



**Verified Carbon
Standard**

QINGDAO XIAOJIANXI PHASE II MSW LANDFILL SITE LFG RECOVERY TO POWER PROJECT



New Power
百川畅银

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Technology Co. Ltd.

Project Title	Qingdao Xiaojianxi Phase II MSW landfill site LFG recovery to power project
Version	3.0
Report ID	NA
Date of Issue	18-08-2023
Project ID	2353
Monitoring Period	01-07-2021 to 31-03-2023 (first and last days included)
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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

Qingdao Xiaojianxi Phase II MSW landfill site LFG recovery to power project (hereafter referred to as the project) is located in Hongdao Economic zone, Qingdao City, Shandong Province, P.R. China. The project is invested, constructed and operated by Qingdao Baichang Environmental Technology Co. Ltd.

The project captures the landfill gas that would have been released to the atmosphere in the absence of the project and generates electricity with the landfill gas. The electricity is supplied to the North China Power Grid (NCPG) to replace the electricity generated from coal-fired power plants of NCPG.

The purpose of the project is to utilize landfill gas (LFG) from the Qingdao Xiaojianxi MSW landfill site, which consists mainly of methane, for electricity generation. The landfill handles an average of 3,500 tonnes MSW per day which is mainly from Qingdao City. The project activity consists in LFG collection, transmission and treatment system, with subsequent electricity generation and grid connection system. VERs are claimed from the methane destroyed by power generation system and the power displacement. The feed-in electricity is estimated to be 145,625MWh during the fixed 10 years crediting period. The expected average annual emission reductions are 73,156 tCO₂e.

The project started construction on 08/01/2019 and commissioned on 13/04/2019. This monitoring period is from 01/07/2021 to 31/03/2023. The total installed capacity is 5.95MW, including 7 sets with each capacity of 0.85MW. For this monitoring period, the net electricity delivered to NCPG was 43,245.349MWh. The total GHG emission reduction was 255,258 tCO₂e.

Audit Type	Period	Program	VVB Name	Number of years
Validation	30/04/2021	Verified Carbon Standard	LGAI Technological Center, S.A. (Applus+ Certification)	/
Verification	(13-04-2019--30-06-2021)	Verified Carbon Standard	LGAI Technological Center, S.A. (Applus+ Certification)	2 years and 78 days
Verification	(01-07-2021--31-03-2023)	Verified Carbon Standard	CTI Certification	1 years and 274 days
Total	/	Verified Carbon Standard	/	/

1.2 Sectoral Scope and Project Type

As the project uses recovered LFG for power generation, the sectoral scopes applicable are:

- Scope 1: energy industries (renewable-/non-renewable sources)
- Scope 13: Waste handling and disposal

The project is neither a AFOLU project nor a grouped project.

1.3 Project Proponent

Organization name	Henan BCCY Environmental Energy Co., Ltd.
Contact person	Yaya Xu
Title	Minister of carbon emission department
Address	8th Floor, Hengmei Business Building, Dongfeng Str.22, Zhengzhou, China
Telephone	+86 371 56737901
Email	xuyaya@bccynewpower.com

1.4 Other Entities Involved in the Project

Organization name	Qingdao Baichang Environmental Technology Co., Ltd.
Role in the Project	Project Operation Entity
Contact person	Lei Wang
Title	Minister of carbon emission department
Address	8th Floor, Hengmei Business Building, Dongfeng Str.22, Zhengzhou, China
Telephone	+86 371 56737901
Email	lwang@bccynewpower.com

1.5 Project Start Date

The project start date is 13/04/2019.

1.6 Project Crediting Period

The crediting period began on 13/04/2019, which is the project start date of operation. It will cease on 12/04/2029, for a total length of ten years.

1.7 Project Location

The Project is located in Xiaojianxi MSW landfill site, Hongdao Economic Zone, Qingdao City, Shandong Province, P.R. China. The geographical coordinates of the project site are longitude 120° 09' 26.06" E and latitude 36° 16' 53.04" N. Figure 1.1 shows the location of the Project.

