



**Verified Carbon
Standard**

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



New Power
百川环能

Document Prepared by: Lei Wang, Qingdao Baichang Environmental
Technology Co. Ltd.

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Prepared By	Qingdao Baichang Environmental Technology Co. Ltd.
Contact	Address: 8 th Floor, Hengmei Business Building, Dongfeng Str.22, Zhengzhou, China Telephone:+86 371 5673 7901; Email:lwang@bccynewpower.com www.bccynewpower.com

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1 PROJECT DETAILS

1.1 Summary Description 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 objective is to collect the landfill gas (LFG) from Qingdao Xiaojianxi MSW landfill site (hereafter referred to as Xiaojianxi landfill site) and utilize it to generate electricity.

Xiaojianxi landfill site is located in Hongdao Economic zone, Qingdao City, and started operation in December 2017 with a total design effective capacity of 3,730,000 m³ and a municipal solid waste (MSW) disposal of 3,500 tons/d and an operational lifespan of 4 years. The project has a total designed capacity 5.95MW (7*850kW) and combusts the LFG, which contains nearly 50% of methane, to generate electricity and export it to the North China Power Grid (NCPG). The project started construction in January 2019 and started operation on 13/04/2019. The operation period of the project will end in 2024.

The project collects and utilizes LFG from Xiaojianxi landfill site for power generation, which would otherwise be released into the atmosphere. Methane in the LFG has been emitted to the atmosphere since the landfill started operation. Therefore the project avoids methane emissions and, at the same time, electricity is generated from a renewable energy source, instead of being provided by the grid.

Scenario existing prior to the start of the implementation of the project activity (the same as baseline scenario)

- LFG from Xiaojianxi landfill site is released into the atmosphere.
- Equivalent electricity generated by the project is supplied by the NCPG, which is dominated by fossil fuel based power plants.

Project scenario

- LFG from Xiaojianxi landfill site is partially used for electricity generation.
- 7×850 kW LFG-generator sets supply electricity to the NCPG.

The total power generation during the operation period is estimated to be 145,625 MWh. The estimated annual average emission reduction generated by the project over the crediting period is 73,156 tCO_{2e} per year by avoiding the CH₄ emissions from the landfill and the CO₂ emissions from the fossil fuel power plants in the NCPG.

1.2 Sectoral Scope and Project Type

Scope 1: energy industries (renewable-/non-renewable sources)

Scope 13: Waste handling and disposal

1.3 Project Eligibility

The project is an LFG power generation project, utilizing landfill gas (LFG), which consists mainly of methane, for electricity generation, which is eligible under the scope of the VCS Program.

1.4 Project Design

The project is not a grouped project.

1.5 Project Proponent

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

1.6 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	8 th Floor, Hengmei Business Building, Dongfeng Str.22, Zhengzhou, China
Telephone	+86 371 56737901
Email	lwang@bccynewpower.com

1.7 Ownership

Qingdao Baichang Environmental Technology Co. Ltd. is the sole project owner of the Project. The approval of Feasibility Study Report (FSR) and Environmental Impact Assessment (EIA) and the Business License of the project owner are the evidences for legislative right. Henan BCCY Environmental Energy Co Ltd. is the mother company of Qingdao Baichang Environmental Technology Co. Ltd., and Qingdao Baichang Environmental Technology Co. Ltd. authorized Henan BCCY Environmental Energy Co Ltd. as the Project Proponent.

1.8 Project Start Date

The project start date is 13/04/2019.

1.9 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.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	√
Large project	

Year	Estimated GHG emission reductions or removals (tCO ₂ e)
13/04/2019-31/12/2019	59,774
2020	123,006
2021	146,971
2022	140,236
2023	133,834
2024	127,745
2025	-
2026	-
2027	-

2028	-
01/01/2029-12/04/2029	-
Total estimated ERs	731,566
Total number of crediting years	10
Average annual ERs	73,156

Since the operation period of the project will end in 2024, the emission reductions after 2024 will be zero.

1.11 Description of the Project Activity

Lifespan of the landfill site is 4 years. After 4 years of operation, the landfill site will be closed, no more garbage will be added, but methane will still be generated. The project will continue to operate for about 3 years after the closure until 2024. The crediting period is 10 years, but emission reductions will be zero after 2024.

GHG emission reductions will be achieved through combustion of the recovered methane gas by gas engines, which would be otherwise emitted to the atmosphere, and the generation of electricity from the landfill gas, which is supplied by the NCPG, prior to the implementation of the project.

Description of the technology in the project

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

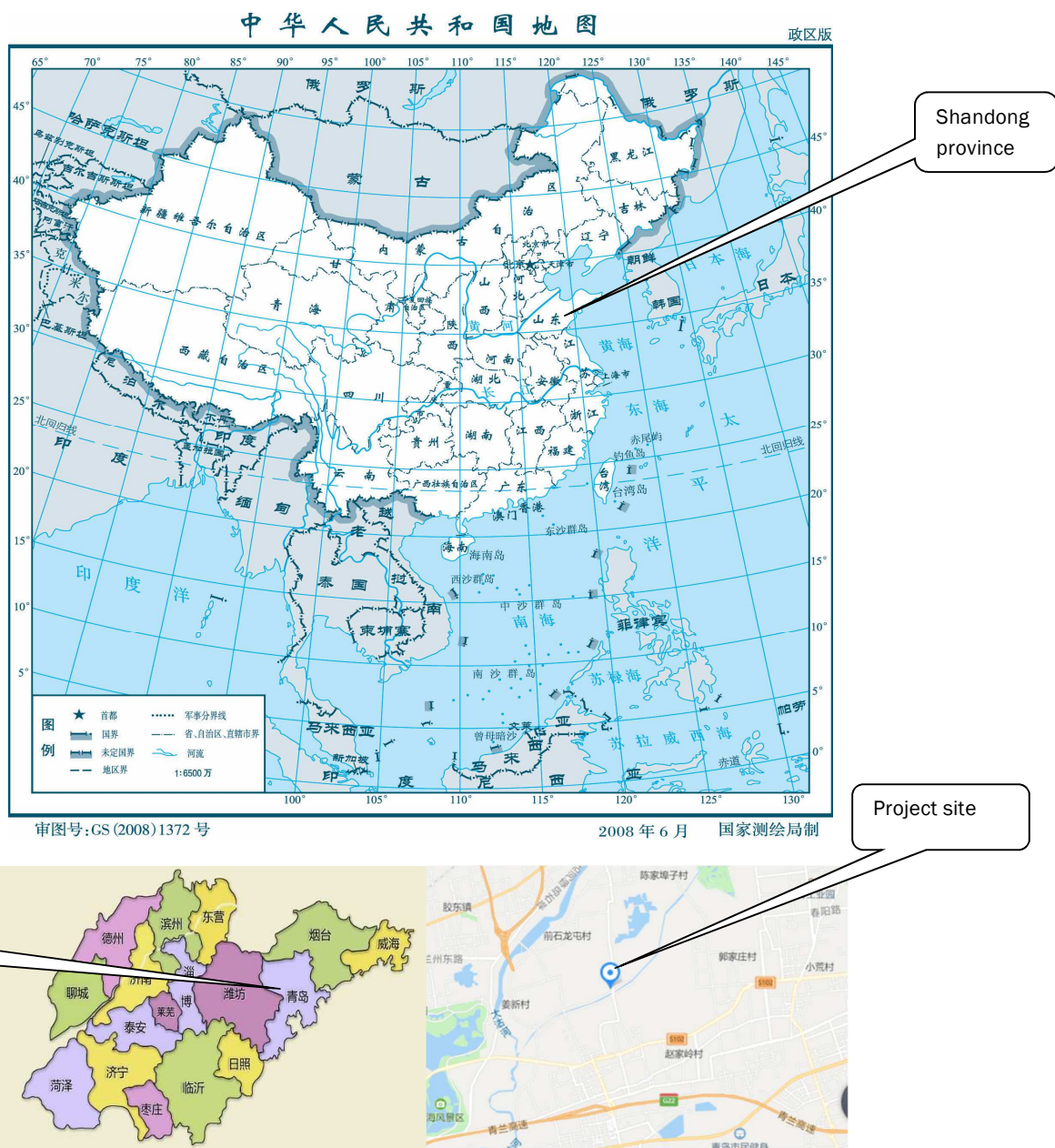
7 gas engines of 850kW rated power each are fed with the LFG and generate electricity, which is then exported to the grid.

Table 1.1 Equipment technical parameters

Main Equipment	Parameter	Value
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)

1.12 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°9′ 26.06″ E and latitude 36°16′ 53.04″ N. Figure A.1 shows the location of the Project.



1.13 Conditions Prior to Project Initiation

The scenario existing prior to the start of the implementation of the project activity (the same as baseline scenario)

- LFG from Xiaojianxi landfill site is released into the atmosphere.
- Equivalent electricity generated by the project is supplied by the NCPG, which is dominated by fossil fuel based power plants.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The project complies with all Chinese relevant laws and regulations. Include:

1. Renewable Energy Law of the People's Republic of China;
2. National Action plan for the collection and Utilization of municipal landfill gas;
3. Catalogue for the Guidance of Industrial Structure Adjustment (2011 version);
4. Shandong provincial "13th Five-Year" energy development plan.

