WUHAN JIANGXIA CHANGSHANKOU LFG POWER PROJECT PHASE I

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Project Title	Wuhan Jiangxia Changshankou LFG Power Project Phase I
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1 PROJECT DETAILS

1.1 Summary Description of the Project

Wuhan Jiangxia Changshankou LFG Power Project Phase I (hereafter referred to as “the Project”) is a landfill gas (LFG) recovery and utilization project developed by Wuhan Huantou Environmental Technology Co., Ltd. (hereinafter referred to as “the project proponent”). The Project is located at Changshankou Landfill, Jinkou Street, Jiangxia District, Wuhan City, Hubei province, People’s Republic of China.

Changshankou Landfill started operation in October 2009, with a designed capacity of 18,800,000 m^3 and a designed lifetime of 21 years. The MSW deposition rate is estimated to be 2,100 tons/day during the operation. The landfill is expected to stop receiving MSW in 2029. LFG generation continues, however, after the closure of the landfill site.

Prior to the implementation of the project activity, the LFG generated from Changshankou Landfill was totally released into the atmosphere; the equivalent amount of electricity supplied by the project activity was supplied by the fossil-fuel-dominated Central China Power Grid (CCPG). The baseline scenario is the same as the conditions existing prior to the implementation of the project activity.

The Project achieves emission reductions in two aspects: 1) it avoids methane emissions by capturing and destroying LFG which would have been directly vented into the atmosphere in the baseline scenario; 2) it reduces CO_2 emissions by displacing part of the electricity that would otherwise have been supplied by CCPG.

The purpose of the Project is to collect LFG from Changshankou Landfill and utilize it for power generation. It includes LFG collection system, LFG pre-treatment system, flaring and electricity generation system. LFG collected will be used for electricity generation with internal combustion generators. The Project started construction in August 2020. Eight power generators of 1.067 MW each, which add up to 8.536 MW, have been installed, and they were put into operation on 10-Mar-2022. A flare system destroys LFG when the power generators are out of operation or under maintenance. The emission reductions achieved due to methane destruction in the flare system will not be included in the calculation, which is conservative.

It is estimated that during the 10-year project crediting period (from 10-Mar-2022 to 09-Mar-2032), the annual average amount of feed-in electricity is estimated to 56,306 MWh, the total GHG emission reductions will be 3,155,702 tCO_2e, with annual emission reductions of 315,570 tCO_2e.

Audit Type	Period	Program	VVB Name	Number of years
Validation/ Verification	This PD (Version 1.0) is used for publishment, the Validation date is not yet determined.	VCS	Chinese Classification Society Quality Authentication Company	-

1.2 Sectoral Scope and Project Type

As per the methodology ACM0001 (version 19.0), if the recovered LFG is used for any other purposes than flaring, then application of sectoral scope 13 and sectoral scope 1 is mandatory.

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

- Sectoral scope 1: energy industries (renewable-/non-renewable sources), and
- Sectoral scope 13: waste handling and disposal.

The Project is not a grouped project.

1.3 Project Eligibility

The scope of the VCS Program includes:

1) The seven Kyoto Protocol greenhouse gases: The emissions reduction of the project comes from two sources: 1) Methane (CH_4) emissions as a result of the previously vented landfill gas that will be captured and destroyed in the project scenario; 2) CO_2 emissions from the production of the equivalent amount of electricity replaced by the Project that would otherwise have been purchased from the fossil fuel fired power plants of Central China Power Grid (CCPG). Thus, the project applicable to this scope.

2) Ozone-depleting substances: NA

3) Project activities supported by a methodology approved under the VCS Program through the methodology approval process: NA

4) Project activities supported by a methodology approved under a VCS approved GHG program, unless explicitly excluded under the terms of Verra approval: The methodology ACM0001 (Version 19.0) of the project utilized is a methodology approved under CDM Program, that is a VCS approved GHG program.

5) Jurisdictional REDD+ programs and nested REDD+ projects as set out in the VCS Program document Jurisdictional and Nested REDD+ (JNR) Requirements: NA

The project does not belong to projects that can reasonably be assumed to have generated GHG emissions primarily for the purpose of their subsequent reduction, removal, or destruction.

Furthermore, the project does not belong to the project activities excluded in Table 1 of VCS Standard 4.5.

Thus, the project is eligible under the scope of VCS program.

1.4 Project Design

☒ The project includes a single location or installation only

☐ The project includes multiple locations or project activity instances, but is not being developed as a grouped project

☐ The project is a grouped project

Eligibility Criteria

The project is not a grouped project. There is no additional information needed to be provided.

1.5 Project Proponent

Organization name	Wuhan Huantou Environmental Technology Co., Ltd.
Contact person	Xu Guangyu
Title	Manager
Address	Room 4625, Floor 1-3, No. 26 Jiangda Road, Jiangan District, Wuhan City, Hubei Province, China
Telephone	+86 021-23019950
Email	3542346576@qq.com

1.6 Other Entities Involved in the Project

Organization name	Climate Bridge (Shanghai) Ltd.
Role in the project	Consultant

Contact person	GAO Zhiwen
Title	General Manager
Address	Block B, Level 24, Jiangong Mansion, 33 Fushan Road, Pudong New Area, Shanghai, China
Telephone	+86 021-62462036
Email	gao.zhiwen@climatebridge.com

1.7 Ownership

The project owner is Wuhan Huantou Environmental Technology Co., Ltd. who has the legal right to control and operate the project activity. The business license, approval of the Environmental Impact Assessment (EIA), the equipment purchasing contract, and the construction contract are evidence of the ownership of the project and carbon credits generated.

1.8 Project Start Date

The project start date is 10-Mar-2022 when the power generator started operation.

1.9 Project Crediting Period

The Project adopts a fixed ten-year crediting period from 10-Mar-2022 to 09-Mar-2032 (both days included).

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

The estimated annual GHG emission reductions/removals of the project are:

☐ <20,000 tCO_2e/year

☐ 20,000 – 100,000 tCO_2e/year

☒ 100,001 – 1,000,000 tCO_2e/year

☐ >1,000,000 tCO_2e/year

Project Scale	
Project	

Large project	✔

Year	Estimated GHG emission reductions or removals (tCO_2e)
10-Mar-2022 to 31-Dec-2022	256,064
01-Jan-2023 to 31-Dec-2023	315,554
01-Jan-2024 to 31-Dec-2024	315,554
01-Jan-2025 to 31-Dec-2025	315,554
01-Jan-2026 to 31-Dec-2026	315,554
01-Jan-2027 to 31-Dec-2027	315,554
01-Jan-2028 to 31-Dec-2028	315,554
01-Jan-2029 to 31-Dec-2029	315,554
01-Jan-2030 to 31-Dec-2030	315,554
01-Jan-2031 to 31-Dec-2031	315,554
01-Jan-2032 to 09-Mar-2032	59,652
Total estimated ERs	3,155,702
Total number of crediting years	10
Average annual ERs	315,570

1.11 Description of the Project Activity

The baseline scenario to the project is the situation existing before the implementation of the project. Before the implementation of the project activity, LFG captured and utilized by the project was released directly into the atmosphere. In addition, the quantity of electricity produced using LFG would have been produced by power plants connected to the grid.

By replacing the electricity generated from fossil fuel-fired power plants dominated CCPG, the proposed project activity will achieve considerable greenhouse gas emission reductions by reducing CO_2 and CH_4 emissions.

The project activity will install a comprehensive system for LFG recovery and utilization on the existing landfill site. The system will involve LFG collection system, LFG pre-treatment system, flaring and electricity generation system. The flare will only be involved when the electricity generation system is not in operation, or the LFG is exceeded. Hence, the project developer determined that VCUs from flare will not be claimed, even if any methane is destroyed by flare during the crediting period. And VCUs will only be claimed from the methane destroyed by power generation system and the power displacement. The project emissions from flaring system are excluded.

The key systems involved in the proposed project are as follows:

- **Gas collection system**

The landfill gas collecting system is a gas pipeline network, consisting of gas collecting wells and gas pipelines which are connected with each gas collecting well, and gas collection blower. LFG will be extracted by gas collection blower and transported by pipeline from gas collection wells to gas pre-treatment system.

- **Gas pre-treatment system**

Before entering the gas engines, the LFG is pre-treated so that impurities and moisture are removed to avoid corrosion of the electricity generation system. In addition, the pre-treatment system maintains the LFG in a continuously stable condition before the gas generator inlets. The pre-treatment includes desulfurization, filtration, dehumidification, cooling and pressurization.

- **Power generation system**

The electricity generated using LFG, except small portion for on-site usage, will be predominantly sold to the CCPG through nearby distribution network. 8 gas generators with a rated capacity of 1.067 MW each will be installed by the project. The annual average running time is 6,800 hours and the power generation efficiency are 37.0%.

The electricity generated by the project is transmitted to the 220kV Yeboshan substation of CCPG through one 10kV transmission line. Electricity meter has been installed at the outlet of the onsite 10kV switchgear box AH02 Metering Point (connection point of the project and the power grid) to monitor the quantity of electricity supplied to CCPG and electricity imported from CCPG.

The technical parameters of main equipment used in this project are shown in the table below:

Table 1-1 Main Equipment Parameter[1]

LFG Generator

[1] According to Equipment Purchase Contract

Parameter	Value	Unit
Model	JGS320	-
Quantity	8	-
Rated capacity	1.067	MW
Rated power factor	0.8	-
Rated frequency	50	Hz
Rated Voltage	400	V
Manufacturer	STAMFORD	-

1.12 Project Location

The Project is located in Changshankou Landfill, Jinkou Street, Jiangxia District, Wuhan City, Hubei province, China. The coordinates of the project site are 114°12′33″E, 30°21′10″N.

The project location is shown in Figure 1.1.

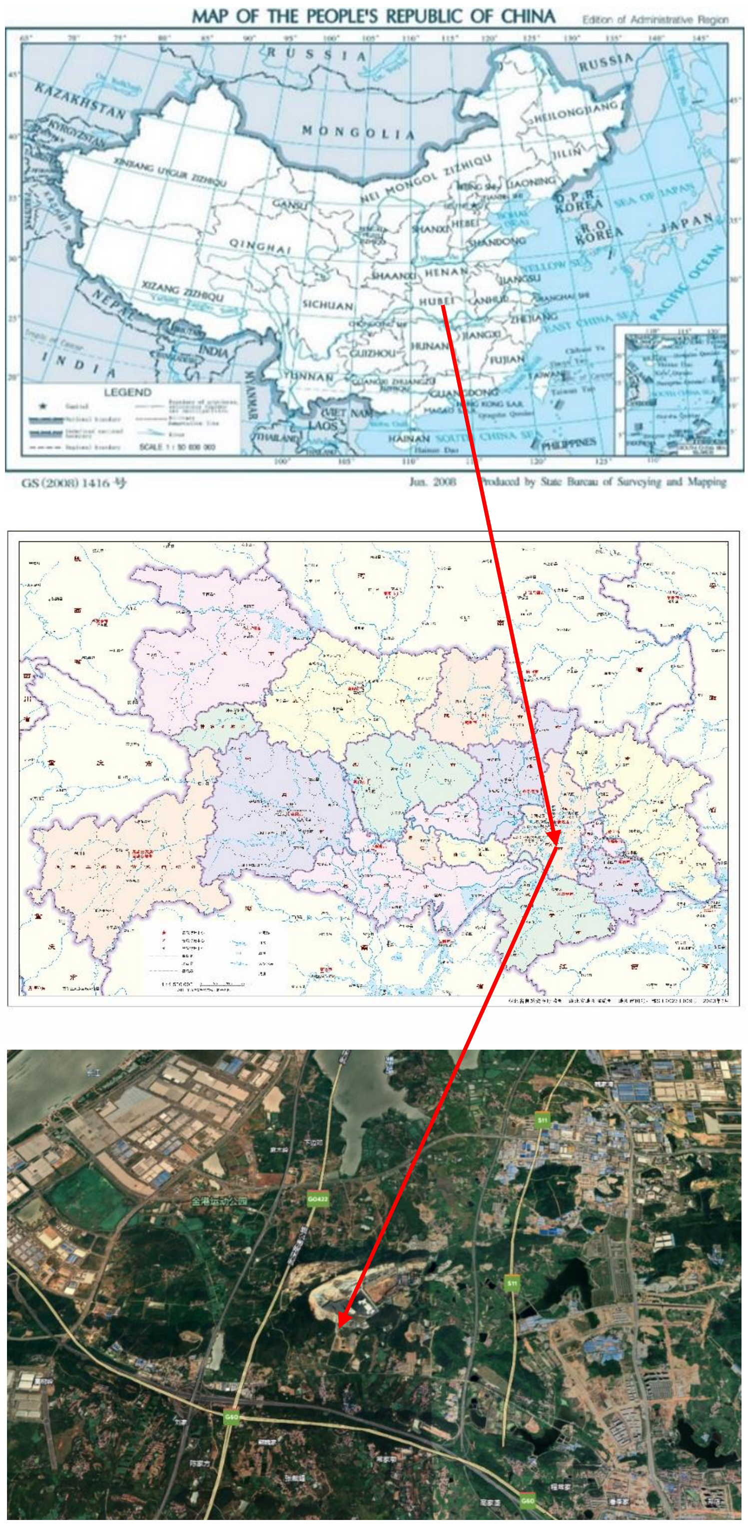


Figure 1.1 Location of the Project

1.13 Conditions Prior to Project Initiation

Prior to the implementation of the project activity, the LFG generated from Changshankou Landfill was totally released into the atmosphere; the equivalent amount of electricity supplied by the project activity was supplied by the fossil-fuel-dominated Central China Power Grid (CCPG).

