Composting of organic waste project in Guangxi

Document Prepared by Beijing Ruifang Technology Co., Ltd

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CONTENTS

1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The composting of organic waste project in Guangxi (hereafter referred to as the Project) is located in Guangxi, China, which is operated by Guangxi Liyuanbao Science and Technology Co., Ltd. The proposed project includes two project activity instances. One is located in Tiandong Petrochemical Industrial park, Tiandong County, Baise city (hereafter referred to as Instance 1), another one is located in the Yizhou District, Hechi City (hereafter referred to as Instance 2).

The project is a new building composting plant which designed to treat organic wastes to produce organic fertilizer. The project comprises of fermentation system and fertilizer production system, etc. The instances 1 is designed to treat 400,000 tonnes wet organic waste per year and produce 300,000 tonnes fertilizer per year. The instances 2 is designed to treat 150,000 tonnes wet organic waste per year and produce 110,000 tonnes fertilizer per year.

Scenario prior to the project:

The project uses waste biomass, manure, food waste for composting. These materials are bought directly from households, farms or food companies. In absence of the project, the organic wastes would have been dumped in the solid waste disposal site (SWDS).

This project avoids CH_4 emissions from the disposal of the waste in a landfill site in absence of the Project. The project is estimated to deliver totally 6,199,571 tCO_2e emission reduction during the 7 years' crediting period, at an average amount of 885,653 tCO_2e per year.

This project started construction on 19/03/2018 (instance 1 started construction on 19/03/2018 and instance 2 started construction on 20/04/2018). This project started operation on 06/01/2020 (Instance 1 starts commission on 06/01/2020. Instance 2 starts commissioning on 15/01/2020).

This monitoring period is from 06/01/2020 to. 31/12/2022. The total emission reductions in this monitoring period are 1,417,023 tCO_2.

Audit Type	Period	Program	VVB Name	Number of years
Validation	Registration	VCS	Applus+ Certification	/
Verification	06/01/2020-31/12/2022	VCS	Applus+ Certification	2.99years (1096days)
Total				3

1.2 Sectoral Scope and Project Type

The project activity treats the wastes that would have been dumped in SWDS for composting. The fertilizer generated by the composting could replace the chemical fertilizer which is of more GHG content. Therefore, the following sectoral scopes are applicable to the project activity.

- Sectoral scope 13: Waste handling and disposal

The project is not AFOLU project and not a grouped project.

1.3 Project Proponent

Organization name	Guangxi Liyuanbao Science and Technology Co., Ltd.
Contact person	Yao Baojie
Title	Manager
Address	Hong Li Road 10, Nanning City, Guangxi Zhuang Autonomous Region
Telephone	+86 539 60888170
Email	yaobaojie@126.com

1.4 Other Entities Involved in the Project

Organization name	Beijing Ruifang Technology Co., Ltd.
Role in the Project	Project developer for development of emission reductions through the Voluntary Carbon Standard
Contact person	Teng Haipeng
Title	Manager
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1.5 Project Start Date

The project activity started operation on 06/01/2020 (instance 1 started operation on 06/01/2020. Instance 2 started on 15/01/2020), which is the date that generates emission reductions.

1.6 Project Crediting Period

The 1st crediting period is from 06/01/2020 to 05/01/2027, which is 7 years and can be renewed twice. Therefore, the total crediting period is 21 years, from 06/01/2020 to 05/01/2041.

1.7 Project Location

The instance 1 is located in Tiandong Petrochemical Industrial Park, Nanning city, Guangxi Zhuang Autonomous region. The longitude of the proposed project site of instance 1 is 107°08'35" E. The latitude is 23°39'17" N.

Figure 1. Location of Guangxi province in China

Figure 2. Location of Nanning city in Guangxi

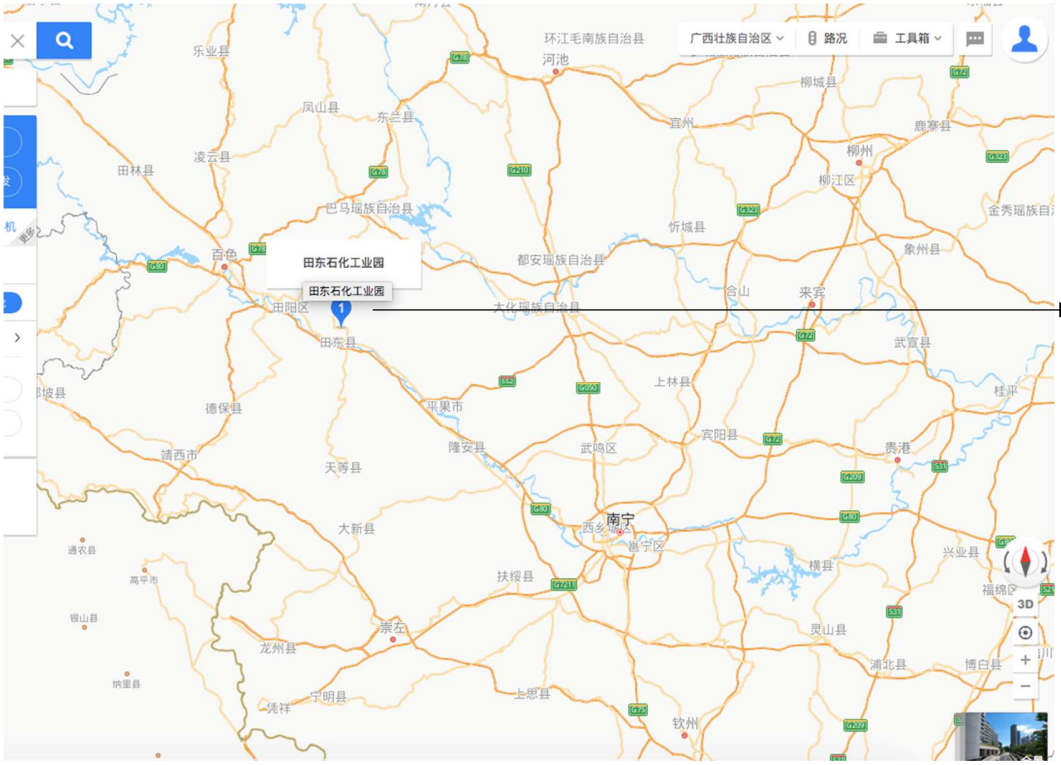

Figure 3. Location of instance 1 in Nanning city

The instance 2 is located in Tan Cun village, Huaiyuan Town, Yizhou District, Hechi City, Guangxi Zhuang Autonomous Region, China. The proposed project activity location is depicted in figure 1 and figure 2. Project coordinates of instance 2 are 24°34'19"N, 108°26'52" E.

Hechi City

Figure 4. Location of Hechi city in Guangxi

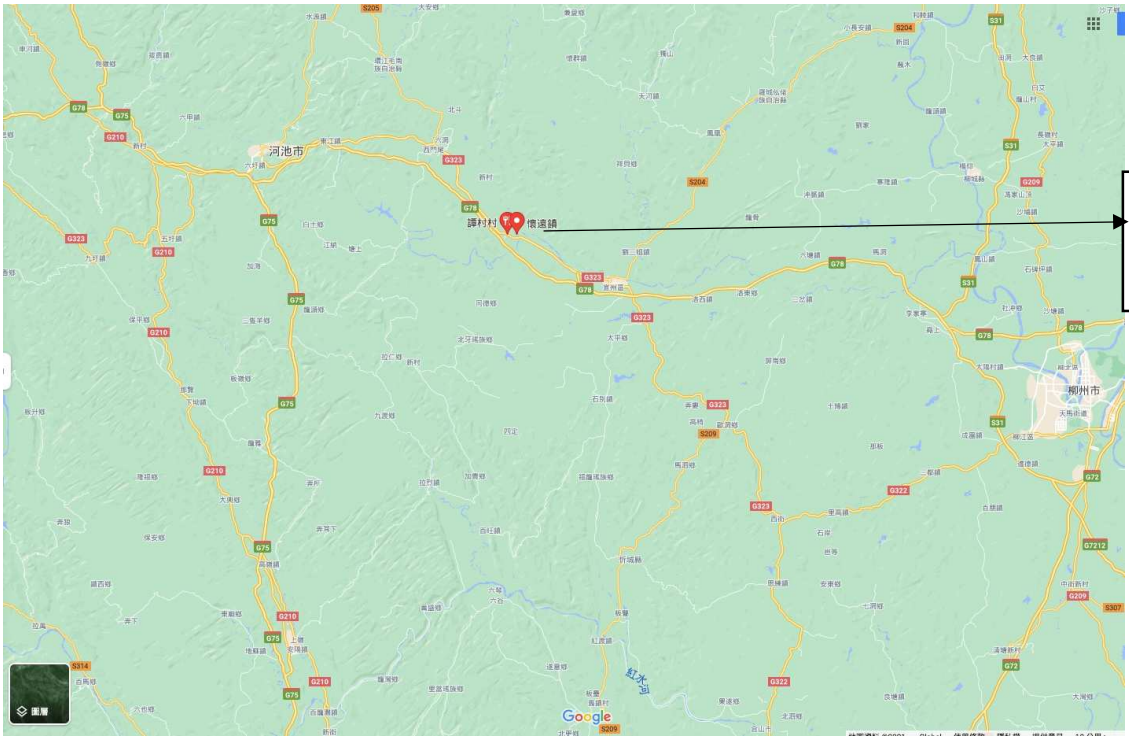

Figure 5. Location of instance 2

1.8 Title and Reference of Methodology

The following methodology is applicable to the proposed project activity:

Approved baseline and monitoring methodology ACM0022 "Alternative waste treatment process (version 03.0)"

The following methodological tools will also be used in this project activity:

- "Combined tool to identify the baseline scenario and demonstrate additionality (version 07.0)"
- "Emissions from solid waste disposal sites (version 08.0)"
- "Tool to calculate the emission factor for an electricity system (version 07.0)"
- "Project and leakage emissions from composting (version 02.0)"
- "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (version 03.0)"

1.9 Participation under other GHG Programs

The project is not registered under any other GHG programs.

