



**Verified Carbon
Standard**

SHIZAIQIAN MSW LANDFILL SITE LFG RECOVERY TO POWER PROJECT

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Project Title	Shizaiqian MSW landfill site LFG recovery to power project
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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

Shizaiqian MSW landfill site LFG recovery to power project (hereafter referred to as the project) is developed by Quanzhou BCCY New Energy CO., Ltd., which aims to recover and destroy landfill gas (LFG) generated at the municipal solid waste (MSW) landfill site in Quanzhou city, Fujian province, P.R. China. The collected LFG is used for electricity production. The electricity generation offsets carbon emissions from the combustion of fossil fuel. Consequently, ERs are claimed for both methane combustion and power displacement.

The project employs a gas collection system, a transmitting system, a pre-treatment system and gas engines with 5 sets of gas engines with capacity of 1000kW each (a total capacity of 5 MW). The gas engines combust landfill gas, which contains methane, to produce electricity and export it to the Eastern China Power Grid (ECPG).

The project construction began on 18/06/2018 and was commissioned on 01/07/2019. The total GHG emission reductions or removals generated in this monitoring period from 01/07/2019 to 30/06/2021 (first and last days included) is 268,047 tCO₂e.

1.2 Sectoral Scope and Project Type

Sector scope 1: energy (renewable /Non-renewable) and

Sector scope 13: waste handling and disposal

1.3 Project Proponent

Organization name	Quanzhou BCCY New Energy CO., Ltd.
Contact person	Lei Wang
Title	Minister of carbon emission department
Address	Room 1003, Hengmei Building, Dongfeng Road, No.22, Jingshui District, Zhengzhou city, Henan Province, P.R. China
Telephone	+81 371 56737901
Email	lwang@bccynewpower.com

1.4 Other Entities Involved in the Project

Organization name	Henan BCCY Environmental Energy Co., Ltd.
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Role in the Project	Project developer
Contact person	Xu Han
Title	Vice Executive President
Address	Room 802, Hengmei Building, Dongfeng Road, No.22, Jingshui District, Zhengzhou city, Henan Province, P.R. China
Telephone	+81 371 65521780
Email	xhan@bccynewpower.com

1.5 Project Start Date

01/07/2019 (commercial operation started date)

1.6 Project Crediting Period

The project crediting period runs from 01/07/2019 through 30/06/2029 for 10 years fixed.

1.7 Project Location

The Project is located on Shizaiqian Landfill Site, Luojiang District, Quanzhou City of Fujian Province, P.R. China. The geographical coordinates of the project site are longitude 118°37'45.96"E and latitude 24°57'55.72"N. Figure 1 shows the 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 7.0);

“Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (Version 3.0);

“Emissions from solid waste disposal sites” (Version 8.0);

“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 3.0);

“Positive lists of technologies” (Version 2.0)

1.9 Participation under other GHG Programs

The project was not registered (or seeking registration) under other GHG Program(s).

1.10 Other Forms of Credit

The project didn't reduce GHG emissions from activities that are included in an 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 credit, including renewable energy certificates.

1.11 Sustainable Development

The project contributes to sustainable development in the following ways:

Landfill safety

If methane concentration in the air increases by up to 5-15% in volume with the confined space of a building, the risk of explosion is very high. Prior to the implementation of the project, a few venting pipes and wells have been installed for LFG emitting for safety reasons. With the project, a modern gas extraction system has been installed to ensure the effective collection of LFG and also avoid the risk of landfill explosions.

Odour reduction

Odour from landfill negatively impacts on residents around the landfill. Implementation of the project will reduce odours through LFG collection and will thus mitigate the impact of landfill odour on people's daily lives.

Energy potential

Methane is an ideal clean fuel. Each cubic meter of methane contains about 360000kJ calorific value, LFG recovery and utilization will supplement the energy supply of Quanzhou city.

