



**Verified Carbon
Standard**

GUIZHOU XINTIAN CMM POWER GENERATION PROJECT



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CONTENTS

1	PROJECT DETAILS.....	4
1.1	Summary Description of the Project	4
1.2	Sectoral Scope and Project Type	5
1.3	Project Eligibility	5
1.4	Project Design	5
1.5	Project Proponent	6
1.6	Other Entities Involved in the Project	6
1.7	Ownership.....	6
1.8	Project Start Date	7
1.9	Project Crediting Period	7
1.10	Project Scale and Estimated GHG Emission Reductions or Removals	7
1.11	Description of the Project Activity	8
1.12	Project Location	10
1.13	Conditions Prior to Project Initiation	10
1.14	Compliance with Laws, Statutes and Other Regulatory Frameworks	11
1.15	Participation under Other GHG Programs	11
1.16	Other Forms of Credit.....	11
1.17	Sustainable Development Contributions	12
1.18	Additional Information Relevant to the Project	16
2	SAFEGUARDS	16
2.1	No Net Harm	16
2.2	Local Stakeholder Consultation	16
2.3	Environmental Impact	22
2.4	Public Comments	24
2.5	AFOLU-Specific Safeguards	24
3	APPLICATION OF METHODOLOGY.....	24
3.1	Title and Reference of Methodology	24
3.2	Applicability of Methodology	25
3.3	Project Boundary	31
3.4	Baseline Scenario	34

3.5	Additionality	44
3.6	Methodology Deviations	46
4	ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS.....	46
4.1	Baseline Emissions	47
4.2	Project Emissions	60
4.3	Leakage.....	63
4.4	Net GHG Emission Reductions and Removals	63
5	MONITORING	66
5.1	Data and Parameters Available at Validation	67
5.2	Data and Parameters Monitored.....	69
5.3	Monitoring Plan.....	73
6	ACHIEVED GHG EMISSION REDUCTIONS AND REMOVALS	76
6.1	Data and Parameters Monitored.....	76
6.2	Baseline Emissions	81
6.3	Project Emissions	82
6.4	Leakage.....	84
6.5	Net GHG Emission Reductions and Removals	84
APPENDIX		85

1 PROJECT DETAILS

1.1 Summary Description of the Project

Guizhou Xintian CMM Power Generation Project (hereafter referred to as “the Project”) refers to a power plant which utilizes low concentration coal mine methane (CMM) for power generation to supply electricity to the Xintian coal mine and to China Southern Power Grid (CSPG). The Project is located in Gantang Town, Qianxi County, Bijie City, Guizhou Province, People’s Republic of China, and developed by **Yonggui Energy Development Co., Ltd. Xintian Branch** (hereafter referred to as “the project proponent”).

Prior to the project initiation, the Xintian coal mine was equipped with CMM extraction facilities and all extracted CMM was directly vented into the atmosphere; the electricity consumed at coal mine was imported from China Southern Power Grid (CSPG), and the heat was provided by waste coal boilers.

The baseline scenario is the same as the conditions existing prior to the project initiation.

The purpose of the Project is to utilize the extracted low concentration CMM to produce electricity. No coal bed methane (CBM)¹ or ventilation air methane (VAM) utilization is involved. It was planned that CMM power generators with a total capacity of 17.6 MW (2 × 0.5 MW, 7 × 0.6 MW, 2 × 1.2 MW and 10 × 1 MW) would be installed for the Project; power generators of 7.6 MW (2 × 0.5 MW, 7 × 0.6 MW, 2 × 1.2 MW) would be first installed, leaving the remaining 10 MW (10 × 1 MW) to be installed later depending on the CMM availability². Based on ex ante estimates, the power plant will destroy a total amount of 35.2 million m³ (under normal conditions³) of methane and export 82,720 MWh of electricity every year, when all power generators are in full operation. The generated electricity is supplied to the Xintian coal mine through the electricity distribution network in the coal mine area; part of the electricity produced by the Project is exported to CSPG after the coal mine demand is fully met. In consequence, the project activity displaces an amount of electricity generated by fossil fuel-fired power plants of the CSPG. In addition, by recovering waste heat from the generators to provide hot water for free to the coal mine, the project activity also displaces an amount of thermal energy which was provided by waste coal fired boilers prior to the project initiation; however, to be conservative, emission reductions will not be claimed for such displacement.

¹ As per the methodology ACM0008 (version 08.0), coal bed methane is a generic term for the methane-rich gas naturally occurring in coal seams typically comprising 80 per cent to 95 per cent methane. The coal mine methane involved in the Project comprises less than 30% methane.

² The estimated operation start date of the remaining 10 MW is 01-Jan-2023.

³ Defined as 1 atm and 20 °C.

The Project achieves emission reductions in two aspects: 1) it reduces methane emissions by capturing and destroying methane which would have been directly vented into the air in the baseline scenario; 2) it reduces CO₂ emissions by displacing an amount of electricity that would otherwise have been supplied by CSPG. During the 10-year project crediting period (from 26-September-2020 to 25-September-2030), the total GHG emission reductions are estimated to be 5,529,129 tCO₂e, with estimated emission reductions of 552,913 tCO₂e on average per year.

During the first monitoring period from 26-September-2020 to 28-February-2022, the power generators of 7.6 MW were actually installed, and the Project achieved 350,473 tCO₂e of emission reductions.

1.2 Sectoral Scope and Project Type

The sectoral scopes applicable to the Project are:

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

Sectoral Scope 8: Mining/mineral production⁴.

The Project is not a grouped project.

1.3 Project Eligibility

The scope of the VCS Program includes six *Kyoto Protocol* greenhouse gases. As stated in Section 1.1, the Project achieves emission reductions in two aspects: 1) it reduces methane emissions by capturing and destroying methane which would have been directly vented into the air in the baseline scenario; 2) it reduces CO₂ emissions by displacing part of the electricity that would otherwise have been supplied by CSPG. Both CH₄ and CO₂ are *Kyoto Protocol* greenhouse gases.

Meanwhile, the Project does not belong to the project types excluded in Table 1 of *VCS Standard 4.2*.

Therefore, the Project is eligible under the scope of VCS program.

1.4 Project Design

The Project has been designed to include a single project activity. The Project is not a grouped project.

Eligibility Criteria

⁴ According to CDM Standard: Applicability of sectoral scopes (CDM-EB88-A04-STAN), which came into effect on 11 March 2016, certain baseline and monitoring methodologies have to be reclassified with respect to the linked sectoral scopes; the mandatory sectoral scopes linked to ACM0008 are 1 and 8. Please refer to the link for detailed information: <https://cdm.unfccc.int/methodologies/methodologiesAccrv6/index.html>

Not applicable.

1.5 Project Proponent

Organization name	Yonggui Energy Development Co., Ltd. Xintian Branch
Contact person	XU Minghui
Title	Project manager
Address	Gantang Town, Qianxi County, Bijie City, Guizhou Province, People's Republic of 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 200120
Telephone	+86 021-62462036
Email	projects@climatebridge.com

1.7 Ownership

The Project has obtained the approval from the Development and Reform Commission of Qianxi County. The environmental impact assessment (EIA) form of the Project has been approved by the Ecology and Environment Department of Bijie City.

The project approval and the EIA approval show clearly that the project proponent has the legal right to control and operate the Project. The business license of the project proponent is supporting evidence that the project proponent operates legally under Chinese legislative frameworks.

1.8 Project Start Date

The project start date is 26-September-2020 when the first CMM generators of the Project started operation.

1.9 Project Crediting Period

The Project adopts a fixed ten-year crediting period from 26- September-2020 to 25-September-2030.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	
Large project	✓

Year	Estimated GHG emission reductions or removals (tCO _{2e})
26-Sep-2020 to 31-Dec-2020 ⁵	72,826
01-Jan-2021 to 31-Dec-2021	274,036
01-Jan-2022 to 31-Dec-2022	274,036
01-Jan-2023 to 31-Dec-2023	634,610
01-Jan-2024 to 31-Dec-2024	634,610
01-Jan-2025 to 31-Dec-2025	634,610
01-Jan-2026 to 31-Dec-2026	634,610
01-Jan-2027 to 31-Dec-2027	634,610
01-Jan-2028 to 31-Dec-2028	634,610
01-Jan-2029 to 31-Dec-2029	634,610
01-Jan-2030 to 25-Sep-2030 ⁶	465,960
Total estimated ERs	5,529,129

⁵ The period 26-Sep-2020 to 31-Dec-2020 covers 97 days; the estimated emission reductions for this period are calculated as follows: (274,036 tCO_{2e} / 365 days) × 97 days = 72,826 tCO_{2e}.

⁶ The period 01-Jan-2030 to 25-Sep-2030 covers 268 days; the estimated emission reductions for this period are calculated as follows: (634,610 tCO_{2e} / 365 days) × 268 days = 465,960 tCO_{2e}.

Total number of crediting years	10
Average annual ERs	552,913

1.11 Description of the Project Activity

It was planned during the project design phase that CMM power generators with a total capacity of 17.6 MW would be installed for the Project. Based on ex ante estimates, the Project will destroy 35.2 million m³ (under normal conditions) of methane and export 82,720 MWh of electricity every year when all power generators are in full operation.

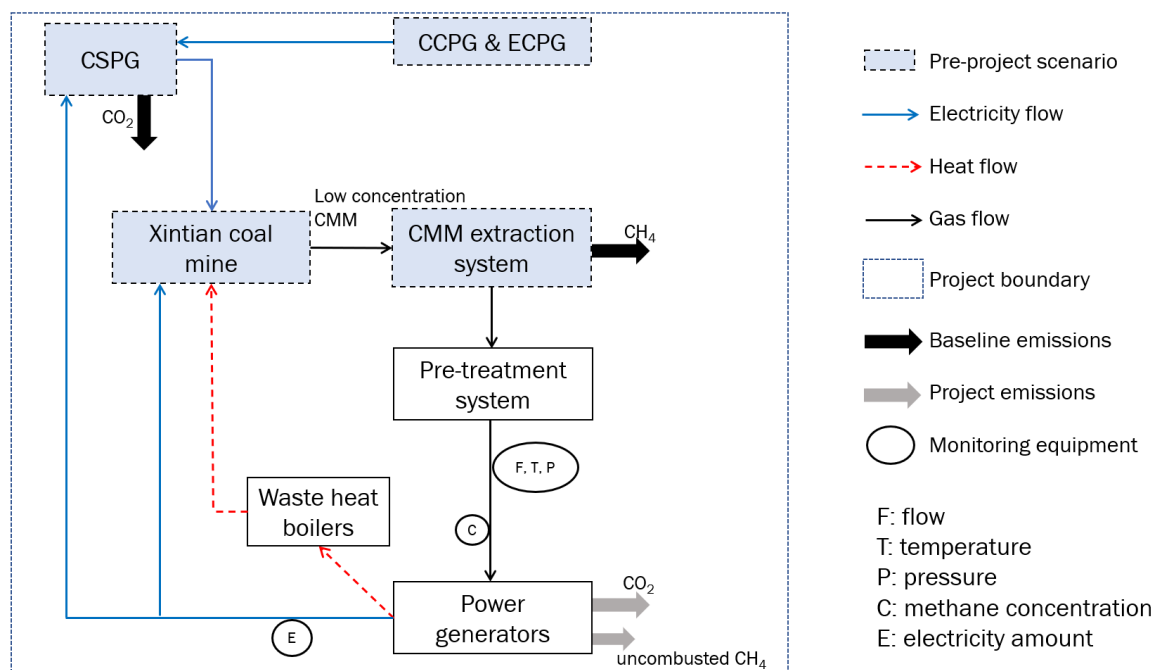


Figure 1.1 Technical process of the Project

Figure 1.1 shows the technical process of the Project. The low concentration CMM is delivered through methane extraction pumps to the pre-treatment system for safety treatment, and then enters the generators to be combusted for power generation. The generated electricity is supplied to the local coal mine as well as the grid. The waste heat from the generators is recovered by the waste heat boilers to provide hot water to the coal mine.

As shown in **Figure 1.1**, the Project has installed a gas analyser which measures the methane concentration of the gas entering the power generators (noted as C in Figure 1.1) as well as a multi-parameter measuring instrument for gas drainage which simultaneously measures the flow, temperature and pressure (noted as F, T and P, respectively, in Figure 1.1); the amount of methane utilized in power generation is thus calculated based on the monitored data. A bidirectional electricity meter has also been installed to monitor the electricity exported and imported. Please refer to Section 5.3 for detailed information about the monitoring plan.

