



GUANGZHOU EASTERN SOLID RESOURCE RECYCLING CENTER MSW INTEGRATED TREATMENT PLANT PROJECT



Document Prepared by Climate Bridge (Shanghai) Ltd.

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Project Title	Guangzhou Eastern Solid Resource Recycling Center MSW Integrated Treatment Plant Project
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¹ This ID is consistent with Verification Report ID

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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

Guangzhou Eastern Solid Resource Recycling Center MSW Integrated Treatment Plant Project (hereinafter referred to as the project) is located at the Solid Resource Recycling Center, Fushan Village, Jiulong Town, Luogang District, Guangzhou City, Guangdong Province, P.R China. The project is owned and implemented by Guangzhou LEO-KING Environmental Technology Co., Ltd.

The purpose of the project is to treat MSW with anaerobic digesters and utilize recovered biogas for electricity generation. The project activity includes MSW collection, MSW pre-treatment system, biodiesel production system, anaerobic digester, biogas purification, electricity generation system and waste heat recovery. However, in terms of the biodiesel production system and waste heat recovery, waste oil sourced from MSW pre-treatment system is used for biodiesel production, and the waste heat is recovered to be the source of heat supply for the operation. To be conservative, emission reductions is not claimed for waste heat recovery and biodiesel production system.

The fresh waste of the project is mainly kitchen and catering waste of the Guangzhou City and the design processing capacity of the project for the fresh waste is 2,040 tonnes per day. The biogas from anaerobic digestion is used for electricity generation with internal combustion generators. The total installed capacity is 10.45 MW included 4 generators with each 1.053 MW and 2 generators with each 3.119 MW.

The liquid digestate and solid digestate are produced in anaerobic digester. The solid digestate is outward transported and incinerated directly in thermal power plant and will not be stored under anaerobic conditions. And the wastewater is treated aerobically by wastewater treatment plant nearby.

The project started construction on 12-October-2017 and the operation start date of which is 01-April-2020. The annual average amount of exported electricity is estimated to 61,842 MWh in the twice renewable crediting period from 01-April-2020 to 31-March-2041. And the expected total emission reductions are 2,513,097 tCO₂e during the first crediting period, with average annual emission reductions 359,014 tCO₂e. In this monitoring period from 01-January-2022 to 31-December-2022, the emission reductions are 312,451 tCO₂e.

Audit Type	Period	Program	VVB Name	Number of years
Validation	15-July-2022	Verified Carbon Standard	Shenzhen CTI International Certification Co., Ltd	-

Verification	01-April-2020 to 31-December-2021	Verified Carbon Standard	Shenzhen CTI International Certification Co., Ltd	1 years and 9 months
Verification	01-January-2022 to 31-December-2022	Verified Carbon Standard	China Classification Society Certification Co. Ltd.	1 years
Total	01-April-2020 to 31-December-2022	-	-	2 years and 9 months

1.2 Sectoral Scope and Project Type

Sectoral Scope 1: Energy industries (renewable - / non-renewable sources)

Sectoral Scope 13: Waste handling and disposal.

The project is not a grouped project.

1.3 Project Proponent

Organization name	Guangzhou LEO-KING Environmental Technology Co., Ltd.
Contact person	Peng Tao
Title	General manager
Address	No.118 fushantandong Road, Huangpu District, Guangzhou City, Guangdong Province, P.R China.
Telephone	+86-2162462036
Email	3542346576@qq.com

1.4 Other Entities Involved in the Project

Organization name	Climate Bridge (Shanghai) Ltd.
Role in the Project	Consultancy
Contact person	Gao Zhiwen

Title	General Manager
Address	Block B, Level 24, Jiangong Mansion, 33 Fushan Road, Pudong New Area, Shanghai, China 200120
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Email	gao.zhiwen@climatebridge.com; projects@climatebridge.com

1.5 Project Start Date

01-April-2020 (operation start date is the date on which the project began recovering biogas for electricity generation).

1.6 Project Crediting Period

The project adopts seven years, twice renewable crediting period for a total of 21 years, and the first crediting period is from 01-April-2020 to 31-March-2027.

1.7 Project Location

The project is located at the Solid Resource Recycling Center, Fushan Village, Jiulong Town, Luogang District, Guangzhou City, Guangdong Province, P.R China. The geographical coordinates for the project site are east longitude 113°30'54" and north latitude 23°17'4". The geographic location of the project is shown in Figure 1.1.

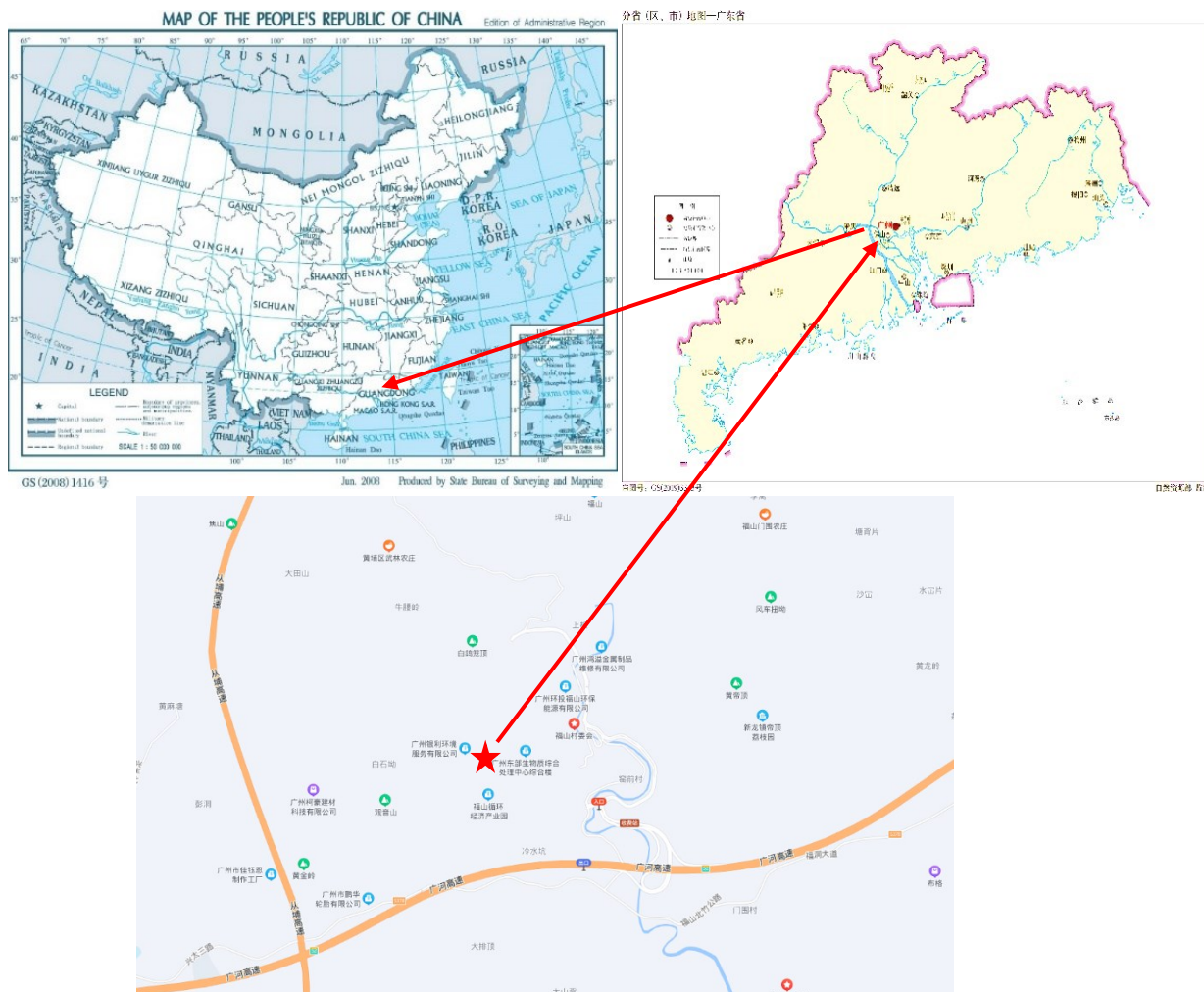


Figure 1.1 Location of the project

1.8 Title and Reference of Methodology

The approved consolidated methodology applied in the project activity is ACM0022 Alternative waste treatment processes (Version 03.0).

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

- “Emissions from solid waste disposal sites” (version 08.1);
- “Project and leakage emissions from anaerobic digesters” (version 02.0);
- “Tool to calculate the emission factor for an electricity system” (version 07.0);
- “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (version 03.0);
- “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 03.0);

“Project emissions from flaring” (version 04.0);

For more detail information about the methodology and tools, please reference to the following link: <https://cdm.unfccc.int/methodologies/DB/AUR5PLW743TS000CWRS55XXT86WV4J>

1.9 Participation under other GHG Programs

The project has neither been registered nor seeking registration under any other GHG programs.

