COMPOSTING OF ORGANIC WASTE PROJECT IN GUANGXI

Document Prepared by Beijing Ruifang Technology Co., Ltd

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1 PROJECT DETAILS

1.1 Summary Description of the Project

The composting of organic waste project in Guangxi (hereafter referred to as the proposed Project) is located in Guangxi, China, which is operated by Guangxi Tiandong 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 proposed project is a new building composting plant which designed to treat organic wastes to produce organic fertilizer. The proposed project comprises of fermentation system and fertilizer production system, etc. The instances 1 is site 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.

In absence of the project, the organic wastes would have been dumped in the landfill sites. This new project will avoid CH_4 emissions from the disposal of the waste in a landfill site in absence of the Project. The proposed project is estimated to deliver totally 32,087,169 tCO_2e emission reduction during the 21 years' crediting period, at an average amount of 1,527,960 tCO_2e per year.

This project started operation on 06/01/2020 (Instance 1 starts commission on 06/01/2020. Instance 2 starts commissioning on 15/01/2020).

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

- The proposed project will avoid GHG emissions by treatment organic waste that would have been dumped in landfill site. Thus will effectively improve the living circumstances for local people.

- This project will also improve soil condition by providing organic fertilizer for local people, boosting farm crop production and promote the incomes of local farmers.

- This project could provide job opportunities for local people, which is beneficial for local livelihood.

1.2 Sectoral Scope and Project Type

The following sectoral scopes are applicable to the proposed project activity.

- Sectoral scope 13: Waste handling and disposal
- Sectoral scope 1: Energy industries (renewable - / non-renewable sources)

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

1.3 Project Eligibility

The proposed project treats organic wastes for fertilizer, which complies with Section 2.1 of the VCS Standard (version 4.1), the proposed project activity is eligible under the scope of the VCS Program.

1.4 Project Design

The proposed project has been designed to include two project instances, as per the proposed project description in Section 1.1 and the detail of installed technology in Section 1.11. The proposed project location is described in Section 1.12.

Eligibility Criteria

The proposed project activity is not grouped project. This section is not applicable.

1.5 Project Proponent

Organization name	Guangxi Tiandong Liyuanbao Science and Technology Co., Ltd.
Contact person	Liang Xin
Title	Manager
Address	Tian Petrochemical park, Tiandong County, Baise city, Nanning City, Guxangi Province
Telephone	0772-4223121
Email	liangxi@vip.sina.com

1.6 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	-
Address	Haidian District, Beijing, PRC China
Telephone	+86-10-86291231
Email	Teng_hp@126.com

1.7 Ownership

The proposed project ownership can be demonstrated by the approval of FSR (Feasibility Study Report) and the approval of EIA.

1.8 Project Start Date

The proposed 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.

1.9 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.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	
Large project	√

Year	Estimated GHG emission reductions or removals (tCO_2e)
06/01/2020 – 31/12/2020	154,775
01/01/2021 – 31/12/2021	382,170
01/01/2022 – 31/12/2022	610,027
01/01/2023 – 31/12/2023	805,610
01/01/2024 – 31/12/2024	969,766
01/01/2025 – 31/12/2025	1,108,127
01/01/2026 – 31/12/2026	1,939,627
01/01/2027 – 31/12/2027	1,324,589
01/01/2028 – 31/12/2028	1,413,262
01/01/2029 – 31/12/2029	1,481,633
01/01/2030 – 31/12/2030	1,543,678
01/01/2031 – 31/12/2031	1,597,043
01/01/2032 – 31/12/2032	1,643,093
01/01/2033 – 31/12/2033	1,682,961
01/01/2034 – 31/12/2034	1,717,600
01/01/2035 – 31/12/2035	1,747,803
01/01/2036 – 31/12/2036	1,774,242
01/01/2037 – 31/12/2037	1,797,475
01/01/2038 – 31/12/2038	1,817,976
01/01/2039 – 31/12/2039	3,079,189
01/01/2040-- 31/12/2040	1,852,316
01/01/2041-05/01/2041	1,641,570
Total estimated ERs	**32,084,534**
Total number of crediting years	21
Average annual ERs	**1,527,835**

1.11 Description of the proposed project Activity

Technology description

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.

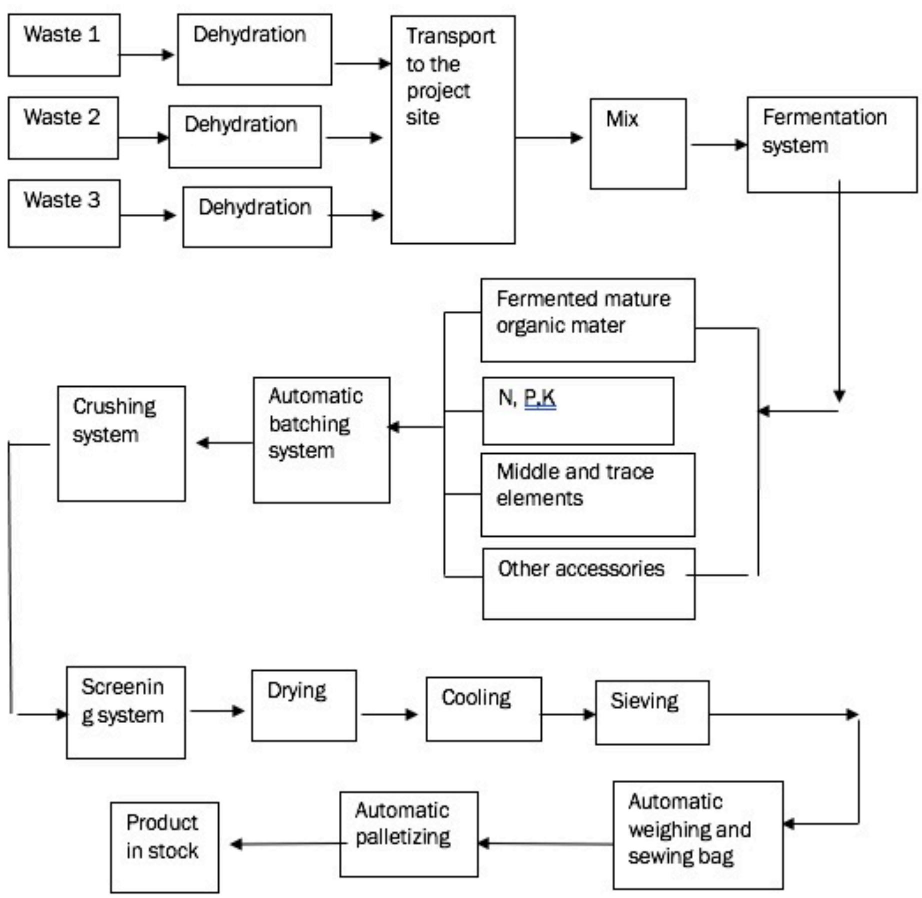

Figure 1. Flowchart of the proposed project

1.12 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°8’35” E. The latitude is 23°39’17” N.