The baseline scenario is the same as the conditions existing prior to the project initiation. Please refer to Section 3.4 (Baseline Scenario).

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The Project complies with all Chinese relevant laws and regulations, as shown in Table 1.2.

Table 1.2 Compliance with relevant laws and regulations

Laws and regulations	The Project
Regulations on the Approval and Recordation of Enterprise Investment Projects[2], Administrative Measures on the Approval and Recordation of Enterprise Investment Projects[3], which sets out the procedures of project approval and recordation.	The Project has obtained the approval and has been recorded by the Development and Reform Commission of Jiangxia District, Wuhan City, in compliance with the regulation and the administrative measure.
Law of People's Republic of China on Environmental Impact Assessment[4], which sets out the requirements on the completion and approval of the environmental impact assessment (EIA) report/form of construction projects.	The (EIA) form of the Project has been completed and then approved by the Ecology and Environment Department of Wuhan City, which is in compliance with the provisions in the law.
Construction Law of the People's Republic of China[5], which sets out the requirements on application and approval of the construction permit prior to the project construction.	The Project obtained the construction permit prior to the construction in compliance with the provisions in the law.

[2] http://www.gov.cn/zhengce/content/2016-12/14/content_5147959.htm

[3] https://www.ndrc.gov.cn/xxgk/zcfb/fzggwl/201703/W020190905495074985482.pdf

[4] https://www.mee.gov.cn/ywgz/fgbz/fl/201901/t20190111_689247.shtml

[5] http://www.npc.gov.cn/npc/c30834/201905/0b21ae7bd82343dead2c5cdb2b65ea4f.shtml

Catalogue for the Guidance of Industrial Structure Adjustment[6], which lists projects in three categories: encouragement category, restriction category and elimination category.	The Project is a landfill gas project, and belongs to the encouragement category of the Catalogue.

1.15 Participation under Other GHG Programs

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

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

The Project is seeking registration only under VCS 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 reduces GHG emissions from activities that are not included in an emissions trading program or any other mechanism that includes GHG allowance trading.

The project proponent is not part of any emission trading program. The net GHG emission reductions from the project will not be used for compliance with emission trading programs or to meet binding limits on GHG emissions. The project activity has not participated in any other GHG programs.

China has a national emissions trading scheme only cover the high-emission industries, such as thermal power generation, petrochemical, chemical, building materials, iron and steel, non-ferrous, paper, aviation and other key emission industries that emitted at least 26,000 tons of CO_2e/year. And the project activity is not included the mandatory emission control scheme and there is no emission cap enforced for the project owner according to the enforced company list in public information. Hence, it is confirmed that the emission reductions will not be double counted.

1.16.2 Other Forms of Environmental Credit

[6] http://www.gov.cn/xinwen/2019-11/06/5449193/files/26c9d25f713f4ed5b8dc51ae40ef37af.pdf

The project has not sought or received another form of GHG-related environmental credit.

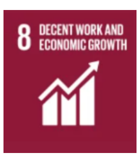
Supply Chain (Scope 3) Emissions

As per Clarification to VCS program rules and requirements issued on 31-May-2023, projects are not required to complete the sections in the affected VCS project templates that relate to Scope 3 emissions double claiming until the effective date of the revised requirements of 01-Jan-2024.[7] Therefore, this section is not required in this PD.

1.17 Sustainable Development Contributions

The Project contributes to achieving sustainable development goals in the following aspects:

The project is to capture and utilize landfill gas for power generation to avoid landfill gas emissions and CO_2 emissions from the production of the equivalent amount of electricity replaced by the project that would otherwise have been purchased from the CCPG. The project will achieve a GHG emission reduction of 185,873 tCO_2e/yr during the crediting period. Thus, the project will achieve SDG 13 Climate Action[8]. This contributes to achieve China's stated sustainable development priorities "China's carbon dioxide emissions would strive to peak by 2030 and strive to achieve carbon neutrality by 2060".



The construction and operation of the project will provide new local jobs and increase tax revenue, which will have a positive effect on the local economy. During the crediting period, direct and indirect employment opportunities will be generated. Thus, the project will achieve SDG 8 Decent Work and Economic Growth[9]. This contributes to one of China's actions for promoting sustainable developing: "by 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value".

[7] https://verra.org/verra-issues-clarification-on-effective-date-of-vcs-scope-3-requirements/

[8] https://sdgs.un.org/goals/goal13

[9] https://sdgs.un.org/goals/goal8

The project increase electricity production from renewable sources, which will certainly reduce the consumption of fossil fuel in Central China Power Grid and further help to achieve the national action to promote renewable energy development. Thus, the project will achieve SDG 7 Affordable and Clean Energy[10]. This contributes to achieve China's stated sustainable development priorities "By 2030, the proportion of non-fossil energy consumption will reach about 25%".

1.18 Additional Information Relevant to the Project

Leakage Management

Not applicable as the project is not a AFOLU project.

Commercially Sensitive Information

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

Further Information

Not applicable as there is no further information relevant to the project.

2 SAFEGUARDS

2.1 No Net Harm

The Environmental Impact Assessment (EIA) *of* the Project has been completed by a third-party company (Please refer to Section 2.3 for details). Every aspect of environmental impact has been considered in the EIA report with corresponding measures during project development. The environmental impacts, treatment, and effects arising from the Project during operation have been analysed in section 2.3 of this report below. And no net harm has been detected.

[10] https://sdgs.un.org/goals/goal7

Meanwhile, the implementation of the project will contribute to local sustainable development as described in section 1.17 of this report above. The Project does not result in any negative socio-economic impacts.

2.2 Local Stakeholder Consultation

Local stakeholder consultation before the Project construction

The local stakeholders identified include personnel of the landfill and the power plant, local residents around the project area and government officials. Prior to the Project construction, the project proponent conducted local stakeholder consultation by distributing survey questionnaires in May 2020, to get informed of the stakeholders' opinion about the Project in various aspects.

The survey questionnaire was designed to assess the project impacts on the local environment and social economic development. The surveyed stakeholders varied in age, gender, occupation and educational background. The structure of the survey respondents is listed in Table 2.1 below.

Table 2.1 Basic information of the stakeholders surveyed

Item \ Distribution		Number	Percentage
Gender	Male	23	57.5%
	Female	17	42.5%
Age	<25	4	10.0%
	25-45	13	32.5%
	45-60	11	27.5%
	>60	12	30.0%
Education	Junior high school or below	22	55.0%
	Senior high school	11	27.5%
	College or above	7	17.5%
Occupation	Worker	16	40.0%
	Farmer/peasant	3	7.5%
	Management personnel	9	22.5%
	Civil servant	7	17.5%
	Other	5	12.5%

A total number of 40 questionnaires were distributed, and all questionnaires were recollected. The survey results are summarized in Table 2.2.

The survey shows that the Project is well known by local residents. Most of them are supportive of the project construction and believe that the Project will bring more benefit than loss. 92.5% of the respondents have confirmed their willingness to participate in the construction and/or operation of the Project. 90% of the respondents believe that the Project will not have any environmental impact, but a few respondents show their concern about the potential negative environmental impacts caused by the Project. Regarding the landfill condition, 95% of the respondents consider that the Project will have positive impacts. All the respondents believe that the Project will create employment opportunities; almost all of them believe that the Project will contribute to local economic development and increase local power supply.

Table 2.2 Summary of the survey results

No.	Questions	Response	Number	Percentage
1	Are you informed of the project activity?	Very much	34	85.0%
		A little	6	15.0%
		Not at all	0	0%
2	In general, what is your attitude towards the project construction?	Supportive	38	95.0%
		Against	0	0%
		Indifferent	2	5.0%
3	What do you think will be the major environmental impacts of the project? (multiple choices possible)	None	36	90.0%
		Air pollution	3	7.5%
		Water pollution	1	2.5%
		Noise pollution	2	5.0%
		No idea	0	0%
4	Do you believe that the project operation will bring more benefit than loss?	Yes	40	100%
		No	0	0%
		No idea	0	0%
5	Are you willing to participate in the project construction and/or operation?	Yes	37	92.5%
		No	1	2.5%
		Indifferent	2	5.0%
6	What influence do you think the project will bring to you and your family?	Positive	36	90.0%
		None	4	10.0%
		Negative	0	0%
7		Positive effect	38	95.0%
		None	2	5.0%

	What kind of effect do you think the project operation will have on the landfill condition?	Negative effect	0	0%
8	What kind of impact do you think the project will bring to the local employment?	Increase	40	100%
		Decrease	0	0%
		No impact	0	0%
9	What kind of impact do you think the project will bring to the local economy?	Positive	37	92.5%
		Negative	0	0%
		No impact	3	7.5%
10	What kind of impact do you think the project will bring to the local power supply?	Increase	36	90.0%
		Decrease	0	0%
		No impact	4	10.0%

In conclusion, the implementation of the Project is regarded as beneficial by majority of the local stakeholders.

Local stakeholder consultation during the project operation

During the project implementation, local stakeholders' opinions are collected through two channels available: regular questionnaire surveys conducted by the project proponent which take place every year, communications between local residents and authorities. The project proponent informs the local authorities of key implementation events or changes of the Project, then the local authorities inform the residents living around the project sites, and the comments and suggestions from residents are collected by the local authorities; the local government agencies also conduct spot checks on the project implementation on a regular basis, and give suggestions on potential issues.

2.3 Environmental Impact

The Environmental Impact Assessment (EIA) of the Project has been conducted by Wuhan Zhihuiyuan Environmental Protection Technology Co., Ltd. and approved by Ecology and Environment Department of Wuhan City. The environmental impacts and associated mitigation measures of the project are summarized as follows.

Air pollution

The exhaust gas generated by the power generators contains particulate matter, SO_2 and NO_x. The combustion exhaust gas of the power generator is to be treated through SCR denitration device before being discharged through exhaust funnels. The emissions of exhaust gas can meet the requirements in “Comprehensive Emission Standard of Air Pollutants” (GB 16297-1996), “Boiler Air Pollutant Emission Standard” (GB 13271-2014) and "Odorous Pollutant Emission Standard" (GB14554-93).

By taking the measures above, the impact of the project's exhaust gas on the surrounding area is small.

Wastewater

The wastewater during operation is mainly domestic sewage and landfill gas condensate wastewater. The domestic sewage of the project is pretreated by the self-built septic tank and discharged into the existing leachate treatment station of Changshankou Landfill Site. The project landfill gas condensate wastewater is directly discharged into the existing leachate treatment station in Changshankou landfill site. The treated water can meet the requirements in “Comprehensive Sewage Discharge Standard” (GB8978-1996)” and it will be further treated in Jinkou sewage Treatment Plant.

By taking the measures above, the impact of the project's wastewater on the surrounding area is small.

Noise

Noise is generated by pneumatic pumps, generators, and water pumps during the project operation. After sound insulation, vibration reduction, noise elimination and distance attenuation, the noise at the plant boundary can meet the requirements of Class II standard of the “Emission Standard for Industrial Enterprises Noise at Boundary” (GB12348-2008). By taking the measures above, the impact of the project's noises on the surrounding area is small.

Solid waste

The solid waste of the project is mainly waste catalyst, waste lubricating oil, waste oil drums, other hazardous waste and general industrial solid waste. The general industrial solid waste is collected uniformly and then sent to Changshankou MSW landfill site for landfill treatment. The waste catalyst, waste lubricating oil, waste oil drums, other hazardous waste shall be properly collected and stored in the hazardous waste temporary deposit and shall be submitted to the relevant qualified units for centralized treatment regularly.

In conclusion, the environmental impact during the project operation will be minor. The project activity can reduce greenhouse gas emissions and environmental pollution caused by methane release. The Project owner takes appropriate measures to minimize adverse environmental impacts.

2.4 Public Comments

The project is going to open for public comment on the VERRA website.

2.5 AFOLU-Specific Safeguards

The project is a non-AFOLU project. Thus this section is not applicable to the project.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

The Project applies the large-scale consolidated methodology ACM0001: Flaring or use of landfill gas (version 19.0):

https://cdm.unfccc.int/methodologies/DB/JPYB4DYQUXQPZLBDVPHA87479EMY9M

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

TOOL04: “Emissions from solid waste disposal sites” (version 08.0);

https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-04-v8.0.pdf

TOOL05: “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (version 03.0);

https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v3.0.pdf

TOOL07: “Tool to calculate the emission factor for an electricity system” (version 07.0):

https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf

TOOL08: “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 03.0);

https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-08-v3.0.pdf

TOOL32: “Positive lists of technologies” (version 03.0):

https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-32-v3.0.pdf

3.2 Applicability of Methodology

The Project fulfils each of the applicability conditions of the applied methodology ACM0001 (version 19.0) as shown in Table 3.1.