The project obtained the approval letters from local governmental authorities: Investment Supervisory Department, as well as Environment Protection Agency (EPA). The two approvals well demonstrate that local governments permit the construction of the project. Hence, the project is in compliance with laws, status and other regulatory frameworks.

1.15 Participation under Other GHG Programs

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

The project was not registered under other GHG Program.

1.15.2 Projects Rejected by Other GHG Programs

The project has not been rejected by any other GHG programs.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

The project didn't 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.

1.16.2 Other Forms of Environmental Credit

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

1.17 Additional Information Relevant to the Project

Leakage Management

Not applicable as not AFOLU project

Commercially Sensitive Information

No commercially sensitive information has been excluded from the public version of the project description.

Sustainable Development

The project will contribute to the sustainable development, not only it because of mitigating global warming, but also because it increases the availability of electricity from renewable sources. It will also minimize the explosion risk at the landfill site and will increase job availability through the operation and maintenance of the LFG capture system and the power units.

Further Information

No further information available.

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. At the same time, the implementation of the project will improve 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.

2.3 Environmental Impact

On 29/11/2018, an environmental impact assessment (EIA) was completed in accordance with Chinese regulation as part of the feasibility study for the Project and was approved by the Environmental Protection Bureau of High-tech District, Qingdao city on 12/12/2018. The objective of this EIA was to identify the effects of the project on both the biophysical components of the environment and socio-economical aspects of local community and to provide measures and procedures to mitigate the possible effects.

The outcome of the EIA was favourable and the project was found to have no significant environmental impacts. The project not only reduces the danger caused by uncontrolled release of LFG, but also reduces the pollution caused by the landfill to the air, soil and water quality in

the local area. From environmental protection perspectives, the project is in compliance with national industry policy, promoting sustainable development and utilisation of waste.

During the construction period, dust, noise, wastewater and solid waste caused by the project were treated according to the measures in the EIA, and there were no significant impact on the environment.

During the operation period, the mitigation measures proposed by the EIA were implemented and the following key aspects were addressed:

Wastewater

Wastewater includes cooling wastewater, resin regeneration wastewater, condensation cooling system discharged water and sewage. After neutralization, resin regeneration wastewater will be gathered with the cooling wastewater and sewage, and then will be used to water plants after aerobic sludge treatment. Since no wastewater will be drained, there is no much impact on the environment.

Waste Gas

Concentrations and emission rates of the pollutants (mainly SO₂, NO_x and smoke) of residual gas after utilization of LFG meet the requirement of “Integrated emission standard of air pollutants” (GB16297-1997).

Noise pollution

The noise level of noisy equipment (e.g. gas-generator sets) are in 75~100 dB (A). The noise level can fall below than 85dB (A) after some measures like sound proof, reducing vibration, etc, but still cannot meet the category II of “Displacement noise standard for industrial enterprise” (GB12348-2008). However, noise will not affect surrounding residents because of the considerable distance from the project site to the residential area.

Solid waste

The particulate matter from filtering system, household garbage and office garbage will be delivered to the Xiaojianxi MSW landfill site.

2.4 Public Comments

No comments were received.

2.5 AFOLU-Specific Safeguards

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

3 APPLICATION OF METHODOLOGY

3.1 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).

3.2 Applicability of Methodology

The selected methodology (ACM0001, version 19.0) is appropriate to LFG project activities, where the baseline scenario is the atmospheric release of the LFG, and that all or part of the electricity exported to the grid is the electricity generation in existing and/or new grid-connected power plants. In this case, the LFG is released to atmosphere prior to the implementation of the project; electricity generated by the project is exported to NCPG.

The project fulfils the following applicability conditions of the methodology:

Applicability conditions	Justifications
(a) Install a new LFG capture system in an existing or new (Greenfield) SWDS where no LFG capture system was or would have been installed prior to the implementation of the project activity; or	Applicable. The project involves the installation of a new LFG capture system in an existing SWDS.
(b) Make an Investment into an existing LFG capture system to increase the recovery	Not applicable. There wasn't a LFG capture system prior to the implement of the project.

rate or change the use of the captured LFG, provided that: (i) The captured LFG was vented or flared and not used prior to implementation of the project activity; and (ii) In the case an existing active LFG capture system for which the amount of LFG cannot be collected separately from the project system after the implementation of the project activity and its efficiency is not impacted on by the project system: historical data on the amount LFG capture and flared is available;	
(c) Flare the LFG and/or use the captured LFG in any (combination) of the following ways: (i) Generation electricity; (ii) Generation heat in a boiler, air or kiln (brick firing only) or glass melting furnace; and/or (iii) Supplying the LFG to consumers through a natural gas distribution network; (iv) Supplying compressed/liquefied LFG to consumers using trucks; (v) Supplying the LFG to consumers through a dedicated pipeline;	Applicable. The project uses the captured LFG to generate electricity, which corresponds to point (i).
(d) Do not reduce the amount of organic waste that would be recycled in the absence of the project.	The implementation of the project does not reduce the amount of organic waste that would be recycled in the absence of the project. All the solid waste is disposed in the Xiaojianxi landfill site.

The methodology is only applicable if the application of the procedure to identify the baseline scenario confirms that the most plausible baseline scenario is: (a) Atmospheric release of the LFG or captured of LFG and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons; and (b) In the case that the LFG is used in the project activity for generation electricity and/or generating heat in a boiler, air heater, glass melting furnace or kiln: (i) For electricity generation: that electricity would be generated in the grid or in captive fossil fuel fired power plants; and/or (ii) For heat generation: that heat would be generated using fossil fuels in equipment located within the project boundary (c) In the case of LFG supplied to the end-user(s) through natural gas distribution network, trucks or the dedicated pipeline, the baseline scenario is assumed to be displacement of the natural gas. (d) In the case of LFG from a Greenfield SWDS, the identified baseline scenario is atmospheric release of the LFG or captured of LFG in a managed SWDS and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons.	The most plausible baseline scenario of the project is : (1)LFG from Xiaojianxi landfill site is emitted to the atmosphere directly. (2)Equivalent electricity generated by the project is supplied by the NCPG.
The methodology is not applicable:	Not applicable.

(a) In combination with other approved methodologies. For instance, ACM0001 cannot be used to claim emission reductions for the displacement of fossil fuels in a kiln or glass melting furnace, where the purpose of the VCS project activity is to implement energy efficiency measures at a kiln or glass melting furnace; (b) If the management of the SWDS in the project activity is deliberately changed during the crediting in order to increase methane generation compared to the situation prior to the implementation of the project activity.	
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Regarding to tool—“Combined tool to identify the baseline scenario and demonstrate additionality” (Version 07.0):

Applicable conditions	Justifications
The tool is applicable to all types of proposed project activities. However, in some cases, methodologies referring to this tool may require adjustments or additional explanations as per the guidance in the respective methodologies. This could include, inter alia, a listing of relevant alternative scenarios that should be considered in Step 1, any relevant types of barriers other than those presented in this tool and guidance on how common practice should be established.	Applicable.

Regarding to tool—“Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (Version 03.0):

Applicable conditions	Justifications
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If emissions are calculated for electricity consumption, the tool is only applicable if one out of the following three scenarios applied to the sources of the electricity consumption: (a) Scenario A: Electricity consumption from the grid. The electricity is purchased from the grid only, and either no captive power plant(s) is/are installed at the site of electricity consumption or, if any captive power plant exists on site, it is either not operating or it is not physically able to provide electricity to the electricity consumer; (b) Scenario B: Electricity consumption from (an) off-grid fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants are installed at the site of the electricity consumer and supply the consumer with electricity. The captive power plant(s) is/are not connected to the electricity grid; or (c) Scenario C: Electricity consumption from the grid and (a) fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants operate at the site of the electricity consumer. The captive power plant(s) can provide electricity consumer. The captive power plant(s) is/are also connected to the electricity grid. Hence, the electricity consumer can be provided with electricity from the captive power plant(s) and the grid.	Scenario A is applicable for the project. The project purchases electricity from the grid during the operation. There is no captive power plant(s) at the site of the project.
This tool is not applicable in cases where captive renewable power generation technologies are installed to provide	Not applicable.

electricity in the project activity, in the baseline scenario or to sources of leakage.	
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Regarding to tool— “Emissions from solid waste disposal sites” (Version 08.0):

Applicable conditions	Justifications
(a) Application A: The VCS project activity mitigates methane emissions from a specific existing SWDS. Methane emissions are mitigated by capturing and flaring or combusting the methane (e.g. "ACM0001: Flaring or use of landfill gas). The methane is generated from waste disposed in the past, including prior to the start of the VCS project activity. In these cases, the tool is only applied for an ex ante estimation of emissions in the project design document (VCS-PDD). The emissions will then be monitored during the crediting period using the applicable approaches in the relevant methodologies (e. g. measuring the amount of methane captured from the SWDS).	Applicable. The project collects the methane from the Xiaojianxi landfill site and uses it to generate the electricity.
(b) Application B: The VCS project activity avoids or involves the disposal of waste at SWDS. An example of this application of the tool is ACM0022, in which municipal solid waste (MSW) is treated with an alternative option, such as composting or anaerobic digestion, and is then prevented from being disposed of in a SWDS. The methane is generated from waste disposed or avoided from disposal during the crediting period. In these cases, the tool can be applied for both ex ante and ex post estimation of emissions. These project activities may apply the simplified approach detailed in 0 when calculating baseline emissions.	Not applicable.