Figure 2. Location of Guangxi province in China

Figure 3. Location of Nanning city in Guangxi

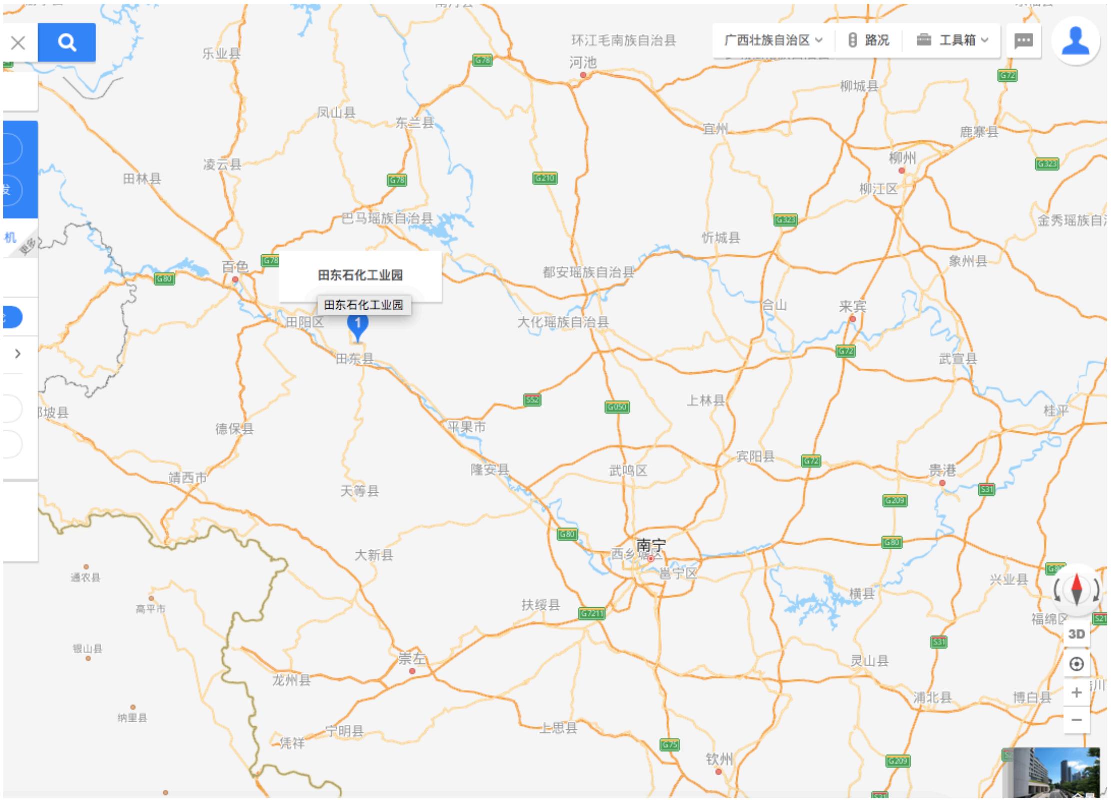

Figure 4. Location of instance 1 in Nanning city

The instance 2 is located in Tan cun village, Huaiyuan Town, Yizhou District, Hechi City, Guangxi Province, China. The proposed project activity location is depicted in figure 1 and figure 2. Project coordinates of instance 2 are 23°39’17”N, 107° 8’35” E.

Figure 5. Location of Hechi city in Guangxi

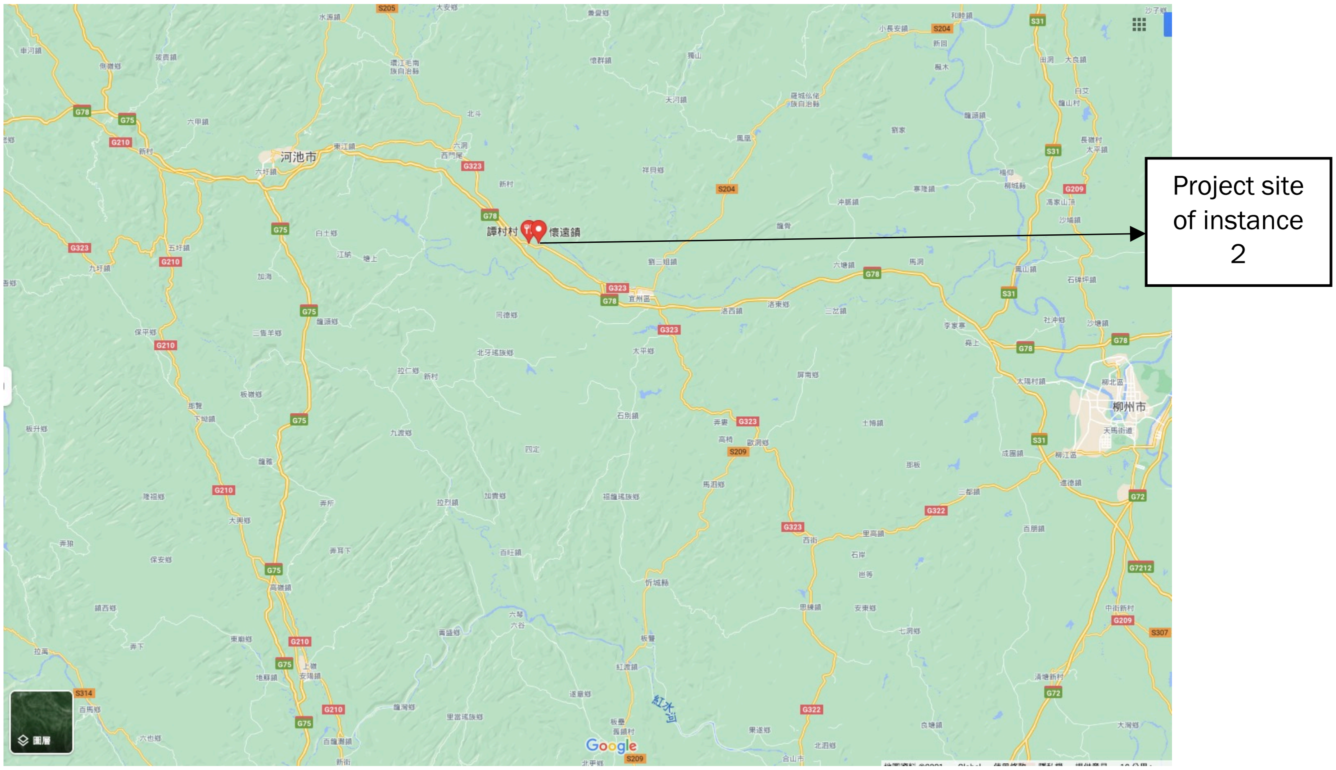

Figure 6. Location of instance 2

1.13 Conditions Prior to Project Initiation

The proposed project activity is implemented in a Greenfield location. In the baseline scenario the organic waste would have been dumped in landfill site.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The proposed project activity is in compliance with national laws and regulations, which can be demonstrated by the approval of FSR and EIA.

The main laws and regulations are summarized below:

Environmental Impact Assessment Law of the People's Republic of China;

Law of the People's Republic of China on the Prevention and Control of Air Pollution ；

Water Pollution Prevention and Control Law of the People's Republic of China ；

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

Measures for the Management of Urban Construction Waste

1.15 Participation under Other GHG Programs

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

The proposed project has not been registered or is seeking registration under any other GHG programs.

1.15.2 Projects Rejected by Other GHG Programs

According to Section 1.15.1, the proposed project has not been rejected under by any other GHG programs.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

The proposed project does not reduce GHG emissions from activities that are included in an emissions trading program or any other mechanism that includes GHG allowance trading.

1.16.2 Other Forms of Environmental Credit

The proposed project has not sought or received another form of GHG-related environmental credit, including renewable energy certificates.

1.17 Additional Information Relevant to the proposed project

Leakage Management

This is not applicable.

Commercially Sensitive Information

The proposed project has no commercially sensitive information included in the public version of the proposed project description. Thus, this is not applicable.

Sustainable Development

The proposed project will directly contribute to sustainable development, which is described in section 1.1 above.

Further Information

This section is not applicable.

2 SAFEGUARDS

2.1 No Net Harm

There is no negative environmental and socio-economic impact. The proposed project uses wastes for composting, which could avoid the methane that would have generated in baseline. This project is also good for local social and economy. The proposed project follows the local and national regulation.

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 proposed project activity and think that the proposed 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 proposed project activity is expected to deliver multiple benefits in respect of sustainable development including environmental, social and economic benefits.

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.

2.3 Environmental Impact

The Environmental Impact Assessment of the two projects instances were both completed in Oct. 2017. The EIA of Project 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.

A brief overview of environmental impacts related to the proposed project activity is summarised here.

1. Atmosphere

In operation period, dust mainly comes from fermentation workshop, industrial furnace. Through treatment of two-alkali method， dust collector, the dust concentration is greatly decreased and then emitted into the atmosphere.

During the production process of feeding, granulation and cooling, some dust also occurred. By setting airtight cover, the dust concentration could greatly decreased.

Fermentation workshop may generate some malodorous gas. The fully enclosed three-dimensional dust removal and deodorization automatic environmental protection fermentation system can capture more than 80% of the fermentation malodorous gas. After the living photolysis evolution process, it is discharged through a 15m high exhaust tube at a high altitude.

2. Wastewater

During the construction and operation period, the major wastewater emission sources are domestic sewage. The wastewater will be treated by the wastewater treatment center of the proposed project site and the final flue complied with national discharge standard.

This project in the operation period only consume water for flushing. These flushing water will be precipitated in the sedimentation tank, and then reused for flushing.

3. Noise

Several measures have been taken to control and mitigate the noise impact of the proposed project. During the operation period, silencer will be installed to mitigate the noise impacts; for the workers, the proposed project owner will outfit them with the relevant noise reducing equipment in accordance with the national standard. The noise impact on the surrounding residents is acceptable.

4. Solid waste

Solid waste mainly includes waste bags, furnace ash, and daily life garbage. 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. In conclusion, the solid wastes in this project has no negative impact on environment.

In summary, the proposed project will not bring significant impacts on the environment during the construction period and operation period.

2.4 Public Comments

The document of this proposed project was updated to verra for public comment. The conclusion will be added after the end of the public comment period.

2.5 AFOLU-Specific Safeguards

The proposed project activity is not AFOLU project. Thus, this section is not required.

