. The estimation of manure methane emissions as the latest version of AMS-III.D (Version 21.0) and the estimation of biomass methane emissions as the latest version of methodology tool 04 "Emission from solid waste disposal sites" (Version 08.1).
6. Blending materials may be added in the project scenario to increase the efficiency of the composting process (e.g., to achieve a desirable C/N ratio or free air space value), however, only monitored quantity of solid waste or manure or wastewater diverted from the baseline treatment system is used for emission reduction calculation. Project activities for composting of animal manure shall also meet the requirements under paragraphs 3 and 4(c) of the latest versions of AMS-III.D.	A small blending material i.e., bacterium agent decomposing agent is added in the process of composting, which will not be included in the emission reduction calculations. For this project, cow, swine manure as primary material is used for composting, therefore it meets the requirements under paragraphs 3 and 4(c) of the latest versions of AMS-III.D, please see text below at the end of this table.
7. For solid wastes diverted from a solid waste disposal site, the following requirement shall be checked ex ante at the beginning of each crediting period: (a) Establish that identified landfill(s)/stockpile(s) can be expected to accommodate the waste to be used for the project activity for the duration of the crediting period; or	Prior to the project, the biomass waste residue is left to decay anaerobically in SWDS, which is the common practice in the region[2]. The biomass waste residue used in this project is straw, which comes from the SWDS in Santai County. Also, according to the straw disposal agreement signed by the project owner and SWDS shows that the straw used in the project activity for the duration of the crediting period

[1] In the baseline case, cow, swine manure decays in the uncovered anaerobic pond located at the cow, swine farms in Santai County. Biomass waste residue (straw) decomposes in the SWDS located in Santai County.

[2] According to the FSR, the natural stacking technology simply stacks the straw for a long time, with little ventilation and management. It is an anaerobic fermentation technology. Due to its low investment and simple process, it has become a common treatment for straw.

(b) Establish that it is common practice in the region to dispose of the waste in solid waste disposal site (landfill)/stockpile(s).	can be accommodated by the SWDS. In addition, it is expected that disposal in SWDS would continue being the common practice in the region and this can be checked at the beginning of this fixed crediting period.
8.The project participants shall clearly define the geographical boundary of the region referred in paragraph 11(b), and document it in the CDM-PDD. In defining the geographical boundary of the region, project participants should take into account the source of the waste i.e., if waste is transported up to 50 km, the region may cover a radius of 50 km around the project activity. In addition, it should also consider the distance to which the final product after composting will be transported. In either case, the region should cover a reasonable radius around the project activity that can be justified with reference to the project circumstances but in no case, it shall be more than 200 km. Once defined, the region should not be changed during the crediting period(s).	The waste being used in the project activity is manure (cow, swine) and biomass waste residue (straw). The manure used in this project comes from local cow, swine farms in Santai County, which is less than 50 km from the project site[3]. Similarly, the biomass waste residue (straw) is sourced from the SWDS in Santai County, which is also within a radius of 50 km[3]. A portion of the organic fertilizer obtained is sold to the local government for improving the quality of local high-standard farmland, and another portion is sold to local farmers, farmer cooperatives and businesses. Therefore, it is only transported within Mianyang City , with a radius of no more than 200 km[4].
9. In case produced compost is handled aerobically and submitted to soil application, the proper conditions and procedures (not resulting in methane emissions) must be ensured.	The compost produced will be used as fertilizer for the soil. The compost will be applied to the soil similarly to the way used for chemical fertilizers. The low agglutination of the compost and the short time needed to apply it ensure that there is not enough time available to develop anaerobic conditions. Therefore, the proper conditions and procedures (not resulting in methane emissions) can be ensured.
10. In case produced compost is treated thermally/mechanically, the provisions in AMS-III.E related to thermal/mechanical treatment shall be applied.	This project activity does not involve thermal/mechanical treatment to the compost once it is produced.
11. In case produced compost is stored under anaerobic conditions and/or delivered to a	The project activity will involve storage in aerobic conditions and kept in packed bags

[3] All raw materials are sourced from Santai County, according to Google Maps, where the farthest distance from the project site is about 16 kilometers from the cow farm and 28 kilometers from the swine farm, and the SWDS where the biomass waste residue (straw) is located is about 29 kilometers from the project site.

[4] Organic fertilizer products are only sold in Mianyang City. According to Google Maps, the farthest distance between the project site and the sales company is about 130 kilometers, so the sales radius is less than 200 kilometers.

landfill, emissions from the residual organic content shall be taken into account and calculated as per the latest version of the methodological tool "Emissions from solid waste disposal sites".	for a limited period before it is applied by the user. Thus, the project does not involve storage of produced compost in an anaerobic condition, nor would it be delivered back to landfill.

Further information on applicability conditions of the requirements under paragraphs 3 and 4(c) of the latest version of AMS-III.D. is provided below:

AMS-III.D. Methane recovery in animal manure management systems, Version 21.0	
Applicability Criteria	**Justification**
This methodology is only applicable under the following conditions: (a) The livestock population in the farm is managed under confined conditions; (b) Manure or the streams obtained after treatment are not discharged into natural water resources (e.g. river or estuaries), otherwise "AMS-III.H Methane recovery in wastewater treatment" shall be applied; (c) The annual average temperature of baseline site where anaerobic manure treatment facility is located is higher than 5°C; (d) In the baseline scenario the retention time of manure waste in the anaerobic treatment system is greater than one month, and if anaerobic lagoons are used in the baseline, their depths are at least 1 m; (e) No methane recovery and destruction by flaring or combustion for gainful use takes place in the baseline scenario.	(a) The manure used to produce organic fertilizer comes from local cow and swine farms in Santai County. All cow and swines are managed under confined conditions[5], which can be confirmed during the field visits. (b) The manure is dumped into open anaerobic lagoons and it is prohibited to discharge into any natural water resources without treatment according to Regulations on Prevention and Control of Pollution from Livestock and Poultry Farming[6]. (c) The annual average ambient temperature at the site is 16.7°C[7], which is higher than 5°C. (d) The minimum retention time of manure waste in the open anaerobic lagoons is not less than 45 days, i.e., at least 60 days in the baseline scenario and the open anaerobic lagoons considered in the baseline scenario are designed for deep storage and has a depth of 3-5 meters in accordance with the" design code for wastewater stabilization ponds (GJJ/T54-93)". (e) Prior to the implementation of the project, the cow and swine manure waste was left to decay in anaerobic manure management system (uncovered open lagoon) at the livestock farms and methane is emitted to the

[5] http://mymxkj.com/
[6] http://www.gov.cn/zwgk/2013-11/26/content_2534836.htm
[7] http://wap.tcmap.com.cn/sichuan/santai.html

	atmosphere directly without any methane recovery and destruction facility.
The project activity shall satisfy the following conditions: The storage time of the manure after removal from the animal barns, including transportation, should not exceed 45 days before being fed into the anaerobic digester. If the project proponent can demonstrate that the dry matter content of the manure when removed from the animal barns is larger than 20%, this time constraint will not apply.	The cow and swine manure used in this project is transported directly from the farms to the project site in a special tank vehicle in a sealed manner, and the manure at the project site is not stored to enter the mixing and fermentation workshop directly, so the storage time of the manure does not exceed 45 days.

Tool 03: "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion (version 03.0)"	
This tool provides procedures to calculate project and/or leakage CO_2 emissions from the combustion of fossil fuels. It can be used in cases where CO_2 emissions from fossil fuel combustion are calculated based on the quantity of fuel combusted and its properties. Methodologies using this tool should specify to which combustion process j this tool is being applied.	This project may consume fossil fuel during the composting process.

Tool 04: "Emissions from solid waste disposal sites (version 08.1)"	
The tool can be used to determine emissions for the following types of applications: Application A: The CDM project activity mitigates methane emissions from a specific existing SWDS. Methane emissions are mitigated by capturing and flaring or combusting the methane (e.g., "ACM0001: Flaring or use of landfill gas"). The methane is generated from waste disposed in the past, including prior to the start of the CDM project activity. In these cases, the tool is only applied for an ex-ante estimation of emissions in the project design document (CDM-PDD). The emissions will then	The proposed project is designed to treat the livestock manure and biomass waste to produce the organic fertilizers through aerobic composting; therefore, it belongs to (b), Application B is applicable for this project.

be monitored during the crediting period using the applicable approaches in the relevant methodologies (e.g., measuring the amount of methane captured from the SWDS); Application B: The CDM project activity avoids or involves the disposal of waste at a SWDS. An example of this application of the tool is ACM0022, in which municipal solid waste (MSW) is treated with an alternative option, such as composting or anaerobic digestion, and is then prevented from being disposed of in a SWDS. The methane is generated from waste disposed or avoided from disposal during the crediting period. In these cases, the tool can be applied for both ex ante and ex post estimation of emissions. These project activities may apply the simplified approach detailed in 0 when calculating baseline emissions.	
These two types of applications are referred to in the tool for determining parameters	Several parameters in the calculation of baseline emissions use the default values provided in application B of Tool 04: "Emissions from solid waste disposal sites (version 08.1)".
In the case that: (a) different types of residual waste are disposed or prevented from disposal; or that (b) both MSW and residual waste(s) are prevented from disposal, then the tool should be applied separately to each residual waste and to the MSW.	All of the livestock manure and biomass waste used in the proposed project is used for composting. Therefore, there is no residual waste with MSW.
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: 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	All the electricity used by the project will be from Central China Power Grid (CCPG)[8], which falls under scenario A of Tool 05 (Version 03.0). Therefore, emissions related to electricity consumption need to be calculated based on Tool 05.

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

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; Scenario B: Electricity consumption from(an) off-grid fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants are installed at the site of the electricity consumer and supply the consumer with electricity. The captive power plant(s) is/are not connected to the electricity grid; or(c) Scenario C: Electricity consumption from the grid and (a) fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants operate at the site of the electricity consumer. The captive power plant(s) can provide electricity to the electricity consumer. The captive power plant(s) is/are also connected to the electricity grid. Hence, the electricity consumer can be provided with electricity from the captive power plant(s) and the grid.	
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.	Not relevant. This methodological tool is applied for calculating for emission by electricity consumption in project activity. The proposed project does not generate electricity, So, this criterion is not applicable.
This tool is not applicable in cases where captive renewable power generation technologies are installed to provide electricity in the project activity, in the baseline scenario or to sources of leakage. The tool only accounts for CO_2 emissions.	Not relevant. No captive renewable power generation technologies will be installed to provide electricity in the Project. This criterion is not relevant.