1.10 Other Forms of Credit and Supply Chain (Scope 3) Emissions

The Project is not included in any other emissions trading program or any other mechanism that includes GHG allowance trading.

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

As per Clarification to VCS program rules and requirements issued on 31/05/2023, projects are not required to complete the sections in the affected VCS project templates that relate to Scope 3 emissions double claiming until the effective date of the revised requirements of 1 January 2024.

1.11 Sustainable Development Contributions

The contributions of the proposed project to local, host country and global environment and economy sustainable developments are shown as follows:

- The project avoids GHG emissions by treatment organic waste that would have been dumped in landfill site. Thus effectively improves the living circumstances for local people.
- This project also improves soil condition by providing organic fertilizer for local people, boosting farm crop production and promote the incomes of local farmers.
- This project provides job opportunities for local people, which is beneficial for local livelihood.

Table 1: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	8.3	8.3.1 Proportion of informal employment in total employment, by sector and sex	Implemented activities to decrease	The project provides 38 job opportunities for local people in this monitoring period	The project provides 38 long-term job opportunities for local people.
2)	12.4	12.4.2 (b) proportion of hazardous waste treated, by type of treatment	Implemented activities to increase	The solid waste disposed by this project is 1,066,343 ton (instance 1) and 393,784 ton (instance 2).	From the start date of project operation to the end date of this monitoring period, 1,460,127 ton solid waste are disposed.
3)	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to increase	By building composting plant, this project has prevented the release of 1,417,023CO_2 into the atmosphere during this monitoring period.	From the start date of project operation to the end date of this monitoring period, 1,417,023 tCO_2 emissions are avoided.

2 SAFEGUARDS

2.1 No Net Harm

There is no negative environmental and socio-economic impact. The project will prevent the CH_4 emission, thus is good for the environment. The project follows the local and national regulation in order to maintain and prevent the environmental impact. Besides, the project could provide job opportunities for local people, which is beneficial for local people's livelihood.

The EIA of instance 1 was approved by Baise city Environmental and Protection Bureau in Dec. 2017. The EIA of Project instance 2 was approved by Hechi city Environmental and Protection Bureau in Jan. 2018.

The environment protection measures that were taken include:

Through two-alkali method treatment and dust collector installation, dust concentration was decreased.

In the Fermentation workshop, enclosed three-dimensional dust removal and deodorization automatic environmental protection fermentation system was installed to the fermentation malodorous gas. And a 15m high exhaust tube was installed to discharge the gas.

The wastewater in construction period was treated by the wastewater treatment center of the project site and the final flue complied with national discharge standard. These flushing water in the operation period is precipitated in the sedimentation tank, and then reused for flushing.

During the operation period, silencer is installed to mitigate the noise impacts. The workers, is outfitted with the relevant noise reducing equipment.

The waste bags are recycled for industry production material. Industrial kiln furnace ash are recycled for construction material. Ash from dust collector are recycled for composting process. Daily life garbage are transported to solid waste treatment plant

2.2 Local Stakeholder Consultation

The stakeholder consultation for instance 1 was held in office of instance 1 on 07/09/2020. Participants, including local residents and employees attended the meeting.

The stakeholder consultation for instance 2 was held in office of instance 2 on 10/09/2020. Participants, including local residents and employees attended the meeting.

Before the stakeholder consultation meeting, the proposed project information was put on local village and near the power plant for public comment. Stakeholders were identified and informed through oral and bulletin. Invitation notice were put on the bulletin of local villages nearby the proposed project site. The invitation process was conducted 3 weeks prior to the meeting date.

Meeting Agenda

- Registration
- Welcome speech and purpose of the meeting by representative of Liyuanbao company.
- Description of the background of the proposed project implementation by Liyuanbao company.
- Description of the proposed project and environmental impacts.
- Questions and Answers
- Completing questionnaires

Compilation of comments received

The survey was conducted through distributing and collecting responses to the questionnaire. Totally, 60 questionnaire were sent (30 for instance 1 and 30 for instance 2) and 60 responses were collected.

The questionnaires mainly focus on following issues:

- What do you think is the possible environment problem that the proposed project may generate?

- What do you think is the effect of the proposed project on local environment?

- Are you satisfied with the environmental protection measures that the proposed project has made?

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

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

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

- Do you have any suggestions on this project?

The proposed project activity and its environmental impacts were described to the stakeholders during the meeting. Stakeholders acknowledged that the development of the proposed project would reduce methane emissions. The produced fertilizer could be used for soil application, and is good for environment than some other chemical fertilizer. They also have discount rights to buy the fertilizer if they want.

Table 1. Interviewee statistics for instance 1

Basic information	Classified items	Number of Persons	Percentage
Age	Younger than 30	2	7%
	30-50	24	80%
	>50	4	13%
Occupation	Working staff	15	50%

	Farmers	10	33%
	Teachers	5	17%
Education	Primary school	4	13%
	Middle school	6	20%
	College and above	20	67%
Gender	Male	18	60%
	Female	12	40%

Table 2. Interviewee statistics for instance 2

Basic information	Classified items	Number of Persons	Percentage
Age	Younger than 30	0	0%
	30-50	27	90%
	>50	3	10%
Occupation	Working staff	5	17%
	Farmers	25	83%
	Others	0	0%
Education	Primary school	22	73%
	Middle school	5	17%
	College and above	3	10%
Gender	Male	24	80%
	Female	6	20%

The responses are concluded as follows:
- 100% people think the proposed project would not generate environment problem.

- 100% people think the proposed project would improve local environment.
- 100% people are satisfied about the environment protection measures that the proposed project has made.
- 100% people think the proposed project could improve local employment.
- 100% people think the proposed project has good impact on local economy.
- 100% people agree with the construction of the proposed project.

According to the feedback during the meeting, all the stakeholders support the project activity and think that the project has provided environmental and safety measures. Therefore, this project activity is perceived as an environmentally friendly project, which can improve the quality of life of the surrounding community. The project activity is expected to deliver multiple benefits in respect of sustainable development including environmental, social and economic benefits.

During the stakeholder consultation meeting, the contact information of the project owner had been made public to the attenders.
Besides, a grievance book is put in the communication room of the company gate. Those who want to put his comment can write on the book.

In this monitoring period, no comment was received.

2.3 AFOLU-Specific Safeguards

N/A

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

The project uses waste biomass, manure, food waste for composting. This project uses microbial aerobic fermentation technology.

The mixed organic matter is directly sent to a fully enclosed three-dimensional dust removal and deodorization, automatic environmental protection fermentation system for efficient aerobic fermentation. In the process of fermentation and maturation of organic waste, water is evaporated, and the material is dried at the same time, so as to meet the water requirements for the production and processing of commercial ecological fertilizers.

The produced manure powder is moved to manure workshop in where some auxiliary elements (Nitrogen, Phosphorus, Kalium etc.) are added for producing final manure.

The wastewater produced during the composting is sprinkled back to composting workshop for keeping the temperature and humidity. Therefore, the wastewater is treated in aerobic conditions.