The reported monitoring period spans from 26-September-2020 to 28-February-2022. During this period, the generators of 7.6 MW were installed, lower than initially planned due to a lower level of CMM availability than estimated back then⁷. The technical specifications of the installed power generators are shown in **Table 1.1**. The other generators will be installed and put into operation when the CMM amount meets the requirement.

Table 1.1 Specifications of the generators installed during this monitoring period

Type	500GF1-1RW _D	600GF1-1RW _D	1200GF1-1RW _D
Supplier	Henan Diesel Engine Heavy Industry Co., Ltd.		
Quantity	2	7	2
Rated power (kW)	500	600	1200
Rated current (A)	1,083	1,083	1,083
Rated voltage (V)	400	400	800
Rated speed (r/min)	1,000	1,000	2,000
Rated frequency (Hz)	50	50	50
Power factor	0.8	0.8	0.8
Lifetime (year)	10	10	10

The implementation timeline of the Project is shown in **Table 1.2**.

Table 1.2 Implementation timeline of the Project

Key event	Date
The construction started	24-September-2019
The generators of 7.6 MW started operation (also the start of the crediting period of the Project)	26-September-2020

The equipment employed in the Project is all domestically produced without technology transfer.

The Project achieves emission reductions in two aspects: 1) methane which was previously directly vented into the air is captured and destroyed in the project scenario, achieving methane emission reductions; 2) the project reduces CO₂ emissions by displacing part of the electricity that would otherwise have been supplied by CSPG.

⁷ According to *Statement about the CMM availability of Xintian CMM power plant* provided by the project proponent.

1.12 Project Location

The Project is located in Gantang Town, Qianxi County, Bijie City, Guizhou Province, People's Republic of China. Its geographical coordinates are E 106° 6' 0.28", N 27° 6' 22.20". Its locations are shown in **Figure 1.2**.

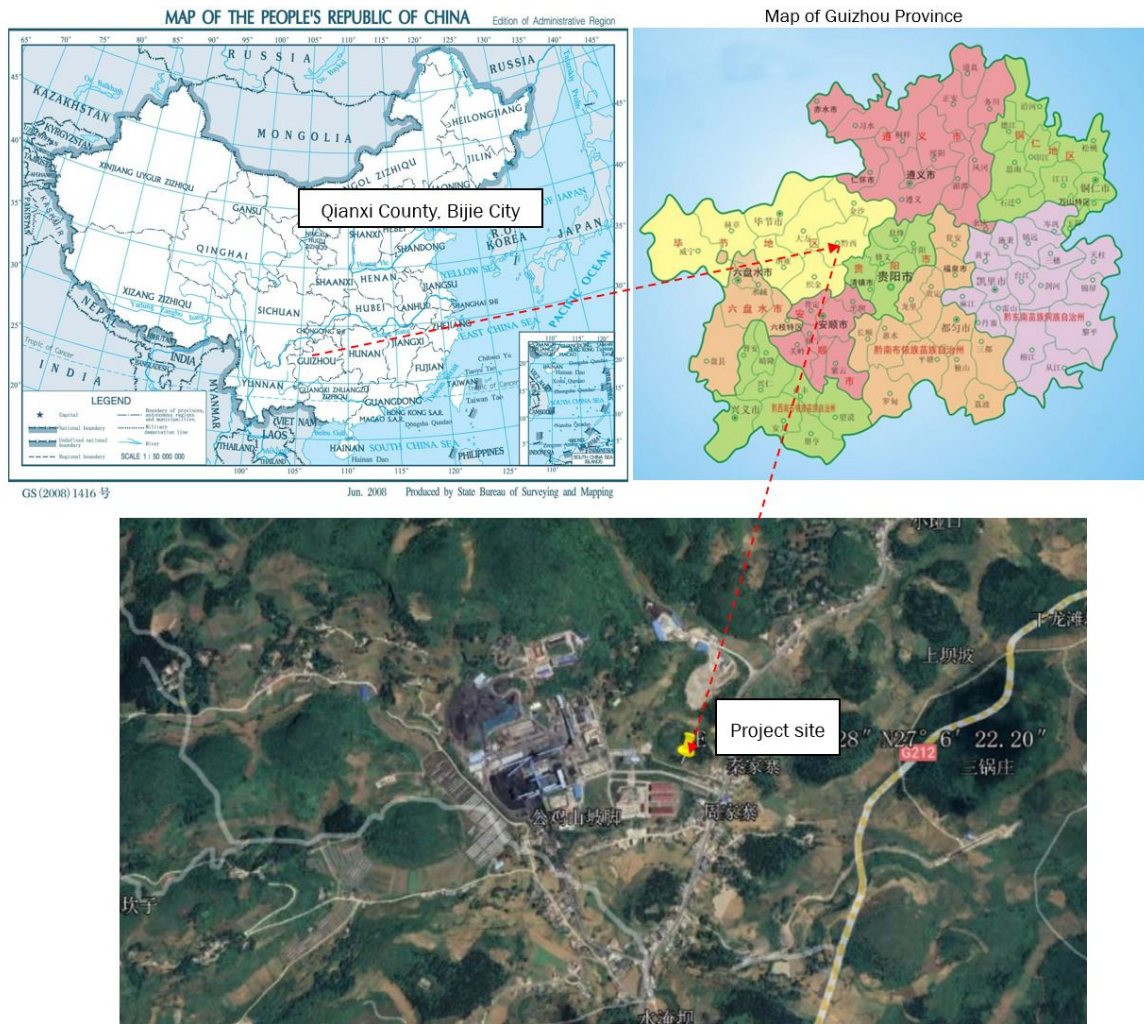


Figure 1.2 Location of the Project

1.13 Conditions Prior to Project Initiation

Prior to the project initiation, the Xintian coal mine was equipped with CMM extraction facilities and all extracted CMM was directly vented into the atmosphere; the electricity consumed at coal mine was imported from China Southern Power Grid (CSPG), and the heat was provided by waste coal boilers.

The baseline scenario is the same as the conditions existing prior to the project initiation; please refer to Section 3.4 for the description of the baseline scenario.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The Project complies with all relevant laws and regulations in China, which include:

- *Renewable Energy Law of the People's Republic of China* ⁸,
- *Catalogue for the Guidance of the Development of Renewable Energy Industry* ⁹,
- *Several Opinions of the General Office of the State Council on Speeding up the Extraction and Utilization of Coal Bed Methane (Coal Mine Gas)* ¹⁰,
- *National Coalmine Safety Regulation (2016)* ¹¹
- *Notice of the National Development and Reform Commission on the Issuance of the Twelfth Five-Year Plan for the Development and Utilization of Coal Bed Methane (Coal Mine Gas)* ¹².

Besides, the Project has obtained the project approval from the Development and Reform Commission of Qianxi County; the environmental impact assessment (EIA) form of the Project has been approved by the Ecology and Environment Department of Bijie City. These approvals demonstrate that the local authorities permit the construction and implementation of the Project and that the Project complies with all relevant laws and regulatory frameworks.

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 GHG programs.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

⁸ <http://english.mofcom.gov.cn/article/policyrelease/Businessregulations/201312/20131200432160.shtml>

⁹ http://www.nea.gov.cn/2015-12/13/c_131051692.htm

¹⁰ http://www.gov.cn/zhengce/content/2008-03/28/content_2576.htm

¹¹ https://www.mem.gov.cn/gk/gwgg/agwzlf/zjl_01/201603/W020190705622814170708.pdf

¹² http://www.nea.gov.cn/2011-12/31/c_131337364.htm

The project proponent is not part of any emissions trading program. The Project does not reduce GHG emissions from activities that are included in an emissions trading program or any other mechanism that includes GHG allowance trading. In fact, China's national emissions trading scheme (ETS) only includes 2,225 fossil fuel-fired power plants in the power sector¹³, and the project proponent is not included in the list. China's ETS is expected to further expand to include emission-intensive companies in other seven industries (petrochemicals, chemicals, building materials, non-ferrous metals, papermaking, steel and aviation)¹⁴. The project proponent will not be included in the national ETS; no emission cap will be enforced on the project proponent, nor can it participate in carbon transactions in the national ETS. Therefore, 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.

1.16.2 Other Forms of Environmental Credit

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

1.17 Sustainable Development Contributions

1.17.1 Sustainable Development Contributions Activity Description

The Project utilizes coal mine methane (CMM) to generate power and produce heat. By destroying CMM that would have been vented into the atmosphere in the absence of the project activity, and by displacing part of the electricity that would have been supplied by the grid, the Project achieves significant GHG emission reductions. The Project provides long-term job opportunities to local people and contributes to the economic prosperity. In addition, the Project reduces CO₂ emissions per unit of value added.

The Project contributes to achieving United Nations' Sustainable Development Goals (SDG) in the following aspects:



SDG 13: Achieving significant reductions in GHG as well as other air pollutants by destroying and utilizing methane. During each monitoring period, the GHG emission reductions will be calculated as per the methodology based on the monitored data (Please refer to Section 4 for details).



SDG 9: Reducing CO₂ emissions per unit of value added. As the value added is difficult to measure and could have confidentiality issues, another self-described indicator, CO₂ emissions per ton of coal produced, is used to quantify the

¹³ <http://mee.gov.cn/xxgk2018/xxgk/xxgk03/202012/W020201230736907682380.pdf>

¹⁴ http://www.mee.gov.cn/xxgk2018/xxgk/xxgk05/202103/t20210330_826728.html

contributions. During each monitoring period, the amount of coal produced will be collected so that this indicator could be calculated.



SDG 8: Creating long-term job opportunities and contributing to local economic prosperity. During each monitoring period, the pay rolls and the labors contracts will be collected to monitor and report this contribution.

1.17.2 Sustainable Development Contributions Activity Monitoring

During this monitoring period, the Project utilized 12,926.23 tCH₄ and exported 50,551.900 MWh electricity, achieving 350,473 tCO_{2e} emission reductions, reducing 0.686 tCO_{2e} emissions per ton of coal for the 510,377 tons of coal produced during this period. In addition, the Project has created 30 long-term jobs.

Table 1.3 Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	8.5	Number of long-term jobs created	Implemented activities to increase	30 employees ¹⁵ have signed long-term labour contracts and receive stable payments due to the implementation of the project activity.	The project has created 30 long-term jobs.
2)	9.4	CO ₂ emission per ton of coal produced	Implemented activities to decrease	86,000 tons of coal were produced at Xintian coal mine from September to December in 2020; 375,000 tons were produced in the year of 2021; 67,000 tons were produced from January and February in 2022. It is thus estimated that 510,377 tons ¹⁶ of coal were produced during this monitoring period. As the Project achieved 350,473 tCO ₂ e emission reductions during this monitoring period, the Project decreased 0.686 tCO ₂ e emissions ¹⁷ for each ton of coal produced.	During this monitoring period, the project decreased 0.686 tCO ₂ e emissions per ton of coal produced for the 510,377 tons of coal.

¹⁵ It was initially estimated that 60 people would be employed in the power plant according to the Feasibility Study Report of the Project; as the actually installed capacity is smaller than planned, the actual number of employees is also less than estimated.

¹⁶ Coal production at 26-September-2020 to 31-December-2020 (by assuming that the coal production rate was constant during the three months):

86,000 tons / 122 days × 97 days = 68,377 tons;

therefore, coal production during the monitoring period: 68,377 tons + 375,000 tons + 67,000 tons = 510,377 tons.

¹⁷ 350,473 tCO₂e / 510,377 tons of coal produced = 0.686 tCO₂e/ton of coal produced

3)	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to increase	The project achieved GHG emission reductions of 350,473 tCO ₂ e during the monitoring period	By the end of this monitoring period, the project has achieved GHG emission reductions of 350,473 tCO ₂ e.
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The evidence of the Project's SD contributions has been provided to the VVB for verification and is not provided as appendices to this report due to confidentiality issues.

1.18 Additional Information Relevant to the Project

Leakage Management

The leakage management is not applicable.

Commercially Sensitive Information

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

Further Information

Not applicable.

2 SAFEGUARDS

2.1 No Net Harm

The potential negative environmental impacts of the Project have been analysed by a third-party company; please refer to Section 2.3 for details. With necessary mitigation measures taken, there are no negative environmental impacts due to the Project.

The Project brings many socio-economic benefits to local people, as mentioned in Section 1.17. The Project does not result in any negative socio-economic impacts.