Regarding to tool—“Tool to calculate the emission factor for an electricity system” (Version 07.0):

Applicable conditions	Justifications
This tool may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity that is where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand-side energy efficiency projects). Under this tool, the emission factor for the project electricity system can be calculated either for grid power plants only or, as an option, can include off-grid power plants. In the latter case, two sub-options under the step 2 of the tool are available to the project participants, i.e. option IIa and option IIb. If option IIa is chosen, the conditions specified in “Appendix 1: Procedures related to off-grid power generation” should be met. Namely, the total capacity of off-grid power plants (in MW) should be at least 10 per cent of the total capacity of grid power plants in the electricity system; or the total electricity generation by off-grid power plants (in MWh) should be at least 10 per cent of the total electricity generation by grid power plants in the electricity system; and that factors which negatively affect the reliability and stability of the grid are primarily due to constraints in generation and not to other aspects such as transmission capacity. In case of VCS projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I country. Under this tool, the value applied to the CO₂ emission factor of biofuels is zero.	Applicable. This tool is applied to calculate baseline emissions for power replace. Equivalent electricity generated by the project is supplied by the NCPG, which is dominated by fossil fuel based power plants.

Regarding to tool—“Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 03.0):

Applicable conditions	Justifications
Typical applications of this tool are methodologies where the flow and composition of residual or flared gases or exhaust gases are measured for the determination of baseline or project emissions. Methodologies where CO₂ is the particular and only gas of interest should continue to adopt material balances as the means of flow determination and may not adopt this tool as material balances are the cost effective way of monitoring flow of CO₂. The underlying methodology should specify: (a) The gaseous stream the tool should be applied to; (b) For which greenhouse gases the mass flow should be determined; (c) In which time intervals the flow of the gaseous stream should be measured; and (d) Situations where the simplification offered for calculating the molecular mass of the gaseous stream (equations (3) or (17)) is not valid (such as the gaseous stream is predominantly composed of a gas other than N₂).	Applicable. The project collects the methane from the Xiaojianxi landfill site and uses it to generate the electricity. The flow of methane is measured for the determination of baseline emissions.

Regarding to tool—“Positive lists of technologies” (Version 02.0):

Applicable conditions	Justifications
The use of this methodological tool is not mandatory for the project participants of a VCS project activity for demonstrating their	Applicable. The project collects the LFG from the Xiaojianxi landfill site and uses it to generate the electricity, with a total

additionality. This methodological tool shall be applied in conjunction with a small-scale or large-scale methodology which refers to this tool. The positive lists as contained in section 5 of this tool are valid up to 28 November 2021. Notwithstanding the provisions on the validity of new, revised and previous versions of methodologies and methodological tools in the “Procedure: Development, revision and clarification of baseline and monitoring methodologies and methodological tools”, there will be no grace period for the application of this tool and the validity of the positive list after this date, including in cases where further technologies are added to the positive list through revisions of this tool before this date.	capacity of 5.95MW, which conforms to 5.1.1 (a) “The LFG is used to generate electricity in one or several power plants with a total nameplate capacity that equals or is below 10 MW”.
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3.3 Project Boundary

Project boundary

According to the adopted methodology, the project boundary is determined as follows:

- The project boundary is the site of the project activity where the gas is captured and destroyed/used.
- If the electricity for project activity is sourced from grid or electricity generated by the LFG captured would have been generated by power generation sources connected to the grid, the project boundary shall include all the power generation sources connected to the grid to which the project activity is connected.
- If the electricity for project activity is from a captive generation source or electricity generated by the captured LFG would have been generated by a captive power plant, the captive power plant shall be included in the project boundary.

The project boundary is the site of the project activity, Xiaojianxi landfill site, where the LFG is captured and used, and also includes all the power sources connected to the NCPG, which

expands throughout Beijing City, Tianjin City, Hebei Province, Shanxi Province, Shandong Province and Inner Mongolia Autonomous Region.

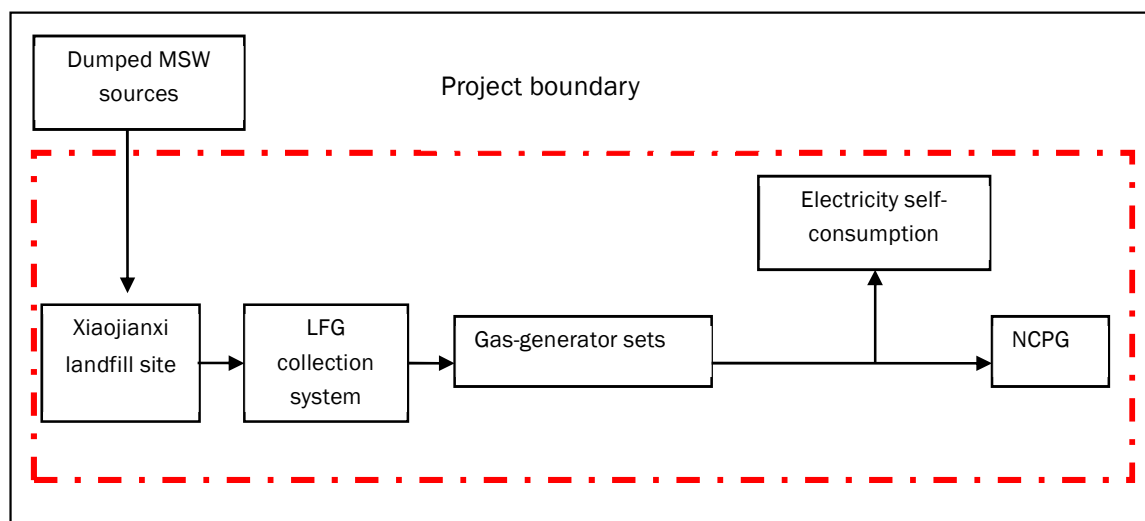


Figure 3.1 the Diagram of Project Boundary

Source		Gas	Included	Justification/Explanation
Baseline	Emissions from decomposition of waste at the SWDS site	CH ₄	Yes	The major source of emissions in the baseline
		N ₂ O	No	N ₂ O emissions are small compared to CH ₄ emissions from SWDS. This is conservative

Source		Gas	Included	Justification/Explanation
		CO ₂	No	CO ₂ emissions from decomposition of organic waste are not accounted since the CO ₂ is also released under the project activity
	Emissions from electricity generation	CO ₂	Yes	Major emission source if power generation is included in the project activity
		CH ₄	No	Excluded for simplification. This is conservative
		N ₂ O	No	Excluded for simplification. This is conservative
	Emissions from heat generation	CO ₂	Yes	Major emission source if heat generation is included in the project activity
		CH ₄	No	Excluded for simplification. This is conservative
		N ₂ O	No	Excluded for simplification. This is conservative

Source		Gas	Included	Justification/Explanation
	Emissions from the use of natural gas	CO ₂	No	Excluded for simplification. This is conservative
		CH ₄	Yes	Major emission source if supply of LFG through a natural gas distribution network, dedicated pipeline or using trucks is included in the project activity
		N ₂ O	No	Excluded for simplification. This is conservative
Project activity	Emissions from fossil fuel consumption for purposes other than electricity generation or transportation due to the project activity	CO ₂	Yes	May be an important emission source
		CH ₄	No	Excluded for simplification. This emission source is assumed to be very small
		N ₂ O	No	Excluded for simplification. This emission source is assumed to be very small
	Emissions from electricity consumption	CO ₂	Yes	May be an important emission source

Source		Gas	Included	Justification/Explanation
	due to the project activity	CH ₄	No	Excluded for simplification. This emission source is assumed to be very small
		N ₂ O	No	Excluded for simplification. This emission source is assumed to be very small
	Emissions from flaring	CO ₂	No	Emissions are considered negligible
		CH ₄	Yes	May be an important emission source
		N ₂ O	No	Emissions are considered negligible
	Emissions from distribution of LFG using trucks and dedicated pipelines	CO ₂	Yes	May be an important emission source
		CH ₄	Yes	May be an important emission source
		N ₂ O	No	Emissions are considered negligible

3.4 Baseline Scenario

According to the section 5.3.1 of the methodology ACM0001, the project chooses simplified procedures to identify the baseline scenario.

The LFG from Xiaojianxi landfill site is vented to the atmosphere prior the implementation of the project for safety concerns, and the majority electricity generated by the LFG will be exported to the NCPG, and a little of which is consumed by the project.

Therefore, the baseline scenario is:

LFG from Xiaojianxi landfill site is emitted to the atmosphere directly.