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

● Emission Trading Programs and Other Binding Limits:

China has a national emissions trading scheme only cover the high-emission industries, such as thermal power generation, petrochemical, chemical, building materials, iron and steel, non-ferrous, paper, aviation and other key emission industries that emitted at least 26,000 tons of CO₂e/year, not including renewable project². And the project activity is not included the mandatory emission control scheme and there is no emission cap enforced for the project owner according to the enforced company list³ in public information. Hence, it is confirmed that the emission reductions will not be double counted.

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

● Other Forms of Environmental Credit:

The project hasn't sought or received another form of environmental credits, including renewable energy certificates.

● Supply Chain (Scope 3) Emissions:

As per para 15 on page 75 of “VCS-Standard-v4.4-final”, this sub-section will be effective 01-July-2023, and public statements are required for all emission reductions and removals associated with impacted goods or services for which VCUs may be requested from this date onwards. Thus, this MR won't describe this sub-section.

1.11 Sustainable Development Contributions

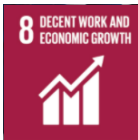
The project will contribute to sustainable development in the following ways:

² http://www.mee.gov.cn/xxgk2018/xxgk/xxgk05/202103/t20210330_826728.html

³ <http://mee.gov.cn/xxgk2018/xxgk/xxgk03/202012/W020201230736907682380.pdf>



The project utilizes fresh waste to generate biogas that would otherwise be treated in a landfill site with a partial capture of the landfill gas (LFG) and flaring of the captured LFG, effectively reducing air pollution and improving the environment around landfills. The project achieves GHG emission reduction and therefore contributes to SDG 13 Climate Action⁴. This contributes to achieve one of China's stated sustainable development priorities "Actively adapt to climate change and strengthen resistance capacity to climate risks in agriculture, forestry, water resources and other key fields, as well as cities, coastal regions and ecologically vulnerable areas".



The project provides long-term employment positions for local villagers and increase tax revenue, which has a positive effect on the local economy. Thus, the project achieves SDG 8 Decent Work and Economic Growth⁵. This contributes to one of the China's actions for promoting sustainable developing, "Increase labor force participation rate through implementation of the classification policy. Vigorously enforce the Law on Promotion of Employment".



The project supplies renewable electricity to the power grid and contributes to SDG 7 Affordable and Clean Energy⁶. This contributes to achieve one of China's stated sustainable development priorities "By 2030, increase the share of non-fossil fuels in primary energy consumption to about 25 percent. Optimize the energy mix by improving fossil-fuel efficiency and increasing the share of clean energy consumption, so that non-fossil fuels and natural gas become the main energy sources".

Evidence for SDG Target 8.3: The payroll of the project is submitted as a separate document to Verra to protect employee privacy.

⁴ <https://sdgs.un.org/goals/goal13>

⁵ <https://sdgs.un.org/goals/goal8>

⁶ <https://sdgs.un.org/goals/goal7>

Table 1.1: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	7.2	Renewable energy supplied to the power grid	Implemented activities to increase	16,600MWh of electricity from renewable sources have been supplied to the SCPG during this monitoring period, replacing fossil fuel powered electricity.	From 01-April-2020 onwards, 55,953.6 MWh of electricity from renewable sources has been supplied to the power grid.
2)	8.3	Provide job opportunities by implementation of the project	Implemented activities to increase	Provided 308 employment positions for local villagers in this monitoring period.	From 01-April-2020 onwards, the project has provided 308 employment positions for local villagers.
3)	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to increase	The project achieved a GHG emission reduction of 312,451 tCO ₂ e during this monitoring period.	From 01-April-2020 onwards, the project has achieved a GHG emission reduction of 645,007 tCO ₂ e.

2 SAFEGUARDS

2.1 No Net Harm

The EIA Report for the project has been approved by Guangzhou City Environment Bureau on 02-May-2017, with approval Sui Huan Guan Ying No. [2017] No.16. Every aspect of environmental impact has been considered in the EIA report with corresponding measures implemented during project development, and no net harm has been detected. Meanwhile, the implementation of the project improves local socio-economic development through creating career opportunities and paying taxes.

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

2.2 Local Stakeholder Consultation

Communications with local stakeholders are being carried out at periodic intervals. Key implementation schedules or changes of the project shall be communicated to the local authority, who should inform the neighbourhood committee and the local residents, the comments and suggestions from residents should be collected by the local authority meanwhile. And the local government agencies and competent authorities should conduct spot checks on the implementation of the project from time to time and give suggestions on the involved rectification problems. In line with VCS requirements all the processes have been implemented to receive comments from local stakeholders as well as communicate with them at periodic intervals.

In this monitoring period from 01-January-2022 to 31-December-2022, the project owner carried out questionnaire survey for the local stakeholder to collect the relevant comments and suggestions. Questionnaire was implemented by filling the stakeholder comments investigation. The comments, from the government, environmental protection bureau, local farmers, teachers, and other relevant stakeholders, were collected. 30 copies questionnaires were distributed on 2022 and all of them were collected. The recovery rate is 100%. There are no negative comments received for the project according to every questionnaire survey.

2.3 AFOLU-Specific Safeguards

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

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

The fresh waste collected by the project is mainly kitchen and catering waste of the Guangzhou City and the design processing capacity of the project for the fresh waste is 2,040 tonnes per day. The project activity includes MSW collection system, MSW pre-treatment system, biodiesel production system, anaerobic digester, biogas purification, electricity generation system and waste heat recovery. However, in terms of the biodiesel production system and waste heat recovery, waste oil sourced from MSW pre-treatment system is used for biodiesel production, and the waste heat is recovered to be the source of heat supply for the operation. To be conservative, emission reductions are not claimed for waste heat recovery and biodiesel production system.

The fresh waste collected by the project is sent to MSW pre-treatment system, then the uniform organic slurry is pumped into the anaerobic digestion system and waste oil is used for biodiesel production system. The anaerobic digestion system produces biogas under medium temperature anaerobic digestion. After at least 25 days retention time in the anaerobic digester, the solid digestate is outward transported and incinerated directly in thermal power plant and is not stored under anaerobic conditions, and the wastewater is treated aerobically by wastewater treatment plant nearby. The biogas from anaerobic digestion is used for electricity generation with internal combustion generators. Detailed technical information and process are shown in Table 3.1 and Figure 3.1 below.

Table 3.1 Technical parameters of the gas generators and enclosed flare

Gas generator:		
Manufacturer	GE Jenbacher GmbH &Co OG	
Type	J620 GS-F25	JGS 320GS-B.L
Quantity	2	4
Rated capacity	3.119 MW	1.053 MW
Rated power factor	1	1
Rated frequency	50HZ	50HZ
Rated Voltage	10500V	10500V
Rotate Current	167A	58A
Enclosed flare		
Manufacturer	Nanjing Carbon Cycling Biomass Technology Co., Ltd.	
Quantity	1	

Model	Φ3100*14000
Temperature range	0~1200℃
Pressure range	0~20Kpa
Flow range	450~4500m³/h

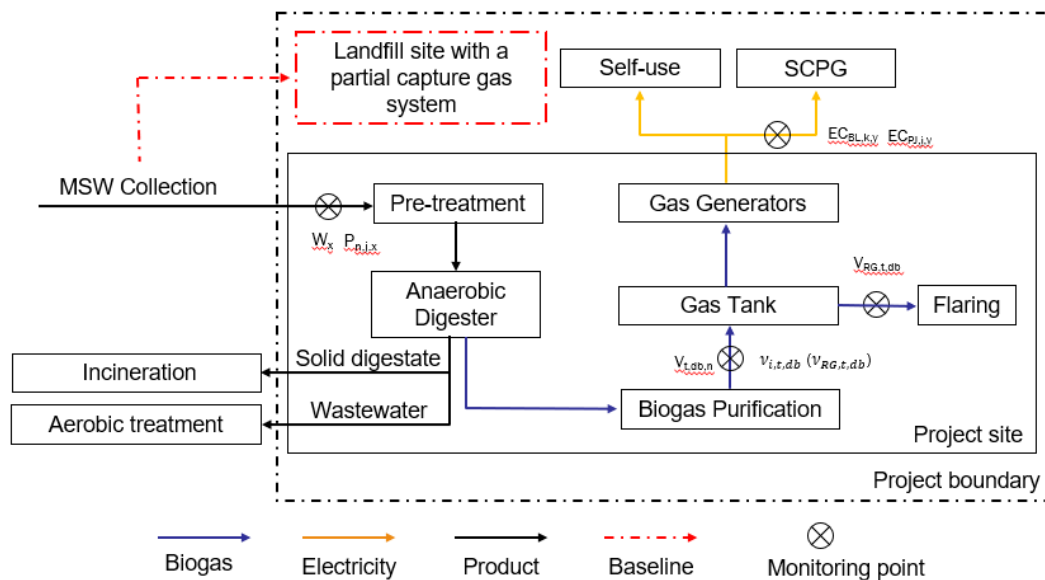


Figure 3.1 Project process diagram

During this monitoring period, the project was implemented in accordance with the registered VCS PD. The project has operated without any accidental or emergency events that might impact the GHG emission reductions and monitoring. The project's anaerobic digester system continuously operated during this monitoring period. According to the ER sheet (Version 1.0), the generators operated for 8522 hours during this monitoring period 8522 hours is operation time of the generators. The flare is activated when the biogas volume exceeds the capacity of the generators or when the generators are under maintenance. According to the ER sheet (Version 1.0), the flare's operation time is 1875 hours during this monitoring period. Through the coordinated operation of the biogas generator set and the flare, it can ensure that all the biogas generated by this project is destroyed.