Tool 13: "Project and leakage emissions from composting (version02.0)"	
Typical applications of the tool include projects composting municipal solid wastes, agricultural wastes and digestate.	Applicable. The proposed project is designed to treat the cow, swine manure and biomass waste (straw) to produce the organic fertilizers through aerobic composting.
The following sources of project emissions are accounted for in this tool: (a) CH_4 and N_2O emission from composting; (b) CO_2 emissions from consumption of fossil fuels and electricity associated with composting; (c) CH_4 emissions from run-off wastewater associated with co-composting.	(a) CH_4 and N_2O emission from composting are accounted. (b) CO_2 emissions from consumption of fossil fuels and electricity associated with composting are accounted. (c) This project is not involving co-composting, therefore, no CH_4 emissions from run-off wastewater is generated.
The following source of leakage emissions is accounted for in this tool: (a) CH_4 emissions from the anaerobic decay of the residual organic content of compost disposed of in a landfill or subjected to anaerobic storage.	The compost and waste are stored in aerobic condition, not anaerobic condition. Therefore, leakage is not accounted.
Transport emissions are not accounted for in this tool because it is assumed that similar transportation activities would occur in the baseline.	Transport emissions are not accounted.
The applicability conditions of the tools referred below also apply.	The tools referred by this project is listed in above tables. This project involves composting of manure and biomass residue through controlled aerobic treatment. No greenhouse gas produced during in the process of composting. Therefore, "Tool to determine the mass flow of a greenhouse gas in a gaseous Stream (version 03.0)" are not applicable for this project.

Tool 21: "Demonstration of additionality of small-scale project activities (version13.1)"	
This methodological tool provides a general	The proposed project is designed to treat the

framework for demonstrating and assessing additionality and is applicable to a wide range of project types.	livestock manure and biomass waste to produce the organic fertilizers through aerobic composting. The applied methodology is AMS-III.F, as per applied methodology, the demonstration of additionality should apply this tool.
In validating the application of this methodological tool, Designated Operation Entities (DOEs) shall carefully assess and verify the reliability and credit ability of all data, rationales, assumptions, justifications and documentation provided by project participants to support the demonstration of additionality. The elements checked during this assessment and the conclusions shall be documented transparently in the validation report.	All the data, rationales, assumptions, justifications and documentation will be provided by project participants to VVB to support the demonstration of additionality in validating the application of this methodological tool, and the elements checked during this assessment and the conclusions has been documented transparently in the validation report.
The use of the methodological tool " Demonstration of additionality of small-scale project activities" is not mandatory for project participants when proposing new methodologies. Project participants and coordinating/managing entities may propose alternative methods to demonstrate additionality for consideration by the Executive Board.	Project participants will not proposing new methodologies and will not propose alternative methods to demonstrate additionality. PP use this tool to demonstration the additionality of the proposed project.
Project participants and coordinating/managing entities may also apply "TOOL19: Demonstration of additionality of microscale project activities" as applicable.	The proposed is a small-scale project not a microscale project, therefore, Tool 19 cannot be used to prove the additionality of this project activity.

3.3 Project Boundary

According to methodology AMS-III.F., version 12.0, the project boundary applicable to the proposed project activity is the physical geographical site:

No.	Methodology requirement	Project activity
a	Where the solid waste would have been disposed and the methane emission occurs in absence of the proposed project activity;	Included. The project involves livestock manure and biomass waste residue for composting. All manure waste produced was left to decay in uncovered anaerobic lagoons and the biomass waste had been left to decay

		anaerobically in a solid waste disposal site (SWDS) prior to the project.
b	In the case of projects co-composting wastewater, where the co-composting wastewater would have been treated anaerobically in the absence of the project activity;	The project does not involve co-composting wastewater.
c	Where the treatment of biomass through composting takes place;	Included, composting plant, i.e., the project site.
d	Where the products from composting (compost) is handled, disposed, submitted to soil application, or treated thermally/mechanically;	Included, fields where compost will be used as fertilizers for soil application.
e	And the itineraries between them (a, b, c and d) where the transportation of waste,wastewater, where applicable manure, product of treatment (compost) occurs.	Included, Transportation of waste to the project site and transportation of composting for soil application.

The project activity boundary is defined as Figure 3-1 below.

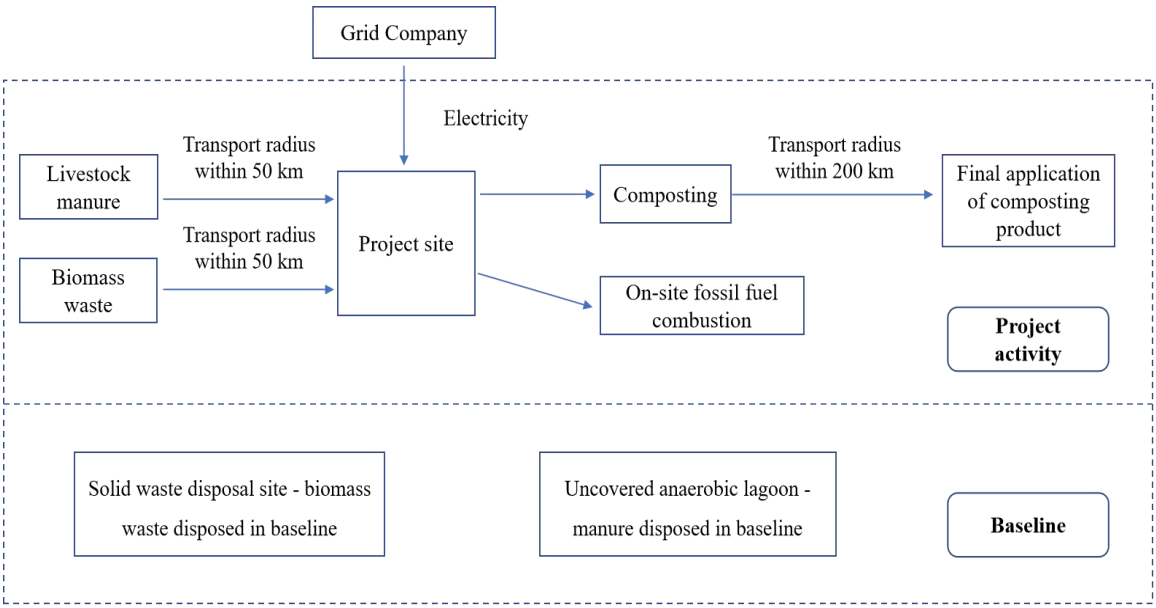

Figure 3-1 The project boundary of the project

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

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

Source		Gas	Included?	Justification/Explanation
Baseline	Biomass disposed in solid waste	CO_2	No	CO_2 emissions from the decomposition of organic waste are not accounted.
		CH_4	Yes	The major source of emissions in the baseline.
		N_2O	No	Excluded for simplification. This is conservative.
	Manure disposed in uncovered anaerobic lagoon	CO_2	No	CO_2 emissions from the decomposition of organic waste are not accounted.
		CH_4	Yes	The major source of emissions in the baseline.
		N_2O	No	Excluded for simplification. This is conservative.
Project	Emissions from transport	CO_2	No	According to Tool 13 "project and leakage emission from composting (version 02.0)", transport emission is not accounted.
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.
	Emissions from on-site electricity use	CO_2	Yes	an important emission source since the electricity consumed by the project is from the grid company.
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.
	Emission from fossil fuel consumption	CO_2	Yes	an important emission source since fossil fuel can be used by the project.
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.
	Emissions from composting processes	CO_2	No	Excluded for simplification.
		CH_4	Yes	May be an important emission source.
		N_2O	Yes	May be an important emission source.
	Emissions from run-off	CO_2	No	Excluded. The project is not involving co-composting.
		CH_4	No	Excluded. The project is not involving co-composting.

Source		Gas	Included?	Justification/Explanation
	water	N_2O	No	Excluded. The project is not involving co-composting.

3.4 Baseline Scenario

According to AMS-III.F Avoidance of methane emissions through composting, version 12.0, the baseline scenario is the situation where, in the absence of the project activity, biomass and other organic matter (including manure where applicable) are left to decay within the project boundary and methane is emitted to the atmosphere.

For the proposed project, livestock manure and biomass waste residue are used for composting. In absence of the project, all manure waste was disposed in uncovered anaerobic lagoons in cow and swine farms, and the biomass waste residue (straw) had been left to decay anaerobically in a solid waste disposal site (SWDS) and methane is emitted to the atmosphere.

3.5 Additionality

Section 3.14 in VCS standard (V4.5) states that "A project activity is additional if it can be demonstrated that the activity results in emission reductions or removals that are in excess of what would be achieved under a 'business as usual' scenario and the activity would not have occurred in the absence of the incentive provided by the carbon markets". Moreover, Section 3.14.2 clearly mandates that "Additionality shall be demonstrated and assessed in accordance with the requirements set out in the methodology applied to the project".

The applied methodology of this project is AMS-III.F. "Avoidance of methane emissions through composting " (Version 12.0), as per paragraph 18 in the applied methodology, Project participants shall apply the general guidelines for the SSC CDM methodologies and the Tool for demonstration of additionality of SSC project activities available at http://cdm.unfccc.int/Reference/index.html, so the additional analysis should be based on the Tool 21 "Demonstration of additionality of small-scale project activities" (version 13.1).

According to the Tool 21, project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

(a) Investment barrier: a financially more viable alternative to the project activity would have led to higher emissions.

(b) Technological barrier: a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions.

(c) Barrier due to prevailing practice: prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions.

(d) Other barriers: without the project activity, for another specific reason identified by the project participant, such as institutional barriers or limited information, managerial resources, organizational capacity, financial resources, or capacity to absorb new technologies, emissions would have been higher.

Project participant has opted to demonstrate the additionality of the project by option a): investment barrier, which is discussed below:

As per Tool 21: Project participant may like to refer to "Non-binding best practice examples to demonstrate additionality for SSC project activities". As per described in "Non-binding best practice examples to demonstrate additionality for SSC project activities", Best practice examples include but are not limited to, the application of investment comparison analysis using a relevant financial indicator, application of a benchmark analysis or a simple cost analysis (where CDM is the only revenue stream such as end-use energy efficiency). It is recommended to use national or global accounting practices and standards for such an analysis.

As the application of investment comparison analysis using a relevant financial indicator is only applicable when alternatives are also an investment project. However, the alternative baseline of this project is not a new investment project, so the investment comparison analysis using a relevant financial indicator is not appropriate.

As this project activity will have revenue by sales of composting products and VCUs, so a simple cost analysis is not appropriate.

In conclusion, the benchmark analysis should be carried out, and IRR is identified as the financial indicator for the benchmark analysis.