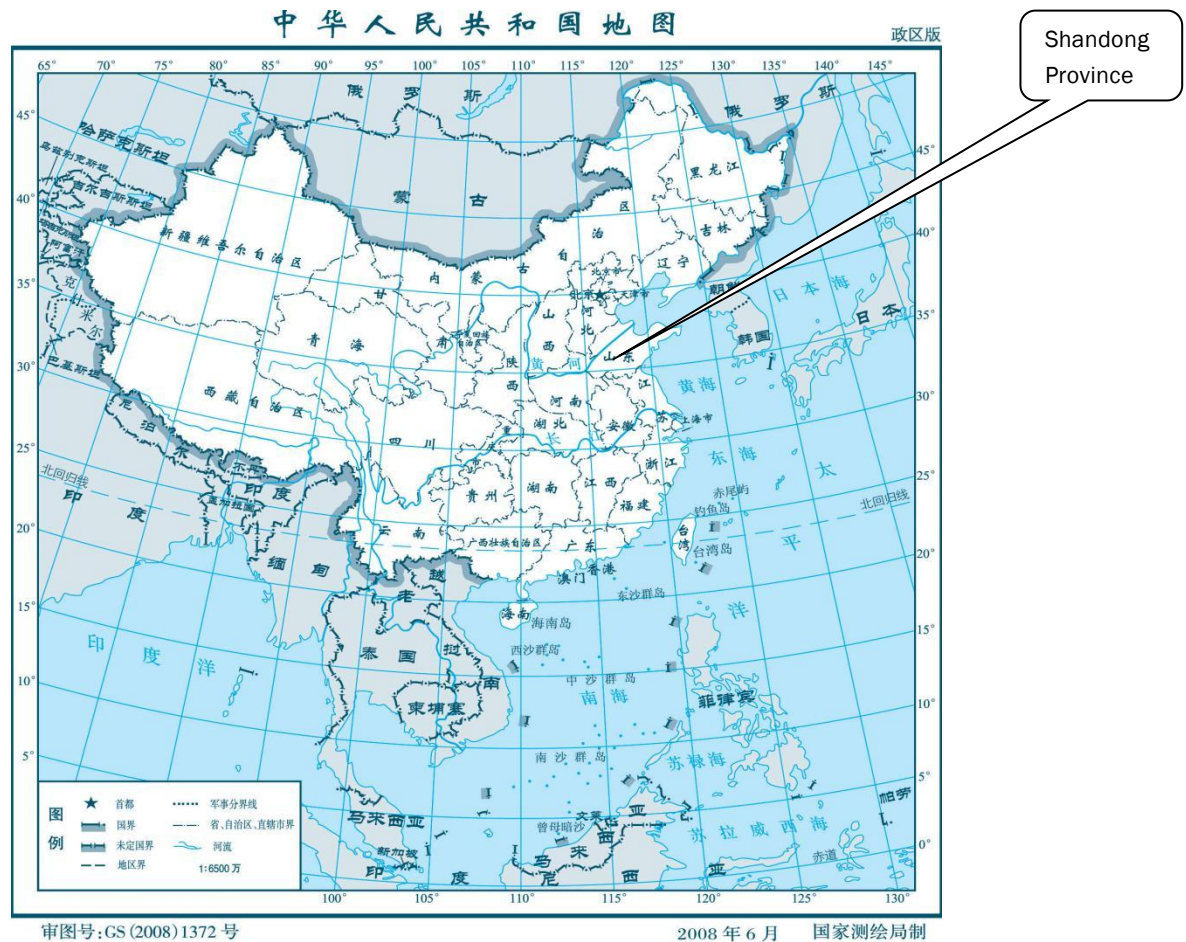




Figure 1.1 Location of the Project

1.8 Title and Reference of Methodology

Title: ACM0001: Flaring or use of landfill gas --- Version 19.0

Reference: <https://cdm.unfccc.int/methodologies/PAmethodologies/approved>

The methodology also refers to the latest approved versions of the following tools:

- “Combined tool to identify the baseline scenario and demonstrate additionality” (Version 07.0);
- “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (Version 03.0);
- “Emissions from solid waste disposal sites” (Version 08.0);
- “Tool to calculate the emission factor for an electricity system” (Version 07.0);
- “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 03.0);
- “Positive lists of technologies” (Version 02.0).

1.9 Participation under other GHG Programs

The project was not registered under other GHG Program.

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

The project does not reduce GHG emissions from activities that are included in emissions trading program or any other mechanism that includes GHG allowance trading, and include details about any such programs or mechanisms.

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

The project is not involved to supply chain (Scope 3) emissions and doesn't affect emissions associated with a good or service.

1.11 Sustainable Development Contributions

The Project is located at Xiaojianxi MSW landfill site, Hongdao Economic Zone, Qingdao City, Shandong Province, P. R. China. The Project contributes to sustainable development in the following ways:

- SDG 13 Climate Action

The project recovers and destroys landfill gas, mainly methane, which would otherwise be released directly into the atmosphere, effectively reducing greenhouse gas emissions, which contributes to the China's commitment to peak carbon dioxide emissions before 2030. Total GHG emission reductions and removals of 731,566 tCO₂e will be achieved during the fixed 10 years crediting period.

- SDG 8 Decent works and Economic Growth

The project can provide permanent and full-time job opportunities over the project lifetime.

- SDG 7 MWh of renewable energy generated

The project utilizes the LFG from Xiaojianxi landfill site to generate electricity by gas engines. Total electricity generation supplied by the project to the grid is estimated to be 145,625MWh, which could replace the equivalent electricity from fossil fuel based grid.

Table 1: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to increase	The project avoided anthropogenic emissions of greenhouse gases (GHG) of 255,258 tCO ₂ e during the monitoring period (01/07/2021 to 31/03/2023)	Prevented the release of 255,258 tonnes of carbon into the atmosphere over project lifetime (01/07/2021 to 31/03/2023)
2)	8.5	Total number of job opportunities	Implemented activities to increase	The project activity employs 15 permanent and full-time employees through its operational company Qingdao Baichang Environmental Technology Co. Ltd. during the monitoring period (01/07/2021 to 31/03/2023)	Increased 15 permanent and full-time job opportunities over project lifetime (01/07/2021 to 31/03/2023)
3)	7.2	MWh of renewable energy generated	Implemented activities to increase	Total 43,245.349 MWh of renewable energy generated during the monitoring period (01/07/2021 to 31/03/2023)	Generated 43,245.349 MWh of renewable energy over project lifetime (01/07/2021 to 31/03/2023)

2 SAFEGUARDS

2.1 No Net Harm

The Environmental Impact Assessment (EIA) Report for the project was compiled by Qingdao Jierui Environment and Technology Service Co. Ltd. The EIA Report for the project has been approved by Ecology and Environment Bureau of Qingdao City on 12/12/2018. According to the approval comments of the EIA Report by Ecology and Environment Bureau of Qingdao City, the environmental impacts likely to be caused by the project are considered insignificant and conforming to the laws and regulations.

During the crediting period, the mitigation measures were implemented and the following key aspects were addressed:

Wastewater

After being treated by septic tank, the sewage is discharged into the adjusting tank of Xiaojianxi MSW landfill site together with the softened wastewater, wastewater then treated .

Waste Gas

LFG is pretreated by iron oxide for H₂S removal, filtration, dust removal and dehydration. The exhaust gas produced by combustion is disposed by seven SCR systems, and finally discharged through seven exhaust cylinders(15m-high).

Noise pollution

The project adopts the following measures to make the noise meet the category II of “Displacement noise standard for industrial enterprise” (GB12348-2008):

The vibration reduction device installed on the base of the project generator set;

The internal combustion generator set is arranged in the power plant;

Install fire-fighting exhaust silencer;

Production workshop set up sound insulation;

The outdoor fan adopts the foundation shock absorber and the muffler is installed.

Solid waste

Household waste is collected and sent to Xiaojianxi MSW landfill site for treatment. Hazardous waste is recycled by the manufacturer. Waste oil shall be set up a hazardous waste temporary storage room and entrusted with hazardous waste disposal qualified units for disposal.

According to the project annual environmental monitoring reports issued by a third party with professional qualifications, the project has adopted various effective measures to control environmental impacts, and the monitoring data is in line with environmental protection requirements. At the same time, the implementation of the project improves local socio-economic development through creating career opportunities and paying taxes. Therefore, there is no net harm.