Equivalent electricity generated by the project is supplied by the NCPG, which is dominated by fossil fuel based power plants.

3.5 Additionality

According to the section 5.3.1 of the methodology ACM0001, the project chooses simplified procedures to demonstrate additionality. Tool 32 (Positive lists of technologies) is used to demonstrate additionality.

Requirements of tool 32(Positive lists of technologies)	The project
5.1Waste handling and disposal 5.1.1Landfill gas recovery and its gainful use The project activities and PoAs at new or existing landfills (greenfield or brownfield)are deemed automatically additional if it is demonstrated that prior to the implementation of the project activities and PoAs the landfill gas (LFG) was only vented and or flared (in the case of brownfield projects)or would have been only vented and/or flared(in the case of greenfield projects)but not utilized for energy generation, and that under the project activities and PoAs any of the following conditions are met: (a) The LFG is used to generate electricity in one or several power plants with a total nameplate capacity that equals or is below 10 MW; (b) The LFG is used to generate heat for internal or external consumption; (c) The LFG is flared.	The LFG from Xiaojianxi landfill site is vented to the atmosphere prior the implementation of the project for safety concerns. Total nameplate capacity of the project is 5.95MW, which is below 10MW.

Conclusion: the project is automatically additional.

3.6 Methodology Deviations

As plant specific fuel consumption and electricity generation data are not publicly available in China, the Guidance caused by DNV's request for deviation of Chinese project activities for the baseline methodology AM0005 has been applied for calculating the build margin (BM) emission factor of this project activity.

Moreover, the result of BM and OM are sourced from 2017 Baseline Emission Factors for Regional Power Grids in China dated 20/12/2018 which is published by local government.

The deviation has no impact on conservativeness of the quantification of GHG emission reductions or removals.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

The project utilizes the LFG for generation to substitute the equivalent electricity supplied by the grid, resulting in CH₄ and CO₂ emissions, which will be calculated as follows according to the methodology ACM0001 (version 19.0):

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

Where:

BE_y	=	Baseline emissions in year y (tCO ₂ e/yr)
$BE_{CH_4,y}$	=	Baseline emissions of methane from the SWDS in year y (tCO ₂ e/yr)
$BE_{EC,y}$	=	Baseline emissions associated with electricity generation in year y (tCO ₂ /yr)
$BE_{HG,y}$	=	Baseline emissions associated with heat generation in year y (tCO ₂ /yr)
$BE_{NG,y}$	=	Baseline emissions associated with natural gas use in year y (tCO ₂ /yr)

The project doesn't involve heat and natural gas. $BE_{HG,y}=0$, $BE_{NG,y}=0$. Therefore:

$$BE_y = BE_{CH_4,y} + BE_{EC,y} \quad (2)$$

Step A: Baseline emissions of methane from the SWDS ($BE_{CH_4,y}$)

$$BE_{CH_4} = ((1 - OX_{top_layer}) \times F_{CH_4,pj,y} - F_{CH,BL,y}) \times GWP_{CH_4} \quad (3)$$

Where:

$BE_{CH_4,y}$	=	Baseline emissions of methane from the SWDS in year y (tCO ₂ e/yr)
OX_{top_layer}	=	Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline (dimensionless)
$F_{CH_4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year y (tCH ₄ /yr)
$F_{CH_4,BL,y}$	=	Amount of methane in the LFG that would be flared in the baseline in year y (tCH ₄ /yr)
GWP_{CH_4}	=	Global warming potential of CH ₄ (tCO ₂ e/tCH ₄)

Step A.1: Ex post determination of $F_{CH_4,PJ,y}$

During the crediting period, $F_{CH_4,PJ,y}$ is determined as the sum of the quantities of methane flared and used in power plant(s), boiler(s), air heater(s), kiln(s) and natural gas distribution network, as follows:

$$F_{CH_4,PJ,y} = F_{CH_4,flared,y} + F_{CH_4,EL,y} + F_{CH_4,HG,y} + F_{CH_4,NG,y} \quad (4)$$

Where:

$F_{CH_4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year y (tCH ₄ /yr)
$F_{CH_4,flared,y}$	=	Amount of methane in the LFG which is destroyed by flaring in year y (tCH ₄ /yr)
$F_{CH_4,EL,y}$	=	Amount of methane in the LFG which is used for electricity generation in year y (tCH ₄ /yr)
$F_{CH_4,HG,y}$	=	Amount of methane in the LFG which is used for heat generation in year y (tCH ₄ /yr)
$F_{CH_4,NG,y}$	=	Amount of methane in the LFG which is sent to the natural gas distribution network and/or dedicated pipeline and/or to the trucks in year y (tCH ₄ /yr)

The working hours of the power plant(s), boiler(s), air heater(s) and kiln(s) should be monitored and no emission reduction should be claimed for methane destruction during non-working hours.

The project utilizes the LFG only for power generation. Therefore:

$$F_{CH_4,PJ,y} = F_{CH_4,EL,y} \quad (5)$$

$F_{CH_4,EL,y}$ is determined using the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”. The following requirements apply:

- As per the gaseous stream tool, if the LFG is used for multiple purposes (e.g. flaring or energy generation), and all methane destruction devices are verified to be operational (e.g. by means of flame detectors records, energy generated), a single flow meter may be used to record the flow into multiple destruction devices. The destruction efficiency of the least

efficient among the destruction devices shall be used as the destruction efficiency for all destruction devices monitored by this flow meter. If there are any periods for which one or more destruction devices are not operational, (a) and (b) of the Appendix of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" tool shall be followed;

- (b) CH₄ is the greenhouse gas for which the mass flow should be determined;
- (c) The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations (3) or (17) in the tool);
- (d) The mass flow should be calculated on an hourly basis for each hour h in year y ;
- (e) The mass flow calculated for hour h is 0 if the equipment is not working in hour h ($Op_{j,h}$ =not working), the hourly values are then summed to a yearly unit basis.

Amount of the methane used for power generation ($F_{CH_4,EL,y}$)

The "Tool to determine the mass of a greenhouse gas in a gaseous stream" provides following 6 options for measuring mass flow of a greenhouse gas i in a gaseous stream.

Table 4.1 Measurement options

Option	Flow of gaseous stream	Volumetric Fraction
A	Volume flow-dry basis	Dry or wet basis
B	Volume flow-wet basis	Dry basis
C	Volume flow-wet basis	Wet basis
D	Mass flow- dry basis	Dry or wet basis
E	Mass flow-wet basis	Dry basis
F	Mass flow-wet basis	Wet basis

In the gas stream, only CH₄ is the greenhouse. Therefore $F_{i,t}=F_{CH_4,EL,y}$.

The flow meter and gas analyzer are installed by the project participant to monitor the volumetric flow of the LFG and the volumetric fraction of CH₄ in the LFG, with both parameters monitored on a dry basis. Therefore, Option A of the "tool to determine the mass of a greenhouse gas in a gaseous stream" will be applied in the project. In addition, if in a particular interval it cannot be demonstrated that the gaseous stream is dry, then the flow measurement shall be assumed to be on a wet basis and the corresponding option from the table 2 showed in the "tool to determine the mass of a greenhouse gas in a gaseous stream" should be applied instead.

Option A

Option A is applicable where the volumetric flow of the LFG is measured on a dry basis. In order to demonstrate that the LFG gaseous stream is dry, the project participants shall:

- (a) Measure the moisture content of the gaseous stream ($C_{H_2O,t,db,n}$) and demonstrate that this is less or equal to 0.05 kg H₂O/m³ dry gas; or
- (b) Demonstrate that the temperature of the gaseous stream (T_t) is less than 60°C (331.15 K) at the flow measurement point.

For the project, according to the Technical Agreement of the pretreatment system, the intake temperature of landfill gas shall not exceed 45°C, so it has been selected to demonstrate it using method (b).

The mass flow of CH₄ shall be determined as follows:

$$F_{i,t} = V_{t,db} \times v_{i,t,db} \times \rho_{i,t} \quad (6)$$

With:

$$\rho_{i,t} = \frac{P_t \times MM_i}{R_u \times T_t} \quad (7)$$

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 (m ³ 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 (m ³ gas i/m ³ dry gas)
$\rho_{i,t}$	=	Density of greenhouse gas i in the gaseous stream in time interval t (kg gas i/m ³ dry gas)
P_t	=	Absolute pressure of the gaseous stream in time interval t (Pa)
MM_i	=	Molecular mass of greenhouse gas i (kg/kmol)
R_u	=	Universal ideal gases constant (Pa.m ³ /kmol.k)
T_t	=	Temperature of the gaseous stream in time interval t (K)

All parameters about the LFG which is fed into the gas engines are converted automatically to normal conditions during the monitoring process. Therefore, P_t and T_t don't need to be monitored.