3.2 Deviations

3.2.1 Methodology Deviations

There are not methodology deviations during this monitoring period. Thus, not applicable.

3.2.2 Project Description Deviations

In the Joint PD&MR (Version 2.1), the total installed capacity will be 10.34 MW included 4 generators with each 1.063 MW and 2 generators with each 3.044 MW, which is based on the data of Electricity Purchase Contract.

According to the nameplate of generators, the total installed capacity is corrected to 10.45 MW included 4 generators with each 1.053 MW and 2 generators with each 3.119 MW in this monitoring period.

3.3 Grouped Projects

The project is not grouped project. Thus, not applicable.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	GWP _{CH4}
Data unit	t CO ₂ e/t CH ₄
Description	Global warming potential of CH ₄
Source of data	IPCC
Value applied	28
Justification of choice of data or description of measurement methods and procedures applied	Default value of 28 from IPCC Fifth Assessment Report (AR5). Shall be updated according to any future COP/MOP decisions.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	NCV _{CH4}
Data unit	TJ/t CH ₄
Description	Net calorific value of methane at reference conditions
Source of data	Technical literature, ACM0001 version 19.0

Value applied	0.0504
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$\eta_{PJflare,m}$
Data unit	Dimensionless
Description	Flare efficiency in minute m
Source of data	"Project emissions from flaring" (Version 04.0)
Value applied	90%
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of project emissions
Comments	-

Data / Parameter	ϕ_y		
Data unit	-		
Description	Model correction factor to account for model uncertainties for year y		
Source of data	“Emissions from solid waste disposal sites” (version 08.1)		
Value applied	0.85		
		Humid/wet conditions	Dry conditions
	Application A	0.75	0.75
	Application B	0.85	0.80

Justification of choice of data or description of measurement methods and procedures applied	Default value suggested in the tool. The project selects Option 1: Use a default value to determine ϕ_y in the tool “Emissions from solid waste disposal sites” (version 08.1), and the project belongs to the situation of Application B, additionally, the climate is wet conditions based on the 23°C of average temperature of Guangzhou city and 1,722mm ⁷ of annual mean precipitation. Thus 0.85 is chosen for ϕ_y .
Purpose of Data	Calculation of baseline 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	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	The landfill is covered with plastic film or soil, for conservative 0.1 was chosen.
Purpose of Data	Calculation of baseline 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	Using IPCC 2006 Guidelines default value

⁷ FSR

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

Data / Parameter	DOC _{f,y}
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	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	Using IPCC 2006 Guidelines default value
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	MCF _y
Data unit	-
Description	Methane correction factor
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied	1.0
Justification of choice of data or description of measurement methods and procedures applied	The nearly landfill of the project is controlled for anaerobic managed, including the following activities: (i) the nearly landfill of the project applies the cover material on the top of the landfill. (ii) Before landfilling, the waste is compacted mechanically. (iii) After landfilling, the waste is levelled. Therefore, 1.0 for anaerobic managed solid waste disposal sites is recommended by "Emissions from solid waste disposal sites (Version 08.1)."
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	DOC _j														
Data unit	-														
Description	Fraction of degradable organic carbon in the waste type <i>j</i> (weight fraction)														
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)														
Value applied	Apply the following values for the different waste types <i>j</i> for MSW: <table border="1"> <thead> <tr> <th>Waste classification</th><th>DOC_j (% wet waste)</th></tr> </thead> <tbody> <tr> <td>Wood and wood product</td><td>43</td></tr> <tr> <td>Pulp, paper and cardboard (other than sludge)</td><td>40</td></tr> <tr> <td>Food, food waste, beverage and tobacco (other than sludge)</td><td>15</td></tr> <tr> <td>Textiles</td><td>24</td></tr> <tr> <td>Gardens, yard and park was</td><td>20</td></tr> <tr> <td>Glass, metal and other inert waste</td><td>0</td></tr> </tbody> </table>	Waste classification	DOC _j (% wet waste)	Wood and wood product	43	Pulp, paper and cardboard (other than sludge)	40	Food, food waste, beverage and tobacco (other than sludge)	15	Textiles	24	Gardens, yard and park was	20	Glass, metal and other inert waste	0
Waste classification	DOC _j (% wet waste)														
Wood and wood product	43														
Pulp, paper and cardboard (other than sludge)	40														
Food, food waste, beverage and tobacco (other than sludge)	15														
Textiles	24														
Gardens, yard and park was	20														
Glass, metal and other inert waste	0														
Justification of choice of data or description of measurement methods and procedures applied	Using IPCC 2006 Guidelines default value														
Purpose of Data	Calculation of baseline emissions														
Comments	-														

Data / Parameter	k _j					
Data unit	1/yr					
Description	Decay rate for the waste type j					
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)					
Value applied	Apply the following default values for the different waste types j:					
	Waste type <i>j</i>		Boreal and Temperate(MAT≤20 °C)		Tropical (MAT>20 °C)	
			Dry (MAP/P ET<1)	Wet (MAP/PE T>1)	Dry (MAP <1000 mm)	Wet (MAP >1000 mm)
	Slowly	Pulp.	0.04	0.06	0.045	0.07

	degradin g	paper, cardboard (other than sludge), textiles				
		Wood, wood products and straw	0.02	0.03	0.025	0.035
	Moderat ely degradin g	Other (non-food) organic putrescibl e garden and park waste	0.05	0.10	0.065	0.17
	Rapidly degradin g	Food, food waste, sewage sludge, beverages and tobacco	0.06	0.185	0.085	0.40
Note: MAT – mean annual temperature, MAP – Mean annual precipitation, PET – potential evapotranspiration. MAP/PET is the ratio between the mean annual precipitation and the potential evapotranspiration.						
Justification of choice of data or description of measurement methods and procedures applied		The average temperature of Guangzhou city is 23°C. The annual mean precipitation is 1,722mm ⁸ , thus, the climate is classed as: Tropical (MAT>20°C), Wet (MAP >1000mm), and the value of k _j for this climate is applied for the project.				
Purpose of Data		Calculation of baseline emissions				
Comments		-				

Data / Parameter	EF _{grid,OM,y}
Data unit	t CO ₂ /MWh
Description	Operating margin CO ₂ emission factor in year y
Source of data	“2019 Baseline Emission Factors for Regional Power Grids in China” published by DNA of China

⁸ FSR

Value applied	0.8042
Justification of choice of data or description of measurement methods and procedures applied	Official and authoritative statistic data.
Purpose of Data	Calculation of baseline emissions and project emissions
Comments	$EF_{grid, OM, y}$ is fixed in the crediting period.

Data / Parameter	$EF_{grid, BM, y}$
Data unit	t CO ₂ /MWh
Description	Build margin CO ₂ emission factor in year y
Source of data	“2019 Baseline Emission Factors for Regional Power Grids in China” published by DNA of China
Value applied	0.2135
Justification of choice of data or description of measurement methods and procedures applied	Official and authoritative statistic data.
Purpose of Data	Calculation of baseline emissions and project emissions
Comments	$EF_{grid, BM, y}$ is fixed in the crediting period.