2.2 Local Stakeholder Consultation

The project owner distributed questionnaires to local residents who may be impacted by the project in order to collect advice for the project. The aim of these questionnaires was to collect opinions concerning the influence the project would have on the local society, environment, economy, daily life etc.

The following questions are from the questionnaires and stakeholder consultancy meeting:

1. What do you think about the environment of surrounding areas?
2. Do you support the construction of this LFG power station?
3. Do you think the implementation of the project will cause positive effect on living of local residents?
4. Do you think the implementation of the project will cause negative effect?

The stakeholders were informed about the stakeholder meeting through posters on 01/12/2018. In the bulletin, the company invited the potential stakeholders to get to know their opinions and/or suggestions about the implementation of the project and VCS application of the project. The stakeholder consultancy meeting for the parties interested in the project was organized at Xiaojianxi Landfill site on 15/12/2018 to collect opinions from all stakeholders, such as representatives of local residents, Xiaojianxi solid waste management station, and the project owner and so on. The project owner appointed one person to make a meeting minute.

30 questionnaires were distributed, and 30 questionnaires were returned. The age range of questioned people was 20-70 years old.

- About 40% of questioned people think the environment of surrounding areas is bad, and others think it is acceptable and good.
- 100% of questioned people support the construction of the project.
- 85% and 90% of questioned people think the implementation of the project will mitigate air pollution and lack of electricity, respectively.

- 7% of questioned people think the noise of implementation of the project will affect the living of local residents surround.

There are 15 stakeholders attended the stakeholder consultation meeting and the project owner had taken meeting minute.

During the stakeholder consultancy meeting, some stakeholders worried that the project will bring noise, land occupying and pollution on employees and local residents' living. For these issues, the project owner will offer some measures: i.e. installation of sound proof devices and plating of green isolation belts are used for mitigating noise; the area the project built on only will not occupy farms of local residents; at the project site, waste recycling will be carried out reduce emit of waste, and the project site meanwhile will be far from the residential area, so the effect of the noise from the plant is little to local residents. All attendances to the meeting were satisfied to the measures.

As a whole, the impacts of construction of the project are basically positive. All stakeholders were pleased with the development of the project. The VCS project would actually facilitate the development of the local economy and increase the income of local residents.

During the meeting, the project information and the continuous input / grievance mechanism have been introduced to the local stakeholders. The project information with contact information has also been posted on the bulletins at the project site and nearby, which states that there is grievance book at the project site, and everyone is welcome to give comments. The continuous input/grievance mechanism is as below.

Table 2 Continuous input/grievance mechanism

	Method Chosen (include all known details e.g. location of book, phone number)	Justification
Continuous Input/Grievance Expression Process Book	A grievance book is put at the project site.	The grievance book is kept at the project owner office. Anyone can go there to record their grievance or comment in the book. The project owner personnel will review and respond to the comments and record the response in the book as well.
Telephone access	+86 18737823320	Ms. Lei Wang, Qingdao Baichang Environmental Technology Co. Ltd.
	+86 037156737901	Ms. Yaya Xu, Henan BCCY Environmental Energy Co., Ltd.

Email access	lwang@bccynewpower.com	Ms. Lei Wang, Qingdao Baichang Environmental Technology Co. Ltd.
	xuyaya@bccynewpower.com	Ms. Yaya Xu, Henan BCCY Environmental Energy Co.,Ltd.

LSC during the operation period

Communications with Local stakeholders have been carried out at periodic intervals. Key implementation schedules and changes of the project have been communicated to the local authority, the neighbourhood committee, and local residents. The comments and suggestions from residents were collected by the local authority, if any.

During the crediting period permanent communication has been maintained with the community. The mechanism for on-going communication with local stakeholders include the following channel: Periodic meetings we representatives of Qingdao Baichang Environmental Technology Co. Ltd. The meetings were organized at Xiaojianxi Landfill site on 17/08/2022 and 25/02/2023 to collect comments from all stakeholders, such as representatives of local residents, Xiaojianxi solid waste management station, and the project owner and so on. The project owner appointed one person to make a meeting minute.

At the stakeholder meeting on 17/08/2022. This meeting was introduced by Yao Hongliang, the plant manager, who described the scale of the project construction, the process flow, the operation of the project and the impact of the application as an emission reduction project on the company. The director of the landfill plant thought that the project had significantly improved the air quality of the landfill during its operation and reduced safety hazards, and that the wastewater and solid waste generated by the project's operation were handled in strict accordance with the requirements to achieve the expected results. The villagers raised questions about whether the project would generate noise in the future, and the plant manager said that the relevant measures would be further strengthened in the future to optimize the reduction of noise. The villagers unanimously praised the project at this meeting.

At the stakeholder meeting on 25/02/2023. This meeting consisted of a main presentation by the plant manager about the project during its operation. The landfill employees expressed their views on the project, he believed that the project could be implemented in accordance with the relevant regulations, and through grid-connected power generation, it could achieve energy saving and emission reduction, which is in line with the national dual-carbon target. The villagers asked questions about whether the project could provide more job opportunities in the future and the environmental impacts generated, and the plant manager said that the demand for jobs in the future would be prioritized to the nearby villagers, that the environment of the plant would be implemented in strict accordance with the requirements, and that the equipment management would be put in place, and that it would not have an impact on the lives of the residents.

As a whole, the impacts of operation of the project are basically positive. All stakeholders were pleased with the development of the project. The VCS project would actually facilitate the development of the local economy and increase the income of local residents. 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. During this monitoring period, there were no negative comments received for the project.

2.3 AFOLU-Specific Safeguards

For non-AFOLU projects, this section is not required.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

The project activity consists in LFG collection, transmission and treatment system, with subsequent electricity generation and grid connection system.

LFG collection system

LFG is extracted from MSW under negative pressure by blower pumps and moved through wells, then collected by gas collection stations and transferred by sub-pipes and a main pipe to LFG treatment equipment. Flow rate of the LFG is regulated at the collection points in order to always fit with the consumption capacity of the generation engines.

LFG treatment system

Prior to electricity generation, LFG is treated to remove impurities and moisture, to avoid corrosion in the engines. The treatment consists of filtration, de-moisturing, cooling and pressurization.