Step A.1.1: Ex ante estimation of $F_{CH_4,PJ,y}$

An ex ante estimate of $F_{CH_4,PJ,y}$ is required to estimate baseline emission of methane from the SWDS (according to equation (3)) in order to estimate the emission reductions of the proposed project activity in the VCS-PDD. It is determined as follows:

$$F_{CH_4,PJ,y} = \eta_{PJ} \times BE_{CH_4,SWDS,y} / GWP_{CH_4} \quad (8)$$

Where:

$F_{CH_4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year y (tCH ₄ /yr)
$BE_{CH_4,SWDS,y}$	=	Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year y (tCO ₂ e/yr)
η_{PJ}	=	Efficiency of the LFG capture system that will be installed in the project activity
GWP_{CH_4}	=	Global warming potential of CH ₄ (tCO ₂ e/tCH ₄)

$BE_{CH_4,SWDS,y}$ is determined using the methodological tool “Emissions from solid waste disposal sites”. The following guidance should be taken into account when applying the tool:

- f_y in the tool shall be assigned a value of 0 because the amount of LFG that would have been captured and destroyed is already accounted for in equation 2 of this methodology; • In the tool, x begins with the year that the SWDS started receiving wastes (e.g. the first year of SWDS operation); and
- Sampling to determine the fractions of different waste types is not necessary because the waste composition can be obtained from previous studies. Actually, the Research Institute of Mudanjiang Environmental & Health held an investigation in 2007. The waste was sampled and analysed in the investigation. The data used in the PDD is from the investigation.

$$BE_{CH_4,SWDS,y} = \varphi_y \times (1 - f_y) \times GWP_{CH_4} \times (1 - OX) \times \frac{16}{12} \times F \times DOC_{f,y} \times MCF_y \times \sum_{x=1}^y \sum_j (W_{j,x} \times DOC_j \times e^{-k_j \times (y-x)} \times (1 - e^{k_j})) \quad (9)$$

Where:

$BE_{CH_4,SWDS,y}$	=	Baseline methane emissions occurring in the year y
φ_y	=	Model correction factor to account for model uncertainties for year y
f_y	=	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emission of methane to the atmosphere in year y
GWP_{CH_4}	=	Global Warming Potential of methane
OX	=	Oxidation factor(reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
F	=	Fraction of the methane in the SWDS gas (volume fraction)

$DOC_{f,y}$	=	Fraction of degradable organic carbon(DOC) that decomposes under the specific conditions occurring in the SWDS for year y(weight fraction)
MCF_y	=	Methane correction factor for year y
$W_{j,x}$	=	Amount of organic waste type j disposed/prevented from disposal in the SWDS in the year y (t)
DOC_j	=	Fraction of degradable organic carbon in the waste type j (weight fraction for year y)
k	=	Decay rate for the waste type(1/yr)
j	=	Type of residual waste or types of waste in the MSW
x	=	Years of the crediting period for which waste is disposed at the SWDS, extending from the first year in the time period($x=1$) to year y($x=y$)
y	=	Years of the crediting period for which methane emissions are calculated

Step A.2: Determination of $F_{CH_4,BL,y}$

This section provides a procedure to determine the amount of methane that would have been captured and destroyed (by flaring) in the baseline due to regulatory or contractual requirements, to address safety and odour concerns, or for other reasons (collectively referred to as requirement in this section). The four cases in

Table 4.1 are distinguished. The appropriate case should be identified, and the corresponding instructions followed.

Table 4.1.Cases for determining methane captured and destroyed in the baseline

Situation at the start of the project activity	Requirement to destroy methane	Existing LFG capture and destruction system
Case 1	No	No
Case 2	Yes	No
Case 3	No	Yes
Case 4	Yes	Yes

Currently China has regulations in place to deal with the management of landfills and to encourage utilization of LFG. Those regulations are:

“Standard for Pollution Control on the Landfill Site of Municipal Solid Waste” (GB 16889-2008), which became effective in 2008, issued by the Environment Protection Administration.

“Technical Code for Municipal Solid Waste Sanitary Landfill” (GB 50869-2013) , issued by the Ministry of Construction in 2013.

According to item 5.15 of GB16889-2008, if the designed landfill capacity is more than 2.5 million tons and the landfill thickness is more than 20m, methane utilization facilities or flare burning facilities shall be built to treat the landfill gas containing methane. For municipal solid waste landfills smaller than the above scale, technologies that can effectively reduce methane generation and emission shall be adopted or flare combustion facilities shall be used to treat methane containing landfill gas.

Item 11.1.1 of GB 50869-2013 stipulates that the landfill site must be equipped with effective landfill gas drainage facilities to prevent the natural accumulation and migration of landfill gas, causing fire and explosion. Item 11.1.3 stipulates that if the landfill does not have the conditions for landfill gas utilization, the flare method shall be adopted for combustion treatment, and the process that can effectively reduce the generation and emission of methane shall be adopted. The old landfills that are not safe and stable should be equipped with effective landfill gas drainage facilities. Among them, item 11.1.1 is mandatory and must be strictly implemented.

In fact, the LFG of Xiaojianxi landfill is emitted to atmosphere without LFG capture system prior the implementation of the project. Therefore, Case 2 listed in the table 3 is applicable for the project.

The requirements above don't specify any amount or percentage of LFG that should be destroyed. In this situation:

$$F_{CH_4,BL,y} = F_{CH_4,BL,R,y} \quad (10)$$

$$F_{CH_4,BL,R,y} = 0.2 \times F_{CH_4,PJ,capt,y} \quad (11)$$

Where:

$F_{CH_4,BL,R,y}$ = Amount of methane in the LFG which is flared in the baseline due to a requirement in year y (tCH₄/yr)

$F_{CH_4,PJ,capt,y}$ = Amount of methane in the LFG which is captured in the project activity in year y (tCH₄/yr)

Step: B Baseline emissions associated with electricity generation ($BE_{EC,y}$)

The baseline emissions associated with electricity generation in year y ($BE_{EC,y}$) shall be calculated using the "Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation".

$$BE_{EC,y} = EC_{BL,k,y} \times EF_{EF,k,y} \times (1 + TDL_{k,y}) \quad (12)$$

Where:

$BE_{EC,y}$ = Baseline emission from electricity consumption in year y (tCO₂/yr)

$EC_{BL,k,y}$ = Quantity of electricity that would be consumed by the baseline electricity consumer k in year y (MWh/y)

$EF_{EF,k,y}$	=	Emission factor for electricity generation for source k in year y (t CO ₂ /MWh)
$TDL_{k,y}$	=	Average technical transmission and distribution losses for providing electricity to source k in year y
k	=	Sources of electricity consumption in the baseline

When applying the tool:

- (a) The electricity sources k in the tool correspond to the sources of electricity generated identified in the selection of the most plausible baseline scenario; and
- (b) $EC_{BL,k,y}$ in the tool is equivalent to the net amount of electricity generated using LFG in year y ($EG_{PJ,y}$).

Scenario A of the tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” is applicable for the project for the electricity is purchased from the grid only, and either no captive power plant is installed at the site of electricity consumption.

According to the tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”, $EF_{EF,k,y}$ is calculated using the “Tool to calculate the emission factor for an electricity system” ($EF_{EF,k,y} = EF_{grid,CM,y}$).

Project participants shall apply the following six steps:

- Step 1:** Identify the relevant electricity systems;
- Step 2:** Choose whether to include off-grid power plants in the project
- Step 3:** Select a method to determine the operating margin (OM);
- Step 4:** Calculate the operating margin emission factor according to the
- Step 5:** Calculate the build margin (BM) emission factor;
- Step 6:** Calculate the combined margin (CM) emission factor.

Step 1: Identify the relevant electricity systems

Ministry of Ecology and Environment of the People’s Republic of China has published a delineation of the project electricity system and connected electricity systems, so the project adopt the delineation of project electricity system and connected electricity system published by Ministry of Ecology and Environment of the People’s Republic of China. The power generated by the project displaces the equivalent electricity generated by the North China Power Grid. The North China Power Grid is a larger regional grid, which consists of six sub-grids: Beijing City, Tianjin City, Hebei Province, Shanxi Province, Shandong Province and Inner Mongolia Autonomous Region.

In addition, there is net imported power to the North China Power Grid from the Northwest China Power Grid and Northeast China Power Grid. According to the “Tool to calculate the emission factor for an electricity system”, use one of the following options to determine the CO₂ emission factor for net electricity imports from a connected electricity system:

- (a) 0tCO₂/MWh; or
- (b) The simple operating margin emission rate of the exporting grid, determined as described in Step 4, if the conditions for this method, as described in Step 3 below, apply to the exporting grid; or
- (c) The simple adjusted operating margin emission rate of the exporting grid, determined as described in Step 4 below; or
- (d) The weighted average operating margin (OM) emission rate of the exporting grid, determined as described in Step 4 below.

The PD will choose option (b) to calculate the CO₂ emission factor for net electricity imports from the Central China Power Grid.

According to the available data of 2013-2015, the corresponding marginal emission factors of electricity are calculated, and weighted average is carried out to obtain the marginal emission factors of electricity.

Step2. Choose whether to include off-grid power plants in the project electricity system (optional).

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

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

Following the calculation of the Ministry of Ecology and Environment of the People’s Republic of China, and statistical data is available, Option I is chosen.