Table 3.1 Applicability of the Project to ACM0001

Applicability conditions of ACM0001 (version 19.0)	Justifications
The methodology is applicable under the following conditions: (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 (b) Make an investment into an existing LFG capture system to increase the recovery rate or change the use of the captured LFG, provided that: (i) The captured LFG was vented or flared and not used prior to the implementation of the project activity; and (ii) In the case of 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 of LFG capture and flared is available; (c) Flare the LFG and/or use the captured LFG in any (combination) of the following ways: (i) Generating electricity; (ii) Generating heat in a boiler, air heater 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; (d) Do not reduce the amount of organic waste that would be recycled in the absence of the project	Applicable. (a) The Project involves the installation of a new LFG capture system in an existing SWDS, i.e., Changshankou Landfill, where no LFG capture system was installed prior to the project activity. (b)The Project is not a retrofit into an existing LFG capture system. (c)The captured LFG in the project activity is utilized to generate electricity. (d)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 landfill site.

activity.	
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 capture 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 generating 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 natural gas. (d) In the case of LFG from a Greenfield SWDS, the identified baseline scenario is atmospheric release of the LFG or capture 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.	Applicable. The identified most plausible baseline scenario (please refer to Section 3.4 for details) is: (a) the LFG from Changshankou Landfill would have been totally released into the atmosphere; (b) the equivalent amount of electricity supplied by the Project would have been supplied by CCPG.
This methodology is 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 CDM project activity is to implement energy efficiency measures	The Project exclusively applies the methodology ACM0001 (version 19.0); no other methodologies are applied in combination. The management of the SWDS remains the same both prior to and during the implementation of the project activity; it is

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.	not deliberately changed under any circumstance to increase methane generation.
The applicability conditions included in the tools referred to below also apply.	Applicable. Please refer to Table 3.2.

The Project also meets each of the applicability conditions of the applied methodological tools as shown in Table 3.2.

Table 3.2 Applicability of the Project to the applied methodological tools

TOOL04: "Emissions from solid waste disposal sites" (version 08.0)	
Applicability conditions	Justifications
The tool can be used to determine emissions for the following types of applications: (a) Application A: The CDM project activity mitigates methane emissions from a specific existing SWDS. Methane emissions are mitigated by capturing and flaring or combusting the methane (e.g. "ACM0001: Flaring or use of landfill gas"). The methane is generated from waste disposed in the past, including prior to the start of the CDM project activity. In these cases, the tool is only applied for an ex ante estimation of emissions in the project design document (CDM-PDD). The emissions will then be monitored during the crediting period using the applicable approaches in the relevant methodologies (e.g., measuring the amount of methane captured from the SWDS); (b) Application B: The CDM project activity avoids or involves the disposal of waste at a SWDS. An example of this application of the tool is ACM0022, in which municipal solid waste (MSW) is treated with an alternative option, such as composting or anaerobic digestion, and is then prevented from	Application A applies: the project activity mitigates methane emissions from Changshankou Landfill by capturing and utilizing the methane for power generation. This tool is only applied for ex ante estimation of the emissions in the PD.

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.	
TOOL05: "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0)	
Applicability conditions	Justifications
If emissions are calculated for electricity consumption, the tool is only applicable if one out of the following three scenarios applies to the sources of electricity consumption: (a) Scenario A: Electricity consumption from the grid. The electricity is purchased from the grid only, and either no captive power plant(s) is/are installed at the site of electricity consumption or, if any captive power plant exists on site, it is either not operating or it is not physically able to provide electricity to the electricity consumer; (b) Scenario B: Electricity consumption from (an) off-grid fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants are installed at the site of the electricity consumer and supply the consumer with electricity. The captive power plant(s) is/are not connected to the electricity grid; or (c) Scenario C: Electricity consumption from the grid and (a) fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants operate at the site of the electricity consumer. The captive power plant(s) can provide electricity to the electricity consumer. The captive power plant(s) is/are also connected to the electricity grid. Hence, the electricity consumer can be provided with electricity from the captive power plant(s) and the	Applicable. The source of electricity consumption of the project is Scenario A: Electricity consumption from the grid.

grid.	
This tool can be referred to in methodologies to provide procedures to monitor amount of electricity generated in the project scenario, only if one out of the following three project scenarios applies to the recipient of the electricity generated: (a) Scenario I: Electricity is supplied to the grid; (b) Scenario II: Electricity is supplied to consumers/electricity consuming facilities; or (c) Scenario III: Electricity is supplied to the grid and consumers/electricity consuming facilities.	The electricity generated by the Project id supplied to CCPG, which is in line with Scenario I.
This tool is not applicable in cases where captive renewable power generation technologies are installed to provide electricity in the project activity, in the baseline scenario or to sources of leakage. The tool only accounts for CO_2 emissions.	NA. No captive renewable power generation technologies are installed to provide electricity in the project activity, in the baseline scenario or to sources of leakage.
TOOL07: "Tool to calculate the emission factor for an electricity system" (version 07.0)	
Applicability 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).	Applicable. The project activity utilizes recovered LGF to export electricity to the grid, and thus substitutes grid electricity. Therefore, this tool is applied to estimate the OM, BM and CM for baseline emissions.
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 II a and option II b. If option II a is chosen, the conditions specified in "Appendix 1: Procedures related to off-grid power generation" should be met. Namely, the total	As off-grid power generation is an insignificant part of the national energy mix in China, the emission factor for the project electricity system is calculated only for the grid power plants, which satisfies this applicability condition.

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 CDM projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I country.	Applicable. The project electricity system is totally located in China, a non-Annex I country.
Under this tool, the value applied to the CO_2 emission factor of biofuels is zero.	The project is not involved in biofuels.
TOOL08: "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0)	
Applicability 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.	Applicable. For the Project, the volumetric flow of the gaseous stream LFG and the volumetric fraction of CH_4 are measured for the determination of baseline emissions.
Methodologies where CO_2 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 CO_2.	NA. For the Project and the applied methodology ACM0001, both CH_4 and CO_2 are involved, but CO_2 is not the particular and only gas. CH_4 is the main gas in the landfill gas for the project.
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;	Applicable. The applied methodology ACM0001 specifies all the required information from (a) to (d).

(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 N_2)	
TOOL32: "Positive lists of technologies" (Version 03.0)	
Applicability conditions	Justifications
The use of this methodological tool is not mandatory for the project participants of a CDM project activity or CDM PoA for demonstrating their additionality.	Applicable. The project selects to use the tool to demonstrate the additionality.
This methodological tool shall be applied in conjunction with a small-scale or large-scale methodology which refers to this tool.	The Project applies this methodological tool in conjunction with the large-scale methodology ACM0001 (version 19.0).
The positive lists as contained in section 5 of this tool are valid up to 10 March 2025. 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.	The positive lists are valid at the time of the PD writing. Prior to the implementation of the project activities, the landfill gas (LFG) was only vented, but not utilized for energy generation, and that under the project activity, the LFG is used to generate electricity in power plant with a total nameplate capacity of 8.536MW.

3.3 Project Boundary

As per the methodology ACM0001 (version 19.0), the project boundary of the project activity shall include the site where the LFG is captured and destroyed/used, as applicable:

(a) Sites where the LFG is flared or used (e.g., flare, power plant, boiler, air heater, glass melting furnace, kiln, natural gas distribution network, dedicated pipeline or biogas processing facility);

=> the LFG is combusted in the gas generators to generate electricity; therefore, the power generation system shall be included in the project boundary;

(b) Captive power plant(s) (including emergency diesel generators) or power generation sources connected to the grid, which are supplying electricity to the project activity;

=> when the generators installed in the Project are out of operation or not able to supply electricity, the Project purchases a small amount of electricity from CCPG, and there is no captive power plant installed at the project site; therefore, power generation sources connected to CCPG shall be included in the project boundary.

(c) Captive power plant(s) (including emergency diesel generators) or power generation sources connected to the grid, which are supplying electricity in the baseline that is displaced by electricity generated by captured LFG in the project activity;

=> power generation sources connected to CCPG shall be included in the project boundary;

(d) Heat generation equipment or sources which are supplying heat in the baseline that is displaced by heat generated by captured LFG in the project activity;

=> the project activity does not involve heat generation;

(e) The transportation of the compressed/liquefied LFG from the biogas processing facility to consumers;

=> the project activity does not involve the transportation of the LFG to consumers.

In summary, the project boundary includes Changshankou Landfill, the entire LFG related system (including the collection system, the pre-treatment system and the power generation system) and all power plants connected to CCPG.

The diagram of the project boundary is shown in Figure 3.1.

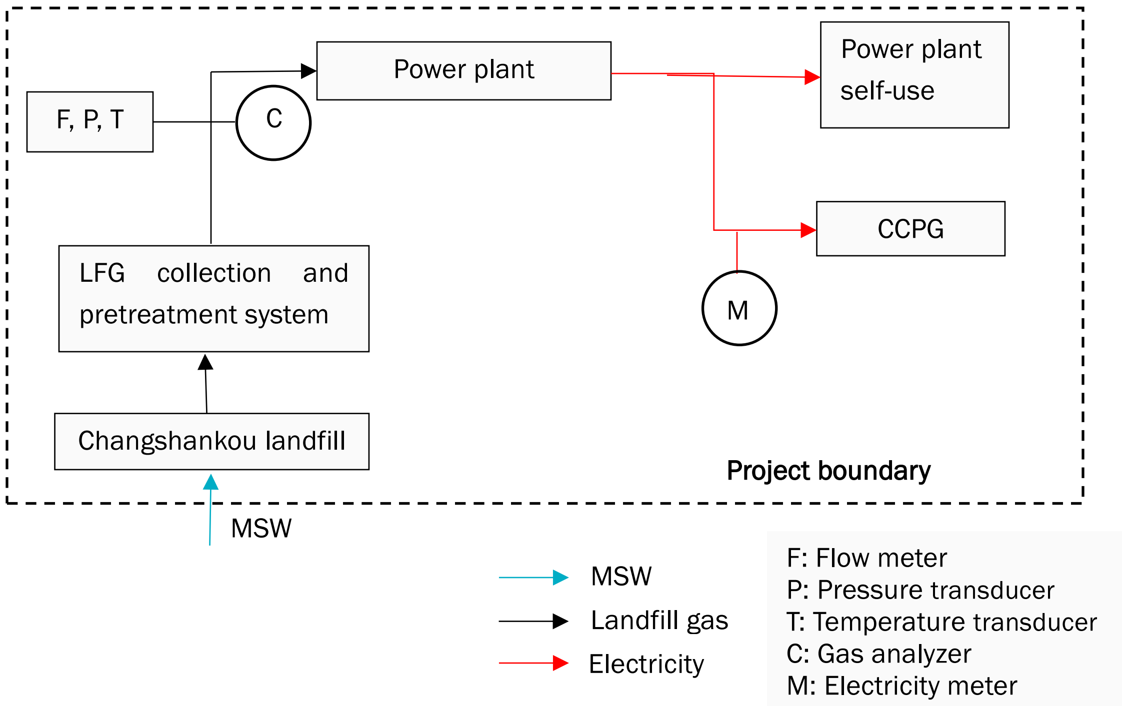


Figure 3.1 Diagram of the project boundary

The main emission sources and gases included in the project boundary are listed in table below:

Source		Gas	Included?	Justification/Explanation
Baseline	Emissions from decomposition of waste at the SWDS site	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.
		CH_4	Yes	The major source of emissions in the baseline.
		N_2O	No	N_2O emissions are small compared to CH_4 emissions from SWDS. This is conservative.
	Emissions from electricity generation	CO_2	Yes	Major emission source, given that power generation is included in the project activity.
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	
	Emissions from heat generation	CO_2	No	The project activity does not involve heat generation.
		CH_4	No	

Source		Gas	Included?	Justification/Explanation
		N_2O	No	
	Emissions from the use of natural gas	CO_2	No	The project activity does not involve the use of natural gas.
		CH_4	No	
		N_2O	No	
Project	Emissions from fossil fuel consumption for purposes other than electricity generation or transportation due to the project activity	CO_2	No	The project activity does not involve fossil fuel consumption for purposes other than electricity generation or transportation due to the project activity.
		CH_4	No	
		N_2O	No	
	Emissions from electricity consumption 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_2O	No	
	Emissions from flaring	CO_2	No	Excluded for simplification. This is conservative. The flare will only be involved when the electricity generation system is not in operation. The project developer determined that VCUs from flare will not be claimed, even if any methane is destroyed by flare during the crediting period. VCUs will only be claimed from the methane destroyed by power generation system and the power displacement.
		CH_4	No	
		N_2O	No	
	Emissions from distribution of LFG using trucks and dedicated pipelines	CO_2	No	The project activity does not involve distribution of LFG using trucks or dedicated pipelines.
		CH_4	No	
		N_2O	No	

3.4 Baseline Scenario

As per Section 5.3 of the methodology ACM0001 (version 19.0), project participants may either apply the simplified procedures in section 5.3.1 or the procedures in section 5.3.2 to select the most plausible baseline scenario and demonstrate additionality.

The simplified procedures are applied to identify the baseline scenario.

According to the simplified procedures to identify the baseline scenario:

- the baseline scenario for LFG is assumed to be the atmospheric release of the LFG or capture of LFG and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons;

  => prior to the implementation of the project activity, the LFG generated from the landfill is totally released into the atmosphere; therefore, the baseline scenario for LFG is assumed to be the continuous atmospheric release of the LFG;

- if all or part of the electricity generated by the project activity is exported to the grid, the baseline scenario for all or the part of the electricity exported to the grid is assumed to be electricity generation in existing and/or new grid-connected power plants;

  => the electricity generated by the project activity is mainly exported to the grid, with a small amount of electricity consumed by the equipment and facilities at the project site; therefore, the baseline scenario for the part of the electricity exported to the grid is assumed to be electricity generation in grid-connected power plants in CCPG.

In conclusion, the identified baseline scenario is:

(a) the LFG from Changshankou Landfill would have been totally released into the atmosphere;

(b) the equivalent amount of electricity supplied by the Project would have been supplied by CCPG.