Electricity generation and grid connection system

7 gas engines of 850kW rated power each are fed with the LFG and generate electricity, which is then exported to the grid. The engine 1# 2# 3# 4# and 5# (745kW) were put into operation on 13/04/2019. The remain engine 6# and 7# (745kW) were put into operation on 01/07/2021.

Table 3 Equipment technical parameters

Main Equipment	Parameter	Value
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Generator	Type	850GF-NK
	Manufacturer	CNPC Jichai Power Company Limited
	Rated Capacity	850 kW
	Rated rotation speed	1000 r/min
	Capacity factor	0.8 (lagging)

During the monitoring period from 01/07/2021 to 31/03/2023, the generation units have been working for about 99,829 hours in total, the 1#, 2#, 3#, 4#, 5#, 6# and 7# gas engine have been operating for 14,047, 14,014, 14,111, 14,170, 14,509, 14,503 and 14,475 hours, respectively. The important events during the operation of the project have been recorded in operation log. During this monitoring period, the project is in good operation.

The project does not include any flare system.

3.2 Deviations

3.2.1 Methodology Deviations

There is no deviation applied to this monitoring period.

3.2.2 Project Description Deviations

There is no deviation applied to this monitoring period.

3.3 Grouped Projects

The project is not a grouped project.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

The parameter of methane generation from the landfill in the absence of the project ($BE_{CH_4, SWDS,y}$) is used for ex-ante estimation of relevant parameter $F_{CH_4,PJ,y}$. For $F_{CH_4,PJ,y}$, there is an ex post determination method. Thus, in this monitoring period, $BE_{CH_4,SWDS,y}$ and the relevant basic parameters (ϕ_y , OX , F , DOC_f , MCF_f , K_j , $W_{j,x}$, DOC_j , f_y , η_{PJ}) for calculation of $BE_{CH_4, SWDS,y}$ are not included here.

Data / Parameter	$OX_{top,layer}$
Data unit	-
Description	Fraction of methane that would be oxidized in the top layer of the SWDS in the baseline
Source of data	"Emission from the solid waste disposal sites" (version 8.0)
Value applied	0.1
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	GWP_{CH_4}
Data unit	tCO_2e/tCH_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	As per VCS Standard Version 4.4
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	ρ_{CH_4}
Data unit	t/m^3
Description	Density of methane gas at Normal Conditions
Source of data	-

Value applied	0.0007168 (Normal conditions: 0 °C and 101.325 kPa)
Justification of choice of data or description of measurement methods and procedures applied	At standard temperature and pressure (0 degree Celsius and 1,013 bar) the density of methane is 0.0007168 tCH ₄ /m ³ CH ₄
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	EF _{grid,OM,y}
Data unit	tCO ₂ /MWh
Description	Operation margin emission factor of NCPG
Source of data	2017 Bulletin on the Baseline Emission Factors of the China Grids
Value applied	0.9680
Justification of choice of data or description of measurement methods and procedures applied	The value is published by Ministry of Ecology and Environment of the People's Republic of China, based on China Electric Yearbook (2014-2016), Electricity Industry Statistics (2013-2015), China Energy Statistical Yearbook (2014-2016) and IPCC data.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	EF _{grid,BM,y}
Data unit	tCO ₂ /MWh
Description	Build margin emission factor of NCPG
Source of data	2017 Bulletin on the Baseline Emission Factors of the China Grids
Value applied	0.4578
Justification of choice of data or description of measurement methods and procedures applied	The value is published by Ministry of Ecology and Environment of the People's Republic of China, based on China Electric Yearbook (2014-2016), Electricity Industry Statistics (2013-2015), China Energy Statistical Yearbook (2014-2016) and IPCC data.

Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$TDL_{j,y}$ and $TDL_{k,y}$
Data unit	-
Description	Average technical transmission and distribution losses for providing electricity to source j,k in year y
Source of data	Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (version 03.0)
Value applied	Use as default values of 20% for project consumption sources; Use as default values of 3% for baseline electricity consumption sources. i.e.: $TDL_{j,y}=3\%$, $TDL_{k,y}=20\%$
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of Baseline, project and/or leakage emissions from electricity consumption
Comments	-

4.2 Data and Parameters Monitored

Data / Parameter	Management of SWDS
Data unit	-
Description	Management of SWDS
Source of data	Original design of the landfill
Description of measurement methods and procedures to be applied	Project participants should refer to the original design of the landfill to ensure that any practice to increase methane generation have been occurring prior to the implementation of the project activity. Any change in the management of the SWDS after the

	implementation of the project activity should be justified by referring to technical or regulatory specifications.
Frequency of monitoring/recording	Annually
Value applied	Since the implementation of the project activity, no changes have taken place in the management of the landfill. By the end of the implementation of the project, the provisions on methane recovery and utilization have not changed in the current effective laws and standards in China, and it is a common phenomenon in China that methane is discharged into the atmosphere without utilization.
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	-

Data / Parameter	$Op_{j,h}$
Data unit	-
Description	Operation of the equipment that consumes the LFG
Source of data	Project participants
Description of measurement methods and procedures to be applied	For each equipment unit j using the LFG monitor that the plant is operating in hour h by the monitoring any one or more of the following three parameters: (a) Temperature. Determine the location for temperature measurements and minimum operational temperature based on manufacturer's specifications of the burning equipment. Document and justify the location and minimum threshold in the PDD; (b) Flame. Flame detection system is used to ensure that the equipment is in operation; (c) Products generated. Monitor the generation of steam for the case of boilers and air-heaters and glass for the case of glass melting furnaces. This option is not applicable to brick kilns.

	$Op_{j,h}=0$ when: (a) One of more temperature measurements are missing or below the minimum threshold in hour h (instantaneous measurements are made at least every minute); (b) Flame is not detected continuously in hour h (instantaneous measurements are made at least every minute); (c) No products are generated in the hour h . Otherwise, $Op_{j,h}=1$
Frequency of monitoring/recording	Hourly
Value applied	In this monitoring period, the operation hours of each generator are as follows. 14,047 h (generator 1#) 14,014 h (generator 2#) 14,111 h (generator 3#) 14,170 h (generator 4#) 14,509 h (generator 5#) 14,503 h (generator 6#) 14,475 h (generator 7#)
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	-

Data / Parameter	$F_{CH_4,BL,R,y}$
Data unit	tCH_4/yr
Description	Amount of methane in the LFG which is flared due to a requirement in year y
Source of data	Information of the host country's regulatory requirements relating to LFG, contractual requirements, or requirements to address safety and odour concerns.