Provide employment

The project was designed and technically supported by experts. Employment opportunities are created during both the project construction and operation periods.

2 SAFEGUARDS

2.1 No Net Harm

The Environment Impact Assessment (EIA) was finished by Fujian Huanan Environmental Assessment and Testing Co., Ltd. and approved by Environment Protection Bureau of Quanzhou City on 25/06/2018. The project has no significant impact on environment.

2.2 Local Stakeholder Consultation

The project owner held a local stakeholder consultation meeting on 23/10/2018 in the Quanzhou Shizaiqian Landfill Site. Before the stakeholder consultation meeting, the project information with contact information and the stakeholder meeting notice were published on the bulletins at the project site and nearby on 08/10/2018. Local stakeholders were invited to attend.

During the meeting, a survey was carried out on the local residents and comments received from the survey are summarized as follows. The survey was conducted through distributing and collecting responses to a questionnaire. In total 25 out of 25 questionnaires were returned with a 100% response rate. The survey shows the stakeholders believe that the project will have positive impacts on the local ecology and employment. All stakeholders expressed their support to the project and no negative comments have been received.

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 2.1 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,Quanzhou BCCY New Power Co.,Ltd.
	+86 037156737901	MR.Xu Han,Henan BCCY Environmental Energy Co.,Ltd.
Email access	lwang@bccynewpower.com	Ms.Lei Wang,Quanzhou BCCY New Power Co.,Ltd.
	xhan@bccynewpower.com	MR.Xu Han,Henan BCCY Environmental Energy Co.,Ltd.

During this monitoring period, there were no negative comments received for the project.

2.3 AFOLU-Specific Safeguards

Not applicable. The project is non-AFOLU project.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

The project 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

According to project design,5 gas engines of 1MW rated power each are fed with the LFG and generate electricity, which is then exported to the grid. Since project implementation (i.e. commercial operation started date on 01/07/2019), the installed engines (engine 1#,2# ,3# and 4#) are sufficient to combust all the landfill gas generated and the engine 5# is not installed (incl.this monitoring period).

Table 1.1 Equipment technical parameters

Main Equipment	Parameter	Value
Gas engine	Type	1000GF-NK
	Manufacturer	CNPC JICAI POWER EQUIPMENT COMPANY
	Rated capacity	1200 kW
	Rated rotation speed	1000 r/min
Generator	Type	1000GF-NK
	Manufacturer	CNPC JICAI POWER EQUIPMENT COMPANY
	Rated Capacity	1000 kW
	Rated rotation speed	1000 r/min
	Capacity factor	0.8 (lagging)

The project operates smoothly during this monitoring period.

3.2 Deviations

3.2.1 Methodology Deviations

There is no methodology deviation applied during this monitoring period.

3.2.2 Project Description Deviations

There is no project description deviation applied during 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	$\text{OX}_{\text{top_layer}}$
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	$\text{tCO}_2\text{e/t CH}_4$
Description	Global warming potential of CH_4
Source of data	IPCC
Value applied	Default value of 25/28. Shall be updated according to any future COP/CMP decisions
Justification of choice of data or description of measurement methods and procedures applied	-
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	-
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 ECPG
Source of data	2019 China baseline emission factor of regional power grid.
Value applied	0.7921
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 (2016-2018), Electricity Industry Statistics (2015-2017), China Energy Statistical Yearbook (2016-2018) 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 ECPG
Source of data	2019 China baseline emission factor of regional power grid.
Value applied	0.3870
Justification of choice of data or description of	The value is published by Ministry of Ecology and Environment of the People's Republic of China, based on China Electric

measurement methods and procedures applied	Yearbook(2016-2018), Electricity Industry Statistics(2015-2017),China Energy Statistic Yearbook(2016-2018) 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	-
Comments	-