In conclusion, the construction and operation of the Project does not result in any significant environmental impacts or any negative socio-economic impact.

2.2 Local Stakeholder Consultation

The procedures or methods used for engaging local stakeholders

The local stakeholders identified by the project proponent include personnel of Xintian coal mine, local residents around the project area as well as government officials. Prior to the Project construction, the project proponent decided that the local stakeholder consultation would be conducted by means of a questionnaire survey. The project proponent put up public announcements on bulletin boards at Xintian coal mine and at villages near the project site; also, the project proponent contacted the local government and the Ecology and Environment Bureau by phone. The general information about the Project, the date (20-August-2019) and the purpose of the questionnaire survey as well as the project proponent's phone number and email address were clearly conveyed via these public announcements and phone calls. On 20-August-2019,

stakeholders from local government gathered at a conference room of Xintian coal mine to participate in the questionnaire survey; on the other hand, the project proponent visited the villages and Xintian coal mine, and directly distributed printed questionnaires to people and workers there.

During this monitoring period, the project proponent adopted the same approach of stakeholder consultation: putting up public announcements at the coal mine and at the villages, and making phone calls to the government agencies, to inform the stakeholders of the upcoming questionnaire survey. Likewise, the questionnaire survey for the government officials took place at a conference room of Xintian coal mine; the questionnaire survey for the villages and the coal mine was conducted by on-site visiting and *distributing questionnaires*.

The procedures or methods used to document the local stakeholder consultation outcomes

The project proponent conducted local stakeholder consultation by distributing survey questionnaires in August 2019, to get informed of their opinion about the Project in various aspects. The surveyed stakeholders varied in age, gender, occupation and educational background, as shown in **Table 2.1**.

Table 2.1 Basic information of the stakeholders surveyed in August 2019

Distribution		Number	Percentage
Item			
Gender	Male	28	56%
	Female	22	44%
Age	<25	3	6%
	25-45	20	40%
	45-60	15	30%
	>60	12	24%
Education	Junior high school or below	23	46%
	Senior high school	19	38%
	College or above	8	16%
Occupation	Farmer/peasant	15	30%
	Worker	16	32%
	Management personnel	8	16%
	Self-employed	5	10%
	Civil servant	4	8%
	Unspecified	2	4%

A total number of 50 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. All respondents know or hear about the Project. Most of them are supportive of the project construction and believe that the Project will bring more benefit than loss. 74% of the respondents have confirmed their willingness to participate in the construction and/or operation of the Project.

82% of the respondents believe that the Project will not have any environmental impact, but a few respondents are concerned about the potential negative environmental impacts.

Regarding the coal mine production safety, 94% of the respondents consider that the Project will improve the operational safety of the coal mine to some extent.

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 in August 2019

No.	Questions	Response	Number	Percentage
1	Are you informed of the Project?	Very much	41	82%
		A little	9	18%
		Not at all	0	0%
2	What is your overall attitude towards the construction of the Project?	Supportive	47	94%
		Against	0	0%
		Indifferent	3	6%
3	What do you think will be the major environmental impact of the Project? (multiple choices possible)	None	41	82%
		Air pollution	4	8%
		Water pollution	2	4%
		Noise pollution	4	8%
		Harm to animals and plants	1	2%
		No idea	2	4%
4	Do you believe that the project operation will bring more benefit than loss?	Yes	50	100%
		No	0	0%
		No idea	0	0%
5	Are you willing to participate in the project construction and/or operation?	Yes	37	74%
		No	2	4%
		Indifferent	11	22%
6		Positive	36	72%
		None	14	28%

	What influence do you think the Project will bring to you and your family?	Negative	0	0%
7	What kind of effect do you think the project operation will have on the production safety of the coal mine?	Positive effect	47	94%
		None	3	6%
		Negative effect	0	0%
8	What kind of impact do you think the Project will bring to the local employment?	Increase	50	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	48	96%
		Negative	0	0%
		No impact	2	4%
10	What kind of impact do you think the Project will bring to the local power supply?	Increase	47	94%
		Decrease	0	0%
		No impact	3	6%

In conclusion, the implementation of the Project is regarded as beneficial by most of the local stakeholders. Regarding the concerns that several respondents expressed over air pollution, water pollution, noise and harm to animals and plants, the project proponent explained the requirements of national and industry standards that have to be followed as well as the mitigation measures taken: sealing transportation, wet operation, road spray, use of high-quality gasoline, installation of vehicle exhaust purification units, etc. would be implemented to mitigate the negative impacts on air quality; the construction wastewater and domestic wastewater would be collected in a sedimentation tank and then recycled to be used in road spray; the use of high-noise equipment would be strictly prohibited during the lunch break (from noon to 2 pm) and during the night (from 10 pm to 6 am), along with other noise-mitigation actions such as use of mufflers and other sound insulation measures, to meet the requirements of the national standard *Emission Standard of Environment Noise for Boundary of Construction Site* (GB 12523-2011); after the construction, planting activities would take place on the project sites to minimize the negative impact on local vegetation, and the impact on wild animals is negligible as the animals still have a vast area of habitats near the project sites.

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 for each of the power plants, communications between local residents and authorities.

During this monitoring period, the project proponent conducted a questionnaire survey among local stakeholders in April 2021. Fifty questionnaires were distributed and all questionnaires have been recollected. The basic information about the survey respondents is listed in **Table 2.3**.

Responses and comments from these questionnaires are summarized in **Table 2.4**. Nearly all respondents believed that the project had positive impact on local employment, economy, power supply and underground mining safety. 98% of the respondents expressed their support towards the project. No negative comments were received for the project.

Table 2.3 Information about the stakeholders surveyed in April 2021

Distribution		Number	Percentage
Item			
Gender	Male	28	56%
	Female	22	44%
Age	<25	4	8%
	25-45	21	42%
	45-60	18	36%
	>60	7	14%
Education	Junior high school or below	24	48%
	Senior high school	17	34%
	College or above	9	18%
Occupation	Worker	24	48%
	Farmer/peasant	9	18%
	Management personnel	6	12%
	Civil servant	9	18%
	Unspecified	2	4%

Table 2.4 Summary of the survey results in April 2021

No.	Questions	Response	Number	Percentage
1	Are you informed of the Project?	Very much	47	94%
		A little	3	6%
		Not at all	0	0
2		Supportive	49	98%
		Against	0	0

	What is your general attitude towards the Project?	Indifferent	1	2%
3	What do you think are the major environmental impacts of the Project? (multiple choices possible)	None	49	98%
		Air pollution	0	0
		Water pollution	0	0
		Noise pollution	0	0%
		Harm to animals and plants	0	0%
		No idea	1	2%
4	Do you believe that the Project operation brings more benefit than loss?	Yes	50	100%
		No	0	0
		No idea	0	0
5	Are you willing to participate in the Project operation?	Yes	45	90%
		No	3	6%
		Indifferent	2	4%
6	What influence do you think the Project brings to you and your family?	Positive	47	94%
		None	3	6%
		Negative	0	0
7	What kind of effect do you think the Project operation has on the production safety of the coal mine?	Positive effect	50	100%
		None	0	0
		Negative effect	0	0
8	What kind of impact do you think the Project brings to the local employment?	Increase	50	100%
		No impact	0	0
		Decrease	0	0
9	What kind of impact do you think the Project brings to the local economy?	Positive	50	100%
		No impact	0	0
		Negative	0	0
10	What kind of impact do you think the Project will bring to the local power supply?	Increase	44	88%
		No impact	6	12%
		Decrease	0	0

The mechanism for ongoing communication with local stakeholders

Besides questionnaire surveys that take place regularly during the project implementation, local stakeholders can also raise their concerns and opinions directly by making a phone call to the

project proponent. In addition, the project proponent informs the local authorities of key implementation events or changes of the project, then the local authorities inform the residents around the project site, 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.

How due account of all and any input received during the consultation has been taken

As described earlier, when some of the stakeholders expressed their concerns in the questionnaire surveys, the project proponent explained related issues including the measures to be taken. The project proponent also organizes internal meetings to ensure that the project operation complies with requirements in the EIA form and applicable laws, regulations and national standards.

2.3 Environmental Impact

The project proponent has entrusted a qualified third party, Guizhou Yining Environmental Technology Consulting Co., Ltd., to conduct the environmental impact assessment (EIA) on the Project. The EIA form, completed by the third party, has been approved by the Ecology and Environment Department of Bijie City. The environmental impacts and associated mitigation measures are summarized as following.

1. Construction Phase

1.1 Air pollution

Dust from machinery use and from transport of construction materials and waste as well as exhaust gas from vehicles and machineries are major impacts on air quality during the construction. Appropriate measures shall be taken to minimize the impacts, including sealing transportation, wet operation, road spray, use of high-quality gasoline, installation of vehicle exhaust purification units, etc. The requirements set out in the national standard *Comprehensive Emission Standard of Air Pollutants* (GB16297-1996) should be strictly followed.

1.2 Wastewater

During the construction, wastewater results from both construction and domestic water use. It is estimated that 2 m³ domestic wastewater, 1 m³ regular construction wastewater and 0.5 m³ oil-containing construction wastewater are generated per day. Both the construction wastewater and domestic wastewater are collected in a sedimentation tank and then recycled to be used in road spray.

1.3 Noise

Noise during the construction period is mainly generated by the construction machineries and vehicles. To minimize noise pollution, low-noise equipment is employed as much as possible, the use of high-noise equipment is strictly prohibited during the lunch break (from noon to 2 pm),

and during the night (from 10 pm to 6 am). Use of mufflers and other sound insulation measures must be carried out on high-noise equipment. The noise control shall meet the requirements of the national standard *Emission Standard of Environment Noise for Boundary of Construction Site* (GB 12523-2011).

1.4 Solid waste

Solid waste during the construction period includes construction waste and domestic waste. Waste rocks and soil generated from excavation are temporarily stored at the construction site and used in earthwork backfilling after the end of the construction. Other construction waste, estimated to be 8.24 t during the construction phase, is either recycled/backfilled (around 15%) or sent to the landfill site. Domestic garbage is estimated to 25 kg per day, and is collected in bins and transported to the landfill site regularly.

1.5 Impact on the ecosystem

The project site is not located within any ecological redline zone¹⁸, according to *Map of the Ecological Redlines in Guizhou Province* published by the government of Guizhou. Original vegetation on the project site is damaged due to the construction; after the construction, planting and soil remediation will take place on the project site to restore the original ecological condition, so that the negative impact on the ecosystem is temporary and minimal.

2. Operation Phase

2.1 Air pollution

The power generators release CO₂, SO₂, NO_x, total suspended particulate (TSP), etc. It is estimated that the Project releases 1.91 tonnes of soot, 7.54 tonnes of NO_x and 3.90 tonnes of SO₂ per year. The TSP and NO_x emissions meet the Period V requirements in the national standard *Limits and Measurement Methods for Exhaust Pollutants from Compression Ignition and Gas Fueled Positive Ignition Engines of Vehicles (III, IV, V)* (GB 17691-2005).

2.2 Wastewater

The domestic wastewater is treated in a sedimentation tank. Circulating cooling water does not contain any pollutants. Other wastewater generated during the operation is used in dust-controlling road spray or vegetation watering.

2.3 Noise

Noise is generated by the CMM generators, cooling towers and circulating water pumps. Mufflers and vibration dampers have been designed for the machinery. The generators and the pumps are located inside of buildings, which are built with reinforced concrete and soundproof materials. The cooling towers, however, are built outdoors; mufflers are installed at their air inlets and outlets, and porous polyurethane foam pads are installed to further reduce the noise. Noise

¹⁸ The ecological redlines demarcate areas that provide important ecological services with the aim of protecting them.

emission from the project operation complies with Category 2 requirements in the national standard *Emission Standard for Industry Enterprise Noise at Boundary* (GB 12348-2008) both during the daytime and the night, and the environmental noise at the residential settlement satisfies Category 2 requirements in the national standard *Environmental Quality Standard for Noise* (GB 3096-2008).

2.4 Solid waste

Domestic solid waste is collected in bins and transported to the landfill site. Dust and sludge collected from the gas filters and the sedimentation tanks are collected and then removed by staff members from the sanitation department. Harmful or dangerous solid waste, such as waste oil, are stashed temporarily in a storage room before being transported and treated by a qualified company; the collection, storage, transport and handling of dangerous solid waste shall comply with *Standard for Pollution Control on the Storage and Disposal Site for General Industrial Solid Wastes* (GB 18599-2001).