Description of measurement methods and procedures to be applied	-										
Frequency of monitoring/recording	Annually										
Value applied	<table> <tr> <th>Date</th><th>$F_{CH_4,BL,R,y}(tCH_4)$</th></tr> <tr> <td>01/07/2021-31/12/2021</td><td>677.37</td></tr> <tr> <td>01/01/2022-31/12/2022</td><td>1,300.15</td></tr> <tr> <td>01/01/2023-31/03/2023</td><td>303.19</td></tr> <tr> <td>Total</td><td>2,280.71</td></tr> </table>	Date	$F_{CH_4,BL,R,y}(tCH_4)$	01/07/2021-31/12/2021	677.37	01/01/2022-31/12/2022	1,300.15	01/01/2023-31/03/2023	303.19	Total	2,280.71
Date	$F_{CH_4,BL,R,y}(tCH_4)$										
01/07/2021-31/12/2021	677.37										
01/01/2022-31/12/2022	1,300.15										
01/01/2023-31/03/2023	303.19										
Total	2,280.71										
Monitoring equipment	-										
QA/QC procedures to be applied	-										
Purpose of data	Calculation of baseline emissions										
Calculation method	-										
Comments	Applicable to Case 2 of section 5.4.1.3 of ACM0001“Flaring or use of landfill gas” (version 19.0)										

Data / Parameter	$P_{reg,y}$
Data unit	Dimensionless
Description	Fraction of LFG that is required to be flared due to a requirement in year y
Source of data	Information of the host country’s regulatory requirements relating to LFG, contractual requirements, or requirements to address safety and odour concerns.
Description of measurement methods and procedures to be applied	-
Frequency of monitoring/recording	Annually

Value applied	20%
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	Applicable to Case 2 of section 5.4.1.3 of ACM0001“Flaring or use of landfill gas” (version 19.0)

Data / Parameter	EG _{PJ,y}										
Data unit	MWh										
Description	Amount of electricity generated using LFG by the project activity in year y										
Source of data	Project participant										
Description of measurement methods and procedures to be applied	Monitor net electricity generation by the project activity using LFG										
Frequency of monitoring/recording	The recording frequency was hourly measured and recorded, and monthly aggregated.										
Value applied	43,245.349 MWh during this monitoring period <table border="1"> <thead> <tr> <th>Date</th><th>EG_{PJ,y} (MWh)</th></tr> </thead> <tbody> <tr> <td>01/07/2021-31/12/2021</td><td>12,843.399</td></tr> <tr> <td>01/01/2022-31/12/2022</td><td>24,653.387</td></tr> <tr> <td>01/01/2023-31/03/2023</td><td>5,748.563</td></tr> <tr> <td>Total</td><td>43,245.349</td></tr> </tbody> </table>	Date	EG _{PJ,y} (MWh)	01/07/2021-31/12/2021	12,843.399	01/01/2022-31/12/2022	24,653.387	01/01/2023-31/03/2023	5,748.563	Total	43,245.349
Date	EG _{PJ,y} (MWh)										
01/07/2021-31/12/2021	12,843.399										
01/01/2022-31/12/2022	24,653.387										
01/01/2023-31/03/2023	5,748.563										
Total	43,245.349										
Monitoring equipment	Electricity meter										

	Model	Serial number	Accuracy class	Date of calibration	Validity
	DSZ331	110029364505	0.5S	30/03/2021	29/03/2022
				26/03/2022	25/03/2023
				24/03/2023	23/03/2024
QA/QC procedures to be applied	The calibration was done once a year by a qualified third party.				
Purpose of data	Calculation of baseline emissions				
Calculation method	-				
Comments	-				

Data / Parameter	EG _{EC,y}	
Data unit	MWh	
Description	Amount of electricity consumed by the project activity in year y	
Source of data	Project participant	
Description of measurement methods and procedures to be applied	Sources of consumption include electricity consumed for the operation of the LFG capture system, for any processing and upgrading of the LFG, for transportation of the LFG to the flare or power generators, etc.	
Frequency of monitoring/recording	The recording frequency was hourly measured and recorded, and monthly aggregated.	
Value applied	3.000 MWh during this monitoring period	
	Date	EG _{EC,y} (MWh)
	01/07/2021-31/12/2021	1.800
	01/01/2022-31/12/2022	0.660
	01/01/2023-31/03/2023	0.540
	Total	3.000
Monitoring equipment	Electricity meter	

	Model	Serial number	Accuracy class	Date of calibration	Validity
	DSZ331	110029364505	0.5S	30/03/2021	29/03/2022
				26/03/2022	25/03/2023
				24/03/2023	23/03/2024
QA/QC procedures to be applied	The calibration was done once a year by a qualified third party.				
Purpose of data	Calculation of baseline emissions				
Calculation method	-				
Comments	-				

Data / Parameter	V _{t,db}				
Data unit	m ³ dry gas/h				
Description	Volumetric flow of the gaseous stream in time interval t on a dry basis				
Source of data	Monitored by project participant				
Description of measurement methods and procedures to be applied	Volume flow measurement always refers to the actual pressure and temperature.				
Frequency of monitoring/recording	Measured continuously by a flow meter (average hourly value was used in the calculations of baseline emission reductions). Data to be aggregated monthly.				
Value applied	2,095.25 (total flow for this monitoring period at normal conditions) The detailed calculation process has been showed in V _{t,db} operating report.				
Monitoring equipment	Flow meter				
	Model	Serial number	Accuracy class	Date of calibration	Validity
	BF-3000-	E01325000003	1.5	27/03/2021	26/03/2022
				21/03/2022	20/03/2023

	2400			19/03/2023	18/03/2024
QA/QC procedures to be applied	Flow meter was subject to a regular maintenance and testing regime to ensure accuracy				
Purpose of data	Calculation of project emissions				
Calculation method	-				
Comments	-				