Data / Parameter	$EF_{grid, CM, y}$
Data unit	t CO ₂ /MWh
Description	Combined margin emission factor for the grid in year y
Source of data	Calculated based on “Tool to calculate the emission factor for an electricity system”
Value applied	0.50885
Justification of choice of data or description of measurement methods and procedures applied	$EF_{grid, CM, y}$ is calculated based on $EF_{grid, OM, y}$ and $EF_{grid, BM, y}$ as per the latest version of “Tool to calculate the emission factor for an electricity system” (version 07.0).
Purpose of Data	Calculation of baseline emissions and project emissions

Comments	For the project, the weight ω_{OM} and ω_{BM} are both 0.5 by default for the fixed crediting period. Thus, $EF_{grid,CM,y}=0.8042 \text{ tCO}_2/\text{MWh} * 0.5 + 0.2135 \text{ tCO}_2/\text{MWh} * 0.5 = 0.50885 \text{ tCO}_2/\text{MWh}$. The $EF_{grid,CM,y}$ is fixed during the crediting period.
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Data / Parameter	$EF_{CH_4,default}$
Data unit	t CH ₄ leaked / t CH ₄ produced
Description	Default emission factor for the fraction of CH ₄ produced that leaks from the anaerobic digester
Source of data	IPCC (2006), Flesch et al. (2011) and Kurup (2003)
Value applied	0.028
Justification of choice of data or description of measurement methods and procedures applied	The digester with steel and gas tank and monolithic construction are installed by the project proponent
Purpose of Data	Calculation of project emissions
Comments	-

Data / Parameter	$f_{CH_4,default}$
Data unit	m ³ CH ₄ / m ³ biogas corrected to reference conditions
Description	Default value for the fraction of methane in the biogas
Source of data	The default value was derived based on reported values from registered projects and research papers (Davidsson, 2007)
Value applied	0.6
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of project emissions
Comments	Use this value for Option 2 of the step "Determination of the quantity of methane produced in the digester"

Data / Parameter	R_u
Data unit	Pa.m ³ /kmol.K
Description	Universal ideal gases constant
Source of data	"Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 03.0)
Value applied	8,314
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline and project emissions
Comments	-

Data / Parameter	MM_i
Data unit	kg/kmol
Description	Molecular mass of greenhouse gas CH ₄
Source of data	"Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 03.0)
Value applied	16.04
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline and project emissions
Comments	-

Data / Parameter	P_n
Data unit	Pa
Description	Total pressure at normal conditions
Source of data	"Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 03.0)

Value applied	101,325 Pa
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline and project emissions
Comments	-

Data / Parameter	T_n
Data unit	K
Description	Temperature at normal conditions
Source of data	“Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 03.0)
Value applied	273.15
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline and project emissions
Comments	-

Data / Parameter	$\rho_{i,n}$ & $\rho_{RG,n}$
Data unit	Kg gas i/m ³ gas I, i=RG=CH ₄
Description	Density of greenhouse gas CH ₄ in the gaseous stream at normal conditions
Source of data	Calculated in the section 4 of joint PD&MR as per the latest version of “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 03.0)
Value applied	0.71566
Justification of choice of data or description of measurement methods and procedures applied	-

Purpose of Data	Calculation of baseline emissions
Comments	Applicable to Option A, $\rho_{i,n} = \rho_{RG,n} = 101,325 \text{ Pa} \times 16.04 \text{ kg/kmol} / (8314 \text{ Pa} \cdot \text{m}^3 / \text{kmol} \cdot \text{K} \times 273.15 \text{ K}) = 0.71566 \text{ kg gas } i / \text{m}^3 \text{ gas } i$

Data / Parameter	$\text{TDL}_{j,y}$ and $\text{TDL}_{k,y}$
Data unit	-
Description	Average technical transmission and distribution losses for providing electricity to source j or k in year y
Source of data	Methodological tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (version 03.0)
Value applied	$\text{TDL}_{j,y}$: 3% $\text{TDL}_{k,y}$: 3%
Justification of choice of data or description of measurement methods and procedures applied	According to the tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (version 03.0), the project belongs to the case of Scenario A, use as default values of 3% for project emission since electricity consumption by all project electricity consumption sources is smaller than the electricity consumption of all baseline electricity consumption sources, and 3% for baseline emissions.
Purpose of Data	Calculation of baseline and project emissions
Comments	-

Data / Parameter	$\text{RATE}_{\text{compliance},t,y}$
Data unit	Fraction
Description	Rate of compliance with a regulatory requirement to implement the alternative waste treatment t implemented in the project activity
Source of data	Ministry of Ecological Environment ⁹
Value applied	0

⁹ <http://www.mee.gov.cn/>

Justification of choice of data or description of measurement methods and procedures applied	There is no regulatory requirement that mandates the use of anaerobic digestion to treat fresh waste according to the most recent information available from website of Ministry of Ecological Environment. Thus, $RATE_{compliance,t,y} = 0$.
Purpose of data	Calculation of baseline emissions
Comments	Calculated based on the number of instances of compliance identified at the time of the investment decision and updated once for every subsequent crediting period

4.2 Data and Parameters Monitored

Data / Parameter	f_y	
Data unit	-	
Description	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year y	
Source of data	ACM0022 (Version 03.0)	
Description of measurement methods and procedures to be applied	According to the ACM0022 (Version 03.0), if the requirement does not specify any amount or percentage of LFG that should be destroyed but require the installation of a system to capture and flare the LFG, then it is assumed $f_y = 0.2$. In China, the requirement does not specify any amount or percentage of LFG that should be destroyed but require the installation of a system to capture and flare the LFG, then it is assumed $f_y = 0.2$.	
Frequency of monitoring/recording	Annually	
Value applied	year	Value
	01-January-2022 to 31-December-2022	0.2
Monitoring equipment	-	
QA/QC procedures to be applied	-	
Purpose of data	Calculation of baseline emissions	
Calculation method	-	

Comments	According to “2021-2025 Five-Year Plan for the Development of Urban Domestic Waste Sorting and Treatment Facilities” (2021)¹⁰, local government should strengthen supervision over the operation of existing landfills and continuously optimize the operation and management model and just recommend installing the landfill gas collection and utilization system. And although most landfills in China are not required to equipped with gas collection devices, the scenario M2 is more conservative option to M3. Please refer to section 3.4 of joint-PD&MR (Version 2.1) for details.
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Data / Parameter	W_x	
Data unit	t	
Description	Total amount of waste disposed in a SWDS in year x	
Source of data	Measurements by project participants	
Description of measurement methods and procedures to be applied	Measure on wet basis	
Frequency of monitoring/recording	Continuously, aggregated at least annually for year x Recording monthly, aggregated annually	
Value applied	year	Value
	01-January-2022 to 31-December-2022	673,264.78 t
Monitoring equipment	There are four weighbridges install at the gate of the project site. In this monitoring period, just one weighbridge was applied to monitor the amount of waste disposed by the project.	
	Monitoring equipment	Weighbridge (Applied)
	Type	SCS-50
	Serial No	22050414BD
	Accuracy	III
	Calibration date	02-February-2021 30-January-2022
	Validity date	01-February-2022 29-January-2023

¹⁰ <https://www.ndrc.gov.cn/xxgk/zcfb/tz/202105/P020210513624038179527.pdf>

	The other three weighbridges were used as backup and were also calibrated regularly.	
	Monitoring equipment	Weighbridge (Backup 1)
	Type	SCS-50
	Serial No	22050413BD
	Accuracy	III
	Calibration date	02-February-2021 30-January-2022
	Validity date	29- February-2022 29-January-2023
	Monitoring equipment	Weighbridge (Backup 2)
	Type	SCS-50
	Serial No	22050415BD
	Accuracy	III
	Calibration date	02-February-2021 30-January-2022
	Validity date	30- February-2022 29-January-2023
	Monitoring equipment	Weighbridge (Backup 3)
	Type	SCS-50
	Serial No	22050416BD
	Accuracy	III
	Calibration date	02-February-2021 30-January-2022
	Validity date	31- February-2022 29-January-2023
QA/QC procedures to be applied	The project proponent will monitor the weight of the MSW regularly. The weighbridge will be calibrated annually.	
Purpose of data	Calculation of baseline emissions	
Calculation method	-	

Comments	For application B														
Data / Parameter	$P_{n,j,x}$														
Data unit	-														
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	Minimum of three samples every three months														
Value applied	The annual data is calculated based on the number of samples and each corresponding weight fraction of waste composition. In this monitoring period, least three samples were collected by project owner every three months, and which were measured according to the relevant standard. Please refer to ER spreadsheet for every sample data during this monitoring period. <table border="1"> <thead> <tr> <th>Year</th><th>2022</th></tr> </thead> <tbody> <tr> <td>Food</td><td>77.90%</td></tr> <tr> <td>Paper</td><td>6.04%</td></tr> <tr> <td>Garden and park waste</td><td>0.00%</td></tr> <tr> <td>Wood</td><td>0.00%</td></tr> <tr> <td>Others (Glass, plastic, metal, etc)</td><td>12.90%</td></tr> <tr> <td>Textile</td><td>3.16%</td></tr> </tbody> </table>	Year	2022	Food	77.90%	Paper	6.04%	Garden and park waste	0.00%	Wood	0.00%	Others (Glass, plastic, metal, etc)	12.90%	Textile	3.16%
Year	2022														
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Garden and park waste	0.00%														
Wood	0.00%														
Others (Glass, plastic, metal, etc)	12.90%														
Textile	3.16%														
Monitoring equipment	-														
QA/QC procedures to be applied	-														
Purpose of data	Calculation of baseline emissions														
Calculation method	-														
Comments	For application B														

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	Minimum of three samples every three months	
Frequency of monitoring/recording	Continuously, aggregated annually	
Value applied	year	Value
	01-January-2022 to 31-December-2022	17
Monitoring equipment	-	
QA/QC procedures to be applied	The sample size and sampling technique must ensure the sample is representative. The samples will be measured by the project owner as per relevant standard.	
Purpose of data	Calculation of baseline emissions	
Calculation method	-	
Comments	For Application B and if the waste includes more than one waste type j. In this monitoring period, the number of samples collected is three at least every three months which is in line with the requirement of the methodology tool.	