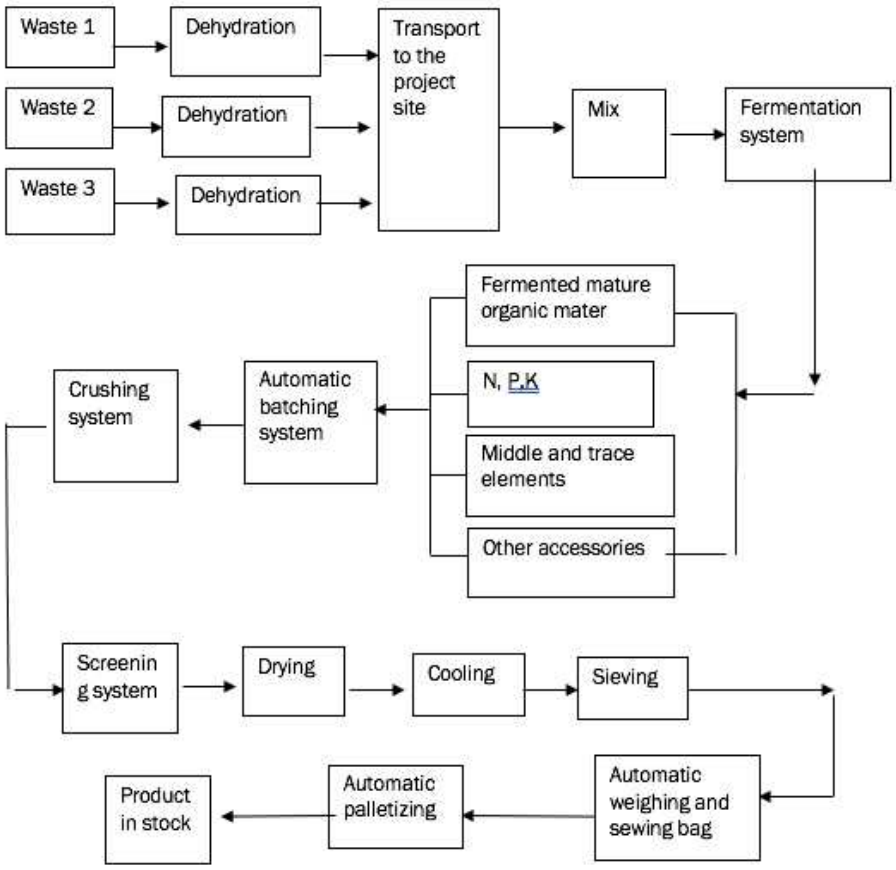

Figure 1. Flowchart of the project

Table 2. Key parameters of main equipment

Number	Equipment	Instance 1	Instance 2
1	Belt conveyor	Type: LYBSSJ Rated power: 3KW	Type: LYSSJ Rated power: 5.5KW, 4.0KW
2	Blender	Type: LYJBJ Rated power: 45KW	Type: LYJBJ Rated power: 55KW
3	Crusher	Type: LYLPJ Rated power: 45KW	Rated power: 45KW

4	Palletizer	Type: LYBMDJ Rated power: 22.5KW	Rated power: 30KW

This project started construction on 19/03/2018 (instance 1 started construction on 19/03/2018 and instance 2 started construction on 20/04/2018). This project started operation on 06/01/2020 (Instance 1 starts commission on 06/01/2020. Instance 2 starts commissioning on 15/01/2020).

This monitoring period covers from 06/01/2020 to 31/12/2022. During this monitoring period, the Project was implemented in line with the monitoring plan. And in this monitoring period, the equipment runs well. No equipment is overhauled or replaced. No events or emergency which may impact the emission reductions and monitoring occurred during this monitoring period.

3.2 Deviations

3.2.1 Methodology Deviations

There is no methodology deviation in this monitoring period.

3.2.2 Project Description Deviations

In the registered PD, the monitoring equipment for $P_{n,j,x}$ is expected to be electronic platform scale with accuracy of class III. However, considering some business reasons, Electronic balance was chosen as the monitoring equipment for $P_{n,j,x}$ of instance 1, with accuracy of class III instead of electronic platform scale.

$P_{n,j,x}$ is the weight fraction of each kind of waste. Both electronic platform scale and electronic balance are both weight monitoring equipment. According to 'JJG1036-2022 Electronic balance[1]', electronic balance could monitor weight and its accuracy includes class I, II, III and IIII. III belongs to middle accuracy. According to JJG539-2016 Digital indicating weighing instruments [2], electronic platform scale could be used to monitor the weight. Its accuracy includes class III and class IIII. III belongs to middle accuracy. Since electronic platform scale and electronic balance both could be used for weight monitoring as per national standard, and their accuracy are satisfied with national standard (Class III). The switch to electronic balance from electronic platform scale in instance 1 is reasonable.

Besides, methodology ACM0022 does not define which equipment should be used.

[1] https://www.doc88.com/p-14659877560633.html

[2] https://www.docin.com/p-1869437693.html

Therefore, this deviation will not impact the methodology applicability, will not impact the project additionality and will not impact the emission reduction calculations. Because the monitoring method is accurate, following national standard and ACM0022.

Therefore, the deviation of monitoring equipment will not impact the project.

3.3 Grouped Projects

N/A

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	φ
Data unit	/
Description	Default value for the model correction factor to account for model uncertainties
Source of data	Default value from "Emissions from solid waste disposal sites"
Value applied	0.85
Justification of choice of data or description of measurement methods and procedures applied	For baseline emissions, 0.85 is applied for Humid/wet conditions, application B For project emissions, φ =1
Purpose of Data	Calculation of baseline emissions and project emissions.
Comments	/

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	Based on an extensive review of published literature on this subject, including the IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied	0.1
Justification of choice of data or description of	Default value

measurement methods and procedures applied	
Purpose of Data	Calculation of baseline emissions
Comments	/

Data / Parameter	GWP_{CH4}
Data unit	$tCO_2e/t\ CH_4$
Description	Global Warming Potential of methane
Source of data	IPCC AR5
Value applied	28
Justification of choice of data or description of measurement methods and procedures applied	Default value
Purpose of Data	Calculation of baseline emissions and project emissions
Comments	/

Data / Parameter	F
Data unit	/
Description	Fraction of methane in the SWDS gas (volume fraction)
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied	0.5
Justification of choice of data or description of measurement methods and procedures applied	Default value
Purpose of Data	Calculation of baseline emissions
Comments	/

Data / Parameter	MCF
Data unit	/
Description	Methane correction factor
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied	0.8 for unmanaged solid waste disposal sites – deep

Justification of choice of data or description of measurement methods and procedures applied	Default value
Purpose of Data	Calculation of baseline emissions
Comments	/

Data / Parameter	k_j
Data unit	1/yr
Description	Decay rate for the waste type j
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)
Value applied	Default values for the decay rate (kj)

	Waste type j	Tropical (MAT>20°C Wet (MAP>1000mm)
Slowly degrading	Pulp, paper and cardboard (other than sludge)	0.07
	Wood, wood products and straw	0.035
Moderately degrading	Other(non-food) organic putrescible garden and park waste	0.17
Rapidly degrading	Food, food waste, beverages and tobacco (other than sludge)	0.40

The annual average temperature of Hechi city is 20.5°C, and annual rainfall is 1,200-1,600mm.[3]

The annual average temperature of Baise city is 22°C, and annual rainfall is 1,000mm[4]

[3] http://www.weather.com.cn/cityintro/101301201.shtml

[4] http://www.weather.com.cn/cityintro/101301001.shtml

Justification of choice of data or description of measurement methods and procedures applied	Default value
Purpose of Data	Calculation of baseline emissions
Comments	/

Data / Parameter	$EF_{grid,CM,y}$
Data unit	tCO_2/MWh
Description	Emission factor for electricity generation for SCPG in year y
Source of data	2019 China's regional power grid baseline emission factor[5]
Value applied	0.50885
Justification of choice of data or description of measurement methods and procedures applied	Calculation based on "Tool to calculate the emission factor for an electricity system (version 07.0)"
Purpose of Data	Calculation of project emissions
Comments	/

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	The emission factor was selected based on studying published results of emission measurements from composting facilities, literature reviews on the subject and published emission factors. Data from recent, high quality sources was analyzed and a value conservatively selected from the higher end of the range in results.
Value applied	0.002
Justification of choice of data or description of measurement	Default value from "project and leakage emissions from composting-v2.0"

[5] https://www.mee.gov.cn/ywgz/ydqhbh/wsqtkz/

methods and procedures applied	
Purpose of Data	Calculation of baseline emissions
Comments	/

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	The emission factor was selected based on studying published results of emission measurements from composting facilities, literature reviews on the subject and published emission factors. Data from recent, high quality sources was analyzed and a value conservatively selected from the higher end of the range in results.
Value applied	0.0002
Justification of choice of data or description of measurement methods and procedures applied	Default value from "project and leakage emissions from composting-v2.0"
Purpose of Data	Calculation of baseline emissions
Comments	/

Data / Parameter	GWP_{N20}
Data unit	$tCO_2e/t\ N_2O$
Description	Global Warming Potential of N_2O
Source of data	IPCC AR5
Value applied	265
Justification of choice of data or description of measurement methods and procedures applied	Default value
Purpose of Data	Calculation of project emissions
Comments	/