There is no benchmark for composting industry. The production of organic fertilizer and chemical fertilizers belongs to fertilizer manufacturing industry as per Industrial classification for national economic activities (GB/T 4754—2017)[9] . Therefore, according to the "Notice on adjusting financial benchmark rate of return of construction projects in some industries" issued by NDRC and Ministry of Housing and Urban-Rural Development of PRC in 2013[10], the benchmark of total investment financial internal rate of return (IRR) of chemical fertilizers production (after tax) is 10%[11].

(a) Basic parameters

item	value	source
Annual Organic waste treatment quantity	149,000 t	FSR
Annual organic fertilizers sales	50,000t	FSR
Sales Price of organic fertilizers	640 RMB/t	FSR
Total static investment	7,475.50*10^4RMB	FSR

[9] http://www.stats.gov.cn/xxgk/tjbz/gjtjbz/201710/t20171017_1758922.html
[10] https://www.ndrc.gov.cn/fggz/gdzctz/tzfg/201907/t20190729_1197578.html?code=&state=123
[11] https://www.ndrc.gov.cn/fggz/gdzctz/tzfg/201907/W020191104862129391071.pdf

O&M cost	2,427.40 *10^4RMB	FSR
Operation period	18 years	FSR
Emission reductions	58,686 tCO_2e	Calculated
Price of VUCs	50 RMB/tCO_2e	Expected

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

Without income from selling VCUs, the IRR of the proposed project is 5.02%, lower than the benchmark IRR 10% and the proposed project is financially unacceptable because of its low profitability. While considering such income, the IRR of the proposed project is 10.36%, higher than the benchmark, and the proposed project is financially acceptable.

item	Without income from VCUs	Benchmark IRR	With income from VCUs
The Project IRR	5.02%	10%	10.36%

Sensitivity analysis

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

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

- Total static Investment
- Annual organic fertilizers sales
- O&M cost

The variation range of -10%~10% which was employed in the FSR. The results of sensitivity analysis of the three parameters of the proposed project are shown in the table 3-2:

Table 3-2 Sensitivity analysis of the Anaerobic Digester-Aerobic Treatment（10^4 RMB）

item	-10%	-5%	0%	5%	10%
Total static investment	6.40%	5.68%	5.02%	4.40%	3.82%
Annual organic fertilizers sales	-0.33%	2.53%	5.02%	7.27%	9.37%
O&M cost	8.44%	6.78%	5.02%	3.11%	1.03%

The sensitivity analysis was further conducted, and the project IRR (after tax) could reach the benchmark of 10% if one of the following conditions can be achieved:

- Total static investment: decrease about 29.85%.
- Annual organic fertilizers sales: increase about 11.58%.
- O&M cost: decrease about 14.95%.

Since all the data used for the investment analysis was sourced from the FSR. Therefore, the data used in the investment analysis are believed to be reliable and credible and none of above conditions can be achieved.

Total static investment decreasing about 29.85%: According to the publicly latest available sources, on the whole, the price indices for steel, fuel, power and construction materials and price indices for fixed asset investment in China have been increasing in the past years. In addition, the project has now been completed and according to the equipment procurement contract, the engineering construction contract and the statistical list of project contracts, the actual investment in the project has amounted to 75.1535 million RMB, exceeding the total static investment by 74.7550 million RMB. As a result, the IRR cannot increase to the benchmark through decreasing the total static investment.

Annual organic fertilizers sales increasing about 11.58%: the organic fertilizers are produced through the aerobic composting system, and the yield is determined by the quantity of organic waste and the production capacity of the composting system. Since the disposal amount of waste and the capacity of the composting system will stay stable in the future, so, the output of organic fertilizer is also stable. In addition, the organic fertilizer is sold to local agricultural company and fertilizer marketing company, long-term contracts are signed with the fixed price. Therefore, the increase of annual organic fertilizers sales to threshold is impossible to achieve.

O&M cost decreasing about 14.95%: However, the decrease of it is not likely to occur. The annual O&M cost of the project includes Maintenance expense, Salary, Welfare, Labor insurance expense. Housing fund expense, insurance expense, raw materials and other cost. Based on “China National Statistical Yearbook, 2021”, the average salary of people employed kept rising from 2018 to 2021 (from 49,575 RMB to 6,2884RMB), the purchase price index of raw materials from 2018 to 2021 was 111.00. Moreover, the equipment will be getting more and more with the abrasion, which means the maintenance cost will be increasing in the coming years. As a result, the drastic decreasing of 14.95% in O&M cost is not realistic.

As shown in the sensitivity analysis above, the project IRR (after tax) will not reach the benchmark of 10% within reasonable fluctuation range, and the fluctuation scenario of the uncertain factors which could make the proposed project financially feasible is unlikely to occur. Therefore, the conclusion regarding the infeasibility of the proposed project is robust to reasonable variations of the critical assumptions.

Conclusion of the assessment and demonstration of additionality

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

3.6 Methodology Deviations

There is no methodology deviation for the project.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

As per para.23 of applied methodology, the baseline emissions are the amount of methane emitted from the decay of the degradable organic carbon in the biomass solid waste or manure. When wastewater is co-composted, baseline emissions include emissions from wastewater co-composted in the project activity. The yearly Methane Generation Potential for the solid waste is calculated using the first order decay model as described in the latest version of the methodological tool "Emissions from solid waste disposal sites". Baseline emissions from the manure composted are calculated as per the procedures of AMS-III.D. Where bedding material is used in the baseline/project activity, the calculation shall be based on the method of paragraph 16(a) (i.e., based on animal population) of AMS-III.D (ver. 21.0). Where no bedding material is used in baseline/project activity, any of the methods provided in paragraph 16(a) and 16(b) of AMS-III.D may be used.

As per paragraph 24 of the applied methodology,

Baseline emissions are:

$$BE_y = BE_{CH4,SWDS,y} + BE_{ww,y} + BE_{CH4,\text{manure,y}} - MD_{y,\text{reg}} \times GWP_{CH4} \quad \text{(Equation 1)}$$

where:

BE_y	Baseline emissions in the year y (t CO_2e)
$BE_{CH4,SWDS,y}$	Yearly methane generation potential of the solid waste composted by the project activity during the years x from the beginning of the project activity (x=1) up to the year y estimated as per the latest version of the methodological tool "Emissions from solid waste disposal sites" (t CO_2e). The tool may be used with the factor "f=0.1" taking into account the methane oxidation effect by the upper layer of the landfill. With the definition of year x

as 'the year since the project activity started diverting wastes from landfill disposal, x runs from the first year of crediting period (x=1) to the year for which emissions are calculated (x=y)'

$MD_{y,reg}$ Amount of methane that would have to be captured and combusted in the year y to comply with the prevailing regulations (tonnes)

$BE_{CH4,manure,y}$ Where applicable, baseline emissions from manure composted by the project activities, as per the procedures in AMS-III.D (t CO_2e)

$BE_{ww,y}$ Where applicable, baseline emissions from the wastewater co-composted, calculated as per the procedures in AMS-III.H (t CO_2e)

GWP_{CH4} Global Warming Potential for CH_4 applicable to the crediting period (t CO_2e/t CH_4)

For this project, the cow, swine manure and biomass waste residue (straw) are used for composting, not involving co-composting. And no bedding material is used. So the $BE_{ww,y}$=0t CO_2e. In addition, as no-regulation requirements specify the amount or methane that should be captured or combusted, therefore $MD_{y,reg}$=0. So, $BE_y=BE_{CH4,SWDS,y}+ BE_{CH4,manure,y}$

1) Baseline CH_4 emissions ($BE_{CH4,SWDS,y}$)-Biomass waste residue

According to Methodology Tool 04 "Emissions from solid waste disposal sites (version 08.1)" and the analysis in section 3.2, the proposed project type is Application B: The CDM project activity avoids or involves the disposal of waste at a SWDS. An example of this application of the tool is ACM0022, in which municipal solid waste (MSW) is treated with an alternative option, such as composting or anaerobic digestion, and is then prevented from being disposed of in a SWDS. The methane is generated from waste disposed or avoided from disposal during the crediting period. In these cases, the tool can be applied for both ex ante and ex post estimation of emissions. These project activities may apply the simplified approach detailed in 0 when calculating baseline emissions.

$$BE_{CH4,SWDS,y} = \varphi_y \times (1 - f_y) \times GWP_{CH4} \times (1 - OX) \times \frac{16}{12} \times F \times DOC_{f,y} \times MCF_y \times \sum_{x=1}^{y} \sum_j (W_{j,x} \times DOC_j \times e^{-kj \times (y-x)} \times (1 - e^{-kj})) \quad \text{(Equation 2)}$$

where:

$BE_{CH4,SWDS,y}$ Baseline emissions occurring in year y generated from waste disposal at a SWDS during a time period ending in year y (t CO_2e/yr)

X Years in the time period in which waste is disposed at the SWDS, extending from the first year in the time period (x = 1) to year y (x = y)

Y Year of the crediting period for which methane emissions are calculated (y is a consecutive period of 12 months)

$DOC_{f,y}$	Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year y (weight fraction)
$W_{j,x}$	Amount of solid waste type j disposed or prevented from disposal in the SWDS in the year x (t)
φ_y	Model correction factor to account for model uncertainties for year y
F_y	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year y
GWP_{CH4}	Global Warming Potential of methane
OX	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
F	Fraction of methane in the SWDS gas (volume fraction)
MCF_y	Methane correction factor for year y
DOC_j	Fraction of degradable organic carbon in the waste type j (weight fraction)
k	Decay rate for the waste type j (1 / yr)
j	Type of residual waste or types of waste in the MSW

Determining the model correction factor (φ_y)

φ_y is used for baseline calculation, and Option 1: Use a default value is chosen. $\varphi_y = \varphi_{default}$.

For the calculation of baseline emissions from the project activity Application B is chosen due to the following reason as per the methodological tool:

The project activity involves treating the biomass waste residue and preventing it from being disposed in solid waste disposal sites; and the methane that would have been generated is avoided from SWDS during the crediting period. As the proposed project is located in Santai County, Mianyang City, Sichuan Province and the climate in Santai is a subtropical humid monsoon climate, also, the annual average precipitation in Santai County is 822.2mm, and the annual average evaporation is 1045.0 mm[12], so the climate of the project site is dry. Therefore, the value of default is 0.80.

Determining the amounts of waste types j disposed in the SWDS ($W_{j,x}$)

Where different waste types j are disposed or prevented from disposal in the SWDS (for example, in the case of MSW), it is necessary to determine the amount of different waste types ($W_{j,x}$ or $W_{j,i}$). In the case that only one type of waste is disposed (for example, in the case of a

[12] http://www.santai.gov.cn/yxst/stnj/2014nstnj/17605511.html

residual waste), then $W_{j,x} = W_x$ and $W_{j,i} = W_i$ and the following procedures do not need to be applied (e.g. waste sampling is not required).