Data / Parameter	$EC_{BL,k,y}$
Data unit	MWh
Description	Quantity of electricity that would be consumed by the baseline electricity consumption source k in year y
Source of data	Electricity meter
Description of measurement methods and procedures to be applied	Electricity meter(s) and monthly recorded. All electronic data and paper documents will be archived for two years following the end of the crediting period.

	In this monitoring period, the electricity is monitored continuously by electricity meter and the recorded at 24:00 on the last day of every month by remote reading system.		
Frequency of monitoring/recording	Monitoring continuously and recording monthly		
Value applied	Please refer to ER spreadsheet for monthly data.		
	year	Value	
	01-January-2022 to 31-December-2022	16,600	
Monitoring equipment	Two bidirectional electricity meters M1(main meter) and M2 (backup meter) with accuracy of 0.5S are installed in the high voltage switch room of the project site.		
	The key information of the electricity meters is shown as below:		
	Monitoring equipment	Electricity meter	
	Type	DSSD71	DSSD71
	Serial No	001800010302	001800010306
	Accuracy	0.5S	0.5S
	Calibration date	02-February-2021 29-January-2022	02-February-2021 29-January-2022
	Validity date	01-February-2022 28-January-2023	01-February-2022 28-January-2023
QA/QC procedures to be applied	The data will be cross checked with sale receipts. The electricity meter(s) will be periodically checked and maintained. Calibration will be carried out annually to ensure normal operation.		
Purpose of data	Calculation of baseline emissions.		
Calculation method	-		
Comments	EC _{BL,k,y} is equivalent to the net amount of electricity generated by the alternative waste treatment process t and exported to the grid or displacing fossil fuel fired captive energy plant in year y (EG _{t,y}), which is the electricity exported by the project activity.		

Data / Parameter	EC _{PJ,j,y}
Data unit	MWh
Description	Quantity of electricity consumed by the project electricity consumption source j in year y

Source of data	Electricity meter																				
Description of measurement methods and procedures to be applied	Electricity meter(s) and monthly recorded. All electronic data and paper documents will be archived for two years following the end of the crediting period. In this monitoring period, the electricity is monitored continuously by electricity meter and the recorded at 24:00 on the last day of every month by remote reading system.																				
Frequency of monitoring/recording	Monitoring continuously and recording monthly																				
Value applied	Please refer to ER spreadsheet for monthly data. <table><tr><td>year</td><td colspan="2">Value</td></tr><tr><td>01-January-2022 to 31-December-2022</td><td colspan="2">3,439.4</td></tr></table>			year	Value		01-January-2022 to 31-December-2022	3,439.4													
year	Value																				
01-January-2022 to 31-December-2022	3,439.4																				
Monitoring equipment	Two bidirectional electricity meters M1(main meter) and M2 (backup meter) with accuracy of 0.5S are installed in the high voltage switch room of the project site. The key information of the electricity meters is shown as below: <table><tr><td>Monitoring equipment</td><td colspan="2">Electricity meter</td></tr><tr><td>Type</td><td>DSSD71</td><td>DSSD71</td></tr><tr><td>Serial No</td><td>001800010302</td><td>001800010306</td></tr><tr><td>Accuracy</td><td>0.5S</td><td>0.5S</td></tr><tr><td>Calibration date</td><td>02-February-2021 29-January-2022</td><td>02-February-2021 29-January-2022</td></tr><tr><td>Validity date</td><td>01-February-2022 28-January-2023</td><td>01-February-2022 28-January-2023</td></tr></table>			Monitoring equipment	Electricity meter		Type	DSSD71	DSSD71	Serial No	001800010302	001800010306	Accuracy	0.5S	0.5S	Calibration date	02-February-2021 29-January-2022	02-February-2021 29-January-2022	Validity date	01-February-2022 28-January-2023	01-February-2022 28-January-2023
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Validity date	01-February-2022 28-January-2023	01-February-2022 28-January-2023																			
QA/QC procedures to be applied	The data will be cross checked with purchase receipts. The electricity meter(s) will be periodically checked and maintained. Calibration will be carried out annually to ensure normal operation.																				
Purpose of data	Calculation of project emissions.																				
Calculation method	-																				
Comments	-																				
Data / Parameter	Q _{CH4, y}																				

Data unit	t CH ₄ /y				
Description	Quantity of methane produced in the digester in year y				
Source of data	Calculated				
Description of measurement methods and procedures to be applied	-				
Frequency of monitoring/recording	-				
Value applied	Please refer to ER spreadsheet for monthly data. <table border="1"> <thead> <tr> <th>year</th><th>Value</th></tr> </thead> <tbody> <tr> <td>01-January-2022 to 31-December-2022</td><td>9,804</td></tr> </tbody> </table>	year	Value	01-January-2022 to 31-December-2022	9,804
year	Value				
01-January-2022 to 31-December-2022	9,804				
Monitoring equipment	-				
QA/QC procedures to be applied	-				
Purpose of data	Calculation of project emissions.				
Calculation method	-				
Comments	-				

Data / Parameter	$V_{t,db,n}$
Data unit	m ³ dry gas/h
Description	Volumetric flow of the gaseous stream in time interval t on a dry basis at normal conditions
Source of data	Measured by a flow meter continuously and converted automatically by the recovery monitoring system
Description of measurement methods and procedures to be applied	The parameters of $V_{t,db,n}$ is measured by a flow meter continuously, which will be converted automatically into standard value $V_{t,db,n}$ (at the normal condition of 0 °C and 101,325 Pa) by the recovery monitoring system
Frequency of monitoring/recording	Monitoring continuously and recording monthly.

Value applied	In this monitoring period, volumetric flow of the biogas is monitored continuously on a dry basis at normal conditions and the average value is recorded and calculated on a monthly basis. <table border="1"> <thead> <tr> <th>Period</th><th>Value</th></tr> </thead> <tbody> <tr> <td>01-January-2022 to 31-January-2022</td><td>2,029</td></tr> <tr> <td>01-February-2022 to 28-February-2022</td><td>2,689</td></tr> <tr> <td>01-March-2022 to 31-March-2022</td><td>3,209</td></tr> <tr> <td>01-April-2022 to 30-April-2022</td><td>2,359</td></tr> <tr> <td>01-May-2022 to 31-May-2022</td><td>2,474</td></tr> <tr> <td>01-June-2022 to 30-June-2022</td><td>2,562</td></tr> <tr> <td>01-July-2022 to 31-July-2022</td><td>2,823</td></tr> <tr> <td>01-August-2022 to 31-August-2022</td><td>3,062</td></tr> <tr> <td>01-September-2022 to 30-September-2022</td><td>3,193</td></tr> <tr> <td>01-October-2022 to 31-October-2022</td><td>3,199</td></tr> <tr> <td>01-November-2022 to 30-November-2022</td><td>2,180</td></tr> <tr> <td>01-December-2022 to 31-December-2022</td><td>2,028</td></tr> </tbody> </table>	Period	Value	01-January-2022 to 31-January-2022	2,029	01-February-2022 to 28-February-2022	2,689	01-March-2022 to 31-March-2022	3,209	01-April-2022 to 30-April-2022	2,359	01-May-2022 to 31-May-2022	2,474	01-June-2022 to 30-June-2022	2,562	01-July-2022 to 31-July-2022	2,823	01-August-2022 to 31-August-2022	3,062	01-September-2022 to 30-September-2022	3,193	01-October-2022 to 31-October-2022	3,199	01-November-2022 to 30-November-2022	2,180	01-December-2022 to 31-December-2022	2,028
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Monitoring equipment	Flow meter The key information of the flow meter installed at inlet of the gas tank is shown as below: <table border="1"> <tbody> <tr> <td>Monitoring equipment</td><td>Flow meter</td></tr> <tr> <td>Type</td><td>ZD7200MT5HEX</td></tr> <tr> <td>Serial No</td><td>2106L3546001</td></tr> <tr> <td>Accuracy</td><td>±1.5%</td></tr> <tr> <td>Calibration date</td><td>02-February-2020 29-January-2022</td></tr> <tr> <td>Validity date</td><td>01-February-2022 28-January-2024</td></tr> </tbody> </table>	Monitoring equipment	Flow meter	Type	ZD7200MT5HEX	Serial No	2106L3546001	Accuracy	±1.5%	Calibration date	02-February-2020 29-January-2022	Validity date	01-February-2022 28-January-2024														
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QA/QC procedures to be applied	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory for all projects applying large scale methodology(ies). Calibration will be carried out once every two years according to manufacturer's specifications.																										
Purpose of data	Calculation of project emissions																										
Calculation method	-																										