3.5 Additionality

To demonstrate additionality, the project proponent applies the simplified procedures in Section 5.3.2 of the methodology ACM0001 (version 19.0), according to which, the methodological tool "TOOL32: Positive lists of technologies" (version 03.0) shall be referenced.

The project activity exclusively applies the technology listed in Section 5.1.1 (landfill gas recovery and its gainful use) of TOOL32 (version 03.0) and it fulfils the related conditions as shown in Table 3.3. Therefore, the project activity is deemed automatically additional.

Table 3.3 Applicability of the Project to TOOL32

Section 5.1.1 of TOOL32 (version 03.0)	The Project
Landfill 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	The Project involves landfill gas recovery and its gainful use. Prior to the implementation of the project activity, the LFG from Changshankou Landfill was vented to the atmosphere but not utilized for energy generation.

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 project activity utilizes LFG to generate electricity and the total nameplate capacity of all generators installed in the project is 8.536MW, which is below 10 MW.

The additionality of the Project has thus been demonstrated.

3.6 Methodology Deviations

There is no methodology deviation involved.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

As per the methodology ACM0001 (version 19.0), the baseline emissions are determined according to Equation (1) and comprise the following sources:

(a) Methane emissions from the SWDS in the absence of the project activity;

(b) Electricity generation using fossil fuels or supplied by the grid in the absence of the project activity;

(c) Heat generation using fossil fuels in the absence of the project activity; and

(d) Natural gas used from the natural gas network in the absence of the project activity.

$$BE_y = BE_{CH4,y} + BE_{EC,y} + BE_{HG,y} + BE_{NG,y} \quad \text{Equation (1)}$$

Where:

BE_y = Baseline emissions in year *y* (tCO_2e/yr)

$BE_{CH4,y}$	=	Baseline emissions of methane from the SWDS in year *y* (tCO_2e/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 does not involve in heat generation or natural gas use, which means that $BE_{HG,y}$= 0 and $BE_{NG,y}$= 0. Therefore, the baseline emissions are calculated as follows:

$$BE_y = BE_{CH4,y} + BE_{EC,y}$$ Equation (2)

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

Baseline emissions of methane from the SWDS are determined as follows, based on the amount of methane that is captured under the project activity and the amount that would be captured and destroyed in the baseline (such as due to regulations). In addition, the effect of methane oxidation that is present in the baseline and absent in the project is taken into account:

$$BE_{CH4} = \left((1 - OX_{top\_layer}) \times F_{CH4,PJ,y} - F_{CH,BL,y}\right) \times GWP_{CH4}$$ Equation (3)

Where:

$BE_{CH4,y}$	=	Baseline emissions of methane from the SWDS in year *y* (t CO_2e/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)
$F_{CH4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (t CH_4/yr)
$F_{CH4,BL,y}$	=	Amount of methane in the LFG that would be flared in the baseline in year y (t CH_4/yr)
GWP_{CH4}	=	Global warming potential of CH_4 (t CO_2e/t CH_4)

<u>**Ex post determination of $\boldsymbol{F_{CH4,PJ,y}}$**</u>

During the crediting period, $F_{CH4,PJ,y}$ 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:

$$F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y} + F_{CH4,HG,y} + F_{CH4,NG,y}$$ Equation (4)

Where:

$F_{CH4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (t CH_4/yr)

$F_{CH4,flared,y}$	=	Amount of methane in the LFG which is destroyed by flaring in year *y* (t CH_4/yr)
$F_{CH4,EL,y}$	=	Amount of methane in the LFG which is used for electricity generation in year *y* (t CH_4/yr)
$F_{CH4,HG,y}$	=	Amount of methane in the LFG which is used for heat generation in year *y* (t CH_4/yr)
$F_{CH4,NG,y}$	=	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* (t CH_4/yr)

The Project utilizes the LFG only for power generation. The flare will not be used when the power plant is in normal operation, thus, the PD decides not to claim the emission reduction from the flare, even if any methane is destroyed by flare during the crediting period. Therefore, which means that $F_{CH4,flared,y}$ = 0, $F_{CH4,HG,y}$ = 0, and $F_{CH4,NG,y}$ = 0. Therefore,

$$F_{CH4,PJ,y} = F_{CH4,EL,y} \qquad \text{Equation (5)}$$

$F_{CH4,EL,y}$ is determined using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", i.e., TOOL08 (version 03.0), and monitoring the working hours of the power plant(s), boiler(s), air heater(s), glass melting furnace(s) and kiln(s), so that no emission reduction are claimed for methane destruction during non-working hours. This is taken into account by monitoring the hours that the equipment utilizing the LFG is operating in *year y* ($Op_{j,h,y}$). The following requirements apply:

(a) 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, paragraph 5 (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) CH_4 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.

TOOL08 (version 03.0) shows 6 different ways to measure and calculate the mass flow of a greenhouse gas *i* in a gaseous stream ($F_{i,t}$), as shown in Table 4.1.

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

Option C is applied in the Project.

CH_4 is the greenhouse gas for which the mass flow should be determined. Therefore, $F_{CH4,EL,y}$ to be determined in Equation (5) is equivalent to the mass flow of a greenhouse gas *i* in a gaseous stream $F_{i,t}$ in TOOL08 (version 03.0).

The mass flow of greenhouse gas *i*, i.e., CH_4, shall be determined as follows:

$$F_{i,t} = V_{t,wb,n} \times v_{i,t,wb} \times \rho_{i,n} \quad \text{Equation (6)}$$

With:

$$\rho_{i,n} = \frac{P_n \times MM_i}{R_u \times T_n} \quad \text{Equation (7)}$$

Where:

$F_{i,t}$	=	Mass flow of greenhouse gas *i* in the gaseous stream in the interval *t* (kg gas/h)
$V_{t,wb,n}$	=	Volumetric flow of the gaseous stream in time interval *t* on a wet basis at normal conditions (m^3 wet gas/h)
$v_{i,t,wb}$	=	Volumetric fraction of greenhouse gas *i* in the gaseous stream in a time interval *t* on a wet basis (m^3 gas *i* /m^3 wet gas)
$\rho_{i,n}$	=	Density of greenhouse gas *i* in the gaseous stream at normal conditions (kg gas *i* /m^3 wet gas *i*)
P_n	=	Absolute pressure at normal conditions (Pa)
MM_n	=	Molecular mass of greenhouse gas *i* (kg/kmol)
R_u	=	Universal ideal gases constant (Pa.m^3/kmol.K)

T_n	=	Temperature at normal conditions (K)

The following equation should be used to convert the volumetric flow of the gaseous stream from actual conditions to normal conditions of temperature and pressure:

$$V_{t,wb,n} = V_{t,wb} \times \frac{T_n}{T_t} \times \frac{P_t}{P_n}$$ Equation (8)

Where:

$V_{t,wb,n}$	=	Volumetric flow of the gaseous stream in time interval *t* on a wet basis at normal conditions (m³ wet gas/h)
$V_{t,wb}$	=	Volumetric flow of the gaseous stream in time interval *t* on a wet basis (m³ wet gas/h)
P_t	=	Pressure of the gaseous stream in time interval *t* (Pa)
T_t	=	Temperature of the gaseous stream in time interval *t* (K)
P_n	=	Absolute pressure at normal conditions (Pa)
T_n	=	Temperature at normal conditions (K)

A flow meter and a methane content analyser have been installed by the project proponent to monitor the volumetric flow of the LFG stream ($V_{t,wb}$) and the volumetric fraction of CH_4 in the LFG ($v_{i,t,wb}$), respectively. In addition to $V_{t,wb}$ measuring, the flow meter also records the temperature and the pressure of the LFG stream (T_t and P_t), and automatically converts the flow into values at normal conditions ($V_{t,wb,n}$).

Ex ante determination of $F_{CH4,PJ,y}$

An ex ante estimate of $F_{CH4,PJ,y}$ is required to estimate the baseline emissions of methane from the SWDS in order to estimate the emission reductions of the proposed project activity in the PD. It is determined as follows:

$$F_{CH4,PJ,y} = \eta_{PJ} \times BE_{CH4,SWDS,y} / GWP_{CH4}$$ Equation (9)

Where:

$F_{CH4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (t CH_4/yr)
$BE_{CH4,SWDS,y}$	=	Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* (t CO_2e/yr)
η_{PJ}	=	Efficiency of the LFG capture system that will be installed in the project activity
GWP_{CH4}	=	Global warming potential of CH_4 (t CO_2e/t CH_4)

$BE_{CH4,SWDS,y}$ is determined using the methodological tool "Emissions from solid waste disposal sites", i.e., TOOL04 (version 08.0). The following guidance should be taken into account when applying the tool:

(a) 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, i.e., Equation (3) of this PD;

(b) In the tool, x begins with the year that the SWDS started receiving wastes (e.g., the first year of SWDS operation); and

(c) Sampling to determine the fractions of different waste types is not necessary because the waste composition can be obtained from previous studies.

As per TOOL04 (version 08.0), $BE_{CH4,SWDS,y}$ is calculated as follows:

$$BE_{CH_4,SWDS,y} = \varphi_y \times (1 - f_y) \times GWP_{CH_4} \times (1 - OX) \times \frac{16}{12} \times F \times DOC_{f,y} \times MCF_y \times \sum_{x=1}^{y} \sum_{j} W_{j,x} \cdot DOC_j \cdot e^{-k_j(y-x)} \cdot (1 - e^{-k_j})$$ Equation (10)

Where:

$BE_{CH_4,SWDS,y}$	=	Baseline methane emissions occurring in year *y* generated from waste disposal at a SWDS during a time period ending in year *y* (t CO_2e/yr)
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_{CH4}	=	Global Warming Potential of methane
OX	=	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
F	=	Fraction of 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 in the SWDS in the year *x* (t)
DOC_j	=	Fraction of degradable organic carbon in the waste type *j* (weight fraction)
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

According to the small-scale methodology AMS-III.G Landfill methane recovery (version 10.0), for project activities that utilize the recovered methane for power generation, $F_{CH4,PJ,y}$ may be calculated as follows, based on the amount of monitored electricity generation, without monitoring methane flow and concentration. The project can use this equation to calculate $F_{CH4,PJ,y}$.

$$F_{CH4,PJ,y} = \frac{EG_y \times 3600}{NCV_{CH4} \times EE_y} \times D_{CH4} \times GWP_{CH4}$$ Equation (11)

Where:

EG_y	=	Electricity generation in year y (MWh)
3600	=	Conversion factor (1 MWh = 3600 MJ)
NCV_{CH4}	=	NCV of methane (MJ/Nm^3), use default value: 35.9 MJ/Nm^3
D_{CH4}	=	Density of methane at the temperature and pressure of the landfill gas in the year y (t/m^3).
EE_y	=	Energy Conversion Efficiency of the project equipment determined from one of the following options:

- Specification provided by the equipment manufacturer specifically for biogas fuel only if the equipment is designed to utilize biogas as fuel. If the specification provides a range of efficiency values, the highest value of the range shall be used for the calculation.
- Default efficiency of 40 percent

Determination of $F_{CH4,BL,y}$

The methodology ACM0001 (version 19.0) 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 4.2 are distinguished. The appropriate case should be identified, and the corresponding instructions followed.

Table 4.2 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

There was no regulation or standard that enforces methane destruction in LFG when Changshankou Landfill started operation; Changshankou Landfill was not equipped with LFG capture and destruction system prior to the implementation of the Project. Therefore, the Project is in line with Case 1 in Table 4.2, and the following equation applies:

$$F_{CH4,BL,y} = 0 \qquad \text{Equation (12)}$$

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, i.e., TOOL05 (version 03.0).

$$BE_{EC,y} = EC_{BL,k,y} \times EF_{EF,k,y} \times (1 + TDL_{k,y}) \qquad \text{Equation (13)}$$

Where:

$BE_{EC,y}$	=	Baseline emission from electricity consumption in year *y* (tCO_2/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* (tCO_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 TOOL05 (version 03.0):

(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* ($EG_{PJ,y}$).

The determination of the emission factor for electricity generation $EF_{EF,k,y}$ depends on which scenario (A, B or C) in TOOL05 (version 03.0) applies to the source of electricity consumption that would be displaced in the baseline by electricity generated in the project. "Scenario A: Electricity consumption from the grid" is applicable to the project activity; Option A1 is selected: $EF_{EF,k,y}$ is equivalent to the combined margin emission factor of the applicable electricity system ($EF_{EF,k,y}$ = $EF_{grid,CM,y}$), calculated using the procedures in the latest approved version of the "Tool to calculate the emission factor for an electricity system", i.e., TOOL07 (version 07.0).

TOOL05 (version 03.0) also provides different approaches to determine the average technical transmission and distribution losses for providing electricity to source k in year y, $TDL_{k,y}$. In case of Scenario A, choose one of the following options:

1. Use annual average value based on the most recent data available within the host country;

2. Use as default values of 20% for:

(a) project or leakage electricity consumption sources;

(b) baseline electricity consumption sources if the electricity consumption by all project and leakage electricity consumption sources to which scenario A applies is larger than the electricity consumption of all baseline electricity consumption sources to which scenario A applies;

3. Use as default values of 3% for:

(a) baseline electricity consumption sources;

(b) project and leakage electricity consumption sources if the electricity consumption by all project and leakage electricity consumption sources to which scenario A applies is smaller than the electricity consumption of all baseline electricity consumption sources to which scenario A applies.

The electricity consumption by all project and leakage electricity consumption sources is smaller than the electricity consumption of all baseline electricity consumption sources. The default value of 3% is applied for $TDL_{k,y}$.