For this project, the biomass waste residue used for composting is straw, which belongs to wood, so only one type biomass waste residue is used for composting, therefore waste sampling is not required, $W_{j,x} = W_x$

Determining the fraction of DOC that decomposes in the SWDS ($DOC_{f,y}$)

The default value ($DOC_{f,y} = DOC_{f,default}$) is chosen for the proposed project.

Procedure to determine the methane correction factor (MCF_y)

A default value ($MCF_y = MCF_{default}$) is chosen for the proposed project, which is provided in the section "Data and parameters available at validation" below.

2) Baseline emissions from manure ($BE_{CH4,manure,y}$)-animal manure

As per paragraph 17 of "AMS-III.D: Methane recovery in animal manure management systems", version 21.0, Baseline emissions ($BE_{CH4,y}$) are calculated by using one of the following two options:

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

produced by the livestock and the maximum amount of methane that can be potentially produced from that manure (B_o);

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

The project applies option (b) to calculate baseline emissions from the manure treatment processes ($BE_{CH4,y}$).

$$BE_{CH4,manure,y} = GWP_{CH4} * D_{CH4} * UF_b * \sum_{j,LT} (MCF_j * B_{O,LT} * Q_{manure,j,LT,y} * SVS_{j,LT,y}$$

(Equation 3)

where:

$BE_{CH4,manure,y}$ Baseline CH_4 emissions in year y (t CO_2e)

$Q_{manure,j.LT,y}$	Quantity of manure treated from livestock type LT and animal manure management system j (tonnes/year, dry basis)
$SVS_{j,LT,y}$	Specific volatile solids content of animal manure from livestock type LT and animal manure management system j in year y (tonnes/tonnes, dry basis)
GWP_{CH4}	Global Warming Potential (GWP) of CH_4 applicable to the crediting period (t CO_2e/t CH_4)
D_{CH4}	Density of CH_4 (0.00067t/m^3 at room temperature(20℃) and 1am pressure)
MCF_j	Annual methane conversion factor (MCF) for the baseline animal manure management system j
$B_{o,LT}$	Maximum methane producing potential of the volatile solid generated by animal type LT (m^3CH_4/kg -dm)
UF_b	Model correction factor to account for model uncertainties (0.94)

Estimation of various variables and parameters for above equations:

(a) Maximum methane producing potential ($B_{o,LT}$)

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

There are no specific B_o values in China, and the proposed project is located in Santai County, Mianyang City, Sichuan Province, China, Asia. According to Table 10A-4 and 10A-5, Table 10A-7 and 10A-8 of IPCC 2006 Guidelines for National Greenhouse Gas Inventories volume 4, chapter 10, the maximum methane producing potential ($B_{o,LT}$) for poultry in developing county cow manure is 0.13 m^3 CH_4/kg-dm and swine manure is 0.29 m^3 CH_4/kg-dm.

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

The MCF_j values given in Table 10.17, chapter 10, volume 4, IPCC 2006 Guidelines should be used. MCF_j values depend on the site annual average temperature is taken from official data at the nearest meteorological station, or from data available from historical on-site observations. For this project, the annual average temperature is 16.7℃ and the value of 75% is applied.

Specific volatile solids ($SVS_{j,LT,y}$)

The Specific volatile solids ($SVS_{j,LT,y}$) value of cow manure is 65%, swine manure is 60%. Which sourced from FSR is used for ex-ante calculation. As $SVS_{j,LT,y}$ is a monitored parameter, so, during the monitoring period, the actual $SVS_{j,LT,y}$ will be determined according to the guideline in annex 2 of AM0073.

4.2 Project Emissions

As per applied methodology, Project emissions from composting process (PE_y) shall be determined as per the Methodology Tool 13:" Project and leakage emissions from composting (Version 02.0)". PE_y is equivalent to parameter $PE_{COMP,y}$ in the tool.

As per paragraph 13 in Tool 13, Project emissions are estimated as follows:

$$PE_y = PE_{COMP,y} = PE_{EC,y} + PE_{FC,y} + PE_{CH4,y} + PE_{N2O,y} + PE_{RO,y} \quad \text{(Equation 4)}$$

Where：

$PE_{COMP,y}$	Project emissions associated with composting in year y (t CO_2e/yr)
$PE_{EC,y}$	Project emissions from electricity consumption associated with composting in year y (t CO_2/yr)
$PE_{FC,y}$	Project emissions from fossil fuel consumption associated with composting in year y (t CO_2/yr)
$PE_{CH4,y}$	Project emissions of methane from the composting process in year y (t CO_2e/yr)
$PE_{N2O,y}$	Project emissions of nitrous oxide from the composting process in year y (t CO_2e/yr)
$PE_{RO,y}$	Project emissions of methane from run-off wastewater associated with co-composting in year y (t CO_2e/yr)

1) Project emissions from electricity consumption associated with composting in year y ($PE_{EC,y}$)

The electricity used in this project comes from regional power grid, i.e., Central China Power Grid, $PE_{EC,y}$ shall be calculated using the Tool 05 "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation".

$$PE_{EC,y} = \sum_{j,LT} EC_{PJ,J,y} * EF_{EF,j,y} * (1 + TDL_{j,y}) \quad \text{(Equation 5)}$$

Where：

$PE_{EC,y}$	Project emissions from electricity consumption in year y (t CO_2e)
$EG_{PJ,J,y}$	Quantity of electricity consumed by the project electricity consumption source j in year y (MWh/yr)

$EF_{EF,j,y}$ Emission factor for electricity generation for source j in year y (t CO_2e/MWh)

$TDL_{j,y}$ Average technical transmission and distribution losses for providing electricity to source j in year y

2) Project emissions from fossil fuel consumption associated with composting in year y ($PE_{FC,y}$)

Where the composting activity involves fossil fuel consumption, project participants may choose between the following two options to calculate $PE_{FC,y}$:

Option 1: Procedure using monitored data

$PE_{FC,y}$ shall be calculated using the latest approved version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion", where the project emission source j referred to in the tool is composting.

Option 2: Procedure using a default value

Project emissions from fossil fuel consumption associated with composting are calculated as follows:

$$PE_{FC,y} = Q_y * EF_{FC,default} \quad \text{(Equation 6)}$$

Where：

$PE_{FC,y}$ Project emissions from fossil fuel consumption associated with composting in year y (t CO_2e/ yr)

Q_y Quantity of waste composted in year y (t/yr)

$EF_{FC,default}$ Default emission factor for fossil fuels consumed by the composting activity per tonne of waste (t CO_2e/t)

The project applies option (1) to calculate project emissions from fossil fuel consumption associated with composting ($PE_{FC,y}$).

As per methodology Tool 03 "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion (Version 03.0)", CO_2 emissions from fossil fuel combustion in process j are calculated based on the quantity of fuels combusted and the CO_2 emission coefficient of those fuels, as follows:

$$PE_{FC,j,y} = \sum_i FCi,j,y \times NCV_{i,y} \times EF_{CO2,i,y} \quad \text{(Equation 7)}$$

Where：

$PE_{FC,j,y}$ the CO_2 emissions from fossil fuel combustion in process j during the year y (t CO_2/yr)

$FC_{i,j,y}$	the quantity of fuel type i combusted in process j during the year y (mass or volume unit/yr)
$NVC_{i,y}$	the weighted average net calorific value of the fuel type j in year y (GJ/mass or volume unit)
$EF_{CO2,i,y}$	the weighted average CO_2 emission factor of fuel type i in year y (t CO_2/GJ)

3) Project emissions of methane from the composting process in year y ($PE_{CH4,y}$)

$$PE_{CH4,y} = Q_y * EF_{CH4,y} * GWP_{CH4} \quad \text{(Equation 8)}$$

Where：

$PE_{CH4,y}$	Project emissions of methane from the composting process in year y (t CO_2e/yr)
Q_y	Quantity of waste composted in year y (t /yr)
$EF_{CH4,y}$	Emission factor of methane per tonne of waste composted valid for year y (t CH_4/t)
GWP_{CH4}	Global Warming Potential of CH_4 (t CO_2e/t CH_4)

Determining parameter of $EF_{CH4,y}$

There are two options which project participants may choose for determining $EF_{CH4,y}$.

Option 1: Procedure using monitored data

$EF_{CH4,y}$ is determined based on measurements of the methane emissions during a composting cycle ($ECC_{CH4,c}$), as follows:

$$EF_{CH4,y} = \frac{\sum_{C=1}^{x} ECC_{CH4}/Q_C}{x} \quad \text{(Equation 9)}$$

Where:

$EF_{CH4,y}$	Emission factor of methane per tonne of waste composted valid for year y (t CH_4/t)
$ECC_{CH4,c}$	Methane emissions from composting during the composting cycle c (t CH_4)
Q_y	Quantity of waste composted in composting cycle c (t)
C	Composting cycles for which measurements were undertaken
X	Number of composting cycles c for which emissions were measured in year y (at least three)

Option 2: Procedure using default values

A default value is used: $EF_{CH4,y}$= $EF_{CH4,default}$. The default value is provided in the "Data and parameters not monitored" section of this tool.

For this project, default value for $EF_{CH4,y}$ is adopted, which is listed in the "Data and parameters available at validation" section.

4) Project emissions of nitrous oxide from the composting process ($PE_{N2O,y}$)

$$PE_{N2O,y} = Q_y * EF_{N2O,y} * GWP_{N2O} \quad \text{(Equation 10)}$$

Where:

$PE_{N2O,y}$	Project emissions of nitrous oxide from composting in year y (t CO_2e/yr)
Q_y	Quantity of waste composted in year y (t/yr)
$EF_{N2O,y}$	Emission factor of nitrous oxide per tonne of waste composted valid for year y (t N_2O/t)
GWP_{N2O}	Global Warming Potential of N_2O (t CO_2e/t N_2O)

Determining parameter of $EF_{N2O,y}$

There are two options which project participants may choose for determining $EF_{N2O,y}$:

Option 1: Procedure using monitored data

$EF_{N2O,y}$ is determined based on measurements of the methane emissions during a composting cycle ($ECC_{N2O,y}$), as follows:

$$EF_{N2O,y} = \frac{\sum_{C=1}^{X} ECC_{N2O}/Q_c}{x} \quad \text{(Equation 11)}$$

Where：

$EF_{N2O,y}$	Emission factor of nitrous oxide per tonne of waste composted valid for year y (t N_2O/t)
$ECC_{N2O,c}$	Nitrous oxide emissions from composting during the composting cycle c (t N_2O)
Q_y	Quantity of waste composted in composting cycle c (t)
C	Composting cycles for which measurements were undertaken
x	Number of composting cycles c for which emissions were measured in year y (at least three)

Option 2: Procedure using default values

A default value is used: $EF_{N2O,y}$= $EF_{N2O,default}$. The default value is provided in the "Data and parameters not monitored" section of this tool.