4.2 Data and Parameters Monitored

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	2,602.06 tCH ₄ during this monitoring period										
	<table> <tr> <th>Date</th><th>F_{CH₄,BL,R,y}(tCH₄)</th></tr> <tr> <td>01/07/2019-31/12/2019</td><td>597.29</td></tr> <tr> <td>01/01/2020-31/12/2020</td><td>1,248.37</td></tr> <tr> <td>01/01/2021-30/06/2021</td><td>756.40</td></tr> <tr> <td>Total</td><td>2,602.06</td></tr> </table>	Date	F _{CH₄,BL,R,y} (tCH ₄)	01/07/2019-31/12/2019	597.29	01/01/2020-31/12/2020	1,248.37	01/01/2021-30/06/2021	756.40	Total	2,602.06
Date	F _{CH₄,BL,R,y} (tCH ₄)										
01/07/2019-31/12/2019	597.29										
01/01/2020-31/12/2020	1,248.37										
01/01/2021-30/06/2021	756.40										
Total	2,602.06										
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	Measured continuously by electricity meter(bi-directional) installed at the project site. All data will be monitored and archived electronically. Double check by receipt of electricity sales.		
Frequency of monitoring/recording	The recording frequency will be hourly measured and record, and monthly aggregated.		
Value applied	53,460.822MWh during this monitoring period		
	Date	EG _{PJ,y} (MWh) Amount of electricity generated using LFG by the project activity	EG _{PJ,y} (MWh) Electricity sales receipt of power grid company
	01/07/2019-31/12/2019	12,446.057	12,446.057
	01/01/2020-31/12/2020	25,532.328	25,532.328
	01/01/2021-30/06/2021	15,482.437	15,482.437
	Total	53,460.822	53,460.822

Monitoring equipment	Electricity meter E shown in the monitoring system as below.
QA/QC procedures to be applied	The calibration should be 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	Measured continuously by electricity meter(bi-directional) installed at the project site. All data will be monitored and archived electronically. Double check by receipt of electricity sales.							
Frequency of monitoring/recording	The recording frequency will be hourly measured and recorded, and monthly aggregated.							
Value applied	8.018MWh during this monitoring period							
	<table border="1"> <thead> <tr> <th>Date</th><th>$EG_{EC,y}$ (MWh) Amount of electricity consumed by the project activity</th><th>$EG_{EC,y}$ (MWh)Electricity purchase receipt of power grid company</th></tr> </thead> <tbody> <tr> <td>01/07/2019-31/12/2019</td><td>1.634</td><td>1.634</td></tr> </tbody> </table>	Date	$EG_{EC,y}$ (MWh) Amount of electricity consumed by the project activity	$EG_{EC,y}$ (MWh)Electricity purchase receipt of power grid company	01/07/2019-31/12/2019	1.634	1.634	
Date	$EG_{EC,y}$ (MWh) Amount of electricity consumed by the project activity	$EG_{EC,y}$ (MWh)Electricity purchase receipt of power grid company						
01/07/2019-31/12/2019	1.634	1.634						

	01//01/2020-31/12/2020	4.231	4.231
	01//01/2021-30/06/2021	2.153	2.153
	Total	8.018	8.018
Monitoring equipment	Electricity meter		
QA/QC procedures to be applied	The calibration should be 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 refer to the actual pressure and temperature.		
Frequency of monitoring/recording	Measured continuously by a flow meter F (average hourly value should be used in the calculations of baseline emission reductions). Data to be aggregated monthly.		
Value applied			