Step3. Select a method to determine the operating margin (OM)

“Tool to calculate the emission factor for an electricity system (Version 07.0)” offers four methods for the calculation of the operating margin emission factor(s) ($EF_{grid,OM,y}$):

- (a) Simple OM; or
- (b) Simple adjusted OM; or
- (c) Dispatch data analysis OM; or
- (d) Average OM.

Method (a) -Simple OM is chosen for calculation and low-cost/must-run resources constitute less than 50% of the total grid generation in average of the five most recent years¹.

¹ 2017 Bulletin on the Baseline Emission Factors of the China Grids

For simple OM, the emission factor can be calculated using either of the two following data vintages:

- (a) Ex ante option: If the ex-ante option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the mission factor during the crediting period is required. For grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of the VCS-PD to the DOE for validation. For off-grid power plants, use a single calendar year within the 5 most recent calendar years prior to the time of submission of the VCS-PD for validation;
- (b) Ex post option: If the ex post option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring. If the data required calculating the emission factor for year y is usually only available later than six months after the end of year y , alternatively the emission factor of the previous year $y-1$ may be used. If the data is usually only available 18 months after the end of year y , the emission factor of the year preceding the previous year $y-2$ may be used. The same data vintage (y , $y-1$ or $y-2$) should be used throughout all crediting periods.

Project participant employs ex ante option for its operation margin calculation.

Step4. Calculate the operating margin emission factor according to the selected method

The simple OM emission factor is calculated as the generation-weighted average CO₂ emissions per unit net electricity generation (tCO₂/MWh) of all generating power plants serving the system, not including low-cost / must-run power plants / units.

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

- (a) Option A: Based on the net electricity generation and a CO₂ emission factor of each power unit; or
- (b) Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system. Option B can only be used if:
 - (i) The necessary data for Option A is not available; and
 - (ii) Only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is known; and
 - (iii) Off-grid power plants are not included in the calculation (i.e., if Option I has been chosen in Step 2).

Since the data of each power plant/unit is unavailable, Option A is not applicable to the project. The project adopts Option B to calculate the operating margin emission factor ($EF_{grid,OM,y}$) of NCPG.

$$EF_{grid,OMsimple,y} = \frac{\sum_i FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_y} \quad (13)$$

Where:

$EF_{grid,OMsimple,y}$	=	Simple operating margin CO ₂ emission factor in year y (tCO ₂ /MWh)
$FC_{i,y}$	=	Amount of fuel type i consumed in the project electricity system in year y (mass or volume unit)
$NCV_{i,y}$	=	Net calorific value (energy content) of fuel type i in year y (GJ/mass or volume unit)
$EF_{CO2,i,y}$	=	CO ₂ emission factor of fossil fuel type i in year y (tCO ₂ e/GJ), 2006 IPCC Guidelines for default values
EG_y	=	Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must run power plants/units in year y (MWh)
i	=	All fuel types combusted in power sources in the project electricity system in year y
y	=	The relevant year as per the data vintage chosen in Step 3

Regarding parameter selection, local values of $NCV_{i,y}$ and $EF_{CO2,i,y}$ should be used where available. If no such values are available, IPCC default values are preferable. The Net Calorific Value ($NCV_{i,y}$) of each type of fossil fuel used in the calculation comes from China Energy Statistic Yearbook 2016. Emission factor ($EF_{CO2,i,y}$) of each type of fossil fuel come from IPCC 2006 default values.

The operating margin emission factor for 2013, 2014 and 2015 are calculated based on the data above. The three-year average is calculated as a weighted average of the emission factors. The Operational Margin Emission Factor is 0.9680 tCO₂/MWh.

Step5. Calculate the build margin emission factor

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

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

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

The project applies option 1 to calculate the build margin emission factor ex-ante.

According to the “Tool to calculate the emission factor for an electricity system”, the sample group of power units m used to calculate the build margin should be determined as per the following procedure, consistent with the data vintage selected above:

- (a) Identify the set of five power units, excluding power units registered as VCS project activities, that started to supply electricity to the grid most recently ($SET_{5 \text{ units}}$) and determine their annual electricity generation ($AEG_{SET-5-units}$, in MWh);
- (b) Determine the annual electricity generation of the project electricity system, excluding power units registered as VCS project activities (AEG_{total} , in MWh). Identify the set of power units, excluding power units registered as VCS project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\%}$) and determine their annual electricity generation ($AEG_{SET-\geq 20\%}$, in MWh);
- (c) From $SET_{5-units}$ and $SET_{\geq 20 \text{ percent}}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample});

Identify the date when the power units in SET_{sample} started to supply electricity to the grid. If none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the build margin. Ignore steps (d), (e) and (f).

Otherwise:

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

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

- (e) Include in the sample group $SET_{sample-VCS}$ the power units that started to supply electricity to the grid more than 10 years ago until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation);
- (f) The sample group of power units m used to calculate the build margin is the resulting set ($SET_{sampleVCS} > 10yrs$)

The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units m during the most recent year y for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad (14)$$

Where:

- $EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (tCO_2/MWh)
- $EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
- $EF_{EL,m,y}$ = CO_2 emission factor of power unit m in year y (tCO_2/MWh)
- m = Power units included in the build margin
- y = Most recent historical year for which electricity generation data is available

According to the tools, the generation capacity of and the proportions of different generating technologies used in the mostly recent capacity additions would be calculated at first. The weight of each generating technology used in capacity additions can then be worked out and finally the Build Margin emission factor would be calculated with the commercial optimal efficiencies of the generating technologies.

The following method is adopted for the BM calculation. The first step is to use the most recently available data on the energy balance to calculate the proportion of CO_2 emissions from solid, liquid, and gas fuels used for power generation in total CO_2 emissions for the NCPG in 2015. Then this proportion is applied as a weight and combined with the emission factors of the best commercially available technologies to calculate the thermal emission factor of the NCPG. Finally, the BM factor of the NCPG can be determined by multiplying its thermal emission factor by the capacity-weighted share of thermal power in the newly added 20% of the installed capacity

(1) Calculate the proportion of CO₂ emissions from solid, liquid, and gas fuels used for power generation in total CO₂ emissions for the NCPG in the base year (2015)

$$\lambda_{Coal,y} = \frac{\sum_{i \in COAL,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (15)$$

$$\lambda_{Oil,y} = \frac{\sum_{i \in OIL,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (16)$$

$$\lambda_{Gas,y} = \frac{\sum_{i \in GAS,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (17)$$

Where:

$F_{i,j,y}$	=	The amount of fuel i(in a mass or volume unit) consumed by province
$NCV_{i,y}$	=	Net calorific value(energy content) of fossil fuel type i(GJ/mass or volume unit)
$COAL,OIL\&GAS$	=	The aggregation of various kinds of coal, oil, and gas as fossil fuels.

(2) Calculate the corresponding emission factor for fossil fuel fired power generation.

$$EF_{Thermal} = \lambda_{Coal} \times EF_{Coal,Adv} + \lambda_{Oil} \times EF_{Oil,Adv} + \lambda_{GAS} \times EF_{Gas,Adv} \quad (18)$$

Where:

$EF_{Coal,adv}$, $EF_{Oil,adv}$, $EF_{Gas,adv}$ are the emission factors of coal, oil and gas-fired power generation with efficiency levels of the best commercially available technology in China in the previous three years.

(3) Calculate the Building Margin emission factor

$$EF_{BM,y} = \frac{CAP_{Thermal}}{CAP_{Total}} \times EF_{Thermal} \quad (19)$$

Where:

$CAP_{Thermal}$	=	Total capacity additions while
CAP_{Total}	=	Capacity additions of thermal power

Following the four steps above, the build margin emission factor, $EF_{grid,BM,y}$ of the NCPG is calculated to be 0.4578 tCO₂/MWh.

Step6. Calculate the combined margin emission factor

Combined Margin emission factor($EF_{grid,CM,y}$) is calculated as the weighted average of the operating margin emission factor($EF_{grid,OM,y}$) and the build margin emission factor ($EF_{grid,BM,y}$),where the

weights ω_{OM} and ω_{BM} , by default, are 0.5 and 0.5 in the first crediting period, and $EF_{grid,OM,y}$ and $EF_{grid,BM,y}$ are calculated as described above and are expressed in tCO_2/MWh .

$$EF_{grid,CM,y} = \omega_{OM} \times EF_{grid,OM,y} + \omega_{BM} \times EF_{grid,BM,y} \quad (20)$$

$$EF_{grid,CM,y} = 0.5 \times 0.9680 + 0.5 \times 0.4578 = 0.7129 \text{ (tCO}_2\text{/MWh)}$$

The $EF_{OM,y}$, $EF_{BM,y}$ and $EF_{CM,y}$ are ex-ante calculation and are fixed during the credit period.

4.2 Project Emissions

Considering when electricity generators will be under regular maintenance and sometimes shut down, the electricity will be purchased from the NCPG during this period of time. Therefore, there will be project emissions, which are calculated following the latest version of “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”.