For this project, default value for $EF_{N2O,y}$ is adopted, which is listed in the "Data and parameters available at validation" section.

5) Project emissions from run-off wastewater ($PE_{RO,y}$)

Project emissions of methane from run-off wastewater ($PE_{RO,y}$) are calculated only for the case of co-composting.

As this project not involves co-composting, therefore $PE_{RO,y}$=0.

4.3 Leakage

As per the methodology, If the project technology is the equipment transferred from another activity or if the existing equipment is transferred to another activity, leakage effects are to be considered (LE_y). However, in case of the project activity there is no equipment transferred from another activity nor is any existing equipment transferred to another activity. The project is greenfield project and all equipment applied is new.

In case compost is subject to anaerobic storage or disposed of in a SWDS, leakage shall be estimated to account for methane emissions from the anaerobic decay of compost. However, the compost won't be subjected to anaerobic storage, neither disposed in a SWDS.

Therefore, this is no leakage emissions associated the project activity.

4.4 Net GHG Emission Reductions and Removals

As per applied methodology, in the case of construction of new composting facilities or expansion of capacity of existing composting facilities, the emission reduction achieved by the project activity will be measured as the difference between the baseline emission and the sum of the project emission and leakage. The project belongs to the construction of new composting facilities; therefore, the calculation is as following:

$$ER_y = BE_y - (PE_y + LE_y) \quad \text{(Equation 12)}$$

Where：

ER_y	Emission reduction in the year y (t CO_2e)
BE_y	Baseline Emission in the year y (t CO_2e)
PE_y	Project Emission in the year y (t CO_2e)
LE_y	Leakage Emission in the year y (t CO_2e)

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

1. Calculation result of baseline emissions:

Table 4-1 Ex-ante calculation of $BE_{CH4,SWDS,y}$

Parameter	value	Unit	source
φ_y	0.80	-	Tool 04: "Emissions from solid waste disposal sites (version08.1)"
f_y	0	-	Local regulation/requirement
GWP_{CH4}	28	tCO_2e/tCH_4	IPCC AR5
OX	0.10	-	Tool 04: "Emissions from solid waste disposal sites (version08.1)"
F	0.50	-	Tool 04: "Emissions from solid waste disposal sites (version08.1)"
$DOC_{f,y}$	0.50	-	Tool 04: "Emissions from solid waste disposal sites (version08.1)"
MCF_y	0.80	-	Tool 04: "Emissions from solid waste disposal sites (version08.1)"
$W_{j,x}$	32,000	t/yr	Feasibility study report
DOC_j	43%	-	Tool 04: "Emissions from solid waste disposal sites (version08.1)"
K_j	0.02	-	Tool 04: "Emissions from solid waste disposal sites (version08.1)"

Table 4-2 the results of $BE_{CH4,SWDS,y}$

Year	$BE_{CH4,SWDS,y}$ (tCO_2e)
01-January-2022 to 31-December-2022	1,465
01-January-2023 to 31-December-2023	2,901
01-January-2024 to 31-December-2024	4,308
01-January-2025 to 31-December-2025	5,687
01-January-2026 to 31-December-2026	7,040
01-January-2027 to 31-December-2027	8,365
01-January-2028 to 31-December-2028	9,664
01-January-2029 to 31-December-2029	10,937
01-January-2030 to 31-December-2030	12,186
01-January-2031 to 31-December-2031	13,409

Table 4-3 Ex-ante calculation of $BE_{CH4,manure,y}$

Parameter	Value	Unit	Source
GWP_{CH4}	28	tCO_2e/tCH_4	IPCC AR5
D_{CH4}	0.00067	t/m^3	AMS-III.D: Methane recovery in animal manure management systems", version 21.0
UF_b	0.94	-	AMS-III.D: Methane recovery in animal manure management systems", version 21.0
MCF_j	0.75	-	AMS-III.D: Methane recovery in animal manure management systems", version 21.0，temperature of the project site is 16.7℃,
$B_{o,LT}$ (cow)	0.13	$m^3CH_4/kg\text{-}dm$	IPCC 2006 table 10A-4 and 10A-5, chapter 10, volume 4
$B_{o,LT}$ (swine)	0.29	$m^3CH_4/kg\text{-}dm$	IPCC 2006 table 10A-7 and 10A-8, chapter 10, volume 4
$Q_{manure,j,LT,y}$ (cow)	5,000	tonnes/yr, dry basis	Feasibility study report
$Q_{manure,j,LT,y}$ (swine)	27,600	tonnes/yr, dry basis	Feasibility study report
$SVS_{j,LT,y}$(cow)	65%	tonnes/tonnes, dry basis	Feasibility study report
$SVS_{j,LT,y}$(swine)	60%	tonnes/tonnes,	Feasibility study report

		dry basis	
$BE_{CH4,manure,y}$ (cow)	5,587	tCO_2e	calculated
$BE_{CH4,manure,y}$ (swine)	63,515	tCO_2e	calculated

Table 4-4 the results of $BE_{CH4,y}$

$BE_{CH4,SWDS,y}$ (tCO_2e)	$BE_{CH4,manure,y}$ (tCO_2e)	$BE_{CH4,y}$ (tCO_2e)
1,465	69,102	70,567
2,901	69,102	72,003
4,308	69,102	73,410
5,687	69,102	74,789
7,040	69,102	76,142
8,365	69,102	77,467
9,664	69,102	78,766
10,937	69,102	80,039
12,186	69,102	81,288
13,409	69,102	82,511

2.Calculation result of project emissions:

Table 4-5 Ex-ante calculation of $PE_{EC,y}$

Parameter	Value	Unit	Source
$EC_{PJ,J,y}$	2,579.60	MWh/yr	Energy Efficiency Report
$EF_{EF,j,y}$	0.57205	tCO_2/MWh	Published by DNA
$TDL_{j,y}$	20%	-	Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation
$PE_{EC,y}$	1,771	tCO_2e	calculated

Table 4-6 Ex-ante calculation of $PE_{FC,y}$

Parameter	Value	Unit	Source
$FC_{i,j,y}$	0	ton/yr	Only diesel used for the project. 0 tonnes for ex ante estimation.
$NVC_{i,y}$	43.3	GJ/ton	Diesel, upper limit of the uncertainty at a 95% confidence interval as provided in table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC
$EF_{CO2,i,y}$	0.0748	tCO_2/GJ	Diesel, upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC
$PE_{FC,y}$	0	tCO_2e	calculated

Table 4-7 Ex-ante calculation of $PE_{CH4,y}$

Parameter	Value	Unit	Source
Q_y	149,000	t/yr	Feasibility study report
GWP_{CH4}	28	tCO_2e/tCH_4	IPCC AR5
$EF_{CH4,y}$	0.002	tCH_4/t	Tool 13:" Project and leakage emissions from composting (Version 02.0)"
$PE_{CH4,y}$	8,344	tCO_2e	calculated

Table 4-8 Ex-ante calculation of $PE_{N2O,y}$

Parameter	Value	Unit	Source
Q_y	149,000	t/yr	Feasibility study report
GWP_{N2O}	265	tCO_2e/tN_2O	IPCC AR5
$EF_{N2O,y}$	0.0002	tN_2O/t	Tool 13:" Project and leakage emissions from composting (Version 02.0)"
$PE_{N2O,y}$	7,897	tCO_2e	calculated

Table 4-9 the result of PE_y

$PE_{EC,y}(tCO_2e)$	$PE_{FC,y}(tCO_2e)$	$PE_{CH4,y}(tCO_2e)$	$PE_{N2O,y}(tCO_2e)$	$PE_y(tCO_2e)$
1,771	0	8,344	7,897	18,012

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)
01-January-2022 to 31-December-2022	70,567	18,012	0	52,554
01-January-2023 to 31-December-2023	72,003	18,012	0	53,990
01-January-2024 to 31-December-2024	73,410	18,012	0	55,397
01-January-2025 to 31-December-2025	74,789	18,012	0	56,777
01-January-2026 to 31-December-2026	76,142	18,012	0	58,129
01-January-2027 to 31-December-2027	77,467	18,012	0	59,454
01-January-2028 to 31-December-2028	78,766	18,012	0	60,754
01-January-2029 to 31-December-2029	80,039	18,012	0	62,027
01-January-2030 to 31-December-2030	81,288	18,012	0	63,275
01-January-2031 to 31-December-2031	82,511	18,012	0	64,499
Total	**766,981**	**180,120**	**0**	**586,856**

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	GWP_{CH4}
Data unit	t $CO_2e/t\ CH_4$
Description	Global Warming Potential of CH_4
Source of data	IPCC Fifth Assessment Report
Value applied	28
Justification of choice of data or description of measurement methods and procedures applied	100-year values are adopted from Box 3.2, table 1, IPCC Fifth Assessment Report, 2014[13], which complies with the requirement described in Section 3.15.4 of VCS Standard (V4.5).
Purpose of Data	Calculation of baseline emissions and project emissions
Comments	N/A

Data / Parameter	GWP_{N2O}
Data unit	t $CO_2e/t\ N_2O$
Description	Global Warming Potential of N_2O
Source of data	IPCC Fifth Assessment Report
Value applied	265
Justification of choice of data or description of measurement methods and procedures applied	100-year values are adopted from Box 3.2, table 1, IPCC Fifth Assessment Report, 2014[13], which complies with the requirement described in Section 3.15.4 of VCS Standard (V4.5).
Purpose of Data	Calculation of baseline emissions and project emissions
Comments	N/A

Data / Parameter	D_{CH4}

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

Data unit	t/m^3
Description	Density of CH_4
Source of data	AMS-III.D Version 21.0
Value applied	0.00067
Justification of choice of data or description of measurement methods and procedures applied	0.00067 t/m^3 at room temperature 20℃ and 1 atm pressure.
Purpose of Data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	MCF_j
Data unit	-
Description	Methane conversion factor for the baseline $AWMS_j$
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 10, Table 10.17
Value applied	75%
Justification of choice of data or description of measurement methods and procedures applied	MCF j value for uncovered anaerobic lagoon (baseline AWMS) is chosen. For this project, the annual average temperature is 16.7℃ and the conservative value of 75% is applied.
Purpose of Data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	UF_b
Data unit	/
Description	Model correction factor to account for model uncertainties
Source of data	AMS-III.D Version 21.0
Value applied	0.94