3 APPLICATION OF METHODOLOGY

3.1 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 02.0)"

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

- "Tool for the demonstration and assessment of additionality (version 07.0.0)"
- "Emissions from solid waste disposal sites (version 08.0)"
- "Tool to calculate the emission factor for an electricity system (version 07)"
- "Project and leakage emissions from composting (version02.0)"
- "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (version 03)"
- "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (version 03)

3.2 Applicability of Methodology

The proposed project meets applicability conditions of ACM0022 (version 02.0) and the analysis is listed below:

Table 3. Applicability conditions analysis of ACM0022(version 02.0)

Applicability criteria	Project situation
Applicability conditions for composting or co-composting in table 2 **Applicable types of wastes that may be treated:** 1. Types of waste specified in the scope and applicability section of the methodological tool "Project and leakage emissions from composting	This project uses biomass, mulberry branch, sugarcane leaf, sugarcane pitch, animal manure,food waste, etc. This project does not use hospital and industrial sludge.

2. Run-off wastewater 3. Excluding hospital and industrial waste **Applicable products and their use:** Compost: any use applicable **Applicable waste by-products :** 1. Glass, aluminium, ferrous metals and plastics from waste sorting stages; 2. Run-off wastewater **Specific applicability conditions for the treatment option:** Any applicability conditions specified in the methodological tool "Project and leakage emissions from composting"	The product of this project is compost The by-product is wastewater Therefore, this criteria is applicable for this project.
The project activity involves the construction of a new plant to implement one or several of the alternative waste treatment options provided in Table 2 below;	The proposed project is a new plant. Therefore, this criteria is applicable for this project.
In the project plant, except for the case of composting, co-composting and anaerobic digestion, only wastes for which emission reductions are claimed (fresh waste or wastewater) are processed. In the case of anaerobic digestion, only run-off wastewater may be processed in addition to fresh waste and wastewater;	The proposed project is a composting project. , Wastes for emission reductions are processed.
Neither organic fresh waste nor products and by-products from the waste treatment plant established under the project activity are stored on-site under anaerobic conditions. For example, no organic materials are stored in a stockpile that is considered a SWDS;	The organic fresh waste, products and by-products are stored in aerobic conditions.
Any run-off wastewater is treated within the project boundary;	This project does not include anaerobic digestion. Therefore, it will not generate run-off wastewater. The small amount of wastewater

	generated by this project is treated in the project boundary.
The project does not reduce the amount of waste that would be recycled in the absence of the project activity. Detailed justifications shall be provided and documented in the clean development mechanism project design document (CDM-PDD) for demonstrating that the project activity does not reduce the amount of waste that would be recycled in the absence of the project activity.	This project mainly uses waste biomass, food wastes, animal manure. In absence of the project, the waste biomass, and food wastes, such as rice straw and banana peel were dumped without recycle. There are no mandatory regulations on the waste recycle and this is the normal condition in China. Therefore, the proposed project will not reduce the amount of waste that would be recycled in the absence of the project activity.
The methodology is only applicable if the procedure for the selection of the most plausible baseline scenario, as outlined below, results in that the baseline scenario is: (a) The disposal of the fresh waste in a SWDS with or without a partial LFG capture system (M2 or M3); and in this case, it shall be demonstrated that land is available to construct a new SWDS with a comparable annual waste acceptance rate and operating lifetime as the project activity; (b) In the case of co-composting or the use of wastewater in an anaerobic digester: the treatment of organic wastewater in an existing or new to be built anaerobic lagoon or sludge pit without methane recovery (W1 or W4); (c) In the case that the project activity generates electricity: the electricity is generated in an existing/new captive fossil fuel fired power-only plant, captive cogeneration plant and/or in the grid (P2, P4 or P6); （d） In the case that the project activity generates heat and this displaces heat generation in the baseline: the heat is	As the demonstration in section 3.4, the baseline scenario of the proposed project is M3 (Disposal of the fresh waste in a SWDS without a LFG capture system) Before this project, all the wastes were transported to local SWDS. The instance 1 project covers an area of 150000m^{2}. The instance 1 project covers an area of 120000m^{2}. it is available to construct a new SWDS with capacity of waste disposal capacity of 550000t/yr with lifetime of 21 years[1]

[1] http://www.nbd.com.cn/articles/2019-11-12/1385723.html

generated in an existing/new fossil fuel fired cogeneration plant, boiler or air heater (H2 or H4).	
Under this methodology, emission reductions can only be claimed for the baseline scenarios indicated above. If project participants wish to claim emission reductions from the use of the products or by-products in other activities than those specified above, then they may request registration for a separate project activity, applying a relevant methodology.	This project only claims the emission reductions from baseline scenarios. This project will not claim emission reductions from the use of the products or by-products.
In addition, in the particular case where heat is generated from combustion of a product or by-product from the waste treatment options and used in the cement industry, the emission reductions for this use shall not be claimed under this methodology but in a separate project activity, applying the relevant methodology (e.g. "ACM0003: Partial substitution of fossil fuels in cement or quicklime manufacture").	This criteria is not applicable for the proposed project
Note that in the case that applicable laws or regulations require the use of the waste treatment option(s) implemented under the project activity, the compliance rate of such laws and regulations should be below 50 per cent in the period for which issuance of CERs is requested in order to claim emission reductions for that period.	There is no laws or regulations require the use of the waste treatment.

The applicability and analysis for tool of "Project and leakage emissions from composting (version 02.0)" is shown as follows

Table 4. Applicability conditions analysis of "Project and leakage emissions from composting (version 02.0)"

Applicability criteria	**Project situation**
Scope: Typical applications of the tool include projects composting municipal solid wastes, agricultural wastes and digestate	This project uses solid wastes from agriculture and forestry.

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; and (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 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 following tables. This project does use gas measurement to determine baseline or project emissons. Therefore, "tool to determine the mass flow of a greenhouse gas in a gaseous stream(verion03.0"is not applicable for this project.

Table 5. Applicability conditions analysis of "Emissions from solid waste disposal sites(version08.0) "

Applicability criteria	Project situation
The tool can be used to determine emissions for the following types of applications: (a) 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.	The proposed project is composting project, therefore, it belongs to application B. (b)is applicable for this project.

"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 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); (b) 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.	

The applicability and analysis for tool of 'Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (version 03.0)' is shown as follows:

Table 6. Applicability conditions analysis of "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (version 03.0)'

Applicability criteria	Project situation
Scope: Depending on their specific scope, methodologies which refer to this tool should: (a) Specify clearly which sources of project, baseline and leakage electricity consumption should be calculated with this tool; and/or (b) Provide the procedures to determine the most likely baseline scenario for each source of baseline electricity consumption; and/or	The baseline is electricity would have been from SCPG, the proposed project electricity consumption is also from SCPG. This is described in section 3.4 of this PDD. Therefore, this scope is applicable

(c) Provide the procedures to determine the most likely baseline scenario for electricity generated and supplied by the proposed project power plant to the grid or consumers; and (d) Provide the procedures to determine the baseline CO_2 emission factors for the electricity generated and supplied by the proposed project power plant ($EF_{BL,grid,CO2,y}$ and $EF_{BL,facility,CO2,i,y}$).	
If emissions are calculated for electricity consumption, the tool is only applicable if one out of the following three scenarios applies to the sources of electricity consumption: (a) Scenario A: Electricity consumption from the grid. The electricity is purchased from the grid only, and either no captive power plant(s) is/are installed at the site of electricity consumption or, if any captive power plant exists on site, it is either not operating or it is not physically able to provide electricity to the electricity consumer; (b) Scenario B: Electricity consumption from (an) off-grid fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants are installed at the site of the electricity consumer and supply the consumer with electricity. The captive power plant(s) is/are not connected to the electricity grid; or (c) Scenario C: Electricity consumption from the grid and (a) fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants operate at the site of the electricity consumer. The captive power plant(s) can provide electricity to the electricity consumer. The captive power plant(s) is/are also connected to the electricity grid. Hence, the electricity consumer can be provided with electricity from the captive power plant(s) and the grid.	The electricity consumption is from grid. Therefore, scenario A is applicable.
This tool can be referred to in methodologies to provide procedures to monitor amount of electricity generated in the proposed 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;	The proposed project does not generate electricity. . Therefore, this item is not applicable.

(b) Scenario II: Electricity is supplied to consumers/electricity consuming facilities; or (c) Scenario III: Electricity is supplied to the grid and consumers/electricity consuming facilities.	
This tool is not applicable in cases where captive renewable power generation technologies are installed to provide electricity in the proposed project activity, in the baseline scenario or to sources of leakage. The tool only accounts for CO_2 emissions.	No captive renewable power stations are installed to provide electricity in baseline scenario, or project activity. Therefore, this tool is applicable for this project.

The applicability and analysis for tool of 'Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion(version03.0)' is shown as follows:

Table 7. Applicability conditions analysis of "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion(version03.0)"

Applicability criteria	Project situation
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 some fossil fuel during the production process.