Project emissions are calculated as follows:

$$PE_y = PE_{EC,y} + PE_{FC,y} + PE_{DT,y} + PE_{SP,y} \quad (21)$$

Where:

PE_y	=	Project emission in year y (tCO_2/yr)
$PE_{EC,y}$	=	Emissions from consumption of electricity due to the project activity in year y (tCO_2/yr)
$PE_{FC,y}$	=	Emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation, in year y (tCO_2/yr)
$PE_{DT,y}$	=	Emissions from the distribution of compressed/liquefied LFG using trucks, in year y (tCO_2/yr)
$PE_{SP,y}$	=	Emissions from the supply of LFG to consumers through a dedicated pipeline, in year y (tCO_2/yr)

The project does not include any activities consuming fossil fuels except electricity generation, so $PE_{FC,y}$ will be 0. The project does not involve the distribution of compressed/liquefied LFG using trucks and supply of LFG to consumers through a dedicated pipeline. Therefore, $PE_{FC,y}$, $PE_{DT,y}$, $PE_{SP,y}$ will be 0. Hence, PE_y is the same with $PE_{EC,y}$.

$PE_{EC,y}$ is determined by “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” as follow:

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} * EF_{EL,j,y} * (1 + TDL_{j,y}) \quad (22)$$

Where:

$$PE_{EC,y} = \text{Project emissions from electricity consumption in year y (tCO}_2\text{/yr)}$$

$EC_{PJ,j,y}$	=	Quantity of electricity consumed by the project electricity consumption source j in year y(MWh/yr)
$EF_{EL,j,y}$	=	Emission factor for electricity generation for source j in year y(tCO ₂ /MWh)
$TDL_{j,y}$	=	Average technical transmission and distribution losses for providing electricity to source j in year y

The “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” provides 3 scenarios for different sources of electricity consumption. Since the electricity generated through the project is consumed solely from grid (NCPG), scenario A is applicable. In the case of applying scenario A, two options are available for determining emission factor. For this project, Option A1 ($EF_{EL,j,y}=EF_{grid,CM,y}$) is chosen.

For simplification, $PE_{EC,y}$ will be 0 in the ex-ante calculation.

4.3 Leakage

No leakage effects are accounted for under the ACM0001 methodology.

4.4 Net GHG Emission Reductions and Removals

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad (23)$$

Where:

ER_y	=	Emission reduction in year y (tCO ₂ e/yr)
BE_y	=	Baseline emissions in year y (tCO ₂ e/yr)
PE_y	=	Project emissions in year y (tCO ₂ e/yr)

Year	Estimated baseline emissions or removals (tCO ₂ e)	Estimated project emissions or removals (tCO ₂ e)	Estimated leakage emissions (tCO ₂ e)	Estimated net GHG emission reductions or removals (tCO ₂ e)
13/04/2019 - 31/12/2019	59,774	-	-	59,774
2020	123,006	-	-	123,006

2021	146,971	-	-	146,971
2022	140,236	-	-	140,236
2023	133,834	-	-	133,834
2024	127,745	-	-	127,745
2025	-	-	-	-
2026	-	-	-	-
2027	-	-	-	-
2028	-	-	-	-
01/01/2029 - 12/04/2029	-	-	-	-
Total	731,566	-	-	731,566

Since the operation period of the project will end in 2024, the emission reductions after 2024 will be zero.

5 MONITORING

5.1 Data and Parameters Available at Validation

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	<i>"Emission from the solid waste disposal sites"(version 8.0)</i>
Value applied	0.1
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	<i>Calculation of baseline emissions</i>

Comments	-
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Data / Parameter	GWP _{CH4}
Data unit	tCO ₂ e/tCH ₄
Description	Global warming potential of CH ₄
Source of data	IPCC
Value applied	Default value of 25 from IPCC Fourth Assessment Report (AR4). 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_{CH4}
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	η_{PJ}
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Data unit	-
Description	Efficiency of the LFG capture system that will be installed in the project activity
Source of data	FSR of the project
Value applied	85%
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	<i>Calculation of baseline emissions</i>
Comments	-

Data / Parameter	Φ_y
Data unit	-
Description	The model correction factor to account for model uncertainties
Source of data	<i>Default value of the tool "Emissions from solid waste disposal sites"(version 08.0)</i>
Value applied	0.75
Justification of choice of data or description of measurement methods and procedures applied	<i>Application A is used to decide the value. And the value of dry conditions for used for the project since the MAP/PET<1.</i> <i>The meteorological data² for the project site (Qingdao City) are:</i> <i>Mean annual temperature (MAT): 12.3 °C</i> <i>Mean annual precipitation (MAP): 683 mm</i> <i>Potential evapotranspiration (PET): 1612 mm</i>
Purpose of Data	<i>Calculation of baseline emissions</i>
Comments	-

Data / Parameter	f_y
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² <http://qdsq.qingdao.gov.cn/n15752132/n30400816/n30400854/n30487109/151215035752002741.html>

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	<i>The tool "Emissions from solid waste disposal sites"(version 08.0)</i>
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	It has been considered in the section 4.1,equation (3).Therefore, $f_y=0$
Purpose of Data	<i>Calculation of baseline emissions</i>
Comments	-

Data / Parameter	OX
Data unit	-
Description	Oxidation factor
Source of data	<i>Based on an extensive review of published literature on this subject, including the IPCC2006 Guidelines for National Greenhouse Gas Inventories.</i>
Value applied	0.1
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	<i>Calculation of baseline emissions</i>
Comments	-

Data / Parameter	F
Data unit	-
Description	Fraction of methane in the SWDS gas(volume fraction)

Source of data	<i>IPCC 2006 Guidelines for National Greenhouse Gas Inventories</i>
Value applied	0.5
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	<i>Calculation of baseline emissions</i>
Comments	-

Data / Parameter	$DOC_{f,y}$
Data unit	Weight fraction
Description	Default value for the fraction of degradable organic carbon(DOC) in MSW that decomposed in the SWDS
Source of data	<i>IPCC 2006 Guidelines for National Greenhouse Gas Inventories</i>
Value applied	0.5
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	<i>Calculation of baseline emissions</i>
Comments	-

Data / Parameter	MCF_y
Data unit	-
Description	Methane correction factor
Source of data	<i>IPCC 2006 Guidelines for National Greenhouse Gas Inventories</i>
Value applied	1.0
Justification of choice of data or description of	<i>The project using application A to decide the value of MCF_y. The Xiaojianxi landfill site has controlled placement of waste, mechanical compacting and levelling of the waste, So MCF_y value</i>

measurement methods and procedures applied	of 1.0 for anaerobic managed solid waste disposal sites should be applied in line with "Emissions from solid waste disposal sites"(version 8.0)
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	W_x	
Data unit	t	
Description	Quantity of MSW land filled during 2017-2021	
Source of data	Records from landfill operator	
Value applied	Year	Annual landfilled MSW (tons)
	2017	52,110
	2018	1,277,701
	2019	1,303,255
	2020	1,329,320
	2021	910,129
	Component	Weight fraction (wet waste)
	W ₁ -Wood and wood products	0.09
	W ₂ -Pulp, paper and cardboard	0.14
	W ₃ -Food, food waste, beverages and tobacco	0.40
	W ₄ -Textiles	0.13
	W ₅ -Garden, yard and park waste	0.04
	W ₆ -Glass, plastic, metal other inert	0.20
	Remark	

Justification of choice of data or description of measurement methods and procedures applied	<i>The data FSR of the project.</i>
Purpose of Data	<i>Calculation of baseline emissions</i>
Comments	-

Data / Parameter	DOC _j														
Data unit	-														
Description	Fraction of degradable organic carbon in the waste type j(weight fraction)														
Source of data	<i>"Emissions from solid waste disposal sites"(version 08.0)</i>														
Value applied	<table border="1"> <thead> <tr> <th>Waste type j</th><th>DOC_j (% wet waste)</th></tr> </thead> <tbody> <tr> <td>Wood and wood products</td><td>43</td></tr> <tr> <td>Pulp, paper and cardboard(other than sludge)</td><td>40</td></tr> <tr> <td>Food, food waste, beverages and tobacco (other than sludge)</td><td>15</td></tr> <tr> <td>Textiles</td><td>24</td></tr> <tr> <td>Garden, yard and park waste</td><td>20</td></tr> <tr> <td>Glass, plastic, metal, other inert waste</td><td>0</td></tr> </tbody> </table>	Waste type j	DOC _j (% wet waste)	Wood and wood products	43	Pulp, paper and cardboard(other than sludge)	40	Food, food waste, beverages and tobacco (other than sludge)	15	Textiles	24	Garden, yard and park waste	20	Glass, plastic, metal, other inert waste	0
Waste type j	DOC _j (% wet waste)														
Wood and wood products	43														
Pulp, paper and cardboard(other than sludge)	40														
Food, food waste, beverages and tobacco (other than sludge)	15														
Textiles	24														
Garden, yard and park waste	20														
Glass, plastic, metal, other inert waste	0														
Justification of choice of data or description of measurement methods and procedures applied	<i>Data available are based on the wet condition of the waste.</i>														
Purpose of Data	<i>Calculation of baseline emissions</i>														
Comments	-														