Justification of choice of data or description of measurement methods and procedures applied	As per the methodology AMS-III.D, the value of this parameter is 0.94.
Purpose of Data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	$\Phi_{default}$
Data unit	/
Description	Default value for the model correction factor to account for model uncertainties.
Source of data	Tool 04: "Emissions from solid waste disposal sites (version 08.1)"
Value applied	0.80
Justification of choice of data or description of measurement methods and procedures applied	For baseline emissions: refer to the table below to identify the appropriate factor based on the application of the tool (A or B) and the climate where the SWDS is located. **Default values for the model correction factor** Humid/wet conditions: Application A = 0.75; Application B = 0.85 Dry conditions: Application A = 0.75; Application B = 0.80 According to the analysis in section 3.2 of this PD, the proposed project type is Application B. This project is located in Santai County and the climate in Santai is a subtropical humid monsoon climate, also, the annual average precipitation in Santai County is 822.2mm, and the annual average evaporation is 1045.0 mm[14], so the climate of the project site is dry. Therefore, the value of default is 0.80.
Purpose of Data	Calculation of baseline emissions
Comments	N/A

[14] http://www.santai.gov.cn/yxst/stnj/2014nstnj/17605511.html

Data / Parameter	OX
Data unit	/
Description	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data	Table 3.2, Section 3.2.3, Chapter 3, Volume 5, 2006 IPCC Guidelines for National Greenhouse Gas Inventories.
Value applied	0.10
Justification of choice of data or description of measurement methods and procedures applied	As per Tool 04 (Version 08.1), this parameter can be sourced from "2006 IPCC Guidelines for National Greenhouse Gas Inventories" which is a reliable data source.
Purpose of Data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	F
Data unit	/
Description	Fraction of methane in the SWDS gas (volume fraction)
Source of data	Section 3.2.3, Chapter 3, Volume 5, IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied	0.50
Justification of choice of data or description of measurement methods and procedures applied	As per Tool 04 (Version 08.1), this parameter can be sourced from "2006 IPCC Guidelines for National Greenhouse Gas Inventories" which is a reliable data source.
Purpose of Data	Calculation of baseline emissions
Comments	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, under anaerobic conditions in the SWDS. A default value of 0.5 is recommended by IPCC.

Data / Parameter	$DOC_{f,default}$
Data unit	Weight fraction

Description	Default value for the fraction of degradable organic carbon ($DOC_{f,default}$) in MSW that decomposes in the SWDS
Source of data	Section 3.2.3, Chapter 3, Volume 5, IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied	0.50
Justification of choice of data or description of measurement methods and procedures applied	As per Tool 04 (Version08.1), this parameter can be sourced from "2006 IPCC Guidelines for National Greenhouse Gas Inventories" which is a reliable data source.
Purpose of Data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	$MCF_{default}$
Data unit	-
Description	Methane correction factor
Source of data	Table 3.1, Section 3.2.3, Chapter 3, Volume 5, 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied	0.80
Justification of choice of data or description of measurement methods and procedures applied	Default value in Tool 04: "Emissions from solid waste disposal sites (version 08.1)" As FSR, the baseline for biomass waste is to decay in unmanaged solid waste disposal site-deep, which is the most economic treatment method. The baseline solid waste disposal site has a depth of around 7 meters, which justifies the choice of value for MCF.
Purpose of Data	Calculation of baseline emissions
Comments	The MCF accounts for the fact that unmanaged SWDS produce less methane from a given amount of waste than managed SWDS, because a larger fraction of waste decomposes aerobically in the top layers of unmanaged SWDS.

Data / Parameter	DOC_j
Data unit	-

<table>
<tr><td>Description</td><td>Fraction of degradable organic carbon in the waste type j (weight fraction)</td></tr>
<tr><td>Source of data</td><td>IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Chapter 2, Tables 2.4 and 2.5)</td></tr>
<tr><td>Value applied</td><td>43%</td></tr>
<tr><td>Justification of choice of data or description of measurement methods and procedures applied</td><td>For MSW, the following values for the different waste types j should be applied:
<table><tr><td>Waste type j</td><td>DOC_j (% wet waste)</td></tr><tr><td>Wood and wood product</td><td>43</td></tr><tr><td>Pulp, paper and carboard (other than sludge)</td><td>40</td></tr><tr><td>Food, food waste, beverages and tobacco (other than sludge)</td><td>15</td></tr><tr><td>Textiles</td><td>24</td></tr><tr><td>Garden, yard and park waste</td><td>20</td></tr><tr><td>Glass, plastic, metal, other inert waste</td><td>0</td></tr></table>For this project, Biomass waste residue i.e., straw is used for composting, which is similar waste type of wood waste, therefore 43% is applied for calculation.</td></tr>
<tr><td>Purpose of Data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Comments</td><td>N/A</td></tr>
</table>

<table>
<tr><td>Data / Parameter</td><td>K_j</td></tr>
<tr><td>Data unit</td><td>1/yr.</td></tr>
<tr><td>Description</td><td>The decay rate for the waste type j</td></tr>
<tr><td>Source of data</td><td>IPCC 2006 Guidelines for National Greenhouse Gas Inventories (Adapted from Volume 5, Chapter 3, Table 3.3)</td></tr>
<tr><td>Value applied</td><td>0.02</td></tr>
<tr><td>Justification of choice of data or description of measurement methods</td><td>Apply the following default values for the different waste types j:
Default values for the decay rate (K_j)</td></tr>
</table>

and procedures applied	

Waste type j		Boreal temperate (MAT≤20°C)		Tropical (MAT>20°C)	
		Dry (MAP/PET<1)	Wet (MAP/PET>1)	Dry (MAP <1000mm)	Wet (MAP>1000mm)
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0.04	0.06	0.045	0.07
Slowly degrading	Wood, wood products and straw	0.02	0.03	0.025	0.035
Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.05	0.1	0.065	0.17
Rapid degrading	Food, food waste, sewage sludge, beverages and tobacco	0.06	0.185	0.085	0.4

Note: MAT – mean annual temperature, MAP – Mean annual precipitation, PET – potential evapotranspiration. MAP/PET is the ratio between the mean annual precipitation and the potential evapotranspiration.

This project is located in Santai County, the annual average ambient temperature is 16.7℃, MAP is 822.2mm and PET is 1045.0 mm[15] in Santai County. Biomass waste residue i.e., straws used for composting, which is similar waste type of wood waste, therefore 0.02 is applied for calculation.

Purpose of Data	Calculation of baseline emissions
Comments	N/A

[15] http://www.santai.gov.cn/yxst/stnj/2014nstnj/17605511.html

Data / Parameter	$EF_{CH4,default}$
Data unit	tCH_4/t
Description	Default emission factor of methane per tonne of waste composted (wet basis)
Source of data	Tool 13:" Project and leakage emissions from composting (Version 02.0)"
Value applied	0.002
Justification of choice of data or description of measurement methods and procedures applied	As per Tool 13 (Version 02.0), the value of this parameter should apply 0.002
Purpose of Data	Calculation of project emission
Comments	Applicable to Option 2 in the step "Determination of methane and nitrous oxide emissions from the composting process"

Data / Parameter	$EF_{N2O,default}$
Data unit	tN_2O/t
Description	Default emission factor of nitrous oxide per tonne of waste composted (wet basis)
Source of data	Tool 13:" Project and leakage emissions from composting (Version 02.0)"
Value applied	0.0002
Justification of choice of data or description of measurement methods and procedures applied	As per Tool 13 (Version 02.0), the value of this parameter should apply 0.0002
Purpose of Data	Calculation of project emission
Comments	Applicable to Option 2 in the step "Determination of methane and nitrous oxide emissions from the composting process"

5.2 Data and Parameters Monitored

Data / Parameter	f_y

Data unit	/
Description	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year y
Source of data	Select the maximum value from the following: (a) contract or regulation requirements specifying the amount of methane that must be destroyed/used (if available) and (b) historic data on the amount captured
Description of measurement methods and procedures to be applied	In China, there are no laws and regulations that require mandatory specifying the amount of methane that must be destroyed/used, so the value is 0.
Frequency of monitoring/recording	Annually
Value applied	0
Monitoring equipment	N/A
QA/QC procedures to be applied	During the monitoring period, this value will be updated according to the specifying the amount of methane that must be destroyed/used that is mandated by laws and regulations.
Purpose of data	Calculation of baseline emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	$W_{j,x}$
Data unit	t
Description	Total amount of waste disposed in a SWDS in year x
Source of data	Data sourced from Project proponents, which is measured by Electronic truck scale in project site
Description of measurement methods and procedures to be applied	Measure on wet basis and by Electronic truck scale
Frequency of monitoring/recording	Continuously, aggregated at least annually for year x or monthly for month i.

Value applied	32,000 tonnes biomass waste residue used for ex-estimated which is sourced from FSR.
Monitoring equipment	Electronic truck scale
QA/QC procedures to be applied	This parameter can be sourced from "Biomass treatment daily record" recorded by PP. Archive electronically during project plus 5 years. Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications.
Purpose of data	Calculation of baseline emissions and project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	$B_{o,\,LT}$
Data unit	$m^3CH_4/kg\text{-}dm$
Description	Maximum methane producing potential of the volatile solid generated by animal type LT
Source of data	(cow)IPCC 2006 table 10A-4 and 10A-5, chapter 10, volume 4, (swine)IPCC 2006 table 10A-7 and 10A-8, chapter 10, volume 4
Description of measurement methods and procedures to be applied	$B_{o,\,LT}$ can be measured as per ISO 11734:1995. As this parameter is not monitored in the actual operation. so, in the monitoring period the cow manure is 0.13 m^3CH_4/kg -dm, swine manure is 0.29 m^3CH_4/kg -dm, which is still applied. according to the public literature[16], while the actual methane producing potential of the volatile solid generated by cow manure is 161.60 ml/g VS, swine manure is 360.58 ml/g VS, which is higher. Therefore cow manure is 0.13 $m^3\,CH_4/kg$ -dm, swine manure is 0.29 m^3CH_4/kg -dm applied in monitoring period is conservative.
Frequency of monitoring/recording	Annually
Value applied	$B_{o,\,LT}$ (cow manure) =0.13 $B_{o,\,LT}$ (swine manure) =0.29