The applicability and analysis for tool of 'Tool to calculate the emission factor for an electricity system (version07.0)' is shown as follows:

Table 8. Applicability conditions analysis of "Tool to calculate the emission factor for an electricity system (version07.0)"

Applicability criteria	Project situation
This tool may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity that is where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand-side energy efficiency projects).	This project results in savings of electricity that would have been provided by the grid. Therefore, this tool is applicable for the project.

Under this tool, the emission factor for the proposed project electricity system can be calculated either for grid power plants only or, as an option, can include off-grid power plants. In the latter case, two sub-options under the step 2 of the tool are available to the proposed project participants, i.e. option IIa and option IIb. If option IIa is chosen, the conditions specified in "Appendix 1: Procedures related to off-grid power generation" should be met. Namely, the total capacity of off-grid power plants (in MW) should be at least 10 per cent of the total capacity of grid power plants in the electricity system; or the total electricity generation by off-grid power plants (in MWh) should be at least 10 per cent of the total electricity generation by grid power plants in the electricity system; and that factors which negatively affect the reliability and stability of the grid are primarily due to constraints in generation and not to other aspects such as transmission capacity.	Only grid power plants are calculated.

3.3 Project Boundary

Source		Gas	Included?	Justification/Explanation
Baseline	Emissions from decomposition of waste at the SWDS	CH_4	Yes	The major source of emissions in the baseline
		N_2O	No	N_2O emissions are small compared to CH_4 emissions from landfills. Excluded for conservative
		CO_2	No	Excluded as per ACM0022
	Emissions from electricity generation	CO_2	No	Electricity generation is not included in this project
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.
	Emissions from heat generation	CO_2	No	Heat generation is not included in this project
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.
Project	Emissions from on-site fossil fuel consumption due to the proposed	CO_2	Yes	This project may consume fossil fuel during the production. 0 is used for ex-ante, and the actual value will be monitored for ex-post calculation.
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small

Source		Gas	Included?	Justification/Explanation
	project activity other than for electricity generation	N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small
	Emissions from on-site electricity use	CO_2	Yes	Electricity consumed for the operation of the proposed project activity will be supplied from the grid.
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small
	Emissions from the waste treatment processes	N_2O	Yes	N_2O may be emitted from composting
		CO_2	No	CO2 emissions from the decomposition or combustion of fresh waste are not accounted
		CH_4	Yes	CH_4 may be emitted from composting
	Emissions from wastewater treatment	CO_2	No	CO_2 emissions from the decomposition of fresh waste are not accounted
		CH_4	No	Aerobic treatment of wastewater shall not result in CH_4 emissions
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small

3.4 Baseline Scenario

Step 1. Identification of alternative scenarios

According to the methodology ACM0022, the step 1a of the latest version of the "Tool for the demonstration and assessment of additionality(version07.0)" should be used to identify all realistic and credible baseline alternatives.

Sub-step 1a. Define alternatives to the proposed project activity:

These alternative scenarios include：

Scenario 1: Continuation of the current situation, i.e disposal of the waste at a landfill without the capture of landfill gas.

Scenario 2: Disposal of the waste at a landfill where landfill gas captured is flared.

Scenario 3: The proposed project activity undertaken without being registered as a VCS project activity

Step 1b: Consistency with mandatory applicable laws and regulations

The Technical code for municipal solid waste sanitary landfill (*GB50869-2013*)[2] was available. *GB50869-2013* specified concentration limits of methane in the air and methane venting measurements. GB50869-2013 also 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. As long as the landfill fulfils the safety requirements, the government must not enforce the utilization of LFG. This statement can also be seen in the other two national regulations (GB16889-2008, CJJ133-2009), which were issued and taken into effective since July 2008 and July 2010 respectively. However, the statement is only a recommendation, not a compulsory requirement. As long as the landfill fulfils the safety requirements, the government must not enforce the utilization of LFG.

Although China government encouraged the collection and utilization of LFG from waste dumps in the past few years, due to financial and technological difficulties most of the landfills just release LFG directly into the atmosphere without any recovery and flaring system.

Until now, China has not issued any mandatory laws or regulations to compulsorily recover and use the LFG from landfill sites. According to "2019 Statistical Yearbook of Urban and Rural Construction" and "2020 China Biomass Power Generation Industry Development Report", till 2019, there were 1,885 sanitary landfills in cities and counties across China[3] , and only 216 biogas power generation projects were installed and connected to the grid. The occupying rate of landfill gas power plants are less than 12%[4] . Therefore, it is obvious that LFG gas flaring or utilization is still exceptional and that under common practice conditions the LFG is not flared in China in baseline conditions. Therefore, it is justifiable to conclude that the specific requirements on LFG recovery and utilization as prescribed in the above mentioned regulations have not been systematically enforced and that non-compliance with those requirements, namely uncontrolled emission of LFG to the atmosphere without any recovery and utilization, has been and is still widespread in China.

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2 Published by China Ministry of Housing and Urban-Rural Development on 8, August 2013 (GB50869-2013), and

taken into effect in March 2014.

3 http://www.mohurd.gov.cn/xytj/tjzljsxytjgb/jstjnj/

4 http://www.csrc.gov.cn/pub/newsite/fxjgb/cybzczl/zcwxjhf/202104/P020210420559819067188.pdf

Therefore, it is the traditional way in China that LFG from the landfill is directly released to the atmosphere through vertical extraction trenches, without flaring. And this is the zero cost way for LFG treatment without economically attractive, also without obligatory restriction by the new issued regulations.

Therefore, scenario 1 is possible baseline scenario. Scenario 2 is not possible baseline scenario.

Scenario 3 is complied with national laws and regulations.

Possible baseline scenario:

Scenario 1: Continuation of the current situation, i.e disposal of the waste at a landfill without the capture of landfill gas.

Scenario 3: The proposed project activity undertaken without being registered as a VCS project activity

Step 2 Barrier analysis

This barrier analysis is not applied.

Step 3: Investment analysis

According to "Combined tool to identify the baseline scenario and demonstrate additionality v07.0", the objective of step 3 is to compare the economic or financial attractiveness of the alternative scenarios by conducting an investment analysis. The analysis should include all alternative scenarios, including scenarios where the proposed project participants do not undertake an investment (e.g. scenario 3).

The investment analysis tool recommends three analysis methods, namely simple cost analysis (Option I), investment comparison analysis (Option II) and the benchmark analysis (Option III).

Since the proposed project can receive revenue from fertilizer sales, and can also receive revenue from VER. So, Option I isn't appropriate.

The Option II is only applicable when alternatives are also investment projects. However, the alternative baseline scenario of the proposed project (scenario 1) is not a new investment project, so the Option II isn't appropriate.

According to the above, this PDD will use the benchmark analysis (Option III) to analyze whether the proposed project is less economically or financially attractive than the alternatives without the revenue from VER.

There is no IRR benchmark for composting industry. While biomass power industry and many other industries use 8% as the benchmark, this proposed project adopts 8% as the benchmark.

In accordance with the feasibility study report (FSR) of the proposed project, the basic parameters for calculation of financial indicator are shown in Table 8:

Table 8. Financial parameters for instance 1

No.	Parameters	Value	*Data source*
2	Static total investment (10,000RMB)	43,084	FSR
3	O&M cost (10,000RMB)	19,935	FSR
4	Construction period (yr)	2	FSR
5	*Operation period* (yr)	20	FSR
	Annual solid waste treatment amount (t/yr)	400000	FSR
	Purchase price for solid waste	300 for biomass; 260 for manure; 50 for food waste	FSR
6	Annual fertilizer generation (t/yr)	300,000	FSR
7	Fertilizer price (CNY/t, including VAT)	700 for organic fertilizer powder; 1100 for columnar granular organic fertilizer; 770 for smart BB fertilizer	FSR
12	VAT for equipment, material and maintenance	17%	FSR
13	VAT for fertilizer, biomass and water	13%	FSR

14	City preservation and development tax	5%	FSR
15	Education surcharges	3%	FSR
16	Income tax	25%	FSR
17	Discount on taxable profit	90%	FSR

Table 9. Financial parameters for instance 2

No.	Parameters	Value	*Data source*
2	Static total investment (10,000RMB)	19,990	FSR
3	O&M cost (10,000RMB)	7,902	FSR
4	Construction period (yr)	2	FSR
5	*Operation period* (yr)	20	FSR
	Annual solid waste treatment amount (t/yr)	150000	FSR
	Purchase price for solid waste	300 for biomass; 260 for manure; 50 for food waste	FSR
6	Annual fertilizer generation (t/yr)	300,000	FSR
7	Fertilizer price (CNY/t, including VAT)	700 for Refined organic fertilizer; 1200 for columnar granular organic fertilizer;	FSR

		790 for smart BB fertilizer	
12	VAT for equipment, material and maintenance	17%	FSR
13	VAT for fertilizer, biomass and water	13%	FSR
14	City preservation and development tax	5%	FSR
15	Education surcharges	3%	FSR
16	Income tax	25%	FSR
17	Discount on taxable profit	90%	FSR

The comparison of the proposed project IRR with and without VER are shown below:

Table 10. IRR with and without VER income

	Project IRR of instance 1 (%)	Project IRR of instance 2 (%)
Without VER income	3.20%	1.71%
With VER income	13.83%	15.98%

From the calculation, it can be seen that without considering VER revenue, the IRR of instance 1 is 3.20%, IRR of instance 2 is 1.71%, lower than the benchmark of 8%. With VER carbon revenue, the financial status of the proposed project could be greatly improved.