In conclusion, the environmental impacts during the construction are temporary and not significant, and the environmental impacts during the operation are minor. The project proponent takes appropriate measures to minimize negative environmental impacts.

2.4 Public Comments

The Project was open for public comments for a month from 02-February-2022 to 04-March-2022 on the Verra Registry (<https://registry.verra.org/app/projectDetail/VCS/2762>). No comments were received.

2.5 AFOLU-Specific Safeguards

Not applicable.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

The Project applies the large-scale consolidated methodology ACM0008 “Abatement of methane from coal mines” (version 08.0):

<https://cdm.unfccc.int/methodologies/DB/YSD3FQ5WR3VPC9Q64CDTLXHLFVKKKU>

The Project also applies the associated tools listed below:

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

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

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

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

TOOL02: Combined tool to identify the baseline scenario and demonstrate additionality (version 07.0), hereafter referred to as “TOOL02 (version 07.0)”:

<https://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-02-v7.0.pdf>

TOOL24: Common practice (version 03.1), hereafter referred to as “TOOL24 (version 03.1)”:

<https://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-24-v1.pdf>

TOOL27: Investment analysis (version 11.0), hereafter referred to as “TOOL27 (version 11.0)”:

<https://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-27-v11.0.pdf>

3.2 Applicability of Methodology

The Project meets all the applicability criteria set out in the methodology ACM0008 (version 08.0) and the applied methodological tools, shown in **Table 3.1**.

Table 3.1 Applicability of the methodology and the tools

ACM0008 “Abatement of methane from coal mines” (version 08.0)	
Applicability criteria	The Project
This methodology applies to project activities that aim for the use and/or destruction of the methane extracted/ obtained from a working or abandoned coal mine(s). The project activities include any of the following methods to treat the methane captured: (a) The methane is destroyed without energy production, for example through flaring; (b) The methane is used to produce energy. This may include electricity, heat, vehicle fuel, etc.	Applicable. The project uses the low concentration CMM extracted from the coal mine for power generation to supply electricity to the coal mine where the Project is located. Therefore, scenario (b) is applicable to the Project.

Emission reductions can be claimed for displacing or avoiding energy from other sources.	Applicable. The Project displaces an amount of electricity that would otherwise have been supplied by CSPG, achieving emission reductions which will be calculated and claimed.
Methane used in the project activities shall be extracted using the following techniques: (a) Surface drainage boreholes to capture coal bed methane (CBM) or methane from open cast mines; (b) Underground boreholes in the mine, surface goaf wells, underground boreholes, gas drainage galleries or other goaf gas capture techniques, including gas from sealed areas, to capture coal mine methane (CMM); (c) Mine ventilation system to dilute and remove ventilation air methane (VAM); (d) Surface drainage boreholes in the case of sealed abandoned mines or ventilation system in the case of ventilated mines to capture abandoned mine methane (AMM).	Applicable. The Project uses underground boreholes in the mine to capture CMM. The project activity does not involve the extraction or utilization of CBM, VAM or AMM.
The remaining share of the methane, to be diluted for safety reason, may still be vented.	Applicable. Prior to the project initiation, the extracted CMM was directly and completely vented; the Project utilizes the extracted CMM for power generation. The remaining unused share of the methane is still vented for safety reasons.
In the case of open cast mines, in addition to the conditions listed above, project activities should meet the following requirements: (a) The mines should have had a working mining concession for at least three years prior to the start of project; (b) Only pre-mining drainage from wells placed within the area to be mined are eligible for crediting; (c) For the calculation of emission reductions, all provisions for CBM should be followed for the open cast mine methane.	The coal mine involved in the Project is not an open cast mine.
The methodology does not apply to project activities with any of the following features:	The Project did not use CO ₂ or any other fluid/gas for CBM drainage before mining

(a) Capture/use of virgin coal bed methane, e.g., methane extracted from coal seams for which there is no valid coal mining concession; (b) Use CO₂ or any other fluid/gas to enhance CBM drainage before mining takes place; (c) Methane extraction from abandoned mines that are flooded due to regulation.	took place. In fact, the Project does not involve the extraction or utilization of CBM. The Project does not use CMM from open cast mining or abandoned mines.
The methodology does not apply to project activities that involve use and/or destruction of CBM or OCM if the baseline scenario identification resulted in partial use and/or destruction of CBM or OCM.	The Project does not involve use and/or destruction of CBM or OCM.
Emission reductions due to the use and/or destruction of CBM or OCM cannot be claimed if surface drainage to capture CBM or methane from open cast mine(s) is used within the project boundaries prior to the implementation of the project activity.	The Project does not involve use and/or destruction of CBM or OCM.
Combined tool to identify the baseline scenario and demonstrate additionality (version 07.0)	
Applicability criteria	The Project
The tool is applicable to all types of proposed project activities. However, in some cases, methodologies referring to this tool may require adjustments or additional explanations as per the guidance in the respective methodologies. This could include, inter alia, a listing of relevant alternative scenarios that should be considered in Step 1, any relevant types of barriers other than those presented in this tool and guidance on how common practice should be established	Applicable. The Project is a CMM power generation project.
Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (version 03.0)	
Applicability criteria	The Project
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:	Applicable. When out of operation or in abnormal operation, the Project consumes a small

(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 grid.	amount of electricity supplied by China Southern Power Grid (CSPG) (Scenario A).
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 supplies the coal mine; part of the electricity produced by the Project is exported to CSPG after the coal mine demand is fully met. Therefore, Scenario III is applicable.
This tool is not applicable in cases where captive renewable power generation technologies are installed to provide electricity	No captive renewable power generation technologies are installed to provide

in the project activity, in the baseline scenario or to sources of leakage. The tool only accounts for CO ₂ emissions.	electricity in the project activity, in the baseline scenario or to sources of leakage.
Tool to calculate the emission factor for an electricity system (version 07.0)	
Applicability criteria	The Project
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 utilizes low concentration CMM from coal mines for power generation to provide the coal mine with electricity that would otherwise have been supplied by CSPG. Therefore, the 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 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.	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 criterion.
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 calculation of the emission factor considers the emission of biofuels as zero.
Common practice (version 03.1)	
Applicability criteria	The Project
This methodological tool is applicable to project activities that apply the methodological tool “Tool for the demonstration and assessment of additionality”, the methodological tool “Combined tool to identify the baseline scenario and demonstrate additionality”, or baseline and monitoring methodologies that use the common practice test for the demonstration of additionality.	Applicable, as the project activity uses “Combined tool to identify the baseline scenario and demonstrate additionality”.
In case the applied approved baseline and monitoring methodology defines approaches for the conduction of the common practice test that are different from those described in this methodological tool, the requirements contained in the methodology shall prevail.	The applied approved baseline and monitoring methodology is “Combined tool to identify the baseline scenario and demonstrate additionality”, according to which the latest version of “Common practice” shall be applied. The methodology does not contain common practice approaches that are different from this methodological tool.
Investment analysis (version 11.0)	
Applicability criteria	The Project
This methodological tool is applicable to project activities that apply the methodological tool “Tool for the demonstration and assessment of additionality”, the methodological tool “Combined tool to identify the baseline scenario and demonstrate additionality”, the guidelines “Non-binding best practice examples to demonstrate additionality for SSC project activities”, or baseline and monitoring methodologies that use the investment analysis for the demonstration of additionality and/or the identification of the baseline scenario.	Applicable, as the project activity applies “Combined tool to identify the baseline scenario and demonstrate additionality”.

In case the applied approved baseline and monitoring methodology contains requirements for the investment analysis that are different from those described in this methodological tool, the requirements contained in the methodology shall prevail.	The applied approved baseline and monitoring methodology is “Combined tool to identify the baseline scenario and demonstrate additionality”. It does not contain investment analysis requirements that are different from the methodological tool.
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3.3 Project Boundary

As per ACM0008 (version 08.0), the spatial extent of the project boundary comprises:

- (a) The coal mine from where the methane is extracted;

For the Project, Xintian coal mine, from which the methane is extracted, should be included in the project boundary.

- (b) All equipment installed and used for the extraction, purification, compression, and storage of methane and transport to an off-site user;

For the Project, there is no equipment for compression, storage of methane or transport to an off-site user. The equipment for CMM extraction is included in the project boundary.

- (c) Facilities that are installed and used as part of the project activity for flaring, flameless oxidation, captive power and heat generation, gas production and transportation;

For the Project, the CMM delivery system, CMM power generation units and waste heat recovery units are installed and used as part of the project activity; these facilities are hence included in the project boundary. No facilities for flaring or flameless oxidation are involved.

- (d) Power plants connected to the electricity grid, where the project activity exports power to the grid and emission reductions are claimed for the displacement of grid emissions, as per the definition of project electricity system and connected electricity system given in the latest version of the “Tool to calculate the emission factor for an electricity system”.

For the Project, the applicable electricity system is China Southern Power Grid (CSPG), and the connected electricity systems are Central China Power Grid (CCPG) and East China Power Grid (ECPG). Therefore, power plants connected to CSPG, CCPG and ECPG are included in the project boundary.

Therefore, the project boundary includes Xintian coal mine, equipment for CMM extraction, the CMM delivery system, CMM power generation units and waste heat recovery units as well as power plants connected to CSPG, CCPG and ECPG.

The equipment, systems and flows of gas and energy within the project boundary are shown in **Figure 3.1**. The main emission sources and gases included in the project boundary are listed in **Table 3.2**.

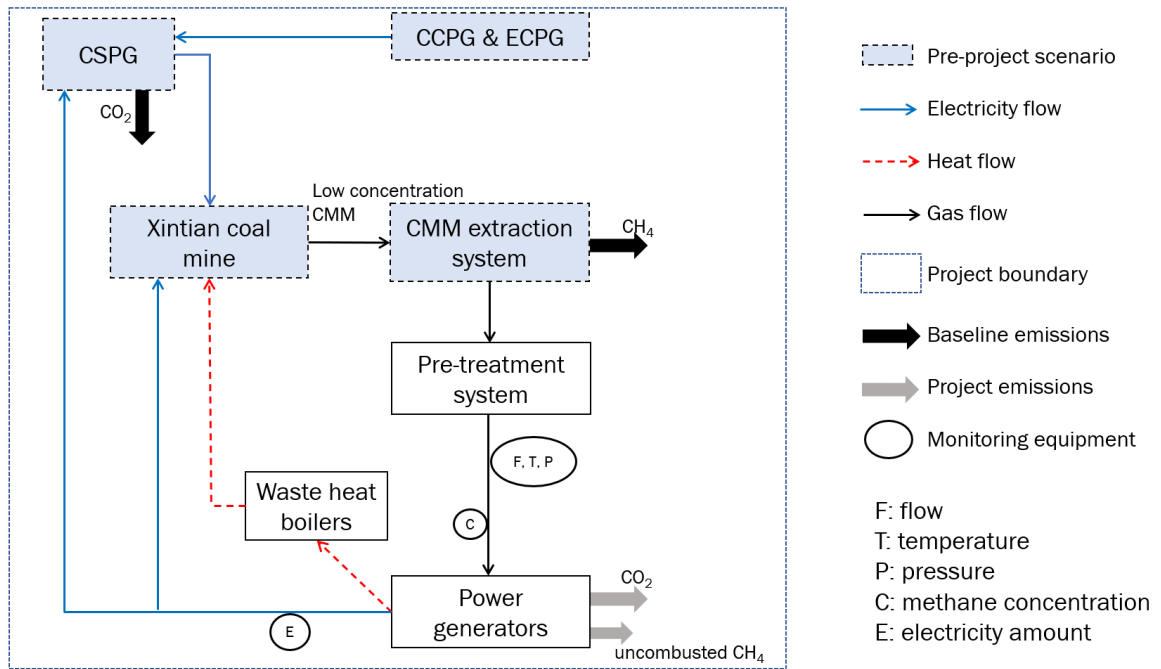


Figure 3.1 Diagram of the project boundary

Table 3.2 Emission sources included in or excluded from the project boundary

	Source	Gas	Included?	Justification/Explanation
Baseline	Methane emissions as a result of venting	CH ₄	Yes	Main emission source. All CMM captured and sent to power generators would have been directly vented into the air in the baseline scenario.
	Emissions from destruction of methane	CO ₂	No	The baseline scenario does not involve flaring or energy use of CMM.
		CH ₄	No	Excluded for simplification.
		N ₂ O	No	Excluded for simplification.
	Electricity generation (electricity provided to the grid and/or to the captive user), heat and vehicle fuel use	CO ₂	Yes	Included because the project activity replaces grid electricity, and emission reductions are claimed for such displacement.
		CH ₄	No	Excluded for simplification.
		N ₂ O	No	Excluded for simplification.
Project	Emissions of methane as a result of continued venting	CH ₄	No	The Project takes into account only the change in CMM emissions; this will be calculated by monitoring the amount of methane used or destroyed by the project activity.
	On-site electricity and fuel consumption due to the project activity, including transport of the gas	CO ₂	Yes	The Project consumes electricity when the generators are shut down. During normal operation, all auxiliary demand can be met by the electricity generated. Other than CMM, the Project does not consume any fossil fuel under any circumstance.
		CH ₄	No	Excluded for simplification. This emission source is assumed to be very small.