[16] https://www.doc88.com/p-97461763657886.html

Monitoring equipment	N/A
QA/QC procedures to be applied	The value is taken from published sources. The parameter value should be updated on latest available public data source.
Purpose of data	Calculation of baseline emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	$Q_{manure,LT,y}$
Data unit	tonnes-dm/year
Description	Quantity of manure treated from livestock type LT at animal manure management system j
Source of data	Data sourced from Project proponents and this parameter can be calculated by the Quantity of manure (wet basis) and the moisture content of manure (wet basis).
Description of measurement methods and procedures to be applied	Quantity of manure (wet basis) is measured by electronic truck scale in project site. Moisture content of manure (wet basis) is measured by electronic balance and electric thermostat dry oven as per GB/T25169 Technical specifications for monitoring of animal manure. The electronic balance is used to measure the net weight of container(m_0), the weight of wet basis manure with container (m_1), the weight of dry manure with the container (m_2). The process of the manure from the wet basis to the dry basis is realized by drying in the electric thermostat dry oven. The moisture content in cow, swine manure can be calculated by the formula: $\frac{m_2-m_0}{m_1-m_0} \times 100\%$.
Frequency of monitoring/recording	The Quantity of daily manure (wet basis) entering the project site is measured by electronic truck scale and the data is summarized monthly. The moisture content of daily manure entering the project site needs to be measured. The monthly moisture content used in the emission reduction calculation is calculated by the weighted average of the daily moisture content and the daily quality of cow, swine manure entering the project site.
Value applied	5,000 tonnes cow manure (dry basis) used for ex-estimated which is sourced from FSR. 5,000 tonnes of dry base manure correspond to 25,000 tonnes of wet base manure with a moisture content of 80%. 27,600 tonnes swine manure (dry basis) used for ex-estimated which is sourced from FSR. 27,600 tonnes of dry base manure correspond to 92,000 tonnes of wet base manure with a

	moisture content of 70%.
Monitoring equipment	electronic truck scale, electronic balance and electric thermostat dry oven
QA/QC procedures to be applied	Calculated by the Quantity of manure (wet basis) multiply (1- moisture content of manure (wet basis)). The Periodic calibration of electronic truck scale and electronic balance should be conducted by an independent accredited laboratory, and which is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications. The electric thermostat dry oven do not require calibration.
Purpose of data	Calculation of baseline emissions
Calculation method	Quantity of manure (dry basis) = quantity of manure (wet basis) × (1- moisture content of manure (wet basis))
Comments	N/A

Data / Parameter	$SVS_{j,LT,y}$
Data unit	tonnes VS/tonnes-dm
Description	Specific volatile solids content of animal manure from livestock type LT and animal manure management system j in year y
Source of data	Data sourced from Project proponents, which is measured as per the guideline in annex 2 of AM0073.
Description of measurement methods and procedures to be applied	Method for determination of Volatile Solids in animal waste From: USDA. Agricultural Waste Management Field Handbook. Chapter 4 - Agricultural Waste Characteristics. Page 2. Definitions • Total Solids: Residue remaining after water is removed from waste material by evaporation; dry matter; • Volatile Solids: The part of total solids driven off as volatile (combustible) gases when heated to 600°C; organic matter; • Fixed Solids: The part of total solids remaining after volatile gases driven off at 600°C; ashes. Determination method 1 - Evaporate free water on steam able and dry in oven at 103°C for 24 hours or until constant weight to obtain the Total Solids. 2 - Place Total Solids residue in furnace at 600°C for at least 1 hour. Volatile Solids are determined from weight difference of total and Fixed Solids. $$\text{volatile matter (dry basis)} = \frac{W_2 - W_f}{W_2 - W_1}$$

	Where W_1 is the weight of sample container, W_2 is combined weight of the sample container and oven dried sample, W_f is the combined constant weight of the sample container and sample after heating at 600°C.
Frequency of monitoring/recording	Annually
Value applied	The $SVS_{j,LT,y}$ value of cow manture is 65%, swine manture is 60%, which is used for ex for ex-ante calculation which is sourced from FSR. $SVS_{j,LT,y}$ will be determined as the guideline in annex 2 of AM0073 during the monitoring period.
Monitoring equipment	Electronic balance and Muffle furnace.Electronic balance is used to measure the net weight of Evaporating dish (W_1), the weight of Evaporating dishes and dry cow/swine manure (W_2), the weight of Evaporating dishes and the swine manure after 600 ℃ burning (W_f). The muffle furnace is used to heat the dry basis manure to 600℃ to remove the volatile solids in the dry basis manure.
QA/QC procedures to be applied	The Periodic calibration of electronic balance should be conducted by an independent accredited laboratory, and which is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications. The Muffle furnace do not require calibration.
Purpose of data	Calculation of baseline emissions
Calculation method	N/A
Comments	Sampling procedures and method is described in Section 5.3 of PD.

Data / Parameter	$EC_{PJ,J,y}$
Data unit	MWh
Description	Quantity of electricity consumed by the proposed project in year y
Source of data	Direct measurement from electricity meter
Description of measurement methods and procedures to be applied	Measured by electricity meter.
Frequency of monitoring/recording	Continuous measurement and at least monthly recording
Value applied	2,579.6 MWh for ex ante estimation, which sourced from Energy Efficiency Report. During the monitoring period, the Quantity of

	electricity consumed by the proposed project will be determined as per the electricity meter monitoring and Cross-check with the"monthly production record".
Monitoring equipment	electricity meter
QA/QC procedures to be applied	The calibration of meter, including the frequency of calibration, should be done in accordance with national standards or requirements.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	$EF_{EF,j,y}$
Data unit	tCO_2e/MWh
Description	Emission factor for electricity generation
Source of data	Published by Ministry of Ecology and Environment of China, which is the DNA of China[17]
Description of measurement methods and procedures to be applied	This parameter can be obtained from the “Emission Factors of China’s Regional Power Grid Baseline for Emission Reduction Projects” published by the Ministry of Ecology and Environment of China, which is the DNA of China.
Frequency of monitoring/recording	This value will change once the latest data is published
Value applied	0.57205
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of project emission
Calculation method	N/A
Comments	N/A

Data / Parameter	$TDL_{j,y}$

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

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

Data / Parameter	$FC_{i,j,y}$
Data unit	tonne
Description	Quantity of fuel type i combusted by the proposed project during the year y
Source of data	Direct measurement by electronic flowmeter
Description of measurement methods and procedures to be applied	Measured by electronic flowmeter
Frequency of monitoring/recording	Continuously monitored by electronic flowmeter and at least monthly recording
Value applied	Only diesel used for the project. 0 tonnes for ex ante estimation. During the monitoring period, the diesel consumption will be recorded in"Diesel usage record" and Cross-check with the "purchase and stock change record".

Monitoring equipment	Electronic flow meter
QA/QC procedures to be applied	Archive electronically during project plus 5 years.The calibration of electronic flowmeter, including the frequency of calibration, should be done in accordance with national standards or requirements.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	$NCV_{i,y}$
Data unit	GJ/ton
Description	Weighted average net calorific value of fuel type i in year y
Source of data	upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC
Description of measurement methods and procedures to be applied	Default value of IPCC are applied. Any future revision of the IPCC Guidelines should be taken into account.
Frequency of monitoring/recording	This value will change once the latest data can be obtained
Value applied	Diesel: 43.3
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of project emission
Calculation method	N/A
Comments	Applicable to Option 1 in the step “Determination of project emissions from fossil fuel consumption ($PE_{FC,y}$)”

Data / Parameter	$EF_{CO2,i,y}$
Data unit	tCO_2e/GJ

Description	Weighted average CO_2 emission factor of fuel type i in year y
Source of data	upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC
Description of measurement methods and procedures to be applied	Default value of IPCC are applied. Any future revision of the IPCC Guidelines should be taken into account.
Frequency of monitoring/recording	This value will change once the latest data can be obtained
Value applied	Diesel: 0.0748
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of project emission
Calculation method	N/A
Comments	Applicable to Option 1 in the step "Determination of project emissions from fossil fuel consumption ($PE_{FC,y}$)"

Data / Parameter	Q_y
Data unit	tonne
Description	Quantity of waste composted in year y (t/yr)
Source of data	Recorded by project participant
Description of measurement methods and procedures to be applied	This parameter can be obtained by sum of the quantity of manure (wet basis) and the total amount of waste disposed in a SWDS. The quantity of manure (wet basis) is measured by electronic truck scale. Total amount of waste disposed in a SWDS measured on wet basis by electronic truck scale.
Frequency of monitoring/recording	Continuously
Value applied	149,000 tonnes of waste (32,000 tonnes biomass waste residue (straw) on wet basis and 117,000 tonnes cow, swine manure on

	wet basis) composted for Ex-ante calculation which is sourced from FSR.
Monitoring equipment	Electronic truck scale in project site
QA/QC procedures to be applied	This parameter can be sourced from “monthly production record” recorded by project participant. Archive electronically during project plus 5 years. Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer’s specifications.
Purpose of data	Calculation of project emissions
Calculation method	This parameter can be obtained by sum of the quantity of manure (wet basis) and the total amount of waste disposed (wet basis) in a SWDS.
Comments	N/A

Data / Parameter	The amount of the organic fertilizers generated
Data unit	tonnes
Description	The amount of the organic fertilizers generated
Source of data	Recorded by project participant
Description of measurement methods and procedures to be applied	The amount of the organic fertilizers generated is measured by electronic truck scale in project site.
Frequency of monitoring/recording	Continuously
Value applied	50,000 tonnes of organic fertilizer which is sourced from FSR.
Monitoring equipment	electronic truck scale
QA/QC procedures to be applied	This parameter can be sourced from “monthly production record” recorded by project participant.Archive electronically during project plus 5 years.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	To demonstrate the contribution of SDG12
Calculation method	N/A