Data / Parameter	V _{i,t,db}				
Data unit	m ³ gas i/m ³ dry gas				
Description	Volumetric fraction of greenhouse gas I in a time interval ton s dry basis				
Source of data	Monitored by the project participant				
Description of measurement methods and procedures to be applied	Continuous gas analyzer operating in operating in dry-basis. Volumetric flow measurement should always refer to the actual pressure and temperature.				
Frequency of monitoring/recording	Continuous if not specified in the underlying methodology				
Value applied	49.51% （average value） The detailed calculation process has been showed in ER Calculation Spreadsheet.				
Monitoring equipment	Gas analyzer				
	Model	Serial number	Accuracy class	Date of calibration	Validity
	GTR196	61584/45	2%	27/03/2021	26/03/2022
				21/03/2022	20/03/2023
				19/03/2023	18/03/2024
QA/QC procedures to be applied	Gas analyzer was subject to a regular maintenance and testing regime to ensure accuracy				
Purpose of data	Calculation of baseline emissions				
Calculation method	-				

Comments	-
Data / Parameter	CAPEX and OPEX
Data unit	CNY
Description	Total investment to implement the project and total cost to operate the project
Source of data	Engineering, procurement and construction contracts; and maintenance contracts
Description of measurement methods and procedures to be applied	-
Frequency of monitoring/recording	At the first issuance request after each phase of the project is fully implemented
Value applied	CAPEX: 33,139,282.33 CNY OPEX: 6,290,815.62 CNY
Monitoring equipment	-
QA/QC procedures to be applied	Audited by professional, independent financial auditors. The DOE should only verify that the data provided corresponds to the data from independent financial auditors.
Purpose of data	Identify the baseline scenario and demonstrate additionality
Calculation method	-
Comments	The information provided for CAPEX shall indicate the investment made: (i) in the collection and flaring system; (ii) in the power plant and connection to the grid (if applicable); and (iii) in the purchase of the new boiler or refurbishment of the existing one and in the steam/hot air pipeline if steam/hot air is exported out of the project boundary (if applicable). The information supplied for OPEX shall indicate the costs for: (i) staff and maintenance involved in the operation of the collection and flaring system; and (ii) staff and maintenance involved in the operation of the collection and power generation system. The monitoring of this parameter is only required for projects applying the simplified procedures to identify the baseline scenario and demonstrate additionality.

Data / Parameter	Tariff of electricity exported
Data unit	CNY/kWh
Description	Tariff of the electricity exported
Source of data	On-grid tariff approval
Description of measurement methods and procedures to be applied	-
Frequency of monitoring/recording	At the first issuance request after each phase of the project is fully implemented
Value applied	0.594
Monitoring equipment	-
QA/QC procedures to be applied	Audited by professional, independent financial auditors. The DOE should only verify that the data provided corresponds to the data from independent financial auditors
Purpose of data	Identify the baseline scenario and demonstrate additionality
Calculation method	-
Comments	The monitoring of this parameter is only required for projects applying the simplified procedures to identify the baseline scenario and demonstrate additionality

4.3 Monitoring Plan

1. The requirement of monitoring plan

The project participant monitors the emission reductions by methods, indicators, and frequency required by Monitoring Methodology ACM0001 (Version 19.0) to ensure project ERs are measurable and real. The monitoring methodology is based on direct measurement of the amount of landfill gas captured and destroyed by the project and electricity generating units.

2. Responsibilities of operational and management structure

The project participant implements this monitoring plan. The plan could be revised according to suggestions from VVB and the practical circumstances, in order to keep it consistent, transparent and conservative during the monitoring process.

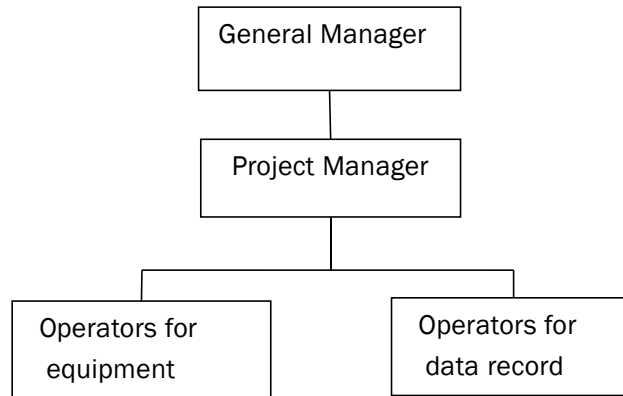


Figure 4.1 Operational and management structure

(1) Principal of the monitoring procedure

The general manager of the project is the leader of the monitoring tasks: he sets out the responsibility of everyone in the monitoring system, and establishes the related documents. The general manager ensures that staff in the monitoring system has the ability to deal with the assigned tasks.

(2) Executive person of the monitoring procedure

Project Manager: a Project Manager is appointed, specifically responsible for training, checking the daily operation, reporting forms and archiving emergency situation reports. The VCS Manager reports monthly to the General Manager (GM) about the project performance and monitored data. In the event that non-conformance in the performance to the mentioned procedures and/or functioning problems of the monitoring equipment is identified, the VCS manager informs the GM about the situation and work out relevant measures to be taken. The VCS manager also is responsible for aggregating the monitored data monthly and yearly, archiving and keeping data during the crediting period and two years after.

(3) Operators of the monitoring procedure

Operators take turns to work in the control center 24 hours a day. They are in charge of data supervision, filling operation report forms and, checking and inspecting the system. If necessary, they have the responsibility for executing the emergency plan and drafting emergency situation reports.