Source	Gas	Included?	Justification/Explanation
	N ₂ O	No	Excluded for simplification. This emission source is assumed to be very small.
Emissions from methane destruction	CO ₂	Yes	Emissions from the combustion of CMM in gas engines in the project activity will be considered.
Fugitive emissions of unburned methane	CH ₄	Yes	Unburned methane released from gas engines will be considered.
Fugitive methane emissions from on-site equipment	CH ₄	No	Excluded for simplification. This emission source is assumed to be very small.

3.4 Baseline Scenario

As per ACM0008 (version 08.0), the latest approved version of the “Combined tool to identify the baseline scenario and demonstrate additionality”, i.e., TOOL02 (version 07.0), shall be applied to identify the baseline scenario. The following steps are applied as per this tool.

Step 0: Demonstration whether the proposed project activity is the first-of-its-kind

The Project is not the first-of-its-kind.

Step 1: Identification of alternative scenarios

This step serves to identify all alternative scenarios to the proposed project activity which can be the baseline scenario.

Sub-step 1a: Define alternative scenarios to the proposed project activity

This Project Description identifies all alternative scenarios that provide the same output (service or product) as the project activity from the following aspects.

Options to handle methane to comply with safety regulations

As per ACM0008 (version 08.0), the baseline scenario alternatives should include all feasible options to handle methane to comply with safety regulations. These alternatives may include, inter alia:

- H1. Extraction of methane prior to the mining (CBM/OCM);
- H2. Extraction of methane during and after the mining (CMM);

- H3. Extraction of methane through ventilation during the mining;
- H4. Extraction of methane from the abandoned mine;
- H5. Possible combinations of options H1 to H4 with the relative shares of gas specified.

Options to deal with methane

The baseline scenario alternatives should include all feasible options to deal with methane. These options could include:

- D1. Venting of methane;
- D2. Flaring of methane;
- D3. Use of methane for energy production, e.g., electricity generation, heat generation, vehicle fuel, gas production, etc.
 - D3.1 Use of methane for electricity generation;
 - D3.2 Use of methane for heat generation;
 - D3.3 Use of methane as vehicle fuel or for gas production;
- D4. Possible combinations of options D1 to D3 with the relative shares of gas specified.

Options for baseline source of energy that is displaced by the project

As per ACM0008 (version 08.0), if a project activity includes energy production, the baseline scenario alternatives should also identify the baseline source of energy that is displaced by the project. Feasible options for baseline source of energy that is displaced by the Project at the coal mine include:

- E1. Equivalent quantity of electricity supplied from CSPG;
- E2. The proposed project activity not undertaken as a VCS project activity;
- E3. Construction of a captive power plant using coal or other fossil fuels with equivalent power supply;
- E4. Construction of a captive power plant using renewable energy resources, e.g., hydro, solar or wind power.

Sub-step 1b. Consistency with mandatory applicable laws and regulations:

Any options listed in Sub-step 1a that do not meet with applicable laws and regulations should be eliminated.

Eliminate options to handle methane to comply with safety regulations

According to the latest version of *National Coalmine Safety Regulation* (2016)¹⁹ issued by the State Administration of Work Safety of China and in effect since 01/10/2016, the coal mine must be equipped with a complete independent ventilation system and a gas drainage system to ensure the underground safe production; therefore, the pumping system must be installed. Under normal circumstances, the pre-mining extraction and the extraction during mining are carried out through the same set of pumping system, so it is difficult to separate the extraction prior to the mining and the extraction during and after the mining. Therefore, it does not comply with the regulations to carry out pre-mining extraction, during and post-mining extraction separately, and the combination of the two methods must be adopted; the options H1 and H2 are excluded. Regarding Option H3, the methane concentration of the gas extracted through ventilation during the mining is below 1% to ensure the safety production, and it cannot be used for electricity generation, which means that Option H3 is excluded. And since the coal mine involved in the Project is not an abandoned mine, Option H4 is excluded.

In conclusion, Option H5, combination of options H1 and H2, is in compliance with legal and regulatory requirements to handle methane to comply with safety regulations.

Eliminate options to deal with methane

Option D1 (venting of methane) complies with mandatory applicable laws and regulations; in fact, this is how methane was dealt with prior to the implementation of the Project.

According to *National Coalmine Safety Regulation* (2016), it is prohibited to flare CMM with a methane concentration below 30%. As the extracted CMM utilized in the Project has a low methane concentration below 30%, Option D2 (flaring of methane) does not comply with the regulations, and is hence eliminated.

Option D3 complies with laws and regulations; the sub-options from D3.1 to D3.3 are separately discussed below.

Option D3.1 (use of methane for electricity generation) and D3.2 (use of methane for heat generation) comply with laws and regulations.

For methane to be used as vehicle fuel or for gas production, the extracted CMM must be purified to achieve a high methane concentration and then transported to users or to factories through a high-pressure gas pipeline network, which is, however, not available in the mountainous area where the Project is located. The construction of a pipeline network would require huge investment, and such a project would have a very low IRR. It is not financially attractive to use the extracted CMM as vehicle fuel or for gas production. Option D3.3 (use of methane as vehicle fuel or for gas production) is excluded.

Option D4 refers to possible combinations of options D1 to D3 with the relative shares of gas specified. Since D2 has been eliminated, only D1 and D3 are left available for combination.

¹⁹ https://www.mem.gov.cn/gk/gwgg/agwzlf/zjl_01/201603/W020190705622814170708.pdf

However, as venting of methane and use of methane for energy production contradict with each other, these two options should not be combined into a single option. Option D4 is excluded.

In conclusion, Option D1 (venting of methane) and Option D3 (D3.1 and D3.2, use of methane for electricity and heat generation) are the applicable scenarios in compliance with legal and regulatory requirements.

Eliminate options for baseline source of energy that is displaced by the project

Option E3 is the construction of a captive power plant using coal or other fossil fuels with equivalent power supply. The total capacity of the power generators installed in the Project is 17.6 MW; therefore, the power plant to be constructed under Option E3 would have a similar capacity of around 17.6 MW. However, since 2002, the General Office of the State Council of China has banned the construction of coal-fired power plants with a capacity equal to or less than 135 MW in areas covered by the national grid²⁰. The construction of a power plant with a capacity of around 17.6 MW using coal, diesel oil, natural gas or other fossil fuel would not be approved by local authorities due to violation of the regulations. Option E3 is eliminated.

The other options for baseline source of energy, E1, E2 and E4, are all in compliance with applicable laws and regulations.

Based on the discussions above, the baseline alternative options that are technically feasible and comply with all legal and regulatory requirements are listed in **Table 3.3**.

Table 3.3 Baseline alternative options

Scenario	CMM extraction	CMM treatment	Baseline source of energy
Scenario 1 H5 + D1 + E1	Combinations of H1 and H2	Venting	Equivalent quantity of electricity supply from CSPG
Scenario 2 H5 + D1 + E2	Combinations of H1 and H2	Venting	The proposed project activity not undertaken as a VCS project activity
Scenario 3 H5 + D1 + E4	Combinations of H1 and H2	Venting	Power generation using renewable energy resources e.g., hydro, solar or wind power
Scenario 4 H5 + D3 + E1	Combinations of H1 and H2	Use of methane for electricity and heat production	Equivalent quantity of electricity supply from CSPG

²⁰ http://www.gov.cn/gongbao/content/2002/content_61480.htm

Scenario 5 H5 + D3 + E2	Combinations of H1 and H2	Use of methane for electricity and heat production	The proposed project activity not undertaken as a VCS project activity
Scenario 6 H5 + D3 + E4	Combinations of H1 and H2	Use of methane for electricity and heat production	Power generation using renewable energy resources e.g., hydro, solar or wind power

Scenario 1: this is the continuation of business-as-usual scenario and thus faces no barrier. It remains as a possible baseline scenario alternative.

Scenario 2: this scenario includes two sub-scenarios which conflict with each other: venting of methane and use of methane for energy production.

Scenario 3: this scenario includes electricity generation using renewable energy sources. However, the coal mining area where the Project is located lacks resources for solar power, hydropower, wind power and geothermal power generation. In addition, as the coal mine area is far from any crop field, the shortage of biomass supply would also hinder the development of a biomass power plant.

Scenario 4: this scenario includes two sub-scenarios which conflict with each other: use of methane for electricity production and equivalent quantity of electricity supply from CSPG.

Scenario 5: this scenario corresponds to the project activity not implemented as a VCS project activity, and it faces investment barriers, which will be discussed in Section 3.5.

Scenario 6: as previously explained for Scenario 3, the electricity generation using renewable energy sources in local area faces major barriers in lack of resources.

Based on the discussions above, scenarios 2, 3, 4 and 6 are eliminated. Regarding the two scenarios left (shown in **Table 3.4**), Scenario 5 is the project activity not undertaken as VCS project activity, and Scenario 1 is the continuation of business-as-usual scenario, the implementation of which is not prevented by any barriers identified.

Table 3.4 Baseline alternative options (as outcome of Step 1b)

Scenario	CMM extraction	CMM treatment	Baseline source of energy
Scenario 1 H5 + D1 + E1	Combinations of H1 and H2	Venting	Equivalent quantity of electricity supply from CSPG
Scenario 5 H5 + D3 + E2	Combinations of H1 and H2	Use of methane for electricity and heat production	The proposed project activity not undertaken as a VCS project activity

Step 2: Barrier analysis

Barrier analysis is not applied by the Project.

Step 3. Investment Analysis

The objective of Step 3 is to compare the economic or financial attractiveness of the alternative scenarios remaining after Step 2 by conducting an investment analysis. The latest approved version of the “Methodological tool: Investment analysis”, i.e., TOOL27 (version 11.0), shall be considered when applying this step.

The alternative scenarios of the Project include:

Scenario 1 (the business-as-usual scenario): venting of CMM does not create economic benefits, but no investment is required for this scenario. Therefore, the investment analysis will not be conducted for this scenario.

Scenario 5: the project activity is implemented without being registered as a VCS project activity. The investment analysis will be conducted for this scenario.

Simple cost analysis, investment comparison and benchmark analysis are three options available for the investment analysis. As the Project generates direct financial benefits from electricity sales, the simple cost analysis is not applicable. The investment comparison is not applicable, either, because the only alternative (Scenario 1, the business-as-usual scenario) is not an investment project and cannot be applied in comparison. Benchmark analysis is considered as the appropriate analysis method for Scenario 5, and IRR is identified as the financial indicator for the benchmark analysis.

According to *Interim Rules on Economic Assessment of Electrical Engineering Retrofit Projects*, the benchmark project IRR of the power industry was 8% for total investment (after tax). This benchmark has been widely recognized in China’s power industry and is thus applied to the benchmark analysis. The main parameters applied for IRR calculation are shown in **Table 3.6**. The IRR calculation results, with and without revenue from carbon credits, are shown in **Table 3.6**.

Table 3.6 Main parameters applied for IRR calculation

Parameter		Unit	Value	Source
Installed capacity		MW	17.6	FSR ²¹
Total static investment ²²		CNY	92,950,900	FSR
Working capital		CNY	700,000	FSR
Annual operating hour		hours	5,000	FSR
Plant load factor		%	57.08	Calculated
Annual electricity generation		MWh/year	88,000	Calculated
Power self-consumption ratio		%	6	FSR
Annual electricity exported		MWh/year	82,720	Calculated
Electricity tariff (including VAT)		CNY/MWh	464	FSR
Income tax		%	25	Law ²³
Value added tax (electricity)		%	16	FSR, China's NDRC ²⁴
Urban maintenance & construction tax		% of VAT	7	FSR
Surtax for education		% of VAT	5	FSR
Depreciation period		Year	10	FSR
Residual ratio		%	3	FSR
Annual O&M cost	Total	CNY	26,903,402	FSR
	Maintenance cost	CNY	2,086,171	FSR

²¹ The Feasibility Study Report of the Project is referred to as FSR.