Comments	N/A

5.3 Monitoring Plan

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

1. Monitoring framework

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

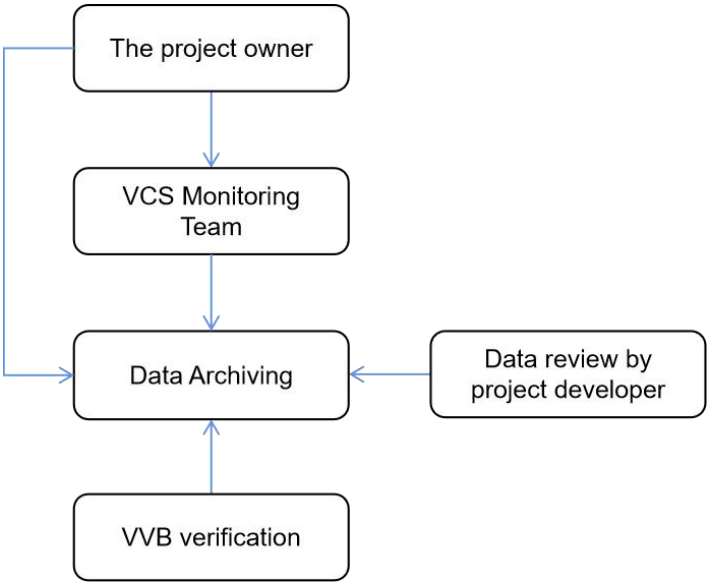

Figure 5-1 The Organization Structure of the Monitoring Team

2. Monitoring equipment and installation

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

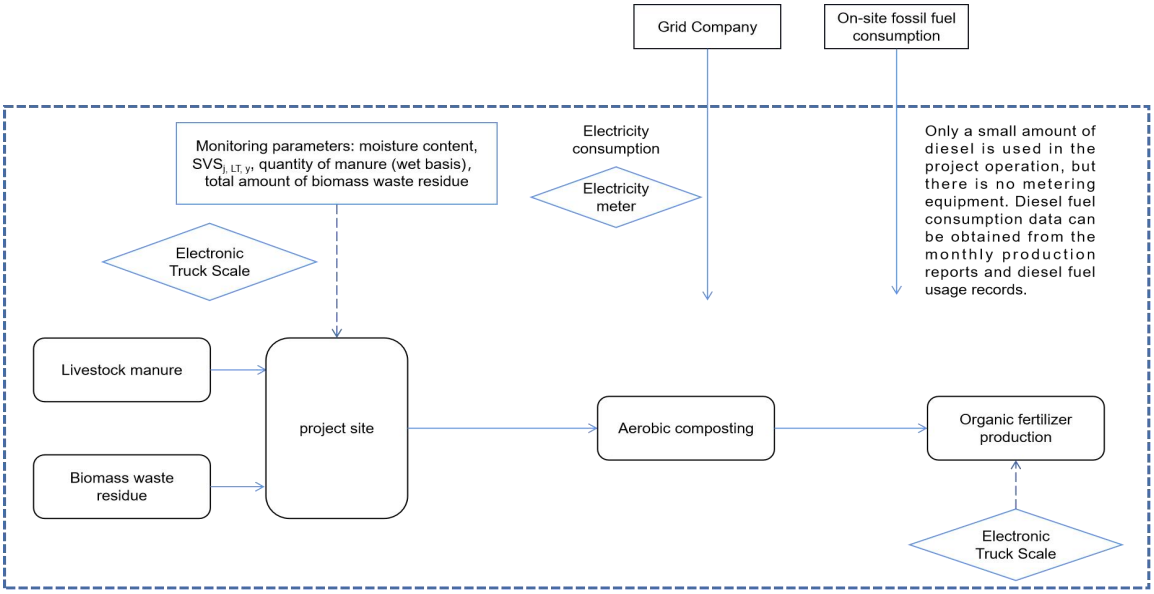

Figure 5-2 Installation and Configuration of Meters

3. Principle of Monitoring

All the data to be monitored in this project has been described in section 5.2 in this PD.

The installation of relevant monitoring instruments and meters shall be carried out in accordance with industry requirements and manufacturer specifications and shall be calibrated regularly as required.

If monitoring instruments is changed or added during the crediting period, this should be documented transparently in the monitoring reports, and the procedure for post registration changes shall be followed.

4. Parameters to be monitored

The monitoring requirements for this methodology include the monitoring of parameters for both baseline and project emissions calculations. All provisions in the methodology and relevant tools shall apply, as described for each parameter in section 5.2 of this PD.

For this project, the parameters that need to be monitored as the description of section 5.2 are as follows:

a) Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year y, f_y

b) Total amount of waste disposed in a SWDS in year x, $W_{j,x}$

c) Maximum methane producing potential of the volatile solid generated by animal type LT, $B_{o, LT}$

d) Quantity of manure treated from livestock type LT at animal manure management system j,$Q_{manure,LT,y}$

e) Specific volatile solids content of animal manure from livestock type LT and animal manure management system j in year y, $SVS_{j,LT,y}$

f) Quantity of electricity consumed by the proposed project in year y, $EC_{PJ,j,y}$

g) Emission factor for electricity generation, $EF_{EF,j,y}$

h) Average technical transmission and distribution losses for providing electricity to source j in year y, $TDL_{j,y}$

i) Quantity of fuel type i combusted by the proposed project during the year y, $FC_{i,j,y}$

j) Weighted average net calorific value of fuel type i in year y, $NCV_{i,y}$

k) Weighted average CO_2 emission factor of fuel type i in year y, $EF_{CO2,i,y}$

l) Quantity of waste composted in year y (t/yr), Q_y

m) The amount of the organic fertilizers generated.

For the fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere, this parameter can be determined by the existing laws and regulations.

Total amount of waste disposed in a SWDS was measured by electronic truck scale and the data can be sourced from the " Biomass treatment daily record " recorded by project participant.

For $B_{o,LT}$, a default value from IPCC 2006 is applied, therefore it is not monitored during the operation period.

Quantity of manure (dry base) treated from livestock type LT at animal manure management system can be calculated by the Quantity of manure (wet base) multiply (1- moisture content of manure (wet basis)). The Quantity of manure (wet base) measured by electronic truck scale, the moisture content of manure (wet basis) can be measured by electronic balance and electric thermostat dry oven as per GB/T25169 Technical specifications for monitoring of animal manure.

For $SVS_{j,LT,y}$, this parameter was determined according to the guideline in annex 2 of AM0073. This parameter can be sourced from "Volatile Solids Test Record".

The quantity of electricity consumed by the proposed project was measured by electricity meter, the data can be sourced from the "monthly production record" and cross-checked by" the electricity invoice".

The value of $EF_{EF,j,y}$ is sourced from the "Emission Factors of China's Regional Power Grid Baseline for Emission Reduction Projects" published by the Ministry of Ecology and Environment of China, which is the DNA of China, therefore it is not monitored during the monitoring period. This value will be updated according to the latest published document.

Average technical transmission and distribution losses for providing electricity to source j is sourced from the tool 05" Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" and will be updated once the tool is updated.

For Quantity of fuel type i combusted by the proposed project during the year y was measured by electronic flowmeter and recorded in "Diesel usage record", so the data can be sourced from "Diesel usage record" and cross-checked by "purchase and stock change record".

For $NCV_{i,y}$ and $EF_{CO2,i,y}$, the source of data applied the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC, therefore it is not to be monitored during the monitoring period. This value will be updated once the IPCC is updated.

For the Quantity of waste composted in year y, the value can be calculated by adding the total amount of waste disposed in a SWDS and the Quantity of manure (wet base) treated. This data can be sourced from "monthly production record".

For the amount of the organic fertilizers generated can be measured by electronic truck scale and the data can be sourced from "monthly production record".

5. Quality control and quality assurance procedures

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

Training

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

Data management

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

Corrective actions

The project signs an agreement that it is not participate in other environment credits, other GHG programs and has not been rejected by any other GHG Programs. The whole VCS monitoring team follow recognized standard data evaluation methods to guarantee that the data is reliable and accurate. The quality control and quality assurance procedures include the

handling and correction of nonconformities in the implementation of the project or the monitoring plan. In case such nonconformities are observed:

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

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

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

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

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

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

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

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

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

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

6.Sample plan

The sampling objective

To determining the specific volatile solids content of cow, swine manure ($SVS_{j,LT,y}$) during the crediting period with a 90/10 confidence/precision.

The determination of sampling sizes

According to the methodology AMS-III.D (Version 21.0)", PP shall use 90/10 confidence/precision as the criteria for the reliability of sampling efforts for large-scale project.

According to the CDM guideline " Sampling and surveys for CDM project activities and programmes of activities" (Version 04.0), the sample size can be calculated by the following equation:

$$n = \left(\frac{t_{n-1} * CV}{0.1}\right)^2$$

Where,

n	Sample size
t_{n-1}	The value of the t-distribution for 90% confidence when the sample size is n, i.e.,1.645
CV	The coefficient of variation. 2% was used as per the public literature[18]

So, the sample size n is rounded to an integer as 1. Also, as per the methodology AMS-III.D (Version 21.0), the Monitoring frequency of this parameter is annually, so during the monitoring period, the value of SVS will be measured once annually, and in order to ensure the accuracy and rationality of the data, three parallel samples will be taken during the measurement, so the sample size is 3.

Testing method

As per methodology AMS-III.D, the testing shall be performed according to the guideline in annex 2 of AM0073. The details as follows:

1-Evaporate free water on steam able and dry in oven at 103°C for 24 hours or until constant weight to obtain the Total Solids.

2-Place Total Solids residue in furnace at 600ºC for at least 1 hour. Volatile Solids are determined from weight difference of total and Fixed Solids.

$$\text{volatile matter (dry basis)} = \frac{W_2 - W_f}{W_2 - W_1}$$

Where W_1 is the weight of sample container, W_2 is combined weight of the sample container and oven dried sample, W_f is the combined constant weight of the sample container and sample after heating at 600ºC.

Procedures for Administering Data Collection and Minimizing Non-sampling Errors

During the yearly monitoring activities, the Specific volatile solids content of cow, swine manure was recorded in the"Volatile Solids Test Record". Then average Specific volatile solids content in the three parallel samples will be used in the calculation of emission reductions. The data will be reviewed by the project developer and VVB.

[18] http://sourcedb.igsnrr.cas.cn/zw/lw/200906/P020090625732387635581.PDF

If the recorded raw data on the "Volatile Solids Test Record" are reasonable and basically consistent with the actual proportion of each component in cow, swine manure, the raw data is archived.

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

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

2) If this is due to the working error of the monitoring personnel, further train the person until he or she can perform the job properly. And in the meantime, use conservative value sourced from the publicly available information for the missing or damaged data;

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

4) If some data recorded are significantly higher than the normal range, the monitoring personnel should ask for the reason. If the measurement is high due to the damage of weighing scales or other measurement equipment, the data needs to be remeasured. And need to calibrate and maintain the weighing scale or replace the measuring equipment immediately and avoid this situation in the future.

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

QA/QC Procedures

Before implementing the project, the project owner train the personnel of monitoring teams on how to properly conduct the monitoring process.

If the data reported by the team member significantly deviates from the normal range, the monitoring personnel should write down the reasons and report to the team leader, any action is forbidden before the permission. The monitoring team arrange research according to the attached form. At the same time, when the verification group has any doubt with the right result, they can arrange related research.

The project owner should enter all the measured data into the data sheet, using Excel to calculate the mean value of Specific volatile solids content of cow, swine manure in the three parallel sample, compared with the publicly available data.

APPENDIX

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