3. Monitoring system

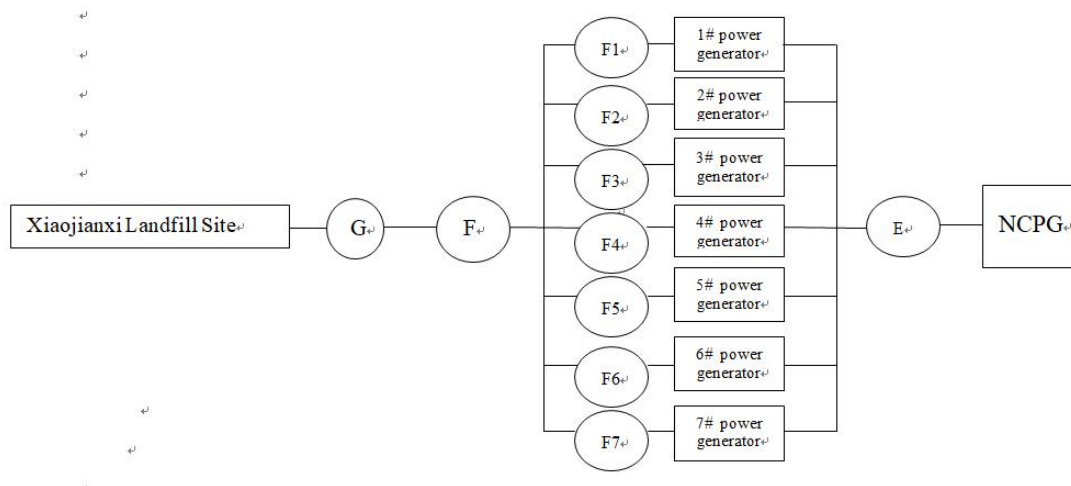


Figure 4.2 Monitoring system

Main parameters:

G	Gas analyzer to continuously measure methane fraction in LFG
F	Flow meter to continuously measure flow rate of total captured LFG, with automatic measure adjustment for temperature and pressure
E	Electricity meter (main meter, bi-directional) to continuously measure the electricity supplied to the NCPG and the electricity supplied by the grid

Net electricity exported to the grid:

Electricity meter E is the main meter for monitoring the net electricity supplied to and imported from the grid. Therefore, the net electricity supplied to the grid is calculated as: $EG_{OUT} - EG_{IN}$.

The meter E is installed at the project site and sends data to the DCS. The data was checked daily and totalized monthly. Electricity receipts and invoices was used as cross check during verification. E was calibrated by a qualified third party according to the industry standards and applicable regulations.

4.QA/QC

In order to ensure monitoring plan with high quality, QA/QC measures are carried out in monitoring data recording and checking, equipment calibrating and staff training.

Data recording: all data collected are recorded in electronic files which are regularly backed up. The data are checked by the specific staff every day and reported to General Manager by Project manager monthly. The data are archiving and keeping during the crediting period and two years after.

Equipment calibration and maintenance: Flow meters, gas analyzer, other critical project equipments are subject to regular maintenance and testing according to technical specifications from the manufactures to ensure accuracy and good performance. The project manager is responsible for periodically sending the equipment to a professional third party for calibration.

If there is a problem with the project's monitoring equipment, the relevant data will be discarded during this period.

5. Emergency procedures

Once a meter in fault, it shall be immediately repaired or replaced with another calibrated meter by a professional engineer, and the LFG or electricity generated during the period of erroneous measurement and replacement of the fault meter shall not be accounted for conservative consideration.

Table4: Detailed calibration information

Name	Model	Serial number	Accuracy class	Date of calibration	Validity
Electricity meter E	DSZ331	110029364505	0.5s	30/03/2021	29/03/2022
				26/03/2022	25/03/2023
				24/03/2023	23/03/2024
Flow meter F	BF-3000-2400	E01325000003	1.5	27/03/2021	26/03/2022
				21/03/2022	20/03/2023
				19/03/2023	18/03/2024
Gas analyzer G	GTR 196	61584/45	2%	27/03/2021	26/03/2022
				21/03/2022	20/03/2023
				19/03/2023	18/03/2024

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

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

Parameter	Description	Unit	2021	2022	2023	Total
BE_y	Baseline emissions	tCO ₂ e	75,812	145,517	33,933	255,262
$BE_{CH_4,y}$	Baseline emissions of methane from the SWDS	tCO ₂ e	66,381	127,415	29,712	223,509
$BE_{EC,y}$	Baseline emissions associated with electricity generation	tCO ₂ e	9,430	18,102	4,221	31,754

$$BE_{CH_4} = ((1 - OX_{top_layer}) \times F_{CH_4,pj,y} - F_{CH,BL,y}) \times GWP_{CH_4} \quad (2)$$

Parameter	Description	Unit	2021	2022	2023	Total
$BE_{CH_4,y}$	Baseline emissions of methane from the SWDS in year y	tCO ₂ e	66,381	127,415	29,712	223,509
OX_{top_layer}	Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline (dimensionless)	/	0.1	0.1	0.1	/
$F_{CH_4,PJ,y}$	Amount of methane in the LFG which is flared and/or used in the project activity in year y	tCH ₄	3,386.83	6,500.77	1,515.94	11,403.54
$F_{CH_4,BL,y}$	Amount of methane in the LFG that would be flared in the baseline in year y	tCH ₄	677.37	1,300.15	303.19	2,280.71
GWP_{CH_4}	Global warming potential of CH ₄	tCO ₂ e/ tCH ₄	28	28	28	/

$$F_{CH_4,PJ,y} = F_{CH_4,EL,y} \quad (3)$$

Parameter	Description	Unit	2021	2022	2023	Total
$F_{CH_4,PJ,y}$	Amount of methane	tCH ₄	3,386.83	6,500.77	1,515.94	11,403.54

	in the LFG which is flared and/or used in the project activity in year y					
$F_{CH_4, EL, y}$	Amount of methane in the LFG which is for electricity generation	tCH ₄	3,386.83	6,500.77	1,515.94	11,403.54

$F_{CH_4, EL, y}$ is determined using the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”. The mass flow of CH₄ shall be determined as follows:

$$F_{i,t} = V_{t,db} \times v_{i,t,db} \times \rho_{i,t} \quad (4)$$

$$\rho_{i,t} = \frac{P_t \times MM_i}{R_u \times T_t} \quad (5)$$

Where:

$F_{i,t}$ = Mass flow of greenhouse gas i in the gaseous stream in the interval t (kg gas/h)

$V_{t,db}$ = Volumetric flow of the gaseous stream in time interval t on a dry basis (m³ dry gas/h)

$v_{i,t,db}$ = Volumetric fraction of greenhouse gas i in the gaseous stream in a time interval t on a dry basis (m³ gas i/m³ dry gas)

$\rho_{i,t}$ = Density of greenhouse gas i in the gaseous stream in time interval t (kg gas i/m³ dry gas)