Comments	This parameter will be monitored in Option A	
Data / Parameter	$F_{CH_4, RG, m}$	
Data unit	t CH ₄	
Description	Mass flow of methane in the residual gas in the minute m	
Source of data	Calculated	
Description of measurement methods and procedures to be applied	-	
Frequency of monitoring/recording	-	
Value applied	Please refer to ER spreadsheet for monthly data.	
	year	Value
	01-January-2022 to 31-December-2022	2,072
Monitoring equipment	-	
QA/QC procedures to be applied	-	
Purpose of data	Calculation of project emissions.	
Calculation method	-	
Comments	-	

Data / Parameter	$V_{RG, t, db}$
Data unit	m ³ dry gas/h
Description	Volumetric flow of the residue gas in time interval t on a dry basis at normal conditions
Source of data	Measured by a flow meter continuously and converted automatically by the recovery monitoring system
Description of measurement methods and procedures to be applied	The parameters of $V_{t, db, n}$ is measured by a flow meter continuously, which will be converted automatically into standard value $V_{t, db, n}$ (at the normal condition of 0 °C and 101,325 Pa) by the recovery monitoring system

Frequency of monitoring/recording	Monitoring continuously and recording monthly																										
Value applied	In this monitoring period, volumetric flow of the remaining biogas is monitored continuously on a dry basis at normal conditions and the average value is recorded and calculated on a monthly basis. <table> <tr> <th>Period</th><th>Value</th></tr> <tr> <td>01-January-2022 to 31-January-2022</td><td>2,450</td></tr> <tr> <td>01-February-2022 to 28-February-2022</td><td>2,629</td></tr> <tr> <td>01-March-2022 to 31-March-2022</td><td>3,072</td></tr> <tr> <td>01-April-2022 to 30-April-2022</td><td>1,777</td></tr> <tr> <td>01-May-2022 to 31-May-2022</td><td>2,346</td></tr> <tr> <td>01-June-2022 to 30-June-2022</td><td>2,164</td></tr> <tr> <td>01-July-2022 to 31-July-2022</td><td>2,392</td></tr> <tr> <td>01-August-2022 to 31-August-2022</td><td>3,423</td></tr> <tr> <td>01-September-2022 to 30-September-2022</td><td>1,810</td></tr> <tr> <td>01-October-2022 to 31-October-2022</td><td>1,466</td></tr> <tr> <td>01-November-2022 to 30-November-2022</td><td>2,681</td></tr> <tr> <td>01-December-2022 to 31-December-2022</td><td>2,746</td></tr> </table>	Period	Value	01-January-2022 to 31-January-2022	2,450	01-February-2022 to 28-February-2022	2,629	01-March-2022 to 31-March-2022	3,072	01-April-2022 to 30-April-2022	1,777	01-May-2022 to 31-May-2022	2,346	01-June-2022 to 30-June-2022	2,164	01-July-2022 to 31-July-2022	2,392	01-August-2022 to 31-August-2022	3,423	01-September-2022 to 30-September-2022	1,810	01-October-2022 to 31-October-2022	1,466	01-November-2022 to 30-November-2022	2,681	01-December-2022 to 31-December-2022	2,746
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Monitoring equipment	Flow meter The key information of the flow meter installed at inlet of the flare is shown as below: <table> <tr> <td>Monitoring equipment</td><td>Flow meter</td></tr> <tr> <td>Type</td><td>JF63N2</td></tr> <tr> <td>Serial No</td><td>18101502</td></tr> <tr> <td>Accuracy</td><td>0.5</td></tr> <tr> <td>Calibration date</td><td>02-February-2020 29-January-2022</td></tr> <tr> <td>Validity date</td><td>01-February-2022 28-January-2024</td></tr> </table>	Monitoring equipment	Flow meter	Type	JF63N2	Serial No	18101502	Accuracy	0.5	Calibration date	02-February-2020 29-January-2022	Validity date	01-February-2022 28-January-2024														
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Purpose of data	Calculation of project emissions
Calculation method	-
Comments	This parameter will be monitored in Option A

Data / Parameter	$v_{i,t,db}$ ($v_{RG,t,db}$)																										
Data unit	m ³ gas CH ₄ /m ³ dry gas																										
Description	Volumetric fraction of greenhouse gas CH ₄ in a time interval t on a dry basis																										
Source of data	Measured by continuous gas analyzer																										
Description of measurement methods and procedures to be applied	Continuous gas analyzer operating on dry basis. Volumetric flow measurement should always refer to the actual pressure and temperature.																										
Frequency of monitoring/recording	Monitoring continuously and recording monthly																										
Value applied	In this monitoring period, volumetric fraction of the CH₄ in biogas is monitored continuously on a dry basis and recorded monthly. <table border="1"> <thead> <tr> <th>Period</th><th>Value</th></tr> </thead> <tbody> <tr> <td>01-January-2022 to 31-January-2022</td><td>61.3%</td></tr> <tr> <td>01-February-2022 to 28-February-2022</td><td>61.4%</td></tr> <tr> <td>01-March-2022 to 31-March-2022</td><td>60.5%</td></tr> <tr> <td>01-April-2022 to 30-April-2022</td><td>60.2%</td></tr> <tr> <td>01-May-2022 to 31-May-2022</td><td>59.5%</td></tr> <tr> <td>01-June-2022 to 30-June-2022</td><td>59.4%</td></tr> <tr> <td>01-July-2022 to 31-July-2022</td><td>59.2%</td></tr> <tr> <td>01-August-2022 to 31-August-2022</td><td>58.9%</td></tr> <tr> <td>01-September-2022 to 30-September-2022</td><td>61.5%</td></tr> <tr> <td>01-October-2022 to 31-October-2022</td><td>61.5%</td></tr> <tr> <td>01-November-2022 to 30-November-2022</td><td>59.9%</td></tr> <tr> <td>01-December-2022 to 31-December-2022</td><td>61.4%</td></tr> </tbody> </table>	Period	Value	01-January-2022 to 31-January-2022	61.3%	01-February-2022 to 28-February-2022	61.4%	01-March-2022 to 31-March-2022	60.5%	01-April-2022 to 30-April-2022	60.2%	01-May-2022 to 31-May-2022	59.5%	01-June-2022 to 30-June-2022	59.4%	01-July-2022 to 31-July-2022	59.2%	01-August-2022 to 31-August-2022	58.9%	01-September-2022 to 30-September-2022	61.5%	01-October-2022 to 31-October-2022	61.5%	01-November-2022 to 30-November-2022	59.9%	01-December-2022 to 31-December-2022	61.4%
Period	Value																										
01-January-2022 to 31-January-2022	61.3%																										
01-February-2022 to 28-February-2022	61.4%																										
01-March-2022 to 31-March-2022	60.5%																										
01-April-2022 to 30-April-2022	60.2%																										
01-May-2022 to 31-May-2022	59.5%																										
01-June-2022 to 30-June-2022	59.4%																										
01-July-2022 to 31-July-2022	59.2%																										
01-August-2022 to 31-August-2022	58.9%																										
01-September-2022 to 30-September-2022	61.5%																										
01-October-2022 to 31-October-2022	61.5%																										
01-November-2022 to 30-November-2022	59.9%																										
01-December-2022 to 31-December-2022	61.4%																										
Monitoring equipment	gas analyzer																										

	The key information of the gas analyzer installed at inlet of gas tank is shown as below:	
	Monitoring equipment	Gas analyzer
	Type	UE50
	Serial No	62387/2
	Accuracy	±2.5%
	Calibration date ⁱ	01-January-2022
	Validity date	31-December-2022
QA/QC procedures to be applied	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory for all projects applying large scale methodology(ies). Calibration will be carried out annually according to the relevant national regulation.	
Purpose of data	Calculation of project emissions	
Calculation method	-	
Comments	The value of both $v_{i,t,db}$ and $v_{RG,t,db}$ is same since the biogas from the same gas tank.	