Sensitivity analysis

According to investment analysis-v9.0, “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 (all parameters varied need not necessarily be subjected to both negative and positive variations of the same magnitude)”

1) Organic fertilizer powder price/generation

2) Columnar granular organic fertilizer price/generation
3) Static total Investment
4) Biomass price
5) O&M cost

Table 11. Sensitivity analysis for instance 1

Parameters	-10%	-5%	0	5%	10%
Organic fertilizer powder price/generation	0.34%	1.93%	3.20%	4.40%	5.54%
Columnar granular organic fertilizer price/generation	0.17%	1.87%	3.20%	4.45%	5.65%
Static total Investment	3.98%	3.58%	3.20%	2.83%	2.49%
Biomass price	4.31%	4.31%	3.20%	2.03%	0.61%
O&M cost	5.86%	4.57%	3.20%	1.74%	0.17%

Table 12. Sensitivity analysis for instance 2

Parameters	-10%	-5%	0	5%	10%
Refined organic fertilizer price/generation	-1.73%	0.08%	1.71%	3.21%	4.38%
Bio-organic fertilizer price/generation	-2.87%	-0.41%	1.71%	3.56%	5.01%
Organic nutrient matrix price/generation	-2.23%	-0.14%	1.71%	3.37%	4.67%
Static total Investment	2.55%	2.12%	1.71%	1.33%	0.97%
Biomass price	5.68%	3.96%	1.71%	-1.10%	-4.98%
O&M cost	4.74%	3.23%	1.71%	0.21%	-1.27%

It can be seen that when electricity Refined organic fertilizer price/generation, Bio-organic fertilizer price/generation, Organic nutrient matrix price/generation, static total investment, biomass cost, O&M cost changes within ±10%, the proposed project IRR (post-tax) of the proposed project is always lower than benchmark IRR.

From above analysis, it can be concluded that without the VER revenues the proposed project is not economically and financially attractive.

It is calculated that under the following variations of the above parameters, the proposed project IRR will reach benchmark.

Table 12. Variation analysis for instance 1

Parameters	Variation of IRR reach benchmark
Organic fertilizer powder price/generation	+21%
Columnar granular organic fertilizer price/generation	+21%
Static total Investment	-43%
Biomass price	-23%
O&M cost	-19%

Table 13. Variation analysis for instance 2

Parameters	Variation of IRR reach benchmark
Refined organic fertilizer price/generation	+28%
Bio-organic fertilizer price/generation	+21%
Organic nutrient matrix price/generation	+25%
Static total Investment	-56%
Biomass price	-18%
O&M cost	-21%

Analysis of fertilizer generation

The proposed project production capacity is elaborately designed based on the applicable amount of raw material nearby, local sales capacity, and the workload of equipment. The production capacity of this project will not increase more than 21% in future.

Analysis of fertilizer price

The fertilizer is sold to local agriculture company, farm and sales intermediary. Long-term contract was signed between project owner and them with stable price. The fertilizer price will not increase more than 21%.

Analysis of static total investment

When the Static total investment decreases 43%（instance 1）and 56% (instance 2) , the IRR would reach benchmark respectively. According to statistical data issued by National Bureau of Statistics of China, the prices of construction materials and labour cost kept increasing in recent years. And the EPC for the two instances were contracted in 2018, with total investment is larger than the design value of FSR. Therefore, it is impossible to decrease the total investment.

Analysis of biomass price

The biomass cost includes purchase cost, transportation cost, and labor cost. It is unlikely that the biomass cost would decrease more than 18% as the biomass is important for the proposed project. The biomass cost has been keeping increasing these years. The proposed project owner has signed biomass acquisition framework agreement with intermediary people and company. The purchase price is no less than 300RMB/t biomass

Analysis of O&M cost

Other O&M cost includes pharmacy cost, water cost, bags cost, maintenance cost and labor cost. According to Guangxi Bureau of Statistics[5], the material price and labor cost are increasing in recent years. It is impossible to decrease the O&M cost by 18%.

Step 4. Common practice analysis

In line with the "Tool of common practice" (version 03.1), four types of measures are currently covered in the framework:

[5] http://tjj.gxzf.gov.cn/tjsj/tjnj/

(a) Fuel and feedstock switch (example: switch from naphtha to natural gas for energy generation, or switch from limestone to gypsum in cement clinker production);

(b) Switch of technology with or without change of energy source including energy efficiency improvement as well as use of renewable energies (example: energy efficiency improvements, power generation based on renewable energy);

(c) Methane destruction (example: landfill gas flaring);

(d) Methane formation avoidance (example: use of biomass that would have been left to decay in a solid waste disposal site resulting in the formation and emission of methane, for energy generation).

As a newly-built biomass cogeneration project, the proposed project is not a first-of-its kind project in China and belongs to the type (b) of measures above.

The common practice analysis is conducted by section 5 of "tool of common practice" (version 03.1)".

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

The total design capacity of the Proposed Project Activity is 450000t/yr, therefore the applicable output range is 230000t/yr to 670000t/yr.

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

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

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

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

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

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

(f) The proposed projects started commercial operation before the proposed project design document (CDM-PDD) is published for global stakeholder consultation or before the start date of proposed project activity, whichever is earlier for the proposed project activity.

In China, the regulatory framework and investment climate for biomass projects are only similar and comparable in the same Province/Autonomous Region. Because each province has its unique economic and cultural environment. Generally, the proposed project proposals are approved by the Provincial DRC, and the proposed projects' EIAs are approved by the provincial Environmental Protection Bureau. So, Guangxi autonomous region is chosen for the proposed project geographical province.

The proposed project is a composting project using the solid organic material as the energy source. Therefore, only composting projects using the solid organic material as the energy source are considered.

The proposed project activity start operation is Jan of 2020, and the date of publishing for stakeholder consultation is in September of 2020, the date of project start date is earlier, therefore only projects which started commercial before Jan of 2020 are considered.

Therefore, all new composting projects using the solid organic wastes as the energy source, located in Guangxi Province which are delivering the capacity within the applicable output range between 230000t and 670000t and starting commercial operation before Jan of 2020 are identified as the similar projects.

Sub-step 3: within the projects identified in Step 2, identify those that are neither registered CDM project activities, project activities submitted for registration, nor project activities undergoing validation. Note their number Nall

After searching the public websites, no similar project is found. After researching UNFCCC/ Verra/ Gold Standard/CCER related website, no similar project is existed.

Therefore, Nall=0

Step 4: within similar projects identified in Step 3, identify those that apply technologies that are different to the technology applied in the proposed project activity. Note their number Ndiff.

After research UNFCCC/ Verra/ Gold Standard/CCER related website, no similar project is existed.

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

Since Nall=0. F=1-Ndiff/Nall can not be calculated.

The proposed project activity is a “common practice” within a sector in the applicable geographical area if the factor F is greater than 0.2 and Nall-Ndiff is greater than 3.

Through above Nall-Ndiff<3.

Therefore, this project is not a common practice

3.5 Additionality

According to the above analysis in step 3 and step 4 in section 3.4, the proposed project is additional.