²² The equipment for CMM extraction had already been installed prior to the implementation of the project activity. They are owned by the coal mines and are used primarily to maintain underground mining safety. Since they were not installed as part of the project activity, they are not considered in the investment analysis.

²³ The applicable law is *Enterprise Income Tax Law of the People's Republic of China*; refer to the link below for details: <http://www.chinatax.gov.cn/chinatax/n810341/n810825/c101434/c28479830/content.html>

²⁴ In 2018, China's National Development and Reform Commission (NDRC) reduced the VAT of electricity from 17% to 16%; the VAT of 16% was in effect since 01-May-2018, until it was further reduced to 13% in April 2019. Since the FSR of the Project was completed in December 2018, the VAT of 16% was reasonable. Refer to the links below for details:

http://www.gov.cn/zhengce/zhengceku/2018-12/31/content_5433828.htm

http://www.gov.cn/zhengce/zhengceku/2019-09/29/content_5435042.htm

	Staff salary and benefits	CNY	6,720,000	FSR
	Insurance cost	CNY	196,231	FSR
	Fuel cost	CNY	7,040,000	Calculated based on FSR ²⁵
	Other material cost ²⁶	CNY	6,509,000	FSR
	Other cost	CNY	4,352,000	FSR
Project operational lifetime		years	10	FSR
Expected VCU Price		CNY/tCO ₂ e	20	FSR

Table 3.6 Comparison of IRR values with and without revenue from carbon credits

Financial indicator	Without revenue from carbon credits	Benchmark rate	With revenue from carbon credits
Project IRR (after tax)	3.61%	8%	18.82%

It is concluded from the investment analysis that Scenario 5 (the Project implemented without being registered as a VCS project activity, and thus without revenue from carbon credits), would not be financially attractive.

A sensitivity analysis is conducted to assess whether the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions, i.e., whether the Project IRR without revenue from carbon credits would remain below the benchmark IRR. As per TOOL27 (version 11.0), variables, including the initial investment cost, that constitute more than 20% of either total project costs or total project revenues should be subjected to reasonable variation. During the project construction, the total static investment is the main project cost; during the project operation, the majority of project costs are O&M cost. Regarding project revenues, the electricity sales constitute the major part; since the electricity sales are directly influenced by the electricity tariff and operational hours²⁷, these two parameters should hence be subjected to variation.

In summary, the variables which are subjected to variation include:

- total static investment,

²⁵ Fuel cost is the product of fuel volume and fuel cost (0.2 CNY/m³). Fuel volume is estimated to be 35,200,000 m³ per year.

²⁶ Including water cost and oil cost

²⁷ Electricity sales = Operational hours × Installed capacity × (1 – Auxiliary electricity consumption rate) × Electricity tariff

- operational hours,
- electricity tariff, and
- annual O&M cost.

The IRR values with variations in these financial parameters are shown in **Table 3.7** and **Figure 3.2**.

Table 3.7 Sensitivity analysis of Project IRR to variations in financial parameters

	-10%	-5%	0	+5%	+10%
Total static investment	6.05%	4.78%	3.61%	2.53%	1.51%
Operational hours	-3.59%	0.19%	3.61%	6.72%	9.26%
Annual O&M cost	7.82%	5.87%	3.61%	1.21%	-1.36%
Electricity tariff	-3.59%	0.19%	3.61%	6.72%	9.26%

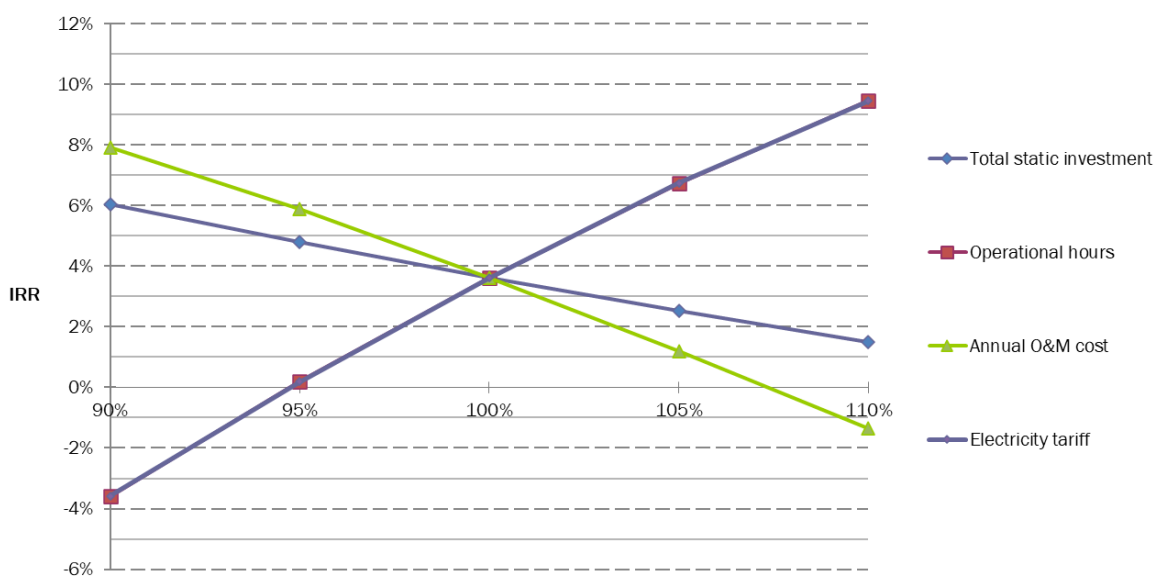


Figure 3.2 Sensitivity analysis of Project IRR to variations in financial parameters

Total static investment

Within $\pm 10\%$ variations in the total static investment, the project IRR ranges between 1.51% and 6.05%; it would reach the benchmark of 8% when the total static investment decreases by 17.2%.

According to data from the National Bureau of Statistics²⁸, the indices of fixed asset investment price were 102.6, 105.4, 105.8, 99.4 and 98.2 (the value of the previous year taken as 100) for the five years from 2015 to 2019, indicating an overall increasing investment cost. Besides, the investment of the Project has also reached 77,693,300 CNY, 83.6% of the initially estimated static investment, with more investment to come if the remaining 10 MW is to be installed. Therefore, the total static investment of the Project is unlikely to decrease by 17.2%.

Operational hours

If the number of operational hours increases by 7.3%, the corresponding project IRR would reach the benchmark of 8%. However, the value of operational hours applied in the IRR calculation has been carefully determined by considering both the generators and the coal mine conditions; at times of low methane concentration or CMM volume fluctuation, the generators would only run at partial loads, essentially reducing the effective operation hours assuming full load. In fact, according to the *monthly reports on electricity generation* of the Project, 53,921.980 MWh of electricity was generated during the reported monitoring period; considering the installed capacity of 7.6 MW, this amount of power generation corresponds to 7,095 hours²⁹ over a 521-day period (12,504 hours), equivalent to 4,970 hours within a 365-day period, less than 5,000 hours applied in the IRR calculation. It is reasonable to apply 5,000 hours in the calculation, and it is highly unlikely that it increases by 7.3%.

Electricity tariff

If the electricity tariff increases by 7.3%, the corresponding project IRR would reach the benchmark of 8%. However, the electricity tariff has been fixed by the electricity sales contracts; for the electricity supplied to the coal mine, it is 464 CNY/MWh according to the contract signed between the project proponent and the coal mine; for the electricity supplied to the grid, it is 471.3 CNY/MWh according to the transaction notes, only 1.6% higher than the value applied in Table 3.5. Therefore, it is highly unlikely that the electricity tariff would be subjected to any variation.

Annual O&M cost

The project IRR would reach the benchmark when the annual O&M cost decreases by 10.5%. Considering the composition of the annual O&M cost, the analysis focuses mainly on material cost, fuel cost and employee salary, as each of these three components constitutes more than 20% of the annual O&M cost.

According to data from the National Bureau of Statistics, the indices of urban employees' wages were 106.4, 109.1, 108.9, 108.2 and 107.2 (the value of the previous year taken as 100) for the last five years from 2016 to 2020, all higher than 100, indicating a continuous increase for these

²⁸ <https://data.stats.gov.cn/easyquery.htm?cn=C01>

²⁹ 53,921.980 MWh / 7.6 MW = 7,095 hours

years. It is reasonable to assume that the increasing trend will continue and the employees' payment is unlikely to reduce.

According to data from the National Bureau of Statistics, the purchase indices of industrial producers were 97.7, 99.3, 104.1, 108.1, 98.0 (the value of the previous year taken as 100) for the last five years from 2016 to 2020, with a compound annual growth rate of 1.36%. Considering the purchase indices of industrial producers over the last five years, a decrease by more than 10.5% is highly unlikely to occur.

Fuel cost is the product of fuel volume and fuel price. Fuel volume has been determined in the FSR by considering actual production conditions. Fuel price has been fixed at 0.2 CNY/m³ by the contract signed between the project proponent and the coal mine which supplies the extracted CMM. It is unlikely to change.

The investment analysis was also conducted by considering the two-step project construction in which the generators of 7.6 MW are first installed in Year 1, followed by 7.6 MW in operation in Year 2 to part of Year 4, and then the remaining 10 MW are installed in Year 4, allowing the total capacity of 17.6 MW in operation from the rest of Year 4 to Year 11. Other related parameters, including investment, amount of electricity generation and operation costs, have also been updated according to the corresponding installed capacity. The IRR calculated without revenue from carbon credits is 0.44%. The sensitivity analysis conducted in the same procedure shows the same results as analysed above.

Based on the investment analysis, the project activity not undertaken as a VCS project activity would not be financially attractive, and Scenario 5 is hence not the baseline scenario.

The only alternative scenario left is Scenario 1 (the continuation of business-as-usual scenario), which is thus the baseline scenario.

3.5 Additionality

During the project design stage, the project proponent seriously considered the important role that carbon revenues would play in improving the project profitability. The FSR completed before the project construction stated clearly that with carbon revenues taken into consideration, the Project would be feasible and financially attractive.

Step 4: Common practice analysis

The methodological tool "Common Practice (version 03.1)" is applied.

Sub-step 4-1: Calculate applicable capacity or output range as $\pm 50\%$ of the total design capacity or output of the proposed project activity

The installed capacity of the Project is 17.6 MW, and $\pm 50\%$ of the capacity is thus from 8.8 MW to 26.4 MW.

Sub-step 4-2: Identify similar projects (both CDM and non-CDM) which fulfil all of the following conditions:

- (a) The projects are located in the applicable geographical area.

As the grid structure, geological and transportation conditions and economic development level vary a lot from one province to another, only projects located in Guizhou Province are considered.

- (b) The projects apply the same measure as the project activity.

Therefore, only projects which generate power using CMM are considered.

- (c) The projects use the same energy source/fuel and feedstock as the proposed project activity, if a technology switch measure is implemented by the proposed project activity.

Therefore, only projects which use CMM are considered.

- (d) The plants in which the projects are implemented produce goods or services with comparable quality, properties and applications areas (e.g., clinker) as the proposed project plant.

Therefore, only projects which generate power are considered.

- (e) The capacity or output of the projects is within the applicable capacity or output range calculated in Step sub-step 4-1.

Therefore, only projects with a total capacity between 8.8 MW to 26.4 MW are considered.

- (f) The projects started commercial operation before the project design document is published for global stakeholder consultation or before the start date of proposed project activity, whichever is earlier for the project activity.

Under the CDM program, the start date is defined as the date on which the project participants commit to making expenditures for the construction or modification of the main equipment or facility, or for the provision or modification of a service; where a contract is signed for such expenditures, it is the date on which the contract is signed; if the project involves more than one of such contracts or incurred expenditures, it is the first of the respective dates. Regarding the Project, the first major contract signed was the *Construction Contract*, signed on 24-Sep-2019; this date is hence considered as the start date. Therefore, only projects which started commercial operation before 24-Sep-2019 are considered.

In summary, similar projects are defined as the CMM power generation projects in Guizhou Province with a total capacity between 8.8 MW to 26.4 MW which started commercial operation before 24-Sep-2019.