	Date	$V_{t,db}$ (Nm ³ ,average value)
	01/07/2019-31/12/2019	464.82
	01//01/2020-31/12/2020	483.24
	01//01/2021-30/06/2021	588.45
	Average	504.93
Monitoring equipment	Flow meter	
QA/QC procedures to be applied	Flow meter should be 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 t on 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	<table><tr><td>Date</td><td>$V_{i,t,db}$ (average value)</td></tr><tr><td>01/07/2019-31/12/2019</td><td>50.74%</td></tr><tr><td>01//01/2020-31/12/2020</td><td>51.59%</td></tr><tr><td>01//01/2021-30/06/2021</td><td>51.60%</td></tr><tr><td>Average</td><td>51.38%</td></tr></table>		Date	$V_{i,t,db}$ (average value)	01/07/2019-31/12/2019	50.74%	01//01/2020-31/12/2020	51.59%	01//01/2021-30/06/2021	51.60%	Average	51.38%
Date	$V_{i,t,db}$ (average value)											
01/07/2019-31/12/2019	50.74%											
01//01/2020-31/12/2020	51.59%											
01//01/2021-30/06/2021	51.60%											
Average	51.38%											

Monitoring equipment	Gas analyzer
QA/QC procedures to be applied	Gas analyzer should be subject to a regular maintenance and testing regime to ensure accuracy
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	-

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	There is no change in the management of the SWDS after the implementation of the project activity.
Frequency of monitoring/recording	Annually
Value applied	-
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	-
Calculation method	-
Comments	-

Data / Parameter	Op _{j,h}
Data unit	-
Description	Operation of the equipment that consumes the LFG

Source of data	Project participant				
Description of measurement methods and procedures to be applied	Operation of the gas generators is automatically monitored and recorded in the daily records.				
Frequency of monitoring/recording	Hourly				
Value applied	In this monitoring period, the operation hours of each generation are as follows:				
	Date	Op _{i,h} (h)			
		generator 1#	generator 2#	generator 3#	generator 4#
	01/07/2019-31/12/2019	4,416	4,416	4,416	4,416
	01//01/2020-31/12/2020	8,733	8,730	8,730	8,735
	01//01/2021-30/06/2021	4,344	4,344	4,344	4,344
	Total	17,493	17,490	17,490	17,495
Monitoring equipment	-				
QA/QC procedures to be applied	-				
Purpose of data	-				
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: 31,312,376.86 RMB OPEX: 5,896,838.01 RMB
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	-
Calculation method	-
Comments	-

Data / Parameter	Tariff of electricity exported
Data unit	CNY/KWh
Description	Tariff of the electricity exported
Source of data	Power purchase agreement
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	0.629
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	-
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 participants will monitor 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 will implement this monitoring plan. The plan could be revised according to suggestions from DOE and the practical circumstances, in order to keep it consistent, transparent and conservative during the monitoring process.

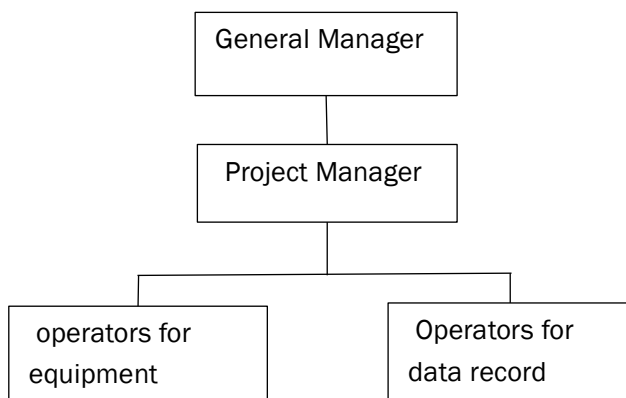


Figure 4.1: Monitoring system

(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 CDM 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 are identified, the CDM manager will inform the GM about the situation and work out relevant measures to be taken. The CDM manager will also be 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 will take turns to work in the control center 24 hours a day. They will be in charge of data supervision, filling operation report forms and, checking and inspecting the system. If necessary, they will have the responsibility for executing the emergency plan and drafting emergency situation reports.