Data / Parameter	$TDL_{k,y}$

Data unit	%
Description	Average technical transmission and distribution losses for providing electricity to SCPG in year y
Source of data	Default value from 'baseline, project and or leakage emissions from electricity consumption and monitoring of electricity generation (version 03.0)'
Value applied	3
Justification of choice of data or description of measurement methods and procedures applied	Default value from 'baseline, project and or leakage emissions from electricity consumption and monitoring of electricity generation (version 03.0)'
Purpose of Data	Calculation of baseline emissions
Comments	/

Data / Parameter	$TDL_{j,y}$
Data unit	%
Description	Average technical transmission and distribution losses for providing electricity to source j in year y
Source of data	Default value from 'baseline, project and or leakage emissions from electricity consumption and monitoring of electricity generation (version 03.0)'
Value applied	20
Justification of choice of data or description of measurement methods and procedures applied	Default value from 'baseline, project and or leakage emissions from electricity consumption and monitoring of electricity generation (version 03.0)'
Purpose of Data	Calculation of project emissions
Comments	/

4.2 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	The Technical code for Municipal solid waste sanitary landfill (GB50869-2013) states (in clause 11.1.3 and clause 11.5.1) that landfill gas should be utilized (for gas that can be utilized) or flared (for gas that cannot be utilized). However, the statement is only a recommendation, not a compulsory requirement.
Description of measurement methods and procedures to be applied	There is no compulsory regulation on methane capture and use for SWDS.
Frequency of monitoring/recording	Annually
Value monitored	0
Monitoring equipment	/
QA/QC procedures to be applied	Published by China Ministry of Housing and Urban-Rural Development on 08/08/2013 (GB50869-2013).
Purpose of the data	Calculation of baseline emissions
Calculation method	/
Comments	/

Data / Parameter	$RATE_{COMPLIANCE,t}$
Data unit	/
Description	Rate of compliance with a regulatory requirement to implement the alternative waste treatment t implemented in the project activity
Source of data	The Technical code for Municipal solid waste sanitary landfill (GB50869-2013)

Description of measurement methods and procedures to be applied	There is no compulsory regulation on methane capture and use for SWDS. This is fixed in the crediting period.
Frequency of monitoring/recording	Fixed in the crediting period
Value monitored	0
Monitoring equipment	/
QA/QC procedures to be applied	Public website
Purpose of the data	Calculation of baseline emissions
Calculation method	/
Comments	/

Data / Parameter	$DOC_{f,y}$
Data unit	Weight fraction
Description	Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year *y*
Source of data	Calculated based on monitoring data of BMP_j, F and DOC_j $DOC_{f,y} = DOC_{f,m} = 0.7 \times \frac{12}{16} \times \frac{BMP_j}{F \times DOC_j}$ BMP_j : Biochemical methane potential for the residual waste type *j* disposed or prevented from disposal (t CH_4/t waste) F: Fraction of methane in the SWDS gas (volume fraction) DOC_j: Fraction of degradable organic carbon in the waste type *j* (weight fraction)
Description of measurement methods and procedures to be applied	The data of BMP_j, DOC_j and F are monitored by qualified party according to national standard. These values are fixed and the $DOC_{f,y}$ are fixed during the crediting period. The monitoring information is shown in following tables.
Frequency of monitoring/recording	The value of DOCf,y is fixed and during the crediting period
Value monitored	For instance 1:

	$DOC_{biomass,y}$=0.7*12/16*0.29/(0.5*32%)=0.95 $DOC_{manure,y}$=0.7*12/16*0.35/(0.54*37%)=0.92 $DOC_{food\ waste,y}$=0.7*12/16*0.43/(0.61*40%)=0.93 For instance 2: $DOC_{biomass,y}$=0.7*12/16*0.31/(0.51*33%)=0.97 $DOC_{manure,y}$=0.7*12/16*0.36/(0.53*38%)=0.94 $DOC_{food\ waste,y}$=0.7*12/16*0.42/(0.62*39%)=0.91 The data of $DOC_{f,y}$ are fixed during the crediting period.
Monitoring equipment	/
QA/QC procedures to be applied	/
Purpose of the data	Calculation of baseline emissions
Calculation method	$DOC_{f,y} = DOC_{f,m} = 0.7 \times \frac{12}{16} \times \frac{BMP_j}{F \times DOC_j}$
Comments	/

Data / Parameter	BMP_j
Data unit	t CH_4/t waste
Description	Biochemical methane potential for the residual waste type *j* disposed or prevented from disposal
Source of data	Material inspection report
Description of measurement methods and procedures to be applied	The values are monitored by Liyuanbao Ecological Big Data Co., Ltd. using fermentation test. The fermentation test was conducted three samples on each type of waste, and each sample is 500g in weight. The fermentation test is to create an anaerobic environment for the waste to generate methane. The duration of fermentation test is waiting untill no further methane is generated.
Frequency of monitoring/recording	These values are monitored before issuance and the values are fixed during the crediting period.
Value monitored	The biochemical methane potential for the residual waste type j is monitored in 2019 by Liyuanbao Ecological Big Data Co., Ltd. The monitoring result is shown as follows: For instance 1 $BMP_{biomass}$=0.29

	BMP_{manure}=0.35 BMP_{food}=0.43 For instance 2: $BMP_{biomass}$=0.31 BMP_{manure}=0.36 BMP_{food}=0.42 These data are monitored by qualified party. The values are fixed during the crediting period.
Monitoring equipment	/
QA/QC procedures to be applied	Liyuanbao Ecological Big Data Co., Ltd. Is established in 2017 in in Nanning city. It is qualified in soil monitoring, agriculture and forestry waste monitoring, data collection and save, quality control, etc. The monitoring equipment are common laboratory equipment.
Purpose of the data	Calculation of baseline emissions
Calculation method	/
Comments	/

Data / Parameter	F
Data unit	volume fraction
Description	Fraction of methane in the SWDS gas (volume fraction)
Source of data	Material inspection report
Description of measurement methods and procedures to be applied	The fractions are monitored by qualified party according to national standard.
Frequency of monitoring/recording	These are monitored by qualified party according to national standard. The values are fixed during the crediting period.
Value monitored	The fraction of methane in the SWDS gas is monitored in 2019 by Liyuanbao Ecological Big Data Co., Ltd. Liyuanbao Ecological Big Data Co., Ltd. Is established in 2017 in in Nanning city. It is qualified in soil monitoring, agriculture and forestry waste monitoring, data collection and save, quality control, etc. The monitoring result is shown as follows:

	For instance 1: $F_{biomass}$=0.5 F_{manure}=0.54 F_{food}=0.61 For instance 2: $F_{biomass}$=0.51 F_{manure}=0.53 F_{food}=0.62
Monitoring equipment	/
QA/QC procedures to be applied	Monitored by qualified party according to national standard.
Purpose of the data	Calculation of baseline emissions
Calculation method	/
Comments	/

Data / Parameter	DOC_j
Data unit	/
Description	Fraction of degradable organic carbon in the waste type *j* (weight fraction)
Source of data	Material inspection report
Description of measurement methods and procedures to be applied	Monitored by Liyuanbao Ecological Big Data Co., Ltd. using potassium dichromate volumetric method.
Frequency of monitoring/recording	These are monitored by qualified party according to national standard. The values are fixed during the crediting period
Value monitored	The fraction of methane in the SWDS gas is monitored in 2019 by Liyuanbao Ecological Big Data Co., Ltd. The monitoring result is shown as follows: For instance 1: $DOC_{biomass}$=32% DOC_{manure}=37% DOC_{food}=40%

	For instance 2: $DOC_{biomass}$=33% DOC_{manure}=38% DOC_{food} =39%
Monitoring equipment	/
QA/QC procedures to be applied	The test is conducted by Liyuanbao Ecological Big Data Co., Ltd. Liyuanbao Ecological Big Data Co., Ltd. is established in 2017 in Nanning city. It is qualified in soil monitoring, agriculture and forestry waste monitoring, data collection and save, quality control, etc. The monitoring equipment are common laboratory equipment.
Purpose of the data	Calculation of baseline emission
Calculation method	/
Comments	/

Data / Parameter	W_x
Data unit	*t*
Description	Total amount of solid waste disposed or prevented from disposal in the SWDS in year *x*
Source of data	Measurements by project participants
Description of measurement methods and procedures to be applied	The quantity of waste is monitored by weighing devices. The information weighting devices are shown in the following row.
Frequency of monitoring/recording	Continuously, aggregated monthly
Value monitored	For instance 1 06/01/2020-31/12/2020: 341,965 01/01/2021-31/12/2021:357,385 01/01/2022-31/12/2022: 366,993 For instance 2

	15/01/2020-31/12/2020: 125,079 01/01/2021-31/12/2021:132,608 01/01/2022-31/12/2022:136,097
Monitoring equipment	For instance 1 (Tiandong company)