P_t = Absolute pressure of the gaseous stream in time interval t (101,325Pa)

T_t = Temperature of the gaseous stream in time interval t (273.15K)

MM_i = Molecular mass of greenhouse gas i (16.04 Kg/kmol)

R_u = Universal ideal gases constant (8,314Pa.m³/kmol.k)

$$BE_{EC,y} = EC_{BL,k,y} \times EF_{EF,k,y} \times (1 + TDL_{k,y}) \quad (6)$$

Parameter	Description	Unit	2021	2022	2023	Total
$BE_{EC,y}$	Baseline emission from electricity	tCO ₂	9,430	18,102	4,221	31,754

	consumption in year y					
$EC_{BL,k,y}$	Quantity of electricity that would be consumed by the baseline electricity consumer k in year y	MWh	12,843.399	24,653.387	5,748.563	43,245.349
$EF_{EF,k,y}$	Emission factor for electricity generation for source k in year y	tCO ₂ /MWh	0.7129	0.7129	0.7129	/
$TDL_{k,y}$	Average technical transmission and distribution losses for providing electricity to source k in year y	/	3%	3%	3%	/

In the monitoring period from 01/07/2021-31/03/2023, the actual monitoring values are shown as follows:

MONTH	EG _{PJ,y}	F _{CH4,PJ,y}	F _{CH4,BL,y}
	Monthly net quantity of electricity produced using LFG	Monthly methane destroyed	Amount of methane in the LFG that would be flared in the baseline
	kWh	tCH ₄	tCH ₄
Jul-21	2,222,452.00	586.10	117.22

Aug-21	2,193,117.00	578.37	115.67
Sep-21	1,978,319.00	521.76	104.35
Oct-21	2,193,212.00	578.29	115.66
Nov-21	2,166,114.00	571.06	114.21
Dec-21	2,090,185.00	551.26	110.25
subtotal	12,843,399.00	3,386.83	677.37
Jan-22	2,223,727.00	586.40	117.28
Feb-22	2,017,685.00	532.24	106.45
Mar-22	1,788,396.00	471.48	94.30
Apr-22	2,117,451.00	558.40	111.68
May-22	2,245,508.00	592.03	118.41
Jun-22	1,786,382.00	471.09	94.22
Jul-22	2,199,779.00	579.84	115.97
Aug-22	2,221,286.00	585.69	117.14
Sep-22	1,820,245.00	480.22	96.04
Oct-22	2,224,215.00	586.48	117.30
Nov-22	2,083,157.00	549.16	109.83
Dec-22	1,925,556.00	507.73	101.55
subtotal	24,653,387.00	6,500.77	1,300.15
Jan-23	2,142,665.00	565.03	113.01
Feb-23	1,889,876.00	498.45	99.69
Mar-23	1,716,022.00	452.46	90.49
subtotal	5,748,563.00	1,515.94	303.19

$$\begin{aligned}
BE_y &= ((1 - OX_{top_layer}) \times F_{CH_4,pj,y} - F_{CH_4,BL,y}) \times GWP_{CH_4+EG_{PJ,y}} \times EF_{EF,k,y} \times (1 + TDL_{k,y}) \\
&= ((1-0.1) * 11,403.54 - 2,280.71) * 28 + 43,245.349 * 0.7129 * (1+3\%) \\
&= 255,262 \text{ tCO}_2\text{e}
\end{aligned}$$

5.2 Project Emissions

Project emissions are calculated as follows:

$$PE_y = PE_{EC,y} \quad (7)$$

Parameter	Description	Unit	2021	2022	2023	Total
PE_y	Project emission in year y	tCO ₂	2	1	1	4

$PE_{EC,y}$	Emissions from consumption of electricity due to the project activity in year y	tCO ₂	2	1	1	4
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$$PE_{EC,y} = \sum_j EC_{PJ,j,y} * EF_{EL,j,y} * (1 + TDL_{j,y}) \quad (8)$$

Parameter	Description	Unit	2021	2022	2023	Total
$PE_{EC,y}$	Project emissions from electricity consumption in year y	tCO ₂	2	1	1	4
$EC_{PJ,j,y}$	Quantity of electricity consumed by the project electricity consumption source j in year y	MWh	1.80	0.66	0.54	3.00
$EF_{EL,j,y}$	Emission factor for electricity generation for source j in year y	tCO ₂ /MWh	0.7129	0.7129	0.7129	/
$TDL_{j,y}$	Average technical transmission and distribution losses for providing electricity to source j in year y	/	20%	20%	20%	/

5.3 Leakage

According to ACM0001, no leakage effects need to be accounted.

5.4 Net GHG Emission Reductions and Removals

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad (9)$$

Where:

ER_y = Emission reduction in year y (t CO₂e/yr)

BE_y = Baseline emissions in year y (t CO₂e/yr)

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)
01/07/2021-31/12/2021	75,812	2	0	75,810
01/01/2022-31/12/2022	145,517	1	0	145,516
01/01/2023-31/03/2023	33,933	1	0	33,932
Total	255,262	4	0	255,258

The monitoring period covers from 01/07/2021 to 31/03/2023, with totally 639 days. Based on the registered VCS PD, the amount of estimated emission reductions for this monitoring period would be $146,971/365 \times 184 + 140,236 + 133,834/365 \times 90 = 247,325 \text{ tCO}_2\text{e}$. The actual emission reductions in this monitoring period are 255,258 tCO₂e, which is 3.21% more than the estimation in the registered VCS PD.

<u>Ex-ante emissions reductions /removals</u>	<u>Achieved emissions reductions /removals</u>	<u>Percent difference</u>	<u>Justification for the difference</u>
247,325	255,258	3.21%	For LFG power project, with many external factors affecting the amount and quality of LFG generated, including climate, quantity of domestic waste landfill, waste composition, gas collection efficiency and technology etc., it is reasonable that the amount of LFG generated differs with the estimated value based on hypothetical model given by the tool given by CDM EB. Comparing to the estimated emission reductions, the mainly reasons of the difference are for that: When calculating the emission

			reductions in 2021, GWP is 25 in advance estimation and 28 is used in actual calculation according to the updated GWP. Therefore, the increase 3.21% is reasonable and acceptable for LFG power project.
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