Therefore, Equation (13) takes the following form:

$$BE_{EC,y} = EG_{PJ,y} \times EF_{grid,CM,y} \times (1 + TDL_{k,y}) \quad \text{Equation (14)}$$

Where:

$BE_{EC,y}$	=	Baseline emission from electricity consumption in year *y* (tCO_2/yr)
$EG_{PJ,y}$	=	Net amount of electricity generated using LFG by the project activity in year *y* (MWh/y)
$EF_{EF,k,y}$	=	Combined margin emission factor for the grid in year *y* (tCO_2/MWh)
$TDL_{k,y}$	=	Average technical transmission and distribution losses for providing electricity to source *k* in year *y* (it takes the default value of 3%)

The combined margin emission factor of the grid ($EF_{grid,CM,y}$) is calculated using the procedures in TOOL07 (version 07.0), and the following six steps are applied:

Step 1: Identify the relevant electricity systems;

Step 2: Choose whether to include off-grid power plants in the project electricity system (optional);

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

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

Step 5: Calculate the build margin (BM) emission factor;

Step 6: Calculate the combined margin (CM) emission factor.

<u>Step 1: Identify the relevant electricity systems.</u>

The delineation of the electricity systems in China is provided by the Development and Reform Commission of China. Among the six regional power grids, Central China Power Grid (CCPG) covers Henan Province, Hubei Province, Hunan Province, Jiangxi Province, Sichuan Province and Chongqing City. Since the Project is located in Hubei Province, CCPG is identified as the relevant electricity system. According to *2019 Baseline Emission Factors for Regional Grids in China*, there is net electricity imported from the North China Power grid (NCPG), Northwest China Power grid (NWCPG) and South China Power Grid (SCPG) to CCPG. Therefore, NCPG, NWCPG and SCPG are identified as the connected electricity systems.

<u>Step 2: Choose whether to include off-grid power plants in the project electricity system (optional).</u>

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

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

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

Considering the structure of China’s power system, only grid power plants are included in the calculation.

<u>Step 3: Select a method to determine the operating margin (OM).</u>

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

(a) Simple OM, or

(b) Simple adjusted OM, or

(c) Dispatch data analysis OM, or

(d) Average OM.

In China, detailed data from each power plant are sensitive business information and are mostly confidential and thus not publicly available. Therefore, method (b) and method (c) are not suitable for the calculation.

The simple OM method can be used if low-cost/must-run resources[11] constitute less than 50% of total grid generation in average of the five most recent years. According to *China Electric Power Yearbook* released from 2014 to 2018, for CCPG to which the project activity is connected, the low-cost/must-run power generation accounted for 39.13%, 45.07%, 47.01%, 49.05% and 49.08% of total grid generation in 2013, 2014, 2015, 2016 and 2017, respectively; considering the average of the five years from 2013 to 2017, the low-cost/must-run power generation accounted for 45.87% of total grid generation, lower than 50%. Therefore, method (a) is applicable, and the simple OM method is applied for the calculation of the operating margin emission factor $EF_{grid,OM,y}$.

For the simple OM, the emissions 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 emissions factor during the crediting period is required. For grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of the PD to the DOE for validation. For off-grid power plants, use a single calendar year within the five most recent calendar years prior to the time of submission of the 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 to calculate 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 proceeding 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.

Based on the most recent data available at the time of this project description submission, the first option (ex-ante) for the calculation of the OM emission factor is selected for the project, and $EF_{grid,OM,y}$ is fixed during the crediting period. The generation data for various power generating sources for the most recent three years (2015-2017) are applied.

<u>Step 4: Calculate the operating margin emission factor according to the selected method.</u>

[11] Low-cost/must-run resources are defined as power plants with low marginal generation costs or power plants that are dispatched independently of the daily or seasonal load of the grid. They typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. If coal is obviously used as must-run, it should also be included in this list.

The simple OM method is applied to calculate the OM emission factor, which is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units. It may be calculated by one of the two following options:

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

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)

The data of each power plant serving the system are difficult to obtain; in this case, Option A is not preferred. In addition, according to *China Energy Statistical Yearbook*, 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; also, off-grid power plants are not included in the calculation, as discussed in Step 2), which justifies the applicability of Option B for the calculation of the OM emission factor.

Under this option, the simple OM emission factor is calculated based on the net electricity supplied to the grid by all power plants serving the system, not including low-cost/must-run power plants/units, and based on the fuel type(s) and total fuel consumption of the project electricity system, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_i (FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y})}{EG_y} \qquad \text{Equation (15)}$$

Where:

$EF_{grid,OMsimple,y}$	=	Simple operating margin CO_2 emission factor in year *y* ($t\ CO_2/MWh$)
$FC_{i,y}$	=	Amount of fuel type *i* consumed in the project electricity system in year *y* (mass or volume unit)
$NCV_{i,y}$	=	Net calorific value (energy content) of fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,y}$	=	CO_2 emission factor of fuel type *i* in year *y* (tCO_2/GJ)

EG_y	=	Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units, in year *y* (MWh)
i	=	All fuel types combusted in power sources in the project electricity system in year *y*

If available, values of $NCV_{i,y}$ and $EF_{CO2,i,y}$ provided by the fuel supplier of the power plants in invoices may be used; otherwise, regional or national average default values may be used. For the Project, the values of $NCV_{i,y}$ for each type of fuel are obtained from *China Energy Statistical Yearbook 2018*, and the emission factors $EF_{CO2,i,y}$ for each type of fossil fuel come from default values in *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Fuel consumption data and electricity generation data are obtained from *China Electric Power Yearbook* 2016~2018 and *China Energy Statistical Yearbook* 2016~2018.

The calculation result of the OM emission factor $EF_{grid,OMsimple,y}$ for CCPG is 0.8587 tCO_2/MWh, as is confirmed by *2019 Baseline Emission Factors for Regional Power Grids in China* published by the Ministry of Ecology and Environment of China.

<u>Step 5: Calculate the build margin (BM) emission factor.</u>

As per Section 6.5 of TOOL07 (version 07.0), 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 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;

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.

Option 1 is chosen; the BM emission factor is calculated ex ante for the first crediting period based on the most recent information available on units already built for sample group m at the time of this project description submission.

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

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

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

(c) From $SET_{5-units}$ and $SET_{\geq 20\ percent}$ 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. In this case 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 CDM project activities, starting with power units that started to supply electricity to the grid most recently, until the electricity generation of the new set comprises 20% of the annual electricity generation of the proposed project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) to the extent is possible. Determine for the resulting set ($SET_{sample-CDM}$) the annual electricity generation ($AEG_{SET-sample-CDM}$, in MWh); if the annual electricity generation of that set comprises at least 20% of the annual electricity generation of the proposed project electricity system (i.e. $AEG_{SET-sample-CDM} \geq 0.2 \times AEG_{total}$), then use the sample group $SET_{sample-CDM}$ to calculate the build margin. Ignore steps (e) and (f).

Otherwise:

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

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

The BM 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 electricity generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m (EG_{m,y} \times EF_{EL,m,y})}{\sum_m EG_{m,y}}$$ Equation (16)

Where:

$EF_{grid,BM,y}$	=	Build margin CO_2 emission factor in year y ($t\ CO_2/MWh$)
$EG_{m,y}$	=	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 ($t\ CO_2/MWh$)
m	=	Power units included in the build margin
y	=	The most recent year for which the generation data is available

As it is difficult to obtain the detailed data on the power generation, fuel consumption and thermal efficiency of each newly built power unit from public documents, a deviation of TOOL07 (07.0) is adopted following the clarifications[12] given by the CDM EB concerning the BM emission factor calculation:

(1) The CDM EB suggested using the efficiency level of the best technology commercially available in the provincial/regional or national grid of China, as a conservative proxy, for each fuel type in estimating the fuel consumption to estimate the build margin.

(2) The EB agreed the use of capacity additions during last 1 ~ 3 years for estimating the build margin emission factor for grid electricity.

(3) The EB also agreed to use of weights estimated using installed capacity in place of annual electricity generation.

The newly built power plants in the past few years are bundled into "grouped new power plant" according to their construction year, their province and their fuel type. The annual net electricity generation in year y of each "grouped new power plant" $EG_{m,y}$ is estimated according to their total capacity and the average utilization hours, using the following equation:

$$EG_{m,y} = CAP_m \times H_{m,y}$$ Equation (17)

Where:

$EG_{m,y}$	=	Annual net electricity generation the unit m in year y (MWh)

[12]http://cdm.unfccc.int/UserManagement/FileStorage/AM_CLAR_QEJWJEF3CFBP1OZAK6V5YXPQKK7WYJ ("Request for clarification on use of approved methodology AM0005 for several projects in China", the EB's guidance on DNV deviation request)

CAP_m	=	Installed capacity of the unit *m* (MW)
$H_{m,y}$	=	Utilization hour of the unit *m* in the year y (h), determined according to the average utilization hour of the same type of unit in the same province
y	=	The most recent year for which the generation data is available. For the calculation of BM in 2019, *y* = 2017
m	=	grouped new power plant

Since the newly built power plants in the same province (*A*), in the same year (*t*) and using the same fuel type (*k*) are grouped into "a grouped new power plant", CAP_m represents the total installed capacity of fuel type *k* power plants located in the province *A* and in the year *t*:

$$CAP_m = CAP_{A,t,k} \qquad \text{Equation (18)}$$

Where:

CAP_m	=	Installed capacity of the unit *m* (MW), with *m* representing the specified combination of *A*, *t*, and *k*
$CAP_{A,t,k}$	=	Total installed capacity of fuel type *k* power plants located in the province *A* and in year *t*
A	=	Provinces covered by CCPG, namely, Henan Province, Hubei Province, Hunan Province, Jiangxi Province, Sichuan Province and Chongqing City
t	=	Years related to the grouped new power plants; for the 2019 calculation, *t* represents 2017, 2016, 2015.... until the aggregated electricity generation of the grouped new power plants reaches 20% of the total electricity generation of CCPG
k	=	Fuel type of the grouped new power plants, including hydro, thermal (coal, gas, oil, waste incineration, other thermal), nuclear, wind, solar and others.

Figure 4.1 shows the procedure applied to determine the sample group of power units *m*.

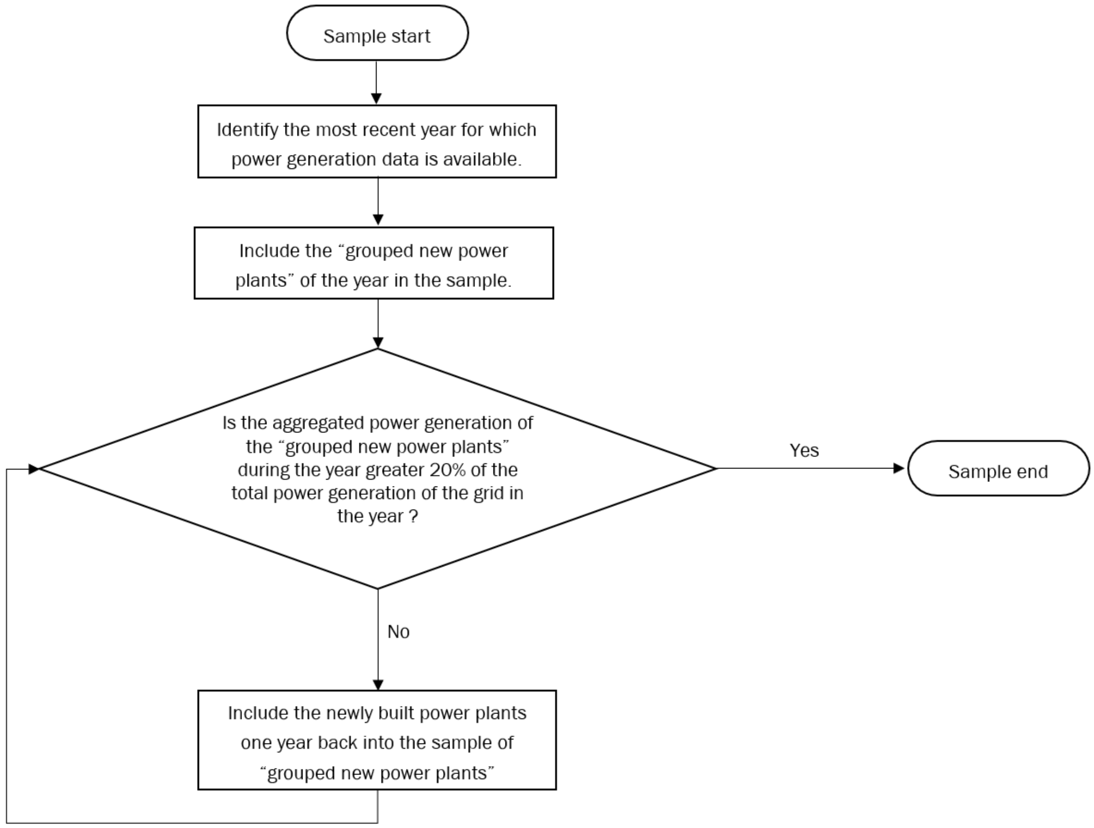


Figure 4.1 Procedure to determine the sample group of power units *m*

The emission factors of each fuel type $EF_{EL,m,y}$ are determined according to Option A2 in TOOL07 (version 07.0), as the following equation:

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \times 3.6}{\eta_{m,y}} \quad \text{Equation (19)}$$

Where:

$EF_{EL,m,y}$	=	CO_2 emission factor of power unit *m* in year *y* (t CO_2/MWh)
$EF_{CO2,m,i,y}$	=	Average CO_2 emission factor of fuel type *i* used in power unit *m* in year *y* (t CO_2/GJ)
$\eta_{m,y}$	=	Average net energy conversion efficiency of power unit *m* in year *y* (ratio)
m	=	All power units serving the grid in year y except low-cost / must-run power units
3.6	=	Conversion factor (GJ/MWh)

Among the fuel types, the emission factors of hydro, nuclear, wind, solar, other thermal and others are 0. Concerning the emission factors of coal, gas, oil and waste incineration, Equation (19) takes the following form, to be conservative:

$$EF_{best,m,y} = \frac{EF_{CO2,m,i,y} \times 3.6}{\eta_{best,y}}$$ Equation (20)

Where:

$EF_{best,m,y}$	=	Emission factor of power unit m with the best technology commercially available in year *y* (t CO_2/MWh)
$\eta_{best,y}$	=	Power generation efficiency of the best technology commercially available in year *y*
m	=	Power units serving the grid with coal, gas, oil or waste incineration in year *y*

The emission factors of coal, natural gas, fuel oil and municipal solid waste (MSW) are sourced from *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, and the lower values of the 95% confidence interval are applied to be conservative.