Equipment	Type	Serial number	Accuracy	Calibration date	Valid till
Electronic weighbridge	D2008	13406	class III	19/11/2019	18/11/2020
				13/11/2020	12/11/2021
				09/11/2021	08/11/2022
				03/11/2022	02/11/2023

For instance 2 (Woze company)

Equipment	Type	Serial number	Accuracy	Calibration date	Valid till
Electronic weighbridge	SCS-120	010688	class III	12/12/2019	11/12/2020
				24/11/2020	23/11/2021
				10/11/2021	09/11/2022
				24/06/2022	23/06/2023

QA/QC procedures to be applied	The methane detector is calibrated as per national standard.
Purpose of the data	Calculation of baseline and project emissions
Calculation method	/
Comments	/

Data / Parameter	$P_{n,j,x}$
Data unit	Weight fraction

<table>
<tr><td>Description</td><td>Weight fraction of the waste type j in the sample n collected during the year x</td></tr>
<tr><td>Source of data</td><td>Sample measurements by project participants</td></tr>
<tr><td>Description of measurement methods and procedures to be applied</td><td>Sample the waste composition, using the waste types j, as provided in the table for DOCj and kj, and weigh each waste fraction (measure on wet basis)</td></tr>
<tr><td>Frequency of monitoring/recording</td><td>Three samples every three months</td></tr>
<tr><td>Value monitored</td><td>For instance 1: $P_{biomass,y}$=76.4%; $P_{manure,y}$=13.9%； $P_{food,y}$=6.9%
For instance 2: $P_{biomass,y}$=77.2%; $P_{manure,y}$=16.7%； $P_{food,y}$=6.2%</td></tr>
<tr><td>Monitoring equipment</td><td>For instance 1 (Tiandong company)
<table>
<tr><th>Equipment</th><th>Type</th><th>Serial number</th><th>Accuracy</th><th>Calibration date</th><th>Valid until</th></tr>
<tr><td rowspan="4">Electronic balance</td><td rowspan="4">FA2004N</td><td rowspan="4">Y201510175</td><td rowspan="4">Class III</td><td>01/08/2019</td><td>31/07/2020</td></tr>
<tr><td>09/07/2020</td><td>08/07/2021</td></tr>
<tr><td>02/07/2021</td><td>01/07/2022</td></tr>
<tr><td>27/06/2022</td><td>26/06/2023</td></tr>
</table>
For instance 2 (woze company)
<table>
<tr><th>Equipment</th><th>Type</th><th>Serial number</th><th>Accuracy</th><th>Calibration date</th><th>Valid until</th></tr>
<tr><td rowspan="4">Electronic platform scale</td><td rowspan="4">TCS-150-66</td><td rowspan="4">T3248673</td><td rowspan="4">class III</td><td>13/12/2019</td><td>12/12/2020</td></tr>
<tr><td>01/12/2020</td><td>30/11/2021</td></tr>
<tr><td>10/11/2021</td><td>09/11/2022</td></tr>
<tr><td>24/06/2022</td><td>23/06/2023</td></tr>
</table></td></tr>
<tr><td>QA/QC procedures to be applied</td><td>The electronic platform scale is calibrated according to national standard.</td></tr>
<tr><td>Purpose of the data</td><td>Calculation of baseline and project emissions</td></tr>
<tr><td>Calculation method</td><td>$p_{j,x} = \frac{\sum_{n=1}^{Z_x} p_{n,j,x}}{Z_x}$</td></tr>
<tr><td>Comments</td><td>/</td></tr>
</table>

Data / Parameter	Z_x
Data unit	/
Description	Number of samples collected during the year x
Source of data	Weight fraction record of raw material by project owner
Description of measurement methods and procedures to be applied	Three samples every three months
Frequency of monitoring/recording	Continuously, aggregated annually
Value monitored	Instance 1: 108 samples were collected during this monitoring period. 36 for biomass 36 for manure 36 for food *Instance 2:* 108 samples were collected during this monitoring period. 36 for biomass 36 for manure 36 for food
Monitoring equipment	/
QA/QC procedures to be applied	The sample size and sampling technique must ensure the sample is representative.
Purpose of the data	Calculation of baseline and project emissions
Calculation method	/
Comments	/

Data / Parameter	$EC_{PJ,comp,y}$ ($EC_{PJ,j,y}$)
Data unit	MWh/yr

<table>
<tr><td>Description</td><td>Quantity of electricity consumed for composting in year y</td></tr>
<tr><td>Source of data</td><td>Project participants</td></tr>
<tr><td>Description of measurement methods and procedures to be applied</td><td>Electricity meter</td></tr>
<tr><td>Frequency of monitoring/recording</td><td>Continuous measurement and at least monthly recording</td></tr>
<tr><td>Value monitored</td><td>Instance 1: 2652.336MWh
Instance 2: 619.450MWh</td></tr>
<tr><td>Monitoring equipment</td><td>For instance 1:
<table>
<tr><th>Equipment</th><th>Type</th><th>Serial Number</th><th>Accuracy</th><th>Calibration date</th><th>Valid until</th></tr>
<tr><td rowspan="4">Electricity meter</td><td rowspan="4">DSSD331</td><td rowspan="4">611P1A05 109275</td><td rowspan="4">0.2s</td><td>30/10/2019</td><td>29/10/2020</td></tr>
<tr><td>26/10/2020</td><td>25/10/2021</td></tr>
<tr><td>21/10/2021</td><td>20/10/2022</td></tr>
<tr><td>17/10/2022</td><td>16/10/2023</td></tr>
</table>
For instance 2:
<table>
<tr><th>Equipment</th><th>Type</th><th>Serial Number</th><th>Accuracy</th><th>Calibration date</th><th>Valid until</th></tr>
<tr><td rowspan="4">Electricity meter</td><td rowspan="4">DSSD331</td><td rowspan="4">0017000 10644</td><td rowspan="4">0.2s</td><td>04/11/2019</td><td>03/11/2020</td></tr>
<tr><td>02/11/2020</td><td>01/11/2021</td></tr>
<tr><td>29/10/2021</td><td>28/10/2022</td></tr>
<tr><td>26/10/2022</td><td>25/10/2023</td></tr>
</table></td></tr>
<tr><td>QA/QC procedures to be applied</td><td>The electricity meter will be calibrated periodically according to national standard.</td></tr>
<tr><td>Purpose of the data</td><td>Calculation of project emissions</td></tr>
<tr><td>Calculation method</td><td>/</td></tr>
</table>

Comments	/

4.3 Monitoring Plan

1. Monitoring team

The general manager of the company monitors overall performance of the plant, ensures the normal operation, management and product sales.

A monitoring team is built, consisted with team manager, monitoring staff, data verifier. The team manager is charge for the monitoring activities, to ensure that all the data are properly recorded and stored, all the equipment are calibrated timely. The monitoring staff is responsible for the specific daily work, including product quality assurance, equipment maintenance and repair, data record and check, etc.

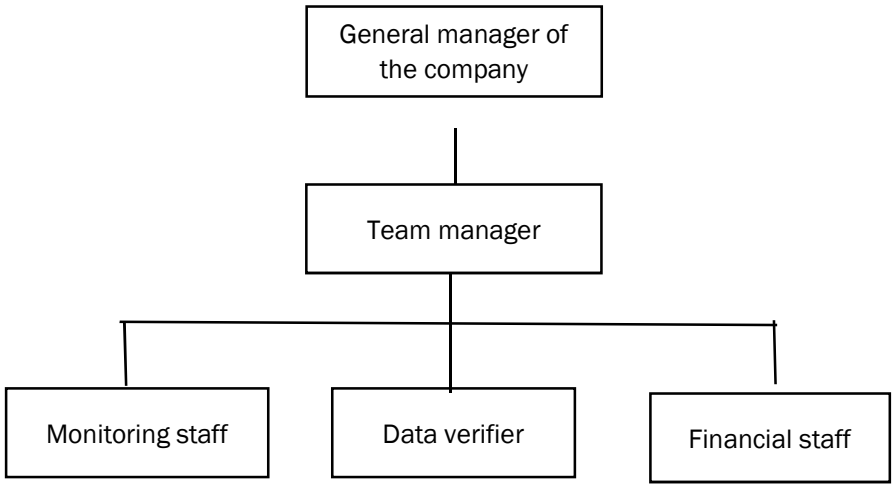

Figure 4. Monitoring structure

2. Monitoring parameters

Parameter	Description	Monitoring measure
W_x	Total amount of solid waste disposed or prevented from disposal in the SWDS in year x	The quantity of waste is monitored by electronic weighbridge with accuracy of class III.
$P_{n,j,x}$	Weight fraction of the waste type j in the sample n collected during the year x	The quantity of waste is monitored by electronic platform scale with accuracy of class III.