3.6 Methodology Deviations

There are no methodology deviations for the proposed project activity. Thus, this section is not applicable.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

ACM0022(version 02.0) is applied and the baseline emissions are as follows:

$$BE_y = \sum_t \left(BE_{CH4,t,y} + BE_{WW,y} + BE_{EN,t,y} + BE_{NG,t,y}\right) \times DF_{RATE,t,y} \qquad (1)$$

With:

$$DF_{RATE,t,y} = \begin{cases} 1 - RATE_{compliance t,y}, & if\, RATE_{compliance t,y} < 0.5 \\ 0, & if\, RATE_{compliance t,y} \geq 0.5 \end{cases}$$

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)
$DF_{RATE,t,y}$	=	Discount factor to account for $RATE_{Compliance,t,y}$
$RATE_{compliance,t,y}$	=	Rate of compliance of a requirement that mandates the use of alternative waste treatment option t in year y
t =		Type of alternative waste treatment option

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 proposed 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. The regulation situation and the compliance rate $RATE_{compliance,\ t,y}$ will be monitored ex-post based on the official reports. Hence, $DF_{RATE,t,y}=1$

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

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

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

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
F	0.5	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
DOCf	0.91 for biomass; 0.88 for manure; 0.93 for food waste	Monitor by PP
MCF	0.8	Unmanaged solid waste disposal sites-deep, IPCC 2006 Guidelines for National Greenhouse Gas Inventories
DOCj	33% for biomass; 38% for manure; 39% for food waste	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)
kj	0.17 for garden and park waste, (wet basis); 0.40 for food, food waste, sewage sludge, beverages and tobacco, (wet basis); 0.036 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)

4.2 Project Emissions

According to ACM0022(version 02.0), the proposed project emissions in year y are calculated for each alternative waste treatment option implemented in the proposed project activity as follows

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

Where:

$PE_{COMP,y}$ = Project emissions from composting or co-composting in year *y* (t CO_2e)

$PE_{AD,y}$ = Project emissions associated from anaerobic digestion and biogas combustion in year y (t CO_2e)

$PE_{GAS,y}$ = Project emissions from gasification in year y (t CO_2e)

$PE_{RDF\_SB,y}$ = Project emissions associated with RDF/SB in year y (t CO_2e)

$PE_{INC,y}$ = Project emissions from incineration in year y (t CO_2e)

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

$PE_{AD,y=0}$

$PE_{GAS,y=0}$

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

$PE_{INC,y=0}$

$PE_{COMP,y}$ are calculated according to the methodological tool “Project and leakage emissions from composting (version 02.0) ”.

$$PE_{COMP,y}=PE_{EC,y}+PE_{FC,y}+PE_{CH4,y}+PE_{N20,y}+PE_{RO,y} \quad (6)$$

Where

$PE_{EC,y}$	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)
$PE_{N20,y}$	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)

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

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)"

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

$=EC_{PJ,j,y}*EF_{grid,CM,y}*(1+TDL_{j,y})$ (7)

According to *"Project and leakage emissions from composting (version 02.0)",* When applying *"Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation(version 03.0)"*, if monitored data for electricity consumption is not available, then electricity consumption from composting ($EC_{PJ,comp,y}$) may be determined based on a default value for the specific quantity of electricity consumed per tonne of waste composted ($SEC_{comp,default}$).

$EC_{PJ,comp,y}=Q_y*SEC_{comp,default}$ (8)

Where

$EC_{PJ,comp,y}$	Quantity of electricity consumed for composting in year y (MWh/yr)
Q_y	Quantity of waste composted in year *y* (t/yr)
$SEC_{comp,default}$	Default value for the specific quantity of electricity consumed per tonne of waste composted (MWh/t)

For ex-ante estimation, $SEC_{comp,default}$ is used. For ex-post estimation, $EC_{PJ,comp,y}$ will be monitored.

The electricity consumed by this project is from national grid. Therefore,

$EF_{EF,j,y}=EF_{grid,CM,y}$

$EF_{grid,CM,y}$ is calculated according to "Tool to calculate the emission factor for an electricity system(version07.0)". Calculation based on public data, the

$EF_{grid,CM,y}$=0.50885tCO_2/MWh

The calculation process is shown in appendix 1.

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

Project emissions from fossil fuel consumption associated with composting are calculated as "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion(version 03.0)"

$PE_{FC,j,y}=FC_{i,j,y}*COEF_{i,y}$. (9)

Where

$PE_{FC,j,y}$	Are the CO_2 emissions from fossil fuel combustion in process *j* during the year *y* (tCO_2/yr)
$FC_{i,j,y}$	Is the quantity of fuel type *i* combusted in process *j* during the year *y* (mass or volume unit/yr)
$COEF_{i,y}$	Is the CO_2 emission coefficient of fuel type *i* in year *y* (tCO_2/mass or volume unit)
i	Are the fuel types combusted in process *j* during the year *y*

0 is used for ex-ante estimation. The actual data will be monitored for ex-post calculation.

Step 3: 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) .

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

Step 4. 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* (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)

4.3 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 ($PE_{COMP,y}$).

Since the waste by-products of the alternative waste treatment option of the proposed project is for soil application, so there're no leakage emissions for the by-products of the proposed project activity.

$$LE_y = LE_{COMP,y} + LE_{AD,y} + LE_{RDF\_SB,y} \quad (12)$$

Where

LEy	Leakage emissions in the year *y* (t CO_2e)
$LE_{COMP,y}$	Leakage emissions from composting or co-composting in year *y* (t CO_2e)
$LE_{AD,y}$	Leakage emissions from anaerobic digester in year *y* (t CO_2e)
$LE_{RDF\_SB,y}$	Leakage emissions associated with RDF/SB in year *y* (t CO_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

4.4 Net GHG Emission Reductions and Removals

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

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)

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
06/01/2020 - 31/12/2020	194,307	39,532	0	154,775
01/01/2021 - 31/12/2021	438,644	56,474	0	382,170
01/01/2022 - 31/12/2022	672,775	62,748	0	610,027
01/01/2023 - 31/12/2023	868,358	62,748	0	805,610
01/01/2024 - 31/12/2024	1,032,514	62,748	0	969,766
01/01/2025 - 31/12/2025	1,170,875	62,748	0	1,108,127
01/01/2026-31/12/2026	2,002,375	62,748	0	1,939,627
01/01/2027-31/12/2027	1,387,337	62,748	0	1,324,589

01/01/2028-31/12/2028	1,476,009	62,748	0	1,413,262
01/01/2029-31/12/2029	1,544,381	62,748	0	1,481,633
01/01/2030-31/12/2030	1,606,427	62,748	0	1,543,678
01/01/2031-31/12/2031	1,659,792	62,748	0	1,597,043
01/01/2032-31/12/2032	1,705,840	62,748	0	1,643,093
01/01/2033-31/12/2033	1,745,709	62,748	0	1,682,961
01/01/2034-31/12/2034	1,780,347	62,748	0	1,717,600
01/01/2035-31/12/2035	1,810,552	62,748	0	1,747,803
01/01/2036-31/12/2036	1,836,990	62,748	0	1,774,242
01/01/2037-31/12/2037	1,860,223	62,748	0	1,797,475
01/01/2038-31/12/2038	1,880,725	62,748	0	1,817,976
01/01/2039-31/12/2039	3,141,937	62,748	0	3,079,189
01/01/2040-31/12/2040	1,915,065	62,748	0	1,852,316
01/01/2041-05/01/2041	1,646,801	5,231	0	1,641,570
Total	33,377,983	1,293,449	0	32,084,534
Average	1,589,428	61,593	0	1,527,835

5 MONITORING

5.1 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 measurement methods and procedures applied	Default value
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	GWP_{CH4}
Data unit	t CO_2e/t CH_4

Description	Global Warming Potential of methane
Source of data	IPCC
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	DOC_f
Data unit	Weight fraction
Description	Default value for the fraction of degradable organic carbon (DOC) in MSW that decomposes in the SWDS
Source of data	Monitored by project participants
Value applied	This is monitored by PP according to national standard. This measurement is fixed during the crediting period.

Justification of choice of data or description of measurement methods and procedures applied	This is monitored by PP according to national standard. This measurement is fixed during the crediting period.
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	DOCj
Data unit	/
Description	Fraction of degradable organic carbon in the waste type *j* (weight fraction)
Source of data	Monitored by PP
Value applied	This is monitored by PP according to national standard. This measurement is fixed during the crediting period.
Justification of choice of data or description of measurement methods and procedures applied	This is monitored by PP according to national standard. This measurement is fixed during the crediting period.