Data / Parameter	k _j
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Data unit	-		
Description	Decay rate for the waste type j		
Source of data	“Emissions from solid waste disposal sites”(version 08.0)		
Value applied	Waste type j		Boreal and temperate (MAT ≤ 20 °C)
			Dry (MAP/PET < 1)
	Slow degrading	Pulp, paper and cardboard (other than sludge), textiles	0.04
		Wood, wood products and straw	0.02
	Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.05
	Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.06
Justification of choice of data or description of measurement methods and procedures applied	MAP/PET <1 and MAT ≤20 °C The meteorological data for the project site (Qingdao City) are: Mean annual temperature (MAT): 12.3 °C Mean annual precipitation (MAP): 683 mm Potential evapotranspiration (PET): 1612 mm		
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	<i>2017 Bulletin on the Baseline Emission Factors of the China Grids</i>
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 Statistic Yearbook(2014-2016) and IPCC data.
Purpose of Data	<i>Calculation of baseline emissions</i>
Comments	-

Data / Parameter	$EF_{grid,BM,y}$
Data unit	tCO ₂ /MWh
Description	Build margin emission factor of NCPG
Source of data	<i>2017 Bulletin on the Baseline Emission Factors of the China Grids</i>
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 Statistic Yearbook(2014-2016) and IPCC data.
Purpose of Data	<i>Calculation of baseline emissions</i>
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	<i>Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation(version 03.0)</i>
Value applied	<i>Use as default values of 20% for project consumption sources;</i>

	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	<i>Calculation of Baseline, project and/or leakage emissions from electricity consumption</i>
Comments	-

5.2 Data and Parameters Monitored

Data / Parameter	Management of SWDS
Data unit	-
Description	<i>Management of SWDS</i>
Source of data	Use different sources of data: (a) <i>Original design of the landfill;</i> (b) <i>Technical specifications for the management of the SWDS;</i> (c) <i>Local or national regulations</i>
Description of measurement methods and procedures to be applied	<i>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.</i> <i>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</i>
Frequency of monitoring/recording	<i>Annually</i>
Value applied	-
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	<i>Calculation of baseline emissions</i>

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	-
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	t CH 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 odor concerns.
Description of measurement methods and procedures to be applied	-
Frequency of monitoring/recording	Annually
Value applied	-
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 odor concerns.
Description of measurement methods and procedures to be applied	-
Frequency of monitoring/recording	Annually
Value applied	-
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	The data below are calculated ex ante <table border="1"> <tr> <td>Year</td><td>Electricity exported to the grid (MWh)</td></tr> </table>	Year	Electricity exported to the grid (MWh)
Year	Electricity exported to the grid (MWh)		

	13/04/2019-31/12/2019	11,899
	2020	24,486
	2021	29,256
	2022	27,915
	2023	26,641
	2024	25,429
	2025	0
	2026	0
	2027	0
	2028	0
	01/01/2029-12/04/2029	0
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	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	<i>For simplification, the data used in ex ante calculation is 0.</i>
Monitoring equipment	<i>Electricity meter</i>
QA/QC procedures to be applied	<i>The calibration should be done once a year by a qualified third party.</i>
Purpose of data	<i>Calculation of baseline emissions</i>
Calculation method	-
Comments	-

Data / Parameter	$V_{t,db}$																
Data unit	m^3 dry gas/h																
Description	<i>Volumetric flow of the gaseous stream in time interval t on a dry basis</i>																
Source of data	<i>Monitored by project participant</i>																
Description of measurement methods and procedures to be applied	<i>Volume flow measurement always refers to the actual pressure and temperature.</i>																
Frequency of monitoring/recording	Measured continuously by a flow meter (average hourly value should be used in the calculations of baseline emission reductions). Data to be aggregated monthly.																
Value applied	The data below are calculated ex ante. <table border="1"> <thead> <tr> <th>Year</th><th>Total combusted LFG(m^3)</th></tr> </thead> <tbody> <tr> <td>13/04/2019-31/12/2019</td><td>7,911,339</td></tr> <tr> <td>2020</td><td>16,280,363</td></tr> <tr> <td>2021</td><td>19,452,083</td></tr> <tr> <td>2022</td><td>18,560,835</td></tr> <tr> <td>2023</td><td>17,713,372</td></tr> <tr> <td>2024</td><td>16,907,438</td></tr> <tr> <td>2025</td><td>0</td></tr> </tbody> </table>	Year	Total combusted LFG(m^3)	13/04/2019-31/12/2019	7,911,339	2020	16,280,363	2021	19,452,083	2022	18,560,835	2023	17,713,372	2024	16,907,438	2025	0
Year	Total combusted LFG(m^3)																
13/04/2019-31/12/2019	7,911,339																
2020	16,280,363																
2021	19,452,083																
2022	18,560,835																
2023	17,713,372																
2024	16,907,438																
2025	0																

	2026	0
	2027	0
	2028	0
	01/01/2029-12/04/2029	0
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	$m^3 \text{ gas } i / m^3 \text{ dry gas}$	
Description	Volumetric fraction of greenhouse gas <i>i</i> in a time interval <i>ton s</i> 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	50%(ex-ante calculation)	
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	CAPEX and OPEX
Data unit	RMB
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	-
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	RMB
Description	<i>Tariff of the electricity exported</i>
Source of data	<i>Power purchase agreement</i>
Description of measurement methods and procedures to be applied	-
Frequency of monitoring/recording	<i>At the first issuance request after each phase of the project is fully implemented</i>
Value applied	-
Monitoring equipment	-
QA/QC procedures to be applied	<i>Audited by professional, independent financial auditors. The DOE should only verify that the data provided corresponds to the data from independent financial auditors</i>
Purpose of data	<i>Identify the baseline scenario and demonstrate additionality</i>
Calculation method	-
Comments	<i>The monitoring of this parameter is only required for projects applying the simplified procedures to identify the baseline scenario and demonstrate additionality</i>

5.3 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.

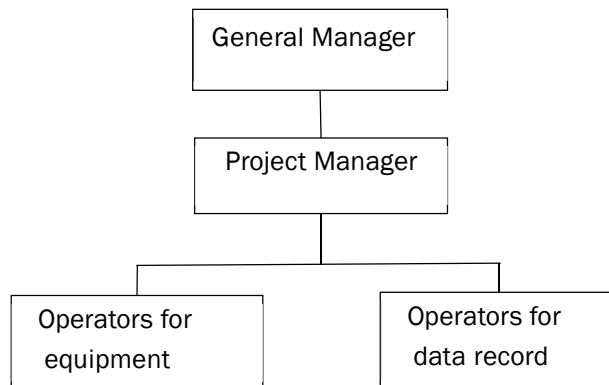


Figure 5.1 Operational and management structure

(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 are identified, the VCS manager will inform the GM about the situation and work out relevant measures to be taken. The VCS 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

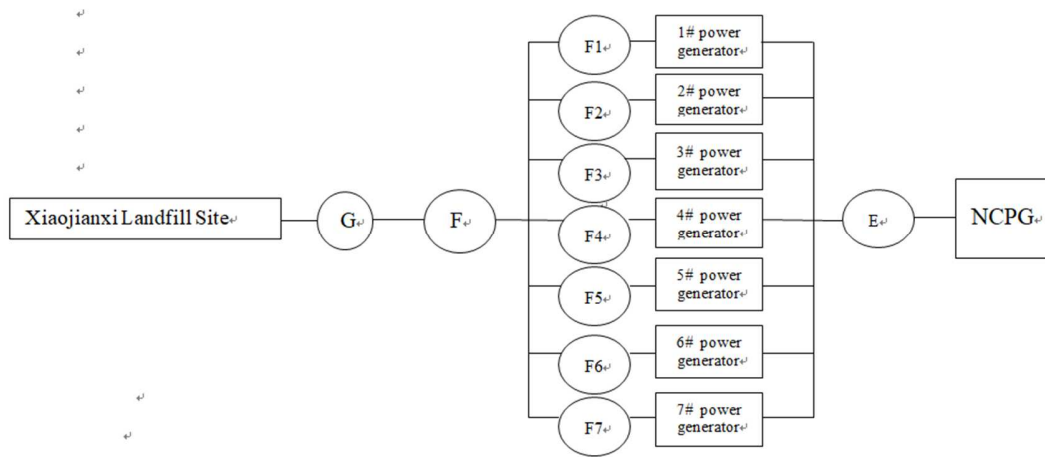


Figure 5.2 Monitoring system

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
F1 F2 F3 F4 F5 F6 F7	Flow meters to continuously measure flow rates of combusted LFG for power generation of each generator set, with automatic measure adjustment for temperature and pressure. To be conservative, the min value of F and F1+F2+F3+F4+F5+F6+F7 will be used to calculate the ex-post emission reductions.
E	Electricity meter (main meter, bi-directional) to continuously measure the electricity supplied to the NCPG and the electricity supplied by the grid

QA/QC

All the monitoring devices listed above (flow meter, gas analyzer and electricity meter) will be calibrated once a year by a qualified third party. The calibration report will be kept in the archives by the project owner, and checked by Project Manager. When the data is not available from the main monitoring devices, the data measured by the back-up devices will be used.