$EC_{PJ,comp,y}$ ($EC_{PJ,j,y}$)	Quantity of electricity consumed for composting in year y	The amount of electricity consumed is monitored by electricity meter with accuracy of 0.5S. The electricity meter will be calibrated according to national standard.
BMP_j	Biochemical methane potential for the residual waste type j disposed or prevented from disposal (t CH4/t waste)	Monitored by qualified party. The value is fixed in the crediting period
DOC_j	Fraction of degradable organic carbon in the waste type j (weight fraction)	Monitored by qualified party. The value is fixed in the crediting period
F	Fraction of methane in the SWDS gas (volume fraction)	Monitored by qualified party. The value is fixed in the crediting period

3. Data collection and Storage

The carbon monitoring team is responsible for the data management and storage. Data are recorded by the workers and checked by the monitoring team members. The collected data is approved and supervised by the plant manager who is in charge of data processing.

All relevant data are stored and will be kept for at least two years after the end of the crediting period or the last issuance of VERs for the project activity, whichever occurs later.

4. Calibration of the equipment

The required monitoring equipment is installed by the technology provider. Monitoring equipment are regularly calibrated according to national standards.

5. Emergency handling

If there is any emergency or shut down, the workers should notice the operation manager as soon as possible. And the professional maintenance personnel will be noticed to check and repair. At the same time, the reasons that cause the shut down and time period will be recorded.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

ACM0022 (version 03.0) is applied and the baseline emissions are as follows:

$$BE_y = \sum_t \left(BE_{CH4,t,y} + BE_{WW,t,y} + BE_{EN,t,y} + BE_{NG,t,y}\right) \times (1 - RATE_{compliance,t}) \quad (1)$$

Where,

BE_y	=	Baseline emissions in year *y* (tCO_2e/yr)
$BE_{CH4,y}$	=	Baseline emissions of methane from the SWDS in year y (tCO_2e)
$BE_{WW,y}$	=	Baseline methane emissions from anaerobic treatment of the wastewater in open anaerobic lagoons or of sludge in sludge pits in the absence of the proposed project activity in year y (tCO_2e)
$BE_{EN,t,y}$	=	Baseline emissions associated with energy generation in year y (tCO_2)
$BE_{NG,t,y}$	=	Baseline emissions associated with natural gas use in year y (tCO_2)
$RATE_{compliance,t}$	=	Discount factor to account for the rate of compliance of a regulatory requirement that mandates the use of alternative waste treatment process t
t	=	Type of alternative waste treatment process

The proposed project does not include wastewater treatment, energy generation and natural gas, therefore

$BE_{WW,y}=0$

$BE_{EN,t,y}=0$

$BE_{NG,t,y}=0$

For the project activity, the baseline emission is that Methane emissions from the SWDS in the absence of the proposed project activity. There is no local or national environmental regulation

that mandates the disposal of SWDS through incineration or composting in China at present. Thus, the compliance rate is determined zero for ex-ante calculation. $RATE_{compliance,\,t}$ =0

Baseline emissions of methane from the SWDS ($BE_{CH4,y}$)

$$BE_{CH4,SWDS,y} = \varphi_y \cdot (1-f_y) \cdot GWP_{CH4} \cdot (1-OX) \cdot \frac{16}{12} \cdot F \cdot DOC_{f,y} \cdot MCF_y \cdot \sum_{x=1}^{y} \sum_{j} W_{j,x} \cdot DOC_j \cdot e^{-k_j \cdot (y-x)} \cdot (1-e^{-k_j})$$

Where

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);
$DOC_{f,y}$	Fraction of degradable organic carbon (DOC) that can decomposes under the specific conditions occurring in the SWDS for year y (weight fraction);
MCF_y	Methane Correction Factor for year y;
$W_{j,x}$	Amount of solid waste type j disposed or prevented from disposal in the SWDS in the year x;
DOC_j	Fraction of degradable organic carbon in the waste type j (by weight);
k_j	The decay rate for the waste type j (1/yr);
j	Type of residual waste or type of waste in the MSW;
x	Year in the time period in which waste is disposed at the SWDS, extending from the first year in the time period (x = 1) to the year y (x = y);
y	Year of the crediting period for which methane emissions are calculated

Determining the fixed parameters that used to calculate the $BE_{CH4,SWDS,y}$

Parameter	Value	Data source
φ_y	0.85	Emissions from solid waste disposal sites (version 08.0) Application B, Humid/wet conditions
GWP_{CH4}	28	AR5

OX	0.1	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
DOC_f	For instance 1: $DOC_{biomass}$=0.95 DOC_{manure}=0.92 DOC_{food}=0.93 For instance 2: $DOC_{biomass}$=0.97 DOC_{manure}=0.94 DOC_{food}=0.91	Calculated based on the monitoring value of BMP_j, F, DOC_j
BMP_j	For instance 1: $BMP_{biomass}$=0.29 BMP_{manure}=0.35 BMP_{food}=0.43 For instance 2: $BMP_{biomass}$=0.31 BMP_{manure}=0.36 BMP_{food}=0.42	The BMP_j is monitored by third party. The result of BMP of biomass is listed in Biomass Inspection report. These data are fixed in the crediting period. The result of BMP of manure is listed in Manure Inspection report. These data are fixed in the crediting period. The result of BMP of food waste is listed in Food waste Inspection report. The data is fixed in the crediting period.
F	For instance 1: $F_{biomass}$=0.50 F_{manure}=0.54 F_{food}=0.61 For instance 2: $F_{biomass}$=0.51 F_{manure}=0.53 F_{food}=0.62	The F is monitored by third party. The result of F of biomass is listed in Biomass Inspection report. These data are fixed in the crediting period. The result of F of manure is listed in Manure Inspection report. These data are fixed in the crediting period. The result of F of food waste is listed in Food waste Inspection report. The data is fixed in the crediting period.
DOC_j	For instance 1: $DOC_{biomass}$=32%;	The DOC_j is monitored by third party. The result of DOC of biomass is listed in Biomass Inspection report. These data are fixed in the crediting period.

	DOC_{manure}=37%; $DOC_{food\ waste}$=40% For instance 2: $DOC_{biomass}$=33%; DOC_{manure}=38%; $DOC_{food\ waste}$=39%	The result of DOC of manure is listed in Manure Inspection report. These data are fixed in the crediting period. The result of DOC of food waste is listed in Food waste Inspection report. The data is fixed in the crediting period.
MCF	0.8	Unmanaged solid waste disposal sites-deep, IPCC 2006 Guidelines for National Greenhouse Gas Inventories
kj	0.17 for garden and park waste, (wet basis); 0.40 for food, food waste, sewage sludge, beverages and tobacco, (wet basis); 0.035 for wood, wood products and straw, manure	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)

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

$$W_{j,x}=W_x \times p_{j,x} \quad (3)$$

Where

W_x	Total amount of solid waste disposed or prevented from disposal in the SWDS in year *x* (t)
$p_{j,x}$	Average fraction of the waste type *j* in the waste in year *x* (weight fraction)
j	Types of solid waste
x	Years in the time period for which waste is disposed at the SWDS, extending from the first year in the time period (*x* = 1) to year *y* (*x* = y)

$$p_{j,x}=\frac{\sum_{n=1}^{Z_x} p_{n,j,x}}{Z_x} \quad (4)$$

where

$P_{j,x}$	Average fraction of the waste type *j* in the waste in year *x* (weight fraction)

$p_{n,j,x}$	Fraction of the waste type *j* in the sample *n* collected during the year *x* (weight fraction)
Z_x	Number of samples collected during the year x
n	Samples collected in year x
j	Types of solid waste
x	Years in the time period for which waste is disposed at the SWDS, extending from the first year in the time period (*x* = 1) to year *y* (*x* = y)

The calculation for baseline emission and project emission is on a yearly basis according to the formula in the tools, but considering the start date for both instances in 2020 and end date of 1st crediting period in 2027, the actual operation days of both instances has been considered in ER calculation.

In following text, the 1st step is calculation of baseline emissions (from table 14 to table 19) and project emissions (from table 23 to table 28) in each whole year.

The 2nd step is calculation the actual baseline and project emissions in each year as per the operation days of the year. the final value of Baseline Emissions are shown in table 20 to table 22. The final values of project emissions are shown in table 29 to table 30. The final ER of the crediting period is shown in table 31.