3. Monitoring system

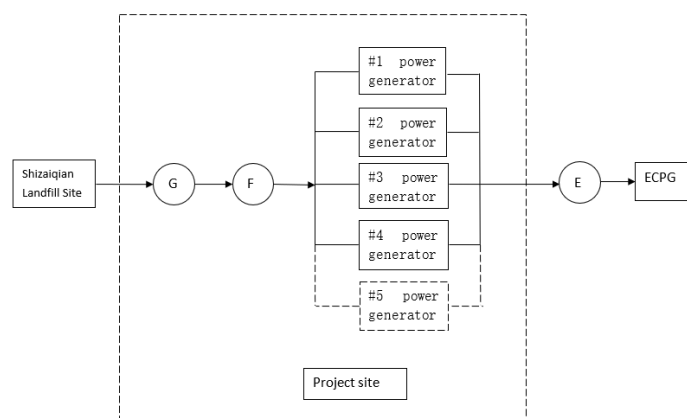


Figure 4.2: Chart of the monitoring meters

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 ECPG and the electricity supplied by the grid

4. Data collection procedures

The data are fully recorded and archived by DCS automatically and shown in the control system. The data are recorded once per hour. DCS of a historian database, primarily to provide data backup to the sheet of excel. Ultimately it forms the Monitoring Operating Record. All data are kept 2 years after the end of the crediting period.

Flow of LFG fed to the Power Plant ($V_{t,db}$)

Flow of LFG fed to the Power Plant is continuously measured by a flow meter and the data are recorded and electronic archived once per hour by computer automatically. The monitoring data are checked every day and summarized every month. The flow meter is calibrated annually to ensure the accuracy.

Methane fraction in the landfill gas ($V_{i,t,db}$)

Methane fraction in the landfill gas is continuously measured by a gas analyzer and the data are recorded and electronic archived once per hour by computer automatically. The monitoring data are checked by the operators every day and reported to General Manger by Project manager monthly. The gas analyzer meter is calibrated annually to ensure the accuracy.

Net amount of electricity exported to the grid ($EG_{PJ,y}$)

This meter is bi-directional and has two-way metering, recording both the electricity exported to the grid and the electricity imported from the grid. The electricity meter E is installed and sealed at the control room of project site by Quanzhou grid company. The data of electricity exports and imports are recorded and archived by DCS per hour automatically and shown in the control system. The monitoring data are checked by the operators every day and reported to General Manger by Project manager monthly. The electricity meter E is calibrated annually to ensure the accuracy. The data could be cross-check by the sale receipts provided by the Quanzhou grid company.

Electricity imported from the grid ($EG_{EC,y}$)

E is the bi-directional electricity meter, it could continuously measure the electricity imported from ECPG simultaneously, when the power plant is shut down and non-operation.

4. QA and 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 Manger by Project manager monthly.

Equipment calibration and maintenance: Flow meters, gas analyzer, other critical project equipment are subject to regular maintenance and testing according to technical specifications from the manufactures to ensure accuracy and good performance.

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.

Table4.1:Detailed calibration information

Name	Model	Serial number	Accuracy class	Date of calibration	Validity
Electricity meter E	DSZ188	010129540186	0.2s	17/06/2019	16/06/2020
				16/06/2020	15/06/2021
				15/06/2021	14/06/2022
Flow meter F	RVM-VS12IIF63N2	18070801	0.5	05/06/2019	04/06/2020
				04/06/2020	03/06/2021
				03/06/2021	02/06/2022
Gas analyzer G	GTR 196 IR	56403/8	2%	25/06/2019	24/06/2020
				24/06/2020	23/06/2021
				23/06/2021	22/06/2022

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

$$BE_y = BE_{CH_4,y} + BE_{EC,y}$$

Equation(1)

Parameter	Description	Unit	2019	2020	2021	Total
BE_y	Baseline emissions	tCO ₂ e	59,813	124,723	83,519	268,055
$BE_{CH_4,y}$	Baseline emissions of methane from the SWDS	tCO ₂ e	52,259	109,224	74,121	235,604