Data / Parameter	Operation hours (to calculate $Q_{CH_4,y}$) Operation hours (to calculate $F_{CH_4,RG,m}$)		
Data unit	Hours		
Description	The total operation hours of the project (to calculate $Q_{CH_4,y}$) The total operation hours of the flare (to calculate $F_{CH_4,RG,m}$)		
Source of data	Project participants		
Description of measurement methods and procedures to be applied	-		
Frequency of monitoring/recording	Monitoring hourly and recording monthly		
Value applied	In this monitoring period, operation hours of the project plant and flare are monitored continuously and recorded monthly by on-line production system. Please refer to ER spreadsheet for monthly data.		
	Year	Operation hours (to calculate $Q_{CH_4,y}$)	Operation hours (to calculate $F_{CH_4,RG,m}$)
	01-January-2022 to 31-December-2022	8,552	1,875
Monitoring equipment	-		
QA/QC procedures to be applied	-		
Purpose of data	Calculation of project emissions.		
Calculation method	-		
Comments	-		

4.3 Monitoring Plan

The monitoring plan presented in this MR assures that real, measurable, long-term GHG emission reductions can be monitored, recorded, and reported. It is a crucial procedure to identify the final VCU of the project. This monitoring plan shall be implemented by the project owner during the

(A) Data and parameters to be monitored

The diagram illustrates the MSW management system at a landfill site with a partial capture gas system. The system is divided into a **Project site** (dashed box) and the **Project boundary** (dotted box).

MSW Collection enters the **Project site** and is processed through **Pre-treatment** and **Anaerobic Digester**. The **Anaerobic Digester** produces **Solid digestate** (sent to **Incineration**) and **Wastewater** (sent to **Aerobic treatment**). The **Anaerobic Digester** also feeds into **Biogas Purification**.

Biogas Purification produces **Biogas** (blue arrow) which is sent to **Gas Generators** via a monitoring point $V_{i,t,db} (V_{RG,t,db})$. The **Gas Generators** produce **Electricity** (orange arrow) which is sent to **Self-use** and **SCPG** via a monitoring point $EC_{BLK,i} EC_{CP,i}$. The **Gas Generators** also feed into **Gas Tank**.

Gas Tank produces **Gas** (blue arrow) which is sent to **Flaring** via a monitoring point $V_{RG,t,db}$. The **Gas Tank** also feeds into **Biogas Purification**.

Baseline (red dashed arrow) is shown for **MSW Collection** and **Flaring**.

Monitoring points (circles with an 'X') are located at the following locations:

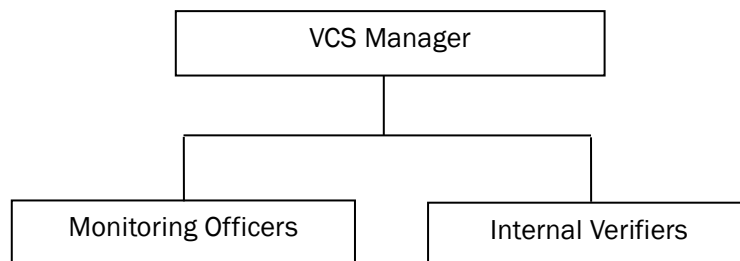
- MSW Collection (Baseline)
- Pre-treatment (Baseline)
- Biogas Purification (Biogas)
- Gas Generators (Electricity)
- Gas Tank (Gas)
- Flaring (Baseline)

Legend:

- Blue arrow: Biogas
- Orange arrow: Electricity
- Black arrow: Product
- Red dashed arrow: Baseline
- Circle with 'X': Monitoring point

Figure 4.1 Project monitoring diagram

The project owner organizes a specific VCS team in project development department to be responsible for data collection, supervision and witness the whole process of data measuring and recording. A VCS manager is appointed to take full responsibility for the overall monitoring of the project. The monitoring and measurement of extracted gas, electricity generation and consumption etc. are carried out by a few designated monitoring officers. A monitoring and management manual of the project that identifies detailed duties and responsibilities of the relevant parties is developed and served as the basis of the project monitoring. Figure 4.2 shows the operation and management structure of the project.



1. The competencies of the VCS team in project development department is described as below: There is regular training for all staff of the specific VCS team department about

monitoring, measuring, and internal verifying. The training content includes not only the explanation of theoretical knowledge, but also simulation exercises of actual operations to ensure that every staff can master the relevant skills.

2. After each regular training, all staff must be tested before working, this test is designed to assess staff understanding and mastery of the training content. Only staff who pass the test can officially take up their posts to ensure the team's professional level and work quality.
3. Professional monitoring and operation personnel must hold professional certificates issued by the government.

(C) Data collection

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

(D) QA&QC

All metering equipment for monitoring should be chosen in accordance with VCS requirements and should be calibrated regularly for accuracy by qualified party according to the national regulations. The flow meter should be calibrated every two years as per Verification Regulation of Thermal Mass Gas Flowmeters (JJG 1132) or other national regulations. The weighbridge, electricity meters and gas analyzer should be calibrated annually according to the corresponding national regulations which are listed in below table.

Metering equipment	National regulations
Weighbridge	Verification Regulation for Digital Indication Weighing Instruments (JJG539) or others
Electricity meters	Verification Regulation of Electrical Meters for Measuring Alternating-current Electrical Energy (JJG596) or Technical Administrative Code of Electric Energy Metering (DL/T448) or others
Gas analyzer	Verification Regulation of Alarmer Detectors of Combustible Gas (JJG693) or others

To assist in future verifications, the project owner should preserve the calibration records, along with the data files of project monitoring.

According to the Figure 4.2, the project developer appoints internal verifiers who is responsible for internal check of the measurement, collection of relevant receipts, and the calculation of the emission reductions. The internal verifiers will cross-check all monitoring data and collection of relevant receipts.

Error check routines should be established on site and at the point of data storage to detect data measuring/transmission failures as well as malfunctions. In the case of malfunction of the

meters, the meter supplier should provide technical support to engage the problem promptly and emission reductions during the corresponding period should be calculated conservatively.

By performing these tasks, internal verifiers ensure that the project's emission reduction claims are credible and verifiable. Their work provides confidence to stakeholders, that the emission reductions reported are based on rigorous and transparent processes.

The installation of the electricity metering equipment should fulfill the requirements of the relevant national standard. The accuracy of the electricity meter is not lower than 0.5S. The accuracy of flow meters and gas analyzers should fulfill the relevant national standard. All the meters should be checked and maintained periodically. All metering equipment should be calibrated regularly for accuracy by qualified party according to the national regulations.

(E) Data file management

All monitoring data should be electronically filed by the end of each month and the electronic data files should be archived in both disk copy and printed hard copy. Other documents in paper e.g. maps, forms and environment assessment reports should be preserved as well. All data collected as part of monitoring should be archived electronically and be kept at least for 2 years after the end of the crediting period. The project owner should provide original records and documents if necessary.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

According to the methodology ACM0022 (version 03.0), baseline emissions are determined based on the section 4.1 of joint-PD&MR (Version 2.1). The BE_y is ex-post determined as the following equations:

$$BE_y = BE_{CH_4,y} + BE_{EC,y} \quad (1)$$

$$BE_{CH_4,y} = \phi_y \times (1-f_y) \times GWP_{CH_4} \times (1-OX) \times \frac{16}{12} \times F \times DOC_{f,y} \times MCF_y \times \sum_{x=1}^y \sum_j (W_x \times \frac{\sum_{n=1}^{Z_x} P_{n,j,x}}{Z_x} \times DOC_j \times e^{-k_j \cdot (y-x)} \times (1 - e^{-k_j})) \quad (2)$$

$$BE_{EC,y} = \sum_k EC_{BL,k,y} \times EF_{EL,k,y} \times (1 + TDL_{k,y}) \quad (3)$$

1. Calculate $(\phi_y \times (1-f_y) \times GWP_{CH_4} \times (1-OX) \times \frac{16}{12} \times F \times DOC_{f,y} \times MCF_y)$ in Equation (2)

The fixed value $(\phi_y \times (1-f_y) \times GWP_{CH_4} \times (1-0X) \times \frac{16}{12} \times F \times DOC_{f,y} \times MCF_y)$ is calculated as 5.712.

2. Calculate $\sum_{x=1}^y \sum_j (W_x \times \frac{\sum_{n=1}^{Z_x} P_{n,j,x}}{Z_x} \times DOC_j \times e^{-k_j \cdot (y-x)} \times (1-e^{-k_j}))$ in Equation (2)

$\sum_{x=1}^y \sum_j (W_x \times \frac{\sum_{n=1}^{Z_x} P_{n,j,x}}{Z_x} \times DOC_j \times e^{-k_j \cdot (y-x)} \times (1-e^{-k_j}))$ is calculated based on the monitored data and parameters, which is ex-post calculated value during this monitoring period as the follows.