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)
Justification of choice of data or description of measurement methods and procedures applied	Default value

	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

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	National public data
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	$COEF_{i,y}$
Data unit	tCO_2/t fuel
Description	CO_2 emission coefficient of fuel type *i* in year *y*
Source of data	National public data
Value applied	99.73 tCO_2/TJ for bituminous coal; 99.73 tCO_2/TJ *25.8 TJ/Gg=2.573 tCO2/t other Bituminous Coal 101.2 tCO_2/TJ for coking coal, 28.2*101.2TJ/Gg=2.854tCO2/t coking coal
Justification of choice of data or description of measurement methods and procedures applied	2006 IPCC guidelines for national greenhouse gas inventories, table 1.3
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 methods and procedures applied	Default value
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	GWP_{N20}
Data unit	t CO_2e/t CH_4
Description	Global Warming Potential of N_20
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 (v03.0)'
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 (v03.0)'
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 (v03.0)'
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 (v03.0)'
Purpose of Data	Calculation of project emissions
Comments	-

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	There is no compulsory regulation on methane capture and use for SWDS.
Frequency of monitoring/recording	Annually
Value applied	0
Monitoring equipment	/
QA/QC procedures to be applied	Public website
Purpose of data	Calculation of baseline emissions
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	The quantity of waste will be monitored by weighing device

and procedures to be applied	
Frequency of monitoring/recording	Continuously, aggregated at least annually for year *x*
Value applied	400,000t for instance 1 150,000 for instance 2
Monitoring equipment	weighing device
QA/QC procedures to be applied	Weighing device is subject to periodic calibration
Purpose of data	Calculation of baseline and project emissions
Calculation method	-
Comments	-

Data / Parameter	$P_{n,j,x}$
Data unit	Weight fraction
Description	Weight fraction of the waste type *j* in the sample *n* collected during the year *x*
Source of data	Sample measurements by project participants
Description of measurement methods and procedures to be applied	Sample the waste composition, using the waste types *j*, as provided in the table for DOC_j and k_j, and weigh each waste fraction (measure on wet basis)
Frequency of monitoring/recording	Three samples every three months
Value applied	For instance 1: $P_{biomass,y}$=80%; $P_{manure,y}$=16%； $P_{food,y}$=4% For instance 2: $P_{biomass,y}$=77%; $P_{manure,y}$=18%； $P_{food,y}$=5%
Monitoring equipment	weighing device
QA/QC procedures to be applied	Weighing device is subject to periodic calibration

Purpose of data	Calculation of baseline and project emissions
Calculation method	$p_{j,x} = \frac{\sum_{n=1}^{Z_x} p_{n,j,x}}{Z_x}$
Comments	-

Data / Parameter	Z_x
Data unit	/
Description	Number of samples collected during the year x
Source of data	Project participants
Description of measurement methods and procedures to be applied	Three samples every three months
Frequency of monitoring/recording	Continuously, aggregated annually
Value applied	12
Monitoring equipment	/
QA/QC procedures to be applied	The sample size and sampling technique must ensure the sample is representative.
Purpose of data	Calculation of baseline and project emissions
Calculation method	$p_{j,x} = \frac{\sum_{n=1}^{Z_x} p_{n,j,x}}{Z_x}$
Comments	-

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

Data unit	MWh/yr
Description	Quantity of electricity consumed for composting in year y
Source of data	Electricity meters
Description of measurement methods and procedures to be applied	Use electricity meters installed at the electricity consumption sources
Frequency of monitoring/recording	Continuous measurement and at least monthly recording
Value applied	For ex-ante calculation, $EC_{PJ,comp,y}$ is calculated using $W_{j,x}$*$SEC_{comp,default}$ The actual data will be monitored for ex-post calculation.
Monitoring equipment	Electricity meters
QA/QC procedures to be applied	The electricity meter shall be subject to periodic calibration according to national standard.
Purpose of data	Calculation of project emissions
Calculation method	-
Comments	-

Data / Parameter	$FC_{i,j,y}$
Data unit	ton/yr or m^3/yr
Description	Quantity of fuel type i combusted in process j during the year y
Source of data	Onsite measurements
Description of measurement methods and procedures to be applied	Use mass meters
Frequency of monitoring/recording	Continuously and aggregated annually

Value applied	0 for ex-ante and the actual value will be monitored for ex-post calculation
Monitoring equipment	Mass meter
QA/QC procedures to be applied	T*he mass meter is calibrated according to national regulations.*
Purpose of data	Calculation of project emissions
Calculation method	-
Comments	-

5.3 Monitoring Plan

1. Monitoring Management

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

The collected data must be approved and supervised by the plant manager who is in charge of data processing.

2. Quality Assurance and Quality Control

The general manager of the company monitors overall performance of the plant, ensures proper and timely calibration, data acquisition and storage.

A monitoring team is built, consisted with team manager, monitoring staff, data verifier.

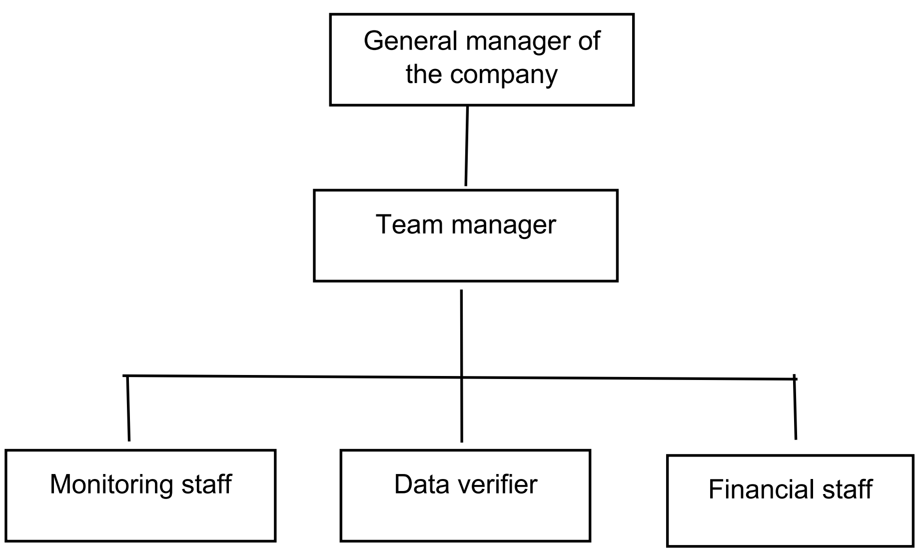

Figure 4. Monitoring structure

3. Data record and Storage

All relevant data is 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 proposed project activity, whichever occurs later.

APPENDIX 1. CALCULATION OF $EF_{GRID,CM,Y}$

Step 1 Identify the relevant electric power system

The delineation of the proposed project electricity system and connected electricity system as defined by the Host Country DNA has been used to define the relevant electric power system. As explained in section 3.4 above, the power generated by the proposed project activity will be transferred to the South China Power Grid (NSCPG). Therefore, the SCPG is identified as the electric power system of the proposed project.

Step 2. Choose whether to include off-grid power plants in the proposed project electricity system

Project participants may choose between the following two options to calculate the operating margin and build margin emission factor:

Option I: Only grid power plants are included in the calculation.

Option II: Both grid power plants and off-grid power plants are included in the calculation.

Following the calculations of the DNA, and the statistical data available, Option I is chosen.

Step 3. Select a method to determine the operating margin (OM)

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:

(a) Simple OM, or

(b) Simple adjusted OM, or

(c) Dispatch data analysis OM, or

(d) Average OM.

Detailed information to carry out a dispatch data analysis is not publicly available; therefore, method (b) and method (c) is not suitable for the proposed project.

According to “Tool to calculate the emission factor for an electricity system”, the Simple OM method is applicable to the proposed project if low-cost resources[6] constitute less than 50% of total grid generation (excluding electricity generated by off-grid power plants) in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production.

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[6] Low-cost/must-run resources are defined as power plants with low marginal generation costs or dispatched independently of the daily or seasonal load of the grid. They include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. If a fossil fuel plant is dispatched independently of the daily or seasonal load of the grid and if this can be demonstrated based on the publicly available data, it should be considered as a low-cost/must-run.

The approach 1) was chosen for calculation and low-cost/must-run resources constitute less than 50% of total grid generation in average of the five most recent years[7]. Therefore, Method (a) Simple OM was selected.

The Simple OM can be calculated using either of the two following data vintages:

(a) Ex ante option: If the ex-ante option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of the PD to the DOE for validation.

(b) Ex post option: If the ex post option is chosen, the emission factor is determined for the year in which the proposed project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring.

Here ex-ante vintage is chosen, and the $EF_{grid,OM,y}$ is fixed during the first crediting period. The date of the publication of the most recent official data for the calculation of the emission factor prior to the start of validation was 29/12/2020.

Power plants registered as CARBON project activities should be included in the sample group that is used to calculate the operating margin if the criteria for including the power source in the sample group apply.

Details of the calculations and data follow the published data from the Chinese DNA, which uses official national statistics. This data does not exclude CARBON projects.

Step 4. Calculate the operating margin emission factor according to the selected method

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (t CO_2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units.

The simple OM may be calculated by one of the following two options：

(a) **Option A**: Based on the net electricity generation and a CO_2 emission factor of each power unit; or

(b) **Option B**: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the proposed project electricity system.

Option B can only be used if:

(a) The necessary data for Option A is not available; and

[7] http://www.mee.gov.cn/ywgz/ydqhbh/wsqtkz/

(b) Only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is known; and
(c) Off-grid power plants are not included in the calculation (i.e. if Option I has been chosen in Step 1.7.2).