Table 3. Calculation result of $BE_{biomass,y}$ in each whole year of the monitoring period for instance 1

Year	Amount of biomass Waste Composted (t)	Wj,x*DOCj*(1-e-kj)*e-kj*(y-x)	(Baseline CH_4 Emissions from biomass Waste) *GWP_{CH4}	$BE_{biomas,y}$ (tCO_2e)
2020	265,253	5,715	160,017	160,017[6]
2021	272,767	10,698	299,551	299,551
2022	276,299	14,979	419,401	419,401
Sum		/	844,294	876,783

Table 4. Calculation value of $BE_{biomass,y}$ in each whole year of the monitoring period for instance 2

Year	Amount of biomass Waste Composted (t)	Wj,x*DOCj*(1-e-kj)*e-kj*(y-x)	(Baseline CH_4 Emissions from biomass Waste) *GWP_{CH4}	$BE_{biomas,y}$ (tCO_2e)
2020	97,166	2,248	62,955	62,955[7]
2021	97,014	4,142	115,970	115,970
2022	109,677	6,032	168,901	168,901

[6] This value is $BE_{biomass,y}$ in the whole year of 2020 for instance 1.

[7] This value is $BE_{biomass,y}$ in the whole year of 2020 for instance 1.

Sum		/	345,418	345,418

Table 5. Calculation value of $BE_{manure,y}$ in each whole year of the monitoring period for instance 1

Year	Amount of manure composted (t)	Wj,x*DOCj*(1-e-kj)*e-kj*(y-x)	(Baseline CH_4 Emissions from manure) *GWP_{CH4}	$BE_{manure,y}$ (tCO_2e)
2020	52,301	300	8,394	8,394[8]
2021	48,989	570	15,969	15,969
2022	46,777	819	22,927	22,927
Sum		/	47,290	47,290

Table 6. Calculation value of $BE_{manure,y}$ in each whole year of the monitoring period for instance 2

Year	Amount of manure composted (t)	Wj,x*DOCj*(1-e-kj)*e-kj*(y-x)	(Baseline CH_4 Emissions from manure) *GWP_{CH4}	$BE_{manure,y}$ (tCO_2e)
2020	20,922	124	3,458	3,458[9]
2021	24,142	262	7,330	7,330
2022	20,551	374	10,475	10,475
Sum	77,869	/	21,264	21,264

Table 7. Calculation value of $BE_{food,y}$ in each whole year of the monitoring period for instance 1

Year	Amount of food composted (t)	Wj,x*DOCj*(1-e-kj)*e-kj*(y-x)	(Baseline CH_4 Emissions from food) *GWP_{CH4}	$BE_{food,y}$ (tCO_2e)
2020	24,409	1642	45,966	45,966[10]
2021	20,559	2,483	69,527	69,527
2022	28,341	3,571	99,975	99,975
Sum	60,883	/	215,468	215,468

Table 8. Calculation value of $BE_{food,y}$ in each whole year of the monitoring period for instance 2

Year	Amount of food composted (t)	Wj,x*DOCj*(1-e-kj)*e-kj*(y-x)	(Baseline CH_4 Emissions from food) *GWP_{CH4}	$BE_{food,y}$ (tCO_2e)
2020	6,991	460	6,991	6,991[11]
2021	11,452	1,061	29,720	29,720
2022	5,869	1,098	30,731	30,731
Sum	24,132	/	73,325	73,325

[8] This value is $BE_{biomass,y}$ in the whole year of 2020 for instance 1.

[9] This value is $BE_{biomass,y}$ in the whole year of 2020 for instance 1.

[10] This value is $BE_{biomass,y}$ in the whole year of 2020 for instance 1.

[11] This value is $BE_{biomass,y}$ in the whole year of 2020 for instance 1.

Table 9. Baseline emissions for instance 1

Year	$BE_{food,y}$ (tCO_2e)	$BE_{biomass,y}$ (tCO_2e)	$BE_{manure,y}$ (tCO_2e)	BE_y (tCO_2e)
06/01/2020-31/12/2020 (361days)	45,338[12]	157,831[13]	8,280[14]	211,448
01/01/2021-31/12/2021	69,527	299,551	15,969	385,046
01/01/2022-31/12/2022	99,975	419,401	22,927	542,303
Sum	214,840	876,783	47,175	1,138,797

Table 10. Baseline emissions for instance 2

Year	$BE_{food,y}$ (tCO_2e)	$BE_{biomass,y}$ (tCO_2e)	$BE_{manure,y}$ (tCO_2e)	BE_y (tCO_2e)
15/01/2020-31/12/2020 (352days)	12,382[15]	60,547[16]	3,326[17]	76,254
01/01/2021-31/12/2021	29,720	115,970	7,330	153,020
01/01/2022-31/12/2022	30,731	168,901	10,475	210,107
Sum	72,832	345,418	21,132	439,381

Table 11. Baseline emissions for this project

Year	$BE_{instance1,y}$ (tCO_2e)	$BE_{instance\ 2,y}$ (tCO_2e)	BE_y (tCO_2e)
06/01/2020-31/12/2020 (361days)	211,448	76,254	287,702
01/01/2021-31/12/2021	385,046	153,020	538,066
01/01/2022-31/12/2022	542,303	210,107	752,410
Sum	1,138,797	439,381	1,578,178

5.2 Project Emissions

According to ACM0022 (version 03.0), the project emissions in year y are calculated for each alternative waste treatment option implemented in the project activity as follows

[12] 45338=45966*361/365

[13] 157831=160017*361/365

[14] 8280=8394*361/365

[15] 12382=12874*352/365

[16] 60547=62955*352/365

[17] 3326=3458*361/365

$PE_y = PE_{COMP,y} + PE_{AD,y} + PE_{GAS,y} + PE_{RDF\_SB,y} + PE_{INC,y}$ (5)

Where:

$PE_{COMP,y}$	=	Project emissions from composting or co-composting in year y (tCO_2e)
$PE_{AD,y}$	=	Project emissions associated from anaerobic digestion and biogas combustion in year y (tCO_2e)
$PE_{GAS,y}$	=	Project emissions from gasification in year y (tCO_2e)
$PE_{RDF\_SB,y}$	=	Project emissions associated with RDF/SB in year y (tCO_2e)
$PE_{INC,y}$	=	Project emissions from incineration in year y (tCO_2e)

The project activity does not include anaerobic digestion, biogas combustion, gasification, RDF/SB and incineration. Therefore,

$PE_{AD,y=0}$

$PE_{GAS,y=0}$

$PE_{RDF\_SB,y=0}$

$PE_{INC,y=0}$

PECOMP,y are calculated according to the methodological tool "Project and leakage emissions from composting (version 02.0) ".

$$PE_{COMP,y}=PE_{EC,y}+PE_{FC,y}+PE_{CH4,y}+PE_{N20,y}+PE_{RO,y}$$

Where

$PE_{EC,y}$	Project emissions from electricity consumption associated with composting in year y (tCO_2/yr)
$PE_{FC,y}$	Project emissions from fossil fuel consumption associated with composting in year y (tCO_2/yr)
$PE_{CH4,y}$	Project emissions of methane from the composting process in year y (tCO_2e/yr)
$PE_{N20,y}$	Project emissions of nitrous oxide from the composting process in year y (tCO_2e/yr)
$PE_{RO,y}$	Project emissions of methane from run-off wastewater associated with co-composting in year y (t CO_2e/yr)

This project does not include treatment of run-off wastewater. Therefore, $PE_{RO,y}$=0

This project does not consume fossil fuel. Therefore, $PE_{FC,y}$=0

$PE_{COMP,y}$=$PE_{EC,y}$ +$PE_{CH4,y}$+$PE_{N20,y}$

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

According to "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (version 03.0)"

$$PE_{EC,y} = \sum_{j} EC_{PJ,j,y} \times EF_{EF,j,y} \times (1 + TDL_{j,y})$$

$$=EC_{PJ,j,y}*EF_{grid,CM,y}*(1+TDL_{j,y}) \qquad (8)$$

Table 12. Calculation of $PE_{EC,y}$ for instance 1.

Vintage	$EC_{PJ,j,y}$ (MWh)	$EF_{EF,grid,y}$ (tCO_2e /MWh)	$TDL_{j,y}$	$PE_{EC,y}$ (tCO_2)
06/01/2020-31/12/2020 (361days)	900.513	0.50885	20%	550
01/01/2021-31/12/2021	775.713	0.50885	20%	474
01/01/2022-31/12/2022	976.100	0.50885	20%	596
Total	2,532.572			1,620

Table 13. Calculation of $PE_{EC,y}$ for instance 2.

Vintage	$EC_{PJ,j,y}$ (MWh)	$EF_{EF,grid,y}$ (tCO_2e /MWh)	$TDL_{j,y}$	$PE_{EC,y}$ (tCO_2)
15/01/2020-31/12/2020 (352days)	170.57	0.50885	20%	104
01/01/2021-31/12/2021	192.75	0.50885	20%	118
01/01/2022-31/12/2022	256.13	0.50885	20%	156
Total	619.45			378

Step 2: Project emissions of methane from the composting process ($PE_{CH4,y}$)

According to "project and leakage emissions from composting (version 02.0)",

$PE_{CH4,y}=Q_y \times EF_{CH4,y} \times GWP_{CH4}$ (10)

Where

$PE_{CH4,y}$	Project emissions of methane from the composting process in year y (tCO_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 (tCH_4/t).
GWP_{CH4}	Global Warming Potential of CH_4 (tCO_2e/tCH_4)

There are two options for determining $EF_{CH4,y}$. This project uses option 2 (procedure using default values).