According to *Compilation of Statistics of the Electric Power Industry* in 2017 published by China Electricity Council, newly built coal-fired power projects of 600 MW and above totalled 19.58 GW in 2017, of which 7 units each with a capacity of 1,000 MW accounted for 35.75%, and 19 units each with a capacity between 600 MW and 1,000 MW accounted for 64.25%. Among these 26 new units, the power generation and coal consumption data for 16 units are available. The 10 units with the lowest coal consumption for power supply are selected as the best commercial technology cases, and their weighted-average coal consumption is 297.59 gce/kWh, equivalent to a power generation efficiency of 41.33%.

According to *Compilation of Statistics of the Electric Power Industry* in 2017 published by China Electricity Council, 59 newly built MSW power units totalled to 1,147.5 MW in 2017, of which the power generation and MSW consumption data for 25 units are available. Their weighted-average power generation efficiency is 516.41 gce/kWh, equivalent to 23.82%.

According to *Compilation of Statistics of the Electric Power Industry* in 2017 published by China Electricity Council, 32 newly built natural gas power units totalled to 5,658.1 MW in 2017, of which the power generation and gas consumption data for 18 units are available. Their weighted-average power generation efficiency is 223.41 gce/kWh, equivalent to 55.05%.

No fuel oil power units were constructed in 2017. The power generation efficiency of the best technology commercially available for fuel oil units comes from *Baseline Emission Factors for Regional Grids in China* of previous years, i.e., 232.3 gce/kWh or 52.9%.

The calculation result of the BM emission factor $EF_{grid,BM,y}$ for CCPG is 0.2854 tCO_2/MWh, as is confirmed by *2019 Baseline Emission Factors for Regional Power Grids in China* published by the Development and Reform Commission of China.

Step 6: Calculate the combined margin (CM) emission factor.

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

(a) Weighted average CM; or

(b) Simplified CM.

The weighted average CM method should be used as the preferred option. The simplified CM method can only be used if the project activity is located in a Least Developed Country (LDC) or in a country with less than 10 registered CDM projects at the starting date of validation or a Small Island Developing States (SIDS), which means this method is not applicable.

Option A (weighted average CM) is applied.

The combined margin (CM) emission factor $EF_{grid,CM,y}$ of the baseline scenario is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,CM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$ Equation (21)

Where:

$EF_{grid,OM,y}$	=	Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EF_{grid,BM,y}$	=	Operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
w_{OM}	=	Weighting of build margin emissions factor (%)
w_{BM}	=	Weighting of operating margin emissions factor (%)

As per TOOL07, w_{OM} and w_{BM} are both 50% during the crediting period. Therefore, the baseline CM emission factor:

$EF_{grid,CM,y}$= 0.8587 × 50% + 0.2854 × 50% = 0.57205 tCO_2/MWh.

4.2 Project Emissions

As per the methodology ACM0001 (version 19.0), project emissions are calculated as follows:

$$PE_y = PE_{EC,y} + PE_{FC,y} + PE_{DT,y} + PE_{SP,y}$$ Equation (22)

Where:

PE_y	=	Project emissions in year *y* (t CO_2/yr)
$PE_{EC,y}$	=	Emissions from consumption of electricity due to the project activity in year *y* (t CO_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* (t CO_2/yr)
$PE_{DT,y}$	=	Emissions from the distribution of compressed/liquefied LFG using trucks, in year *y* (t CO_2/yr)

$PE_{SP,y}$	=	Emissions from the supply of LFG to consumers through a dedicated pipeline, in year *y* (t CO_2/yr)

The Project does not involve consumption of fossil fuels, distribution of compressed/liquefied LFG using trucks or supply of LFG to consumers through a dedicated pipeline, which means that $PE_{FC,y}$ = 0, $PE_{DT,y}$ = 0 and $PE_{SP,y}$ = 0. Thus, $PE_y = PE_{EC,y}$

Project emissions from consumption of electricity due to the project activity ($PE_{EC,y}$) shall be calculated using TOOL05 (version 03.0).

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{j,y}) \qquad \text{Equation (23)}$$

Where:

$PE_{EC,y}$	=	Project emission from electricity consumption in year *y* (tCO_2/yr)
$EC_{PJ,j,y}$	=	Quantity of electricity consumed by the project electricity consumption source *j* in year *y* (MWh/y)
$EF_{EL,j,y}$	=	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*
j	=	Sources of electricity consumption in the project

When applying TOOL05 (version 03.0):

(a) $EC_{PJ,j,y}$ in the tool is equivalent to the amount of electricity consumed by the project activity in year *y* ($EG_{EC,y}$); and

(b) If in the baseline a proportion of LFG is destroyed ($F_{CH_4,BL,y}$ > 0), then the electricity consumption in the tool ($EC_{PJ,j,y}$) should refer to the net quantity of electricity consumption (i.e., the increase due to the project activity). The determination of the amount of electricity consumed in the baseline shall be transparently documented in the PD.

For the same reason discussed in Section 4.1, the emission factor $EF_{EF,j,y}$ is equivalent to the combined margin emission factor of the applicable electricity system ($EF_{EF,j,y}$ = $EF_{grid,CM,y}$).

The electricity consumption by all project and leakage electricity consumption sources is smaller than the electricity consumption of all baseline electricity consumption sources. The default value of 20% is applied for $TDL_{j,y}$.

Therefore, Equation (23) takes the following form:

$$PE_{EC,y} = EG_{EC,y} \times EF_{grid,CM,y} \times (1 + TDL_{j,y}) \qquad \text{Equation (24)}$$

For simplification, $EG_{EC,y}$ is assumed to be 0 in the ex-ante estimate and it will be monitored ex post in the verification period.

4.3 Leakage

No leakage effects are accounted for under the methodology ACM0001 (version 19.0).

4.4 Net GHG Emission Reductions and Removals

1. Calculation of the baseline emissions

The baseline emissions are calculated as follows:

$$BE_y = BE_{CH4,y} + BE_{EC,y}$$

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

As described in Section 4.1, $BE_{CH4,y}$ is ex ante determined based on the following equations:

$$BE_{CH4} = \left(\left(1 - OX_{top\_layer}\right) \times F_{CH4,PJ,y} - F_{CH,BL,y}\right) \times GWP_{CH4}$$

$$F_{CH4,PJ,y} = \eta_{PJ} \times BE_{CH4,SWDS,y} / GWP_{CH4}$$

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

$$F_{CH4,BL,y} = 0$$

Please refer to Table 4.3 and Section 5.1 for values applied in the calculation.

Table 4-3 The necessary values to calculate BE_{CH4}

Parameter	Value	Data sources
OX_{top_layer}	0.1	Emissions from solid waste disposal sites (version 08.0)
η_{PJ}	90%	FSR
φ_y	0.75	Emissions from solid waste disposal sites (version 08.0)
f_y	0	Emissions from solid waste disposal sites (version 08.0)
GWP_{CH4}	28	VCS Standard (version 4.5)

OX	0.1		IPCC 2006 Guidelines for National Greenhouse Gas Inventories
F	0.5		IPCC 2006 Guidelines for National Greenhouse Gas Inventories
$DOC_{f,y}$	0.5		IPCC 2006 Guidelines for National Greenhouse Gas Inventories
MCF_y	1.0		IPCC 2006 Guidelines for National Greenhouse Gas Inventories
$P_{n,j,x}$ (Weight fraction of waste type j in the landfill)	Wood	8.59%	FSR
	Paper	9.26%	
	Food	58.81%	
	Textile	1.53%	
	Garden and park waste	0.81%	
	Others (plastic, glass, metal,etc)	21.0%	
	Total	100%	
DOC_j	Pulp, paper and cardboard	40%	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)
	Textiles	24%	
	Food, food waste, beverages and tobacco	15%	
	Wood and wood products	43%	
	Garden, yard and park waste	20%	
	Rubber and leather	-	
	Plastic	-	
	Metal	-	
	Glass	-	
	Others	-	
k_j	Pulp, paper and cardboard	0.06	

	Textiles	0.06	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)
	Food, food waste, beverages and tobacco	0.185	
	Wood and wood products	0.03	
	Garden, yard and park waste	0.10	
	Rubber and leather	-	
	Plastic	-	
	Metal	-	
	Glass	-	
	Others	-	
y	1-10		ACM0001 (version 19.0)

The calculation results of $BE_{CH_4,SWDS,y}$ based on Equation (10) are listed in Table 4.4. By considering the following parameters:

- annual operating hours of the generators could reach 6,800 hours maximum;

- the power generation efficiency of the generators is 37%;

- power plant self-consumption rate (3%)

- the net calorific value of methane is 50.4 GJ/tCH_4 according to *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (Volume 2, Chapter 1).

The installed capacity required to destroy the captured methane in each year during the crediting period has been calculated and shown in Table 4.4. If the installed capacity required to destroy the captured methane is smaller than the actual installed capacity (8.536MW), then all the captured methane would be utilized by the power generators; if not, part of the capture methane would be combusted by the flare system. Following such comparison, the electricity generation is calculated and shown in Table 4.4.

Table 4.4 Ex ante estimation of electricity generation and amount of methane destroyed

Period	$BE_{CH4,SWDS,y}$ (tCO_2e)	η_{PJ} (%)	Theoretical installed capacity (MW)	Actual installed capacity (MW)	Electricity generation (MWh)
10-Mar-2022~31-Dec-2022	434,644	90%	13.115	8.536	47,102
01-Jan-2023~31-Dec-2023	549,920	90%	13.465	8.536	58,045
01-Jan-2024~31-Dec-2024	562,828	90%	13.781	8.536	58,045
01-Jan-2025~31-Dec-2025	574,535	90%	14.068	8.536	58,045
01-Jan-2026~31-Dec-2026	585,198	90%	14.329	8.536	58,045
01-Jan-2027~31-Dec-2027	594,953	90%	14.568	8.536	58,045
01-Jan-2028~31-Dec-2028	603,912	90%	14.787	8.536	58,045
01-Jan-2029~31-Dec-2029	612,172	90%	14.989	8.536	58,045
01-Jan-2030~31-Dec-2030	534,660	90%	13.091	8.536	58,045
01-Jan-2031~31-Dec-2031	469,025	90%	11.484	8.536	58,045
01-Jan-2032~09-Mar-2032	78,135	90%	10.120	8.536	10,973

Therefore, $BE_{CH4,y}$ is ex ante estimated as shown in Table 4.5.

Table 4.5 Ex ante estimate of $BE_{CH4,y}$

Period	OX_{top_layer}	$F_{CH4,PJ,y}$ (t CH_4)	$F_{CH4,BL,y}$ (t CH_4)	GWP_{CH4} (t CO_2e/t CH_4)	$BE_{CH4,y}$ (t CO_2e)
10-Mar-2022~31-Dec-2022	0.1	9,093	0	28	229,144
01-Jan-2023~31-Dec-2023	0.1	11,206	0	28	282,380

01-Jan-2024~31-Dec-2024	0.1	11,206	0	28	282,380
01-Jan-2025~31-Dec-2025	0.1	11,206	0	28	282,380
01-Jan-2026~31-Dec-2026	0.1	11,206	0	28	282,380
01-Jan-2027~31-Dec-2027	0.1	11,206	0	28	282,380
01-Jan-2028~31-Dec-2028	0.1	11,206	0	28	282,380
01-Jan-2029~31-Dec-2029	0.1	11,206	0	28	282,380
01-Jan-2030~31-Dec-2030	0.1	11,206	0	28	282,380
01-Jan-2031~31-Dec-2031	0.1	11,206	0	28	282,380
01-Jan-2032~09-Mar-2032	0.1	2,118	0	28	53,381

1.2 Baseline emissions associated with electricity generation $(BE_{EC,y})$

$BE_{EC,y}$ is calculated based on the following equation:

$$BE_{EC,y} = EG_{PJ,y} \times EF_{grid,CM,y} \times (1 + TDL_{k,y})$$

The calculation results are shown in Table 4.6.