Following the calculations of the DNA, Option B is chosen. The criteria for Option B are met:

(a) The necessary data for Option A is not available, as indicated in the calculations of the DNA; and

(b) Only nuclear and renewable power generation are considered as low-cost/must-run power sources, and the quantity of electricity supplied to the grid by these sources is known; and

(c) Option I is chosen in Step 1.7.2.

The proposed project uses Option B for calculating the simple OM emission factor as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_i FC_{i,y} \times NCV_{i,y} \times EF_{CO_2,i,y}}{EG_y} \quad (4)$$

Where:

$EF_{grid,OMsimple,y}$	=	Simple operating margin CO_2 emission factor in year *y* (t CO_2/MWh);
$FC_{i,y}$	=	Amount of fuel type *i* consumed in the proposed project electricity system in year *y* (mass or volume unit);
$NCV_{i,y}$	=	Net calorific value (energy content) of fuel type i in year y (GJ/mass or volume unit);
$EF_{CO2,i,y}$	=	CO_2 emission factor of fuel type *i* in year *y* (tCO_2/GJ);
EG_y	=	Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units, in year *y* (MWh);
i	=	All fuel types combusted in power sources in the proposed project electricity system in year *y*;
y	=	The relevant year as per the data vintage chosen in Step 3.

Based on the data available, the three-year average operating margin emission factor is calculated as a full-generation-weighted average of the emission factors. Details of the calculations and data follow the published data from the Chinese DNA[8], which uses official national statistics.

[8] http://qhs.mee.gov.cn/kzwsqtpf/201812/P020181220579925103092.pdf

$EF_{grid,OMsimple,y}$ = 0.8042 tCO_2/MWh

STEP 5. Calculate the build margin (BM) emission factor

In terms of vintage of data, project participants can choose between one of the following two options:

(a) **Option 1:** for the first crediting period, calculate the build margin emission factor *ex ante* based on the most recent information available on units already built for sample group *m* at the time of PD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

(b) **Option 2:** for the first crediting period, the build margin emission factor shall be updated annually, *ex post*, including those units built up to the year of registration of the proposed project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated *ex ante*, as described in Option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

For the proposed project, option 1 is chosen to calculate Build Margin emission factor ($EF_{grid, BM, y}$).

The sample group of power units *m* used to calculate the build margin should be determined as per the following procedure, consistent with the data vintage selected above:

(a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently ($SET_{5\text{-}units}$) and determine their annual electricity generation ($AEG_{SET\text{-}5\text{-}units}$, in MWh);

(b) Determine the annual electricity generation of the proposed project electricity system, excluding power units registered as CDM project activities (AEG_{total}, in MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\%}$) and determine their annual electricity generation ($AEG_{SET\text{-}\geq 20\%}$, in MWh);

(c) From $SET_{5\text{-units}}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample});

Otherwise:

(d) Exclude from SET_{sample} the power units which started to supply electricity to the grid more than 10 years ago. Include in that set the power units registered as CDM project activities, starting with power units that started to supply electricity to the grid most recently, until the electricity generation of the new set comprises 20% of the annual electricity generation of the proposed project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) to the extent is possible. Determine for the resulting set ($SET_{sample\text{-}CDM}$) the annual electricity generation ($AEG_{SET\text{-}sample\text{-}CDM}$, in MWh);

If the annual electricity generation of that set comprises at least 20% of the annual electricity generation of the proposed project electricity system (i.e. $AEG_{SET\text{-}sample\text{-}CDM} \geq 0.2 \times AEG_{total}$), then use the sample group $SET_{sample\text{-}CDM}$ to calculate the build margin. Ignore steps (e) and (f).

Otherwise:

(e) Include in the sample group $SET_{sample\text{-}CDM}$ the power units that started to supply electricity to the grid more than 10 years ago until the electricity generation of the new set comprises 20% of the annual electricity generation of the proposed project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation);

The sample group of power units m used to calculate the build margin is the resulting set ($SET_{sample\text{-}CDM\text{->}10yrs}$).

The Build Margin Emission Factor ($EF_{grid,\,BM,\,y}$) is calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_{m} EG_{m,y} \times EF_{EL,m,y}}{\sum_{m} EG_{m,y}} \qquad (5)$$

Where:

$EF_{grid,BM,y}$	=	Build margin CO_2 emission factor in year *y* (tCO_2/MWh);
$EG_{m,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh);

$EF_{EL,m,y}$ = CO_2 emission factor of power unit m in year y (tCO_2/MWh);

m = Power units included in the build margin;

y = Most recent historical year for which electricity generation data is available.

Due to data's unavailability, the BM calculation follows the guidance provided by CDM EB in the deviation. First, calculate the newly installed capacity and its power generation technology mix, then the weights of different power technologies in the newly installed capacity, finally the BM emission factor base on the emission factors of different types of most advanced commercial generation technologies.[9]

Because the generating capacity of the coal-fired, oil-fired and gas-fired power plants cannot be separated from the existing statistical data, the BM calculation adopts the following method: First, use the available data in the energy balance tables on the most recent year to calculate the proportion of CO_2 emissions from solid, liquid and gaseous fuels corresponding to the total emissions of CO_2 emissions. Second, calculate the emission factor of the fossil fuel fired power generation in each grid using the above proportions as the weights and the emission factors of the most advanced commercial generation technologies as the reference. Finally, the BM emission factor is multiplied by the proportion of fossil fuel fired power generation and the proportion of fossil fuel fired power plants in the newly added 20% capacity. Concrete steps and the formula for BM are as follows:

Sub-step 5a: **Calculating the share of CO_2 emissions of different fuel-fired power plants in the total CO_2 emissions**

$$\lambda_{Coal,y} = \frac{\sum_{i \in COAL,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (6)$$

$$\lambda_{Oil,y} = \frac{\sum_{i \in OIL,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (7)$$

[9]http://www.mee.gov.cn/ywgz/ydqhbh/wsqtkz/

$$\lambda_{Gas,y} = \frac{\sum_{i \in GAS,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (8)$$

Where:

$F_{i,j,y}$	=	The amount of fuel *i* (in a mass or volume unit) consumed by project *j* in year *y*;
$NCV_{i,j}$	=	Net calorific value (energy content) of fossil fuel type *i* consumed by province *j* (GJ/mass or volume unit)
$EF_{co2,i,j,y}$	=	CO_2 emission coefficient of fossil fuel type *i* (tCO_2/mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant provincial sub-grids *j* and the percent oxidation of fuel in year *y*;

COAL, OIL,and GAS refers to all forms of coal, oil and gas.

***Sub-step 5b:* Calculating the Emission Factor of fuel-fired power technology**

$$EF_{Thermal,y} = \lambda_{Coal,y} \times EF_{Coal,Adv,y} + \lambda_{Oil,y} \times EF_{Oil,Adv,y} + \lambda_{Gas,y} \times EF_{Gas,Adv,y} \quad (9)$$

Where:

$EF_{Coal,Adv,y}$, $EF_{Oil,Adv,y}$ and $EF_{Gas,Adv,y}$ are emission factor proxies of efficiency level of the best coal-fired, oil based and gas-based power generation technology commercially available in China.

***Sub-step 5c:* Calculating the $EF_{grid,BM,y}$**

$$EF_{grid,BM,y} = \frac{CAP_{Thermal,y}}{CAP_{Total,y}} \times EF_{Thermal,y} \quad (10)$$

Where:

$CAP_{Total,y}$ = the newly increment of total installed capacity;

$CAP_{Thermal,y}$ = the newly increment of fuel-fired installed capacity.

Details of the calculations and data follow the published data from the Chinese DNA[10], which uses official national statistics.

$EF_{grid,BM,y}$ = 0.2135 tCO_2/MWh

The $EF_{grid,OM,y}$ and $EF_{grid,BM,y}$ of the first crediting period of the proposed project is calculated *ex-ante* and will not change during the first crediting period, but will be updated once the first crediting period is over.

STEP 5. Calculate the combined margin emission factor

The calculation of the combined margin (CM) emission factor ($EF_{grid,CM,y}$) is based on one of the following methods:

(a) Weighted average CM; or

(b) Simplified CM.

The weighted average CM method (option a) should be used as the preferred option. The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \quad (11)$$

Where

$EF_{grid,OM,y}$	=	Operating margin CO_2 emission factor in year *y* (t CO_2/MWh)
$EF_{grid,BM,y}$	=	Build margin CO_2 emission factor in year *y* (t CO_2/MWh)

According to 'Tool to calculate the emission factor for an electricity system', the weights of OM and BM for hydropower projects are as follows:

w_{OM} = 0.5, w_{BM} = 0.5

Therefore, the combined baseline emission factor is:

$EF_{EG,GR,y} = EF_{grid,CM,y}$ = 0.8042×0.5+0.2135×0.5= 0.50885 tCO_2/MWh

[10] http://www.mee.gov.cn/ywgz/ydqhbh/wsqtkz/