$EF_{CH4,y}=EF_{CH4,default}$

Table 14. Calculation result of PE_{CH4} of the monitoring period for instance 1

Year	Q_y(t)	$EF_{CH4,y}$ (tCH_4/t)	GWP_{CH4} (tCO_2e/tCH_4)	PE_{CH4}(tCO_2e/yr)
06/01/2020-31/12/2020 (361days)	341,965	0.002	28	19,150
01/01/2021-31/12/2021	357,385	0.002	28	20,014
01/01/2022-31/12/2022	366,993	0.002	28	20,552
Sum (tCO_2)	1,066,343	/	/	59,716

Table 15. Calculation result of PE_{CH4} of the monitoring period for instance 2

Year	Q_y(t)	$EF_{CH4,y}$ (tCH_4/t)	GWP_{CH4} (tCO_2e/tCH_4)	PE_{CH4}(tCO_2e/yr)
15/01/2020-31/12/2020 (352days)	125,079	0.002	28	7,004
01/01/2021-31/12/2021	132,608	0.002	28	7,426
01/01/2022-31/12/2022	136,097	0.002	28	7,621
Sum (tCO_2)	393,784	/	/	22,051

Step 3. Project emissions of nitrous oxide from the composting process ($PE_{N20,y}$)

$PE_{N20,y} = Q_y \times EF_{N20,y} \times GWP_{N20}$ (11)

Where

$PE_{N20,y}$	Project emissions of nitrous oxide from composting in year *y* (tCO_2e/yr)

Q_y	Quantity of waste composted in year *y* (t/yr)
$EF_{N20,y}$	Emission factor of nitrous oxide per tonne of waste composted valid for year *y* (tN_2O/t). According to project and leakage emissions from composting, $EF_{N20,y}$=0.0002
GWP_{N20}	Global Warming Potential of N_2O ($tCO_2e/t\ N_2O$)

Table 16. Calculation result of PE_{CH4} of the monitoring period for instance 1

Year	Q_y (t)	$EF_{N20,y}$ (tCH_4/t)	GWP_{N20} (tCO_2e/tN_2O)	$PE_{N20,y}$ (tCO_2e/yr)
06/01/2020-31/12/2020 (361days)	341,965	0.002	273	18,124
01/01/2021-31/12/2021	357,385	0.002	273	18,941
01/01/2022-31/12/2022	366,993	0.002	273	19,451
Sum (tCO_2)	1,066,343	/	/	56,516

Table 15. Calculation result of PE_{CH4} of the monitoring period for instance 2

Year	Q_y (t)	$EF_{N20,y}$ (tCH_4/t)	GWP_{N20} (tCO_2e/tN_2O)	$PE_{N20,y}$ (tCO_2e/yr)
15/01/2020-31/12/2020 (352days)	125,079	0.002	273	6,629
01/01/2021-31/12/2021	132,608	0.002	273	7,028
01/01/2022-31/12/2022	136,097	0.002	273	7,213
Sum (tCO_2)	393,784	/	/	20,870

Table 16. Calculation result *of* PE_y for instance 1

Year	$PE_{CH4,y}$ (tCO_2e/yr)	$PE_{N20,y}$ (tCO_2e/yr)	$PE_{EC,y}$ （tCO_2e）	PE_y （tCO_2e）
06/01/2020-31/12/2020(361days)	19,150	18,124	550	37,825
01/01/2021-31/12/2021	20,014	18,941	474	39,429
01/01/2022-31/12/2022	20,552	19,451	596	40,600
Sum (tCO_2)	59,716	56,516	1,620	117,854

Table 17. Calculation result *of* PE_y for instance 2

Year	$PE_{CH4,y}$ (tCO_2e/yr)	$PE_{N20,y}$ (tCO_2e/yr)	$PE_{EC,y}$ （tCO_2e）	PE_y （tCO_2e）
15/01/2020-31/12/2020(361days)	7,004	6,629	104	13,738

01/01/2021-31/12/2021	7,426	7,028	118	14,572
01/01/2022-31/12/2022	7,621	7,213	156	14,991
Sum (tCO_2)	22,051	20,870	378	43,301

Table 18. Calculation result of PE_y for this project

Vintage	$PE_{instance\ 1,y}$ (tCO_2)	$PE_{instance\ 2,y}$ (tCO_2)	PE_y (tCO_2)
06/01/2020-31/12/2020 (361days)	37,825	13,738	51,563
01/01/2021-31/12/2021	39,429	14,572	54,001
01/01/2022-31/12/2022	40,600	14,991	55,591
Total in this monitoring period	117,854	43,301	161,155

5.3 Leakage

Leakage emissions are associated with composting/co-composting, anaerobic digestion and the use of RDF/SB that is exported outside the proposed project boundary. For the case that waste by-products of the alternative waste treatment options are:

- Used for soil application, this emission shall be neglected;

-Composted or co-composted, then these shall be treated as fresh waste with emissions estimated according to the procedure project emissions from composting ($PE_{COMP,y}$).

$$LE_y = LE_{COMP,y} + LE_{AD,y} + LE_{RDF\_SB,y}$$

where

LE_y	Leakage emissions in the year *y* (tCO_2e)
$LE_{COMP,y}$	Leakage emissions from composting or co-composting in year *y* (tCO_2e)
$LE_{AD,y}$	Leakage emissions from anaerobic digester in year *y* (tCO_2e)
$LE_{RDF\_SB,y}$	Leakage emissions associated with RDF/SB in year *y* (tCO_2e)

According to "project and leakage emissions from composting (version 02.0)", $LE_{comp,y}$ shall be accounted for if compost is subjected to anaerobic storage or disposed of in a SWDS.

For this project, the compost is in aerobic condition, not subjected to anaerobic storage or disposed of in a SWDS. Therefore, $LE_{comp,y}$ is 0

This project does not generate wastewater. Therefore $LE_{AD,y}$=0

This project does not include RDF/SB. Therefore, $LE_{RDF\_SB,y}$=0

5.4 Net GHG Emission Reductions and Removals

Net GHG Emission Reductions and Removals

$ER_y = BE_y - PE_y - LE_y$

Where

ER_y = Emissions reductions in year *y* (tCO_2e/year)

BE_y = Baseline emissions in year *y* (tCO_2e/year)

PE_y = Project emissions in year *y* (tCO_2e/year)

LE_y = Leakage emissions in year *y* (tCO_2e/year)

Table 19. Final calculation result of ER_y in this crediting period for the project

Year	$BE_{instance1,y}$	$PE_{instance1,y}$	$ER_{instance\ 1,y}$	$BE_{instance2,y}$	$PE_{instance2,y}$	$ER_{instance\ 2,y}$	ER_y
	tCO_2e/yr	tCO_2e/yr	tCO_2e/yr	tCO_2e/yr	tCO_2e/yr	tCO_2e/yr	tCO_2e/yr
06/01/2020 - 31/12/2020	211,448	37,825	173,623	76,254	13,738	62,516	236,139
01/01/2021 - 31/12/2021	385,046	39,429	345,617	153,020	14,572	138,448	484,065
01/01/2022 - 31/12/2022	542,303	40,600	501,703	210,107	14,991	195,116	696,819
Sum (tCO_2)	1,138,797	117,854	1,020,943	439,381	43,301	396,080	1,417,023

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)

06/01/2020-31/12/2020	287,702	51,563	0	236,139
01/01/2021-31/12/2021	538,066	54,001	0	484,065
01/01/2022-31/12/2022	752,410	55,591	0	696,819
Total	1,578,178	161,155	0	1,417,023

Ex-ante emissions reductions/removals	Achieved emissions reductions	Percent difference	Justification for the difference
1,549,461[18]	1,417,023	-8.55%	The actual emission reductions are less than the ex-ante emission reductions. Because the actual treated waste amount is less than the ex-ante value.
258,332tCO_2 (06/01/2020 - 31/12/2020)	236,139	-8.59%	The actual emission reductions are less than the ex-ante emission reductions. Because the actual treated waste amount is less than the ex-ante value.
533,489 tCO_2 (01/01/2021-31/12/2021)	484,065	-9.26%	The actual emission reductions are less than the ex-ante emission reductions. Because the actual treated waste amount is less than the ex-ante value.
757,640 tCO_2 (01/01/2022-31/12/2022)	696,819	-8.03%	The actual emission reductions are less than the ex-ante emission reductions. Because the actual treated waste amount is less than the ex-ante value.

[18] 258,332+533,489+757,640=1,549,461