$BE_{EC,y}$	Baseline emissions associated with electricity generation	tCO ₂ e	7,554	15,499	9,398	32,451
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$$BE_{CH_4} = ((1 - OX_{top_layer}) \times F_{CH_4,pj,y} - F_{CH,BL,y}) \times GWP_{CH_4} \quad \text{Equation(2)}$$

Parameter	Description	Unit	2019	2020	2021	Total
$BE_{CH_4,y}$	Baseline emissions of methane from the SWDS in year y	tCO ₂ e	52,259	109,224	74,121	235,604
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	2,986.35	6,241.65	3,781.90	13,009.90
$F_{CH_4,BL,y}$	Amount of methane in the LFG that would be flared in the baseline in year y	tCH ₄	597.29	1248.37	756.40	2,602.06
GWP_{CH_4}	Global warming potential of CH ₄	tCO ₂ e/ tCH ₄	25	25	28	/

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

Parameter	Description	Unit	2019	2020	2021	Total
$F_{CH_4,PJ,y}$	Amount of methane in the LFG which is flared and/or used	tCH ₄	2,986.35	6,241.65	3,781.90	13009.90

	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	2,986.35	6,241.65	3,781.90	13009.90

$F_{CH_4,EL,y}$ 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:

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

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

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)

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

Parameter	Description	Unit	2019	2020	2021	Total
$BE_{EC,y}$	Baseline emission from electricity	tCO ₂	7,554	15,499	9,398	32,451

	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	12,446.057	25,532.328	15,482.437	53,460.822
$EF_{EF,k,y}$	Emission factor for electricity generation for source k in year y	tCO ₂ /MWh	0.58955	0.58955	0.58955	/
$TDL_{k,y}$	Average technical transmission and distribution losses for providing electricity to source k in year y	/	20%	20%	20%	/

5.2 Project Emissions

Project emissions are calculated as follows:

$$PE_y = PE_{EC,y}$$

Equation(7)

Parameter	Description	Unit	2019	2020	2021	Total
PE_y	Project emission in year y	tCO ₂	2	4	2	8

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

Parameter	Description	Unit	2019	2020	2021	Total
$PE_{EC,y}$	Project emissions from electricity consumption in year y	tCO ₂	2	4	2	8
$EC_{PJ,j,y}$	Quantity of electricity consumed by the project electricity consumption source j in year y	MWh	1.634	4.231	2.153	8.018
$EF_{EL,j,y}$	Emission factor for electricity generation for source j in year y	tCO ₂ /MWh	0.58955	0.58955	0.58955	/
$TDL_{j,y}$	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:

$$ER_y = BE_y - PE_y \quad \text{Equation(9)}$$

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)
01/07/2019-31/12/2019	59,813	2	0	59,811
2020	124,723	4	0	124,719
2021	83,519	2	0	83,517
Total	268,055	8	0	268,047

The monitoring period covers from 01/07/2019 to 30/06/2021, with totally 731 days. Based on the registered VCS PD, the amount of estimated emission reductions for this monitoring period would be $55,169 + 115,690 + 150,421/365 \times 181 = 245,451 \text{ tCO}_2\text{e}$. The actual emission reductions in this monitoring period are 268,047 tCO₂e, which is 9.21% more than the estimation in the registered VCS PD.

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, and the actual LFG methane fraction is different with the estimated value used in the hypothetical model. According to the ex ante calculation, emission reductions mainly come from CH₄ destruction comparing to the baseline scenario, and electricity generation depends on the amount of CH₄ consumption as well. Comparing to the estimated emission reductions, the mainly reasons of the difference are for that (1) actual generators operation hour is more than ex ante calculation resulting in that the electricity generated by using the LFG is accordingly 7.10% higher than the estimated value, (2) actual average LFG methane fraction is 51.38%, however the estimated value is 50%, (3) with the improvement of gas collection efficiency and technology, more LFG is captured. Therefore, the increase 9.21% is reasonable and acceptable for LFG power project.