Sub-step 4-3: Within the projects identified in Sub-step 4-2, identify those that are neither registered CDM/VCS/CCER project activities, project activities submitted for registration, nor project activities undergoing validation. Note their number N_{all} .

For this sub-step, publicly available sources³⁰, China Electric Power Yearbook, the website of Guizhou Provincial Development and Reform Commission³¹, UNFCCC website³², Verra website³³, website of Clean Development Mechanism in China³⁴ and China Certified Emission Reduction Exchange Info-Platform³⁵ are consulted. No projects in Guizhou Province which fulfill all the conditions in Sub-step 4-2 and Sub-step 4-3 have been identified; therefore, $N_{all} = 0$.

Sub-step 4-4: Within similar projects identified in Sub-step 4-3, identify those that apply technologies that are different to the technology applied in the proposed project activity. Note their number N_{diff} .

Since $N_{all} = 0$, N_{diff} is also 0.

Sub-step 4-5: Calculate factor $F = 1 - N_{diff}/N_{all}$ representing the share of similar projects (penetration rate of the measure/technology) using a measure/technology similar to the measure/technology used in the proposed project activity that deliver the same output or capacity as the proposed project activity.

According to TOOL02 (version 03.1), the project activity is a “common practice” within a sector in the applicable geographical area if the factor F is greater than 0.2 and $(N_{all} - N_{diff})$ is greater than 3.

For the Project, since $N_{all} = 0$ and $N_{diff} = 0$, $N_{all} - N_{diff} = 0$, less than 3. Therefore, the project activity is not a “common practice”.

Therefore, the Project is additional.

3.6 Methodology Deviations

There is no methodology deviation involved.

4 ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

³⁰ <http://news.bjx.com.cn/zt.asp?topic=%CD%DF%CB%B9%B7%A2%B5%E7>

³¹ <http://fgw.guizhou.gov.cn/>

³² <https://cdm.unfccc.int/Projects/projsearch.html>

³³ <https://registry.verra.org/app/search/VCS/All%20Projects>

³⁴ <http://cdm.ccchina.org.cn/>

³⁵ <http://cdm.ccchina.org.cn/ccer.aspx>

4.1 Baseline Emissions

Based on the analysis in Section 3.4, the baseline scenario of the Project is the combination of H5 + D1 + E1:

- Combination of methane extraction prior to, during and after the mining;
- All extracted CMM was vented into the atmosphere directly;
- The electricity consumed at coal mine is supplied by CSPG.

As per the methodology ACM0008 (08.0), baseline emissions are determined in two steps.

Step A. Determination of methane eligible for crediting

For the Project, all captured CMM is eligible for crediting.

Step B. Determination of baseline emissions.

Baseline emissions would have occurred due to methane destruction, methane venting and use of other fossil fuels that are displaced by methane under the project activity. Baseline emissions due to venting should be discounted in case host country has regulations in place that are restricting the release of methane into the atmosphere.

Baseline emissions are calculated as follows:

$$BE_y = BE_{MD,y} + BE_{MR,y} + BE_{Use,y} \quad \text{Equation (1)}$$

Where:

BE_y	=	Baseline emissions in year y (tCO ₂ e)
$BE_{MD,y}$	=	Baseline emissions from destruction of methane in the baseline scenario in year y (tCO ₂ e)
$BE_{MR,y}$	=	Baseline emissions from release of methane into the atmosphere in year y that is avoided by the project activity (tCO ₂ e)
$BE_{Use,y}$	=	Baseline emissions from the production of power, heat or other forms of useful energy replaced by the project activity in year y (tCO ₂ e)

1. Methane destruction in the baseline

The baseline scenario does not involve any flaring or usage of CMM; therefore, there is no methane destruction in the baseline. $BE_{MD,y}$, baseline emissions from destruction of methane in the baseline scenario is 0.

2. Methane venting in the baseline

The amount of methane that would have been emitted to the atmosphere in the baseline scenario shall be determined as follows:

$$BE_{MR,y} = \sum_i \sum_s (MT_{PJ,s,i,y} - MT_{BL,s,i,y}) \times GWP_{CH_4} \quad \text{Equation (2)}$$

Where:

$BE_{MR,y}$	=	Baseline emissions from release of methane into the atmosphere in year y that is avoided by the project activity (tCO ₂ e)
$MT_{PJ,s,i,y}$	=	Methane from source s captured and destroyed by use i in the project activity in year y (t CH ₄)
$MT_{BL,s,i,y}$	=	Methane from source s that would have been captured and destroyed by use i in the baseline scenario in the year y (t CH ₄)
i	=	Use of methane (flaring, power generation, etc.)
s	=	Source of methane that would have been captured, sent to and destroyed by use i in the baseline scenario in the year y . This may include eligible CBM, CMM, VAM, eligible AMM and eligible OCM
GWP_{CH_4}	=	Global warming potential of methane (tCO ₂ e/tCH ₄)

As per VCS Standard v4.2, for GHG emission reductions occurring on or after 01-Jan-2021, all ex-ante estimates and ex-post calculations shall be converted to CO₂e using GWP values from the IPCC *Fifth Assessment Report* (AR5); for GHG emission reductions occurring on or before 31-Dec-2020, all ex-ante estimates and ex-post calculations may be converted to CO₂e using either the GWP values from the IPCC *Fourth Assessment Report* (AR4) or those from AR5. The Project applies GWP_{CH_4} value from AR5 for both ex-ante estimates and ex-post calculations and for GHG emission reductions occurring both before and after 01-Jan-2021. According to AR5, the 100-year GWP value of methane is 28 tCO₂e/CH₄.

In the baseline scenario, no CMM would have been captured and destroyed; therefore, $MT_{BL,s,i,y}$ is 0. Equation (2) is simplified as follows:

$$BE_{MR,y} = \sum_i \sum_s MT_{PJ,s,i,y} \times GWP_{CH_4} \quad \text{Equation (3)}$$

3. Baseline emissions from the production of power, heat or vehicle fuels

The baseline emissions from displacement of power or heat generation, or supply of vehicle fuels are given by the following equation:

$$BE_{Use,y} = \sum_k (EG_{Use,k,y} \times EF_{k,y}) \quad \text{Equation (4)}$$

Where:

$BE_{Use,y}$	=	Baseline emissions from energy displaced by the project activity in year y (t CO ₂)
$EG_{Use,k,y}$	=	Energy of type k displaced by the project activity in year y (energy unit)
$EF_{k,y}$	=	Baseline emissions factor for energy type k production in year y (t CO ₂ /energy unit)
k	=	Energy type displaced by the project activity

The waste heat from the generators of the Project is recovered by waste heat boilers to provide free hot water to the coal mine, which was provided by waste coal fired boilers before the implementation of the Project; however, to be conservative, emission reductions will not be claimed for such displacement. Also, the baseline scenario does not include vehicle operation fuelled by methane produced by the project activity, i.e., the project does not involve replacing vehicle fuel supply. The project activity replaces power generation that would have been supplied by the grid in the baseline scenario; the emission reductions achieved for such displacement will be calculated. Therefore, Equation (4) is simplified as follows:

$$BE_{Use,y} = EG_{Use,ELEC,y} \times EF_{ELEC,y} \quad \text{Equation (5)}$$

Where:

$EG_{Use,ELEC,y}$	=	Amount of electricity displaced by the project activity in year y (MWh)
$EF_{ELEC,y}$	=	Emission factor for displaced electricity in year y (tCO ₂ e/MWh)

As per the methodology, ACM0008 (version 08.0), if the baseline scenario includes power generation that would be replaced by the project activity, the emission factor for displaced electricity ($EF_{ELEC,y}$) is calculated as per the latest version of “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”, i.e., TOOL05 (version 03.0). When applying this tool, the electricity sources k in the tool³⁶ correspond to the sources of electricity generated identified in the selection of the most plausible baseline scenario, i.e., the grid as discussed earlier; $EC_{BL,k,y}$ (quantity of electricity that would be consumed by the baseline electricity consumption source k in year y) in the tool is equivalent to the net amount of electricity generated using methane in year y ($EG_{PJ,y}$). The determination of the baseline emission factor for electricity generation ($EF_{EL,k,y}$) depends on which scenario (A, B or C), as described TOOL05 (version 03.0), applies to the source of electricity consumption that would be displaced in the baseline by electricity generated in the project. The Project corresponds to Scenario A; Option A1 is selected: calculate the combined margin emission factor of the applicable electricity system (i.e., CSPG), using the procedures in the latest approved version of the “Tool to calculate the

³⁶ TOOL05 (version 03.0) applies different subscript notations than ACM0008 (version 08.0), which might lead to some confusion. The subscript k in TOOL05 (version 03.0) refers to baseline electricity consumption sources.

emission factor for an electricity system”, i.e., TOOL07 (version 07.0). Therefore, $EF_{EL,k,y} = EF_{grid,CM,y}$, and Equation (5) is equivalent to the equation below:

$$BE_{Use,y} = EG_{PJ,y} \times EF_{grid,CM,y} \quad \text{Equation (6)}$$

Where:

$$\begin{aligned} EG_{PJ,y} &= \text{Net amount of electricity generated using methane in year } y \text{ (MWh)} \\ EF_{grid,CM,y} &= \text{Combined margin emission factor of the applicable electricity system CSPG in year } y \text{ (tCO}_2\text{e/MWh)} \end{aligned}$$

Determination of the combined margin emission factor for power generation of CSPG

The combined margin emission factor of CSPG ($EF_{grid,CM,y}$) 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.

Step 1: Identify the relevant electricity systems.

The delineation of the electricity systems in China is provided by the Development and Reform Commission of China. Among the six regional power grids, China Southern Power Grid (CSPG) covers Guangdong Province, Guangxi Zhuang Autonomous Region, Yunnan Province, Guizhou Province and Hainan Province. Since the Project is located in Guizhou Province, CSPG is identified as the relevant electricity system, as has been discussed in Section 3.3. According to *2019 Baseline Emission Factors for Regional Grids in China*, there is net electricity imported from the Central China Power grid (CCPG) and East China Power Grid (ECPG) to the CSPG. Therefore, CCPG and ECPG are identified as the connected electricity systems.

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

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.

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

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 resources³⁷ 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 CSPG to which the project activity is connected, the low-cost/must-run power generation accounted for 37.73%, 45.53%, 49.44%, 50.92% and 50.91% 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 47.18% 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

³⁷ 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.

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.

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

The simple OM method is applied to calculate the OM emission factor, which is calculated as the generation-weighted average CO₂ emissions per unit net electricity generation (tCO₂/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units. It may be calculated by one of the two following options:

Option A: Based on the net electricity generation and a CO₂ 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:

$$EF_{grid,OMsimple,y} = \frac{\sum_i (FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y})}{EG_y} \quad \text{Equation (7)}$$

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 CSPG is 0.8042 tCO₂/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 5: Calculate the build margin (BM) emission factor.

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 ($AE_{SET-5-units}$, in MWh);

(b) Determine the annual electricity generation of the proposed project electricity system, excluding power units registered as CDM project activities (AE_{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 AE_{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 ($AE_{SET \geq 20\ percent}$, 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 ($AE_{SET-sample-CDM}$, 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. $AE_{SET-sample-CDM} \geq 0.2 \times AE_{total}$), 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 (tCO₂/MWh) of all power units m during the most recent year y for which electricity generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m (EG_{m,y} \times EF_{EL,m,y})}{\sum_m EG_{m,y}} \quad \text{Equation (8)}$$

Where:

$EF_{grid,BM,y}$ = Build margin CO₂ emission factor in year y (t CO₂/MWh)

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)

$EF_{EL,m,y}$ = CO₂ emission factor of power unit m in year y (t CO₂/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 clarifications³⁸ 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.

³⁸http://cdm.unfccc.int/UserManagement/FileStorage/AM_CLAR_OEJWJEF3CFBP1OZAK6V5YXPQKK7WYJ ("Request for clarification on use of approved methodology AM0005 for several projects in China", the EB's guidance on DNV deviation request)

- (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:

$$EG_{m,y} = CAP_m \times H_{m,y} \quad \text{Equation (9)}$$

Where:

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

$$CAP_m = CAP_{A,t,k} \quad \text{Equation (10)}$$

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 CSPG, namely, Guangdong Province, Guangxi Zhuang Autonomous Region, Yunnan Province, Guizhou Province and Hainan Province

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 CSPG

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 .