Table 5.1 The record of the amount of waste disposed (t) in a SWDS in year $W_{j,x}$ (t)

Parameters		W_x (t)	Food	Paper	Garden and park waste	Wood	Others (Glass, plastic, metal, other inert waste)	Textile
$W_{j,x}$ (t)	2020	482,551.85	374,605	30,304	0	0	61,622	16,021
	2021	654,072.84	508,869	38,525	0	0	83,067	23,612
	2022	673,264.78	524,473	40,665	0	0	86,851	21,275

Table 5.2 The ex-post calculation of $\sum_{x=1}^y \sum_j (W_x \times \frac{\sum_{n=1}^{Z_x} P_{n,j,x}}{Z_x} \times DOC_j \times e^{-k_j \cdot (y-x)} \times (1-e^{-k_j}))$

Period (y=3)	x	Food (t)	Paper (t)	Garden and park waste (t)	Wood (t)	Others (t)	Textile (t)	Total
01-January-2022 to 31-December-2022	1	8,323.80	712.44	0	0	0	225.98	9,262.23
	2	16,868.32	971.38	0	0	0	357.22	18,196.91
	3	25,936.25	1,099.69	0	0	0	345.20	27,381.14

3. Calculate $BE_{CH_4,y}$ according to the calculation results of steps 1 and 2

BE_{CH_4} is ex-post calculated value during this monitoring period as the follows. Please refer to ER calculation spreadsheet for monthly data.

Table 5.3 The ex-post calculation of $BE_{CH_4,y}$

Period	x	Calculation results of steps 1	Calculation results of steps 2	$BE_{CH_4,y}$ (t CO ₂ e) = Calculation results of steps 1 * Calculation results of steps 2
	1	5.712	9,262.23	52,905.85

01-January-2022 to 31-December-2022	2		18,196.91	103,940.73
	3		27,381.14	156,401.05
Total	-	-	-	313,247

According to the Equation (3), $BE_{EC,y}$ is ex-post calculated value during this monitoring period as the follows.

Table 5.4 The calculation of $BE_{EN,t,y}$ ($BE_{EC,y}$)

Period	$EC_{BL,k,y}$ (MWh)	$EF_{EL,k,y}$ (tCO ₂ /MWh)	$TDL_{k,y}$	$BE_{EN,t,y}$ ($BE_{EC,y}$) (t CO ₂ e)
01-January-2022 to 31-December-2022	16,600	0.50885	3%	8,700
Total	16,600	-	-	8,700

Therefore, according to the Equation (1), during this monitoring period from 01-January-2022 to 31-December-2022, BE_y is ex-post calculated value as the following table.

Table 5.5 The ex-post calculation of BE_y

Period	$BE_{EN,t,y}$ ($BE_{EC,y}$) (t CO ₂ e)	$BE_{CH_4,y}$ (t CO ₂ e)	BE_y (t CO ₂ e)
01-January-2022 to 31-December-2022	8,700	313,247	321,947
Total	8,700	313,247	321,947

Thus, the total baseline emission of the project is 321,947 tCO₂e during this monitoring period from 01-January-2022 to 31-December-2022.

5.2 Project Emissions

According to the methodology ACM0022 (version 03.0), project emissions (PE_y) are determined based on the section 4.2 of joint-PD&MR (Version 2.1). The PE_y is ex-post determined as the following equations:

$$PE_y = PE_{AD,y} = PE_{EC,y} + PE_{CH4,y} + PE_{flare,y} \quad (2)$$

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{j,y}) \quad (3)$$

$$PE_{CH4,y} = Q_{CH4,y} \times EF_{CH4,default} \times GWP_{CH4} = \frac{V_{t,db} \times v_{i,t,db} \times \rho_{i,n} \times h}{1000} \times EF_{CH4,default} \times GWP_{CH4} \quad (4)$$

$$PE_{flare,y} = GWP_{CH4} \times \sum_{m=1}^{525600} F_{CH4,RG,m} \times (1 - \eta_{flare,m}) \times 10^{-3} \\ = GWP_{CH4} \times V_{t,db} \times v_{RG,t,db} \times \rho_{RG,n} \times h \times (1 - \eta_{flare,m}) \times 10^{-3} \quad (5)$$

Therefore, $PE_{EC,y}$ is ex-post calculated value during this monitoring period as the follows. Please refer to ER calculation spreadsheet for monthly data.

Table 5.6 The calculation of $PE_{EC,y}$

Period	$EC_{PJ,j,y}$ (MWh)	$EF_{EL,j,y} = EF_{grid,CM,y}$ (tCO ₂ /MWh)	$TDL_{j,y}$	$PE_{EC,y}$ (t CO _{2e})
01-January-2022 to 31-December-2022	3,439.4	0.50885	3%	1,803
Total	3,439.4	-	-	1,803

Based on the monitored data and parameters of section 4.1 and 4.2, $PE_{flare,y}$ and $PE_{CH4,y}$ are ex-post calculated value during this monitoring period as the follows. $Q_{CH4,y}$ and $F_{CH4,RG,m}$ is shown on the monitored parameters in section 4.2.

Table 5.7 The calculation of $PE_{CH_4,y}$

Period	$Q_{CH_4,y}$ (t CH ₄)	$EF_{CH_4,default}$ (t CH ₄ leaked / t CH ₄ produced)	GWP_{CH_4} (tCO ₂ /tCH ₄)	$PE_{CH_4,y}$ (t CO ₂ e)
01-January-2022 to 31-December-2022	9,804	0.028	28	7,687
Total	9,804	-	-	7,687

Table 5.8 The calculation of $PE_{flare,y}$

Period	$F_{CH_4,RG,m}$ (t CH ₄)	$\eta_{flare,m}$ (%)	GWP_{CH_4} (tCO ₂ /tCH ₄)	$PE_{flare,y}$ (t CO ₂ e)
01-January-2022 to 31-December-2022	2,072	90	28	6
Total	2,072	-	-	6

Therefore, during this monitoring period from 01-January-2022 to 31-December-2022, PE_y is ex post calculated value as the following table.

Table 5.9 The ex-post calculation of PE_y

Period	$PE_{EC,y}$ (t CO ₂ e)	$PE_{flare,y}$ (t CO ₂ e)	$PE_{CH_4,y}$ (t CO ₂ e)	PE_y (t CO ₂ e)
01-January-2022 to 31-December-2022	1,803	6	7,687	9,496
Total	1,803	6	7,687	9,496

Thus, during this monitoring period from 01-January-2022 to 31-December-2022, the total project emission of the project is 9,496 tCO₂e.

5.3 Leakage

According to the ACM0022 (Version 03.0), leakage emissions are associated with composting/co-composting, anaerobic digestion and the use of RDF/SB that is exported outside the project boundary.

And the waste by-products of the project do not involve compost or co-compost and the use of RDF/SB outside the project boundary. Leakage emissions associated with anaerobic digestion of waste ($LE_{AD,y}$) are calculated according to “TOOL14: Project and leakage emissions from anaerobic digesters” (Version 02.0).

According to the tool, the leakage emissions associated with the anaerobic digester ($LE_{AD,y}$) depend on how the digestate is managed. They include emissions associated with storage and composting of the digestate. Since the solid digestate is outward transported and incinerated directly in thermal power plant and not be stored under anaerobic conditions and the wastewater is treated aerobically by wastewater treatment plant nearby during this monitoring period, leakage emission is zero, $LE_y = 0$.

5.4 Net GHG Emission Reductions and Removals

As described in section 5.1, 5.2 and 5.3 above, in this monitoring period from 01-January-2022 to 31-December-2022:

$$BE_y = 321,947 \text{ tCO}_2\text{e};$$

$$PE_y = 9,496 \text{ tCO}_2\text{e};$$

$$LE_y = 0 \text{ tCO}_2\text{e};$$

$$ER_y = BE_y - PE_y - LE_y = 312,451 \text{ tCO}_2\text{e}$$

This monitoring period is from 01-January-2022 to 31-December-2022 (Both days included), with totally 365 days. Based on the annual estimated emission reductions, the amount of emission reductions for this monitoring period would be 324,942 tCO₂e. The actual emission reductions in this monitoring period (365 days) are 312,451 tCO₂e, which is 3.84% lower than the estimation and at the normal fluctuation range. Thus, net GHG emission reduction during this monitoring period is considered to be reasonable. The detail information can be obtained as below:

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
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01-January-2022 to 31-December-2022	321,947	9,496	0	312,451
Total	321,947	9,496	0	312,451

<u>Ex-ante emissions reductions /removals</u>	<u>Achieved emissions reductions/ removals</u>	<u>Percent difference</u>	<u>Justification for the difference</u>
324,942	312,451	-3.84%	This is the normal fluctuation range caused by generation efficiency, temperature, waste composition, etc.