Table 4.6 Ex ante estimate of $BE_{EC,y}$

Period	**Electricity generation (MWh)**	**$EG_{PJ,y}$= $EC_{BL,k,y}$ (MWh) (Considering a plant self-consumption rate of 3%)**	**$EF_{EL,k,y}$ = $EF_{grid,CM,y}$ (tCO_2/MWh)**	**$TDL_{k,y}$ (%)**	**$BE_{EC,y}$ (t CO_2e)**
10-Mar-2022~31-Dec-2022	47,102	45,689	0.5720	3%	26,920

01-Jan-2023~31-Dec-2023	58,045	56,303	0.5720	3%	33,174
01-Jan-2024~31-Dec-2024	58,045	56,303	0.5720	3%	33,174
01-Jan-2025~31-Dec-2025	58,045	56,303	0.5720	3%	33,174
01-Jan-2026~31-Dec-2026	58,045	56,303	0.5720	3%	33,174
01-Jan-2027~31-Dec-2027	58,045	56,303	0.5720	3%	33,174
01-Jan-2028~31-Dec-2028	58,045	56,303	0.5720	3%	33,174
01-Jan-2029~31-Dec-2029	58,045	56,303	0.5720	3%	33,174
01-Jan-2030~31-Dec-2030	58,045	56,303	0.5720	3%	33,174
01-Jan-2031~31-Dec-2031	58,045	56,303	0.5720	3%	33,174
01-Jan-2032~09-Mar-2032	10,973	10,644	0.5720	3%	6,271

Therefore, the baseline emissions are estimated ex ante as follows:

Table 4.7 The ex ante estimation of BE_y

Period	$BE_{CH4,y}$ (t CO_2e)	$BE_{EC,y}$ (t CO_2e)	BE_y (t CO_2e)
10-Mar-2022~31-Dec-2022	229,144	26,920	256,064
01-Jan-2023~31-Dec-2023	282,380	33,174	315,554
01-Jan-2024~31-Dec-2024	282,380	33,174	315,554

01-Jan-2025~31-Dec-2025	282,380	33,174	315,554
01-Jan-2026~31-Dec-2026	282,380	33,174	315,554
01-Jan-2027~31-Dec-2027	282,380	33,174	315,554
01-Jan-2028~31-Dec-2028	282,380	33,174	315,554
01-Jan-2029~31-Dec-2029	282,380	33,174	315,554
01-Jan-2030~31-Dec-2030	282,380	33,174	315,554
01-Jan-2031~31-Dec-2031	282,380	33,174	315,554
01-Jan-2032~09-Mar-2032	53,381	6,271	59,652

2. Calculation of the project emissions and leakage emissions

As described in Section 4.2, it is assumed ex ante that the amount of electricity consumed from the grid is zero ($EG_{EC,y}$ = 0). Therefore, PE_y = 0 ex-ante.

Also, no leakage effects are accounted for under the methodology ACM0001 (version 19.0) as discussed in Section 4.3; therefore, LE_y = 0.

3. Calculation of the emission reductions

The emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad \text{Equation (25)}$$

Where:

ER_y	=	Emission reductions in year *y* (t CO_2e/yr)
BE_y	=	Baseline emissions in year *y* (t CO_2e/yr)
PE_y	=	Project emissions in year *y* (t CO_2/yr)

The calculation results are shown below.

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
10-Mar-2022~31-Dec-2022	256,064	0	0	256,064
01-Jan-2023~31-Dec-2023	315,554	0	0	315,554
01-Jan-2024~31-Dec-2024	315,554	0	0	315,554
01-Jan-2025~31-Dec-2025	315,554	0	0	315,554
01-Jan-2026~31-Dec-2026	315,554	0	0	315,554
01-Jan-2027~31-Dec-2027	315,554	0	0	315,554
01-Jan-2028~31-Dec-2028	315,554	0	0	315,554
01-Jan-2029~31-Dec-2029	315,554	0	0	315,554
01-Jan-2030~31-Dec-2030	315,554	0	0	315,554
01-Jan-2031~31-Dec-2031	315,554	0	0	315,554
01-Jan-2032~09-Mar-2032	59,652	0	0	59,652
Total	3,155,702	0	0	3,155,702
Average annual ERs	315,570	0	0	315,570

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	OX_{top_layer}
Data unit	-
Description	Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline
Source of data	Consistent with how oxidation is accounted for in the methodological tool "Emissions from solid waste disposal sites"
Value applied	0.1
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline emissions
Comments	This parameter is the fraction of the methane in the LFG that would oxidize in the top layer of the SWDS in the absence of the project activity. Under the project activity, this effect is reduced as a part of the LFG is captured and does not pass through the top layer of the SWDS. This oxidation effect is also accounted for in the methodological tool "Emissions from solid waste disposal sites". In addition to this effect, the installation of an LFG capture system under the project activity may result in the suction of additional air into the SWDS. In some cases, such as with a high suction pressure, the air may decrease the amount of methane that is generated under the project activity. However, in most circumstances where the LFG is captured and used this effect was very small, as the operators of the SWDS have in most cases an incentive to maintain a high methane concentration in the LFG. For these reasons, the oxidation factor shall be included in the calculation of baseline emissions whereas the effect of oxidation is, as a conservative assumption, neglected under the project activity.

Data / Parameter	GWP_{CH_4}
Data unit	t CO_2e/t CH_4
Description	Global warming potential of CH_4
Source of data	VCS Standard (version 4.5)

Value applied	28
Justification of choice of data or description of measurement methods and procedures applied	Default value of 28 from VCS Standard (version 4.5).
Purpose of Data	Calculation of baseline emissions
Comments	The parameter will be updated according to the latest requirement of VCS Standard as well as the IPCC report.

Data / Parameter	NCV_{CH4}
Data unit	TJ/t CH_4
Description	Net calorific value of methane at reference conditions
Source of data	Technical literature, ACM0001 version 19.0
Value applied	0.0504
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	η_{PJ}
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	90%
Justification of choice of data or description of measurement methods and procedures applied	-

Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$\boldsymbol{\rho_{i,n}}$
Data unit	t/m^3
Description	Density of greenhouse gas *i* in the gaseous stream in time interval *t*
Source of data	Calculation as per Equation (7)
Value applied	0.000716 at normal conditions (273.15 K and 101.325 kPa)
Justification of choice of data or description of measurement methods and procedures applied	As per Equation (7), $\rho_{i,n}$ (greenhouse gas *i* refers to methane) at normal conditions is calculated as follows: $\rho_{CH_4,n}$ = 101,325 Pa × 16.04 kg/kmol / (8,314 Pa.m³/kmol.K × 273.15 K) = 0.716 kg/m³ = 0.000716 t/m³
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$\boldsymbol{\varphi_y}$
Data unit	-
Description	Model correction factor to account for model uncertainties for year *y*
Source of data	Default value from TOOL04: "Emissions from solid waste disposal sites" (version 08.0)
Value applied	0.75
Justification of choice of data or description of measurement methods and procedures applied	Default values for the model correction factor

	Humid/wet conditions	Dry conditions
Application A	0.75	0.75

	Application B | 0.85 | 0.80 Application A (the project activity mitigates methane emissions from a specific existing SWDS) is applied, and the default value of 0.75 is thus used.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	f_y
Data unit	-
Description	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year *y*
Source of data	TOOL04: "Emissions from solid waste disposal sites" (version 08.0)
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline emissions
Comments	This parameter is determined once for the crediting period ($f_y = f$) according to TOOL04 (version 08.0).

Data / Parameter	OX
Data unit	-
Description	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data	*IPCC 2006 Guidelines for National Greenhouse Gas Inventories*
Value applied	0.1
Justification of choice of data or description of	The landfill is covered with plastic film or soil, for conservative 0.1 was chosen.

measurement methods and procedures applied	
Purpose of Data	Calculation of baseline emissions
Comments	When methane passes through the top-layer, part of it is oxidized by methanotrophic bacteria to produce CO_2. The oxidation factor represents the proportion of methane that is oxidized to CO_2 This should be distinguished from the methane correction factor (*MCF*) which is to account for the situation that ambient air might intrude into the SWDS and prevent methane from being formed in the upper layer of SWDS.

Data / Parameter	$\boldsymbol{F}$
Data unit	(Volume fraction)
Description	Fraction of the methane in the SWDS gas
Source of data	*IPCC 2006 Guidelines for National Greenhouse Gas Inventories*
Value applied	0.5
Justification of choice of data or description of measurement methods and procedures applied	Using IPCC 2006 Guidelines default value
Purpose of Data	Calculation of baseline emissions
Comments	Upon biodegradation, organic material is converted to a mixture of methane and carbon dioxide.

Data / Parameter	$\boldsymbol{DOC_{f,y}}$
Data unit	(Weight fraction)
Description	Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year *y*
Source of data	*IPCC 2006 Guidelines for National Greenhouse Gas Inventories*
Value applied	0.5
Justification of choice of data or description of	$DOC_{f,y} = DOC_{f,default}$, because Application A in TOOL04 (version 08.0) is applied.

measurement methods and procedures applied	
Purpose of Data	Calculation of baseline emissions
Comments	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, in the SWDS. This default value can only be used for: (a) Application A; or (b) Application B if the tool is applied to MSW.

Data / Parameter	MCF_y
Data unit	-
Description	Methane correction factor for year *y*
Source of data	*IPCC 2006 Guidelines for National Greenhouse Gas Inventories*
Value applied	1.0
Justification of choice of data or description of measurement methods and procedures applied	The Changshankou MSW landfill is controlled, including the following activities: (i) cover material; (ii) mechanical compacting; (iii) levelling of the waste. Therefore, 1.0 for anaerobic managed solid waste disposal sites is recommended by "Emissions from solid waste disposal sites (Version 08.0)."
Purpose of Data	Calculation of baseline emissions
Comments	MCF accounts for the fact that unmanaged SWDS produce less methane from a given amount of waste than managed SWDS, because a larger fraction of waste decomposes aerobically in the top layers of unmanaged SWDS.

Data / Parameter	$W_{j,x}$
Data unit	t
Description	Amount of organic waste type *j* disposed in the SWDS in the year *x*
Source of data	FSR of the Project
Value applied	The amounts of each waste type are calculated based on estimated disposal rates and composition of the MSW disposed at Changshankou Landfill.

Year	Annual disposed MSW (tons)
2009	240,000
2010	730,000
2011	730,000
2012	730,000
2013	730,000
2014	730,000
2015	730,000
2016	730,000
2017	730,000
2018	730,000
2019	730,000
2020	730,000
2021	730,000
2022	730,000
2023	730,000
2024	730,000
2025	730,000
2026	730,000
2027	730,000
2028	730,000
2029	730,000

Waste type *j*	Weight fraction
Wood and wood products	8.59%
Pulp, paper and cardboard	9.26%

	Food, food waste, beverages and tobacco: 58.81% Textiles: 1.53% Garden, yard and park waste: 0.81% Glass, plastic, metal, other inert waste: 21.0%
Justification of choice of data or description of measurement methods and procedures applied	It is calculated as total waste amount dumped in the landfill site in the year x multiplied by organic waste type j fraction on wet basis. Both total waste amount and waste type j fraction come from FSR.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	DOC_j
Data unit	(Weight fraction)
Description	Fraction of degradable organic carbon in the waste type *j*
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)
Value applied	Default values for DOC_j

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	-
Purpose of Data	Calculation of baseline emissions
Comments	The percentages listed in table above are based on wet waste basis which are concentrations in the waste as it is delivered to the SWDS.

Data / Parameter	k_j
Data unit	1/yr
Description	Decay rate for the waste type *j*
Source of data	TOOL04: "Emissions from solid waste disposal sites" (version 08.0), *IPCC 2006 Guidelines for National Greenhouse Gas Inventories* (adapted from Volume 5, Table 3.3)
Value applied	Provide the value applied
Justification of choice of data or description of measurement methods and procedures applied	The project site is located in Wuhan City, where the meteorological data are: Mean annual temperature (MAT): 17.1°C ≤ 20°C; Mean annual precipitation (MAP): 1316 mm; Potential evapotranspiration (PET): 1250 mm, MAP/PET > 1 Therefore, the values for wet, boreal and temperate area shall be applied.

Waste type *j*		Boreal and Temperate (MAT≤20°C), and wet (MAP/PET>1)
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0.06
	Wood, wood products and straw	0.03

	Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.10
	Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.185
Purpose of Data	Calculation of baseline emissions		
Comments	-		

Data / Parameter	$\boldsymbol{EF_{EL,k,y}}$ and $\boldsymbol{EF_{EL,j,y}}$ ($\boldsymbol{EF_{grid,CM,y}}$)
Data unit	tCO_2/MWh
Description	Combined margin emission factor for the grid in year *y*
Source of data	1. *2019 Baseline Emission Factors for Regional Power Grids in China*[13], *Calculation Instructions for 2019 Baseline OM Emission Factors for Regional Power Grids in China*[14] and *Calculation Instructions for 2019 Baseline BM Emission Factors for Regional Power Grids in China*[15] published by the Ministry of Ecology and Environment of China; 2. Calculated based on TOOL07: "Tool to calculate the emission factor for an electricity system" (version 07.0)
Value applied	0.5720
Justification of choice of data or description of measurement methods and procedures applied	$EF_{EL,k,y} = EF_{EL,j,y} = EF_{grid,CM,y}$ according to TOOL05 (version 03.0). Calculated as per TOOL07 (version 07.0) based on official data published by the Ministry of Ecology and Environment of China
Purpose of Data	Calculation of baseline emissions ($EF_{EL,k,y}$) Calculation of project emissions ($EF_{EL,j,y}$)
Comments	The ex ante option is selected to calculate $EF_{grid,OM,y}$ and $EF_{grid,BM,y}$ and hence $EF_{grid,CM,y}$, which will be fixed throughout the crediting period; therefore, both parameters $EF_{EF,k,y}$ and $EF_{EF,j,y}$ are fixed throughout the crediting period.