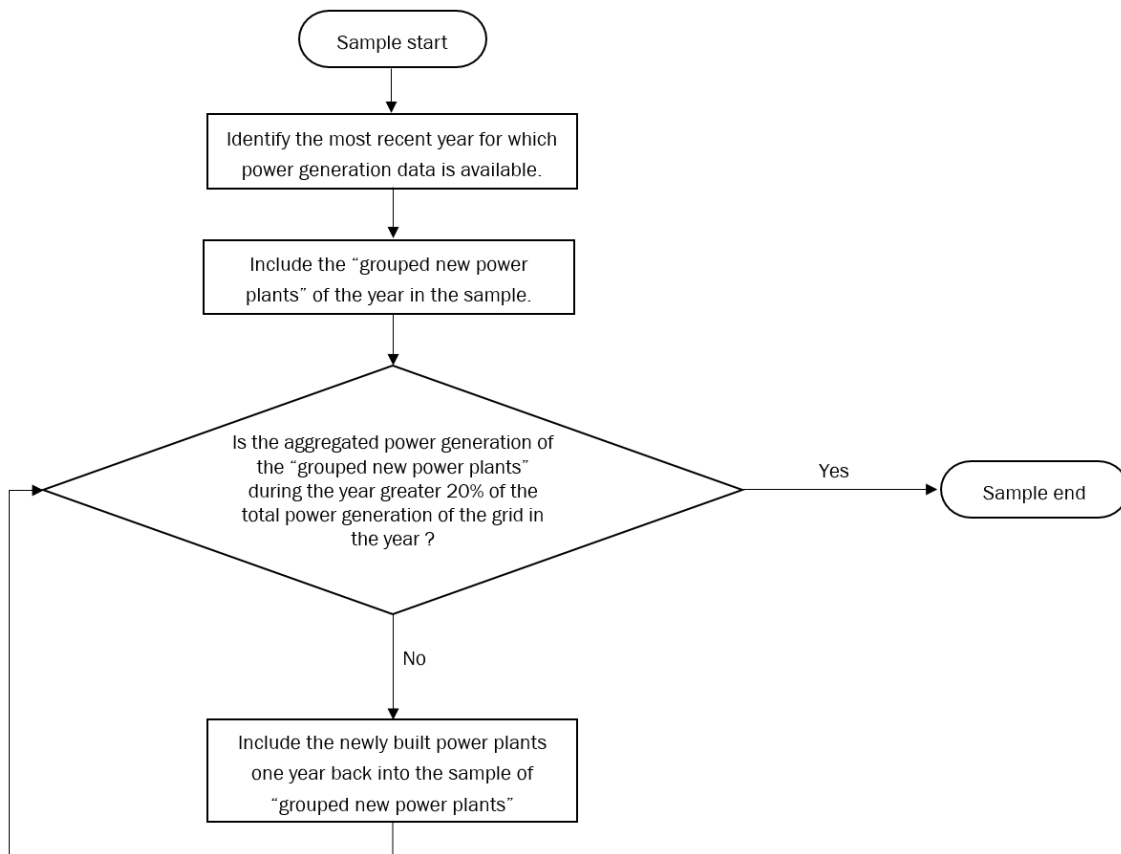


Figure 4.1 Procedure to determine the sample group of power units m

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:

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \times 3.6}{\eta_{m,y}} \quad \text{Equation (11)}$$

Where:

$EF_{EL,m,y}$ = CO₂ emission factor of power unit m in year y (t CO₂/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 (11) takes the following form, to be conservative:

$$EF_{best,m,y} = \frac{EF_{CO2,m,i,y} \times 3.6}{\eta_{best,y}} \quad \text{Equation (12)}$$

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 CSPG is 0.2135 tCO₂/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:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \quad \text{Equation (13)}$$

Where:

$EF_{grid,OM,y}$ = Build margin CO₂ emission factor in year y (tCO₂/MWh)

$EF_{grid,BM,y}$ = Operating margin CO₂ emission factor in year y (tCO₂/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:

$$EF_{grid,CM,y} = 0.8042 \times 50\% + 0.2135 \times 50\% = 0.50885 \text{ tCO}_2/\text{MWh}.$$

4.2 Project Emissions

As per the methodology ACM0008 (version 08.0), project emissions comprise the following sources:

- (a) Emissions from the energy use to capture and use methane;
- (b) Emissions from destruction of captured methane through production of various energy types and/or flaring and/or flameless oxidation;
- (c) Emissions from the un-combusted methane.

Project emissions are calculated as follows:

$$PE_y = PE_{ME,y} + PE_{MD,y} + PE_{UM,y} \quad \text{Equation (14)}$$

Where:

PE_y	=	Project emissions in year y (tCO ₂ e)
$PE_{ME,y}$	=	Project emissions from energy use to capture and use methane in year y (tCO ₂ e)
$PE_{MD,y}$	=	Project emissions from destruction of captured methane in year y (tCO ₂ e)
$PE_{UM,y}$	=	Project emissions from un-combusted methane in year y (tCO ₂ e)

1. Project emissions from the energy use to capture and to use methane

During the normal operation of the project activity, the additional electricity consumption required by the project activity to capture and utilize the CMM is supplied by the power generation of the project; only when the project is out of operation or in abnormal operation will there be a small amount of power consumed.

As per the methodology ACM0008 (version 08.0), emissions due to electricity consumption should be determined using the latest version of the “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”, i.e., TOOL05 (version 03.0), which gives a generic approach for calculation of project emissions from consumption of electricity based on the quantity of electricity consumed, an emission factor for electricity generation and a factor to account for transmission losses, as follows:

$$PE_{ME,y} = PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EF,j,y} \times (1 + TDL_{j,y}) \quad \text{Equation (15)}$$

Where:

$PE_{EC,y}$	=	Project emissions from electricity consumption in year y (tCO ₂ e)
$EC_{PJ,j,y}$	=	Quantity of electricity consumed by the project electricity consumption source j in year y (MWh)

$EF_{EF,j,y}$	=	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 the project is out of operation or in abnormal operation, the project consumes electricity from the grid. It is assumed for ex ante estimation that the amount of electricity consumed from the grid is zero ($EC_{PJ,j,y} = 0$), and this parameter will be monitored during the project operation as part of the monitoring plan.

The determination of the project emission factor for electricity generation ($EF_{EL,j,y}$) depends on which scenario (A, B or C), as described TOOL05 (version 03.0), applies to the source of electricity consumption that would be displaced in the baseline by electricity generated in the project. The Project corresponds to Scenario A; Option A1 is selected: calculate the combined margin emission factor of the applicable electricity system (i.e., CSPG), 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) ($EF_{EL,j,y} = EF_{grid,CM,y}$).

TOOL05 (version 03.0) sets out different default values of $TDL_{j,y}$ which correspond to different scenarios. As per this tool, 3% shall be used for project and leakage electricity consumption sources if the electricity consumption by all project and leakage electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies is smaller than the electricity consumption of all baseline electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies. The Project corresponds to Scenario A (Electricity consumption from the grid) described in TOOL05 (version 03.0); the electricity consumption by all project and leakage electricity consumption sources (which is 0 for ex ante estimation, which will be monitored during the project operation as per the monitoring plan) is smaller than the electricity consumption of all baseline electricity consumption sources (82,720 MWh annually according to the FSR), which justifies the use of 3% as default values for project and leakage electricity consumption sources for the project, i.e., $TDL_{j,y} = 3\%$.

2. Combustion emissions from use of captured methane

When the captured methane is burned in a flare, heat or power plant, or oxidized in a flameless oxidation unit, combustion emissions are released.

$$PE_{MD,y} = \sum_i MD_{i,y} \times CEF_{CH_4} \quad \text{Equation (16)}$$

Where:

$PE_{MD,y}$	=	Project emissions from methane destroyed in year y (tCO ₂ e)
$MD_{i,y}$	=	Methane destroyed through use i in year y (tCH ₄)

i = Use of methane (power generation, heat generation, supply to gas grid to various combustion end uses)

CEF_{CH_4} = Carbon emission factor for combusted methane. Set as 2.75 (tCO₂e/tCH₄)

In each end-use, the amount of methane destroyed depends on the efficiency of combustion of each end use and should be determined as follows:

$$MD_{i,y} = MM_{i,y} \times Eff_{i,y} \quad \text{Equation (17)}$$

Where:

$MD_{i,y}$ = Methane destroyed through use i in year y (tCH₄), which is equivalent to $MM_{ELEC,y}$.

$MM_{i,y}$ = Methane measured sent to use i in year y (tCH₄). For the Project, the only use of methane i is in power generation, so $MM_{i,y} = MM_{ELEC,y}$.

$Eff_{i,y}$ = Efficiency of methane destruction in use i in year y (%). For the Project, the only use of methane i is in power generation, so $Eff_{i,y} = Eff_{ELEC,y}$.

As explained previously, emission reductions will not be claimed for displacing heat supply to be conservative. Also, the project does not involve replacing vehicle fuel supply. The Project only involves methane destroyed through power generation. Therefore, Equation (16) is simplified as follows:

$$PE_{MD,y} = MD_{ELEC,y} \times CEF_{CH_4} = MM_{ELEC,y} \times Eff_{ELEC,y} \times CEF_{CH_4} \quad \text{Equation (18)}$$

Where:

$MD_{ELEC,y}$ = Methane destroyed through use of power generation in year y (tCH₄)

$MM_{ELEC,y}$ = Methane measured sent to use of power generation in year y (tCH₄)

$Eff_{ELEC,y}$ = Efficiency of methane destruction in use of power generation in year y

3. Project emissions from un-combusted methane

Not all of the methane sent to the flare, to the flameless oxidizer or used to generate power and heat will be combusted, so a small amount will be released to the atmosphere. These emissions are calculated as follows:

$$PE_{UM,y} = GWP_{CH_4} \times \sum_i MM_{i,y} \times (1 - Eff_{i,y}) \quad \text{Equation (19)}$$

Where:

$PE_{UM,y}$ = Project emissions from un-combusted methane in year y (tCO₂e).

GWP_{CH_4} = Global warming potential of methane (tCO₂e/tCH₄).

i	=	Use of methane (power generation, heat generation, supply to gas grid to various combustion end uses)
$MM_{i,y}$	=	Methane measured sent to use i in year y (tCH ₄). For the Project, the only use of methane i is in power generation, so $MM_{i,y} = MM_{ELEC,y}$.
$Eff_{i,y}$	=	Efficiency of methane destruction in use i in year y (%). For the Project, the only use of methane i is in power generation, so $Eff_{i,y} = Eff_{ELEC,y}$.

For the Project, Equation (19) is simplified as follows:

$$PE_{UM,y} = GWP_{CH_4} \times MM_{ELEC,y} \times (1 - Eff_{ELEC,y}) \quad \text{Equation (20)}$$

4.3 Leakage

As per the methodology ACM0008 (version 08.0), leakage may occur if the project activity prevents methane from being used to meet baseline thermal energy demand, whether as a result of physical constraints on delivery, or price changes.

Since no methane is used to meet the thermal energy demand of the baseline scenario, the leakage is taken as zero, i.e., $LE_y = 0$.

4.4 Net GHG Emission Reductions and Removals

According to the FSR of the Project, the amount of methane measured sent to use of power generation is estimated to be 35.2 million m³ (under normal conditions, i.e., 1 atm and 293.15 K) per year when the project is in full operation; as the density of methane under normal conditions is 0.67 kg/m³, i.e., 0.00067 t/m³ according to *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*, the amount of methane measured sent to power generation every year is calculated as follows:

$$MM_{ELEC,y} = 35.2 \times 10^6 \text{ m}^3 \times 0.00067 \text{ t/m}^3 = 23,584 \text{ tCH}_4.$$

1. Calculation of the baseline emissions (based on the total capacity of 17.6 MW)

1.1 Baseline emissions from methane destroyed

As described in Section 4.1, $BE_{MD,y} = 0$.

1.2 Baseline emissions from release of methane into the atmosphere

$$BE_{MR,y} = GWP_{CH_4} \times MT_{PJ,s,i,y} = 28 \text{ tCO}_2/\text{tCH}_4 \times 23,584 \text{ tCH}_4 = 660,352 \text{ tCO}_2\text{e}$$

1.3 Baseline emissions from power generation replaced by the project

$$\begin{aligned} BE_{Use,y} &= EG_{Use,k,y} \times EF_{ELEC,y} = EG_{PJ,grid,y} \times EF_{ELEC,