[13] http://mee.gov.cn/ywgz/ydqhbh/wsqtkz/202012/W020201229610353340851.pdf

[14] http://mee.gov.cn/ywgz/ydqhbh/wsqtkz/202012/W020201229610353816665.pdf

[15] http://mee.gov.cn/ywgz/ydqhbh/wsqtkz/202012/W020201229610354442145.pdf

Data / Parameter	$\boldsymbol{TDL_{k,y}}$ and $\boldsymbol{TDL_{j,y}}$
Data unit	-
Description	Average technical transmission and distribution losses for providing electricity to source *k* or source *j* in year *y*
Source of data	TOOL05: "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0)
Value applied	$TDL_{k,y}$ = 3% $TDL_{j,y}$ = 20%
Justification of choice of data or description of measurement methods and procedures applied	The Project is applicable to Scenario A defined in TOOL05 (version 03.0), which requires the default value of 20% for project emissions, and 3% for baseline emissions.
Purpose of Data	Calculation of baseline emission ($TDL_{k,y}$) Calculation of project emissions ($TDL_{j,y}$)
Comments	The parameter will be updated according to the latest version of TOOL05.

5.2 Data and Parameters Monitored

Data / Parameter	**Management of SWDS**
Data unit	-
Description	Management of SWDS
Source of data	Use different sources of data: (a) Original design of the landfill; (b) Technical specifications for the management of the SWDS; (c) Local or national regulations.
Description of measurement methods and procedures to be applied	Project participants should refer to the original design of the landfill to ensure that any practice to increase methane generation have been occurring prior to the implementation of the project activity. Any change in the management of the SWDS after the implementation of the project activity should be justified by referring to technical or regulatory specifications

Frequency of monitoring/recording	Annually
Value applied	-
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	-

Data / Parameter	$V_{t,wb,n}$
Data unit	m^3 wet gas/h
Description	Volumetric flow of the gaseous stream in time interval t on a wet basis at normal conditions
Source of data	Flow meter and computer
Description of measurement methods and procedures to be applied	The flow meter continuously and simultaneously measures the volumetric flow, the temperature and the pressure of the LFG, sends data to the computer, which then automatically converts the flow into values at normal conditions.
Frequency of monitoring/recording	Continuously measured and regularly recorded
Value applied	The data will be monitored ex post in the monitoring period. In the estimated net GHG emission reduction phase, the amount of LFG is estimated as per the equation (10), please refer to ER calculation sheet for details.
Monitoring equipment	Flow meter
QA/QC procedures to be applied	The flow meter is to be calibrated regularly in compliance with the national/industry standard. The calibration reports will be archived for two years following the end of the crediting period.
Purpose of data	Calculation of baseline emissions

Calculation method	-
Comments	This parameter will be monitored for Ex post determination of $F_{CH4,PJ,y}$

Data / Parameter	$v_{i,t,wb}$
Data unit	m³ gas *i*/m³ wet gas
Description	Volumetric fraction of greenhouse gas *i* in a time interval *t* on a wet basis
Source of data	Methane content analyzer
Description of measurement methods and procedures to be applied	Monitored by a methane content analyzer operating in wet basis
Frequency of monitoring/recording	Continuously monitored and regularly recorded
Value applied	-
Monitoring equipment	Methane content analyzer
QA/QC procedures to be applied	The analyzer is to be calibrated regularly in compliance with the national/industry standard. Calibration should include zero verification with an inert gas (e.g. N_2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period. The calibration reports will be archived for two years following the end of the crediting period.
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	This parameter will be monitored for Ex post determination of $F_{CH4,PJ,y}$

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	Monitoring hourly and recording monthly
Value applied	$Op_{j,h}$ = 1 for 6,800 hours (ex ante estimate) within a year
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	-

Data / Parameter	$EG_{PJ,y}$
Data unit	MWh
Description	Net amount of electricity generated using LFG by the project activity in year *y*
Source of data	Electricity meter
Description of measurement methods and procedures to be applied	Measured by a bi-directional electricity meter
Frequency of monitoring/recording	Continuously measured and regularly recorded
Value applied	Please refer to Section 4.4 for details
Monitoring equipment	Electricity meter
QA/QC procedures to be applied	The monitored values will be cross checked with sales receipts. The electricity meter is to be calibrated regularly in compliance with the latest version of "*Technical administrative code of electric energy metering*". The calibration reports, recorded data files and sales receipts will be archived for two years following the end of the crediting period.
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	This parameter is required for calculating baseline emissions associated with electricity generation ($BE_{EC,y}$) using the methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"

Data / Parameter	$EG_{EC,y}$
Data unit	MWh
Description	Amount of electricity consumed by the project activity in year *y*
Source of data	Electricity meter

Description of measurement methods and procedures to be applied	Sources of consumption shall include, where applicable, electricity consumed for the operation of the LFG capture system, for any processing and upgrading of the LFG, for transportation of the LFG to the flare or other applications (boilers, power generators), for the compression of the LFG into the natural gas network, etc. Measured by a bi-directional electricity meter
Frequency of monitoring/recording	Continuously measured and regularly recorded
Value applied	0 estimated at ex ante and will be monitored ex post.
Monitoring equipment	Electricity meter
QA/QC procedures to be applied	The monitored values will be cross checked with sales receipts. The electricity meter is to be calibrated regularly in compliance with the latest version of "*Technical administrative code of electric energy metering*". The calibration reports, recorded data files and sales receipts will be archived for two years following the end of the crediting period.
Purpose of data	Calculation of project emissions
Calculation method	-
Comments	This parameter is required for calculating project emissions from electricity consumption due to an alternative waste treatment process *t* ($PE_{EC,y}$) using the methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation".

Data / Parameter	**CAPEX** and **OPEX**
Data unit	CNY
Description	Total investment to implement the project and total cost to operate the project
Source of data	Engineering, procurement and construction contracts; and maintenance contracts
Description of measurement methods and procedures to be applied	-

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

Data / Parameter	**Tariff of electricity exported**
Data unit	CNY
Description	Tariff of electricity exported
Source of data	Power purchase agreement and/or sales receipts
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	-
Calculation method	-
Comments	The monitoring of this parameter is only required for projects applying the simplified procedures to identify the baseline scenario and demonstrate additionality.

5.3 Monitoring Plan

The monitoring plan presented in this PD assures that real, measurable, long-term GHG emission reductions can be monitored, recorded and reported. It is a crucial procedure to identify the final VCUs of the project. This monitoring plan will be implemented by the project owner during the project operation period. The details of the monitoring plan are specified as follows.

The Project owner organizes a specific VCS team in project development department to be responsible for data collection, supervision and witness the whole process of data measuring and recording.

(A) Management structure

The Project owner organizes a specific VCS team in project development department to be responsible for data collection, supervision and witness the whole process of data measuring and recording. A VCS manager is appointed to take full responsibility for the overall monitoring of the project. The monitoring and measurement of extracted gas, electricity generation and consumption etc. are carried out by a few designated monitoring officers. In addition, the Project developer appoints internal verifiers who is responsible for internal check of the measurement, collection of relevant receipts and invoices, and the calculation of the emission reductions. A monitoring and management manual of the project that identifies detailed duties and responsibilities of the relevant parties is developed and served as the basis of the project monitoring. Figure 5-1 shows the operation and management structure of the Project.

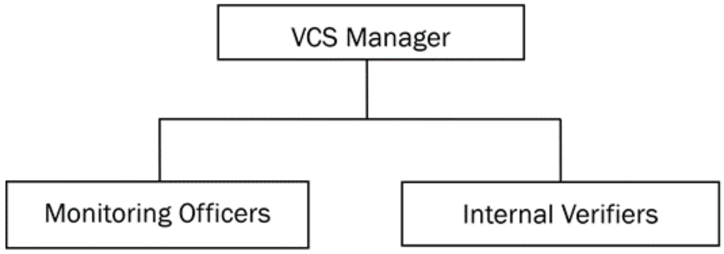


Figure 5.1 Operation and management structure of the project

(B) Data and Parameters to be monitored

Figure 5.1 shows the parameters to be monitored as well as the positions of the monitoring instruments; Table 5.1 further explains each of the monitored parameters.

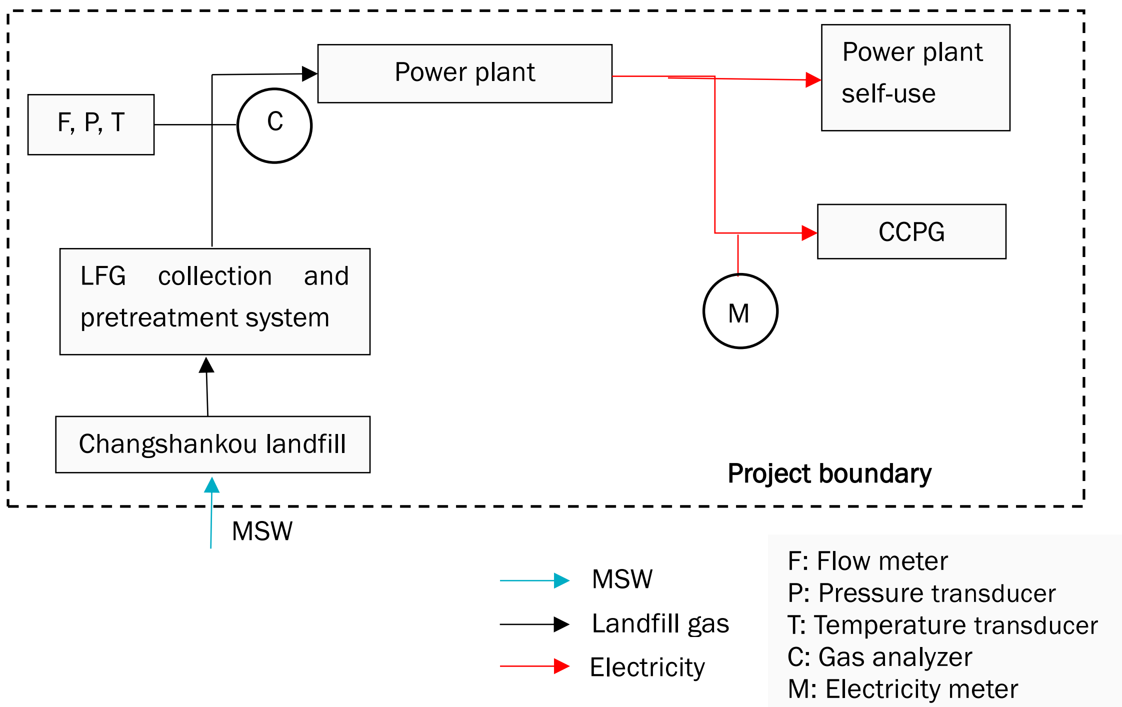


Figure 5.2 Project monitoring diagram

Table 5.1 Description of the monitored parameters

Position	Monitoring instrument	Monitored parameter(s)	Description
LFG inlet of the power generation	Flow meter	$V_{t,wb,n}$	The flow meter simultaneously measures the volumetric flow, the pressure and the

system			temperature of the LFG stream entering the power generators; the volumetric flow values are converted automatically into values at normal conditions (273.15 K and 101,325 Pa). The monitoring is continuous, and the data are recorded and electronically archived on the computer. The data are aggregated for every month.
LFG inlet of the power generation system	Gas analyser	$v_{CH4,t,wb}$	The gas analyser measures the volumetric fraction of greenhouse gas CH_4 in the LFG stream. The monitoring is continuous, and the data are recorded and archived on the computer.
10kV transmission line connecting the Project to the grid	Electricity meter	$EG_{PJ,y}$, $EG_{EC,y}$	The electricity meter measures the amount of electricity supplied to the grid by the project activity and electricity imported from the grid by the project activity. Its accuracy is no less than 0.5 S.
/	On-line operation system	$O_{pj,h}$	Operation hours of generators that consumes the LFG is monitored hourly by on-line operation system. And the data will be recorded and electronic archived everyday by computer automatically. The operators will check the data every day and aggregate monthly data.

(C) Data collection

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

(D) Quality assurance

All the monitoring instruments, which include the electricity meter, the flow meter and the methane content analyser, are chosen in compliance with VCS requirements, and will be calibrated regularly for accuracy by qualified third-party organizations according to the national regulations during the entire crediting period. To assist in future verifications, the project proponent preserves the calibration records, along with the files of monitored data.

Error-checking is carried out regularly on site and at the point of data storage to detect data measuring/transmission failures as well as malfunctions. In case of malfunction of any measuring instrument, the instrument supplier will provide technical support to solve the problem promptly, and the emission reductions during the troubleshooting period will be calculated conservatively.

The installation of the electricity metering equipment will fulfill the requirements of “JJG 596-2012 Verification Regulation of Electrical Meters for Measuring Alternating current Electrical Energy”. The accuracy of all metering equipment will fulfill the relevant national standard. All metering equipment will be calibrated regularly for accuracy by qualified party according to the national regulations.

(E) Data file management

All the monitored data are electronically files at the end of each month and the electronic data files are archived in both disk copy and printed hard copy. Other documents in paper e.g., maps, forms and EIA reports are preserved in good conditions as well. All data collected as part of the monitoring must be archived electronically and be kept at least for two years after the end of the crediting period. The project proponent will provide original records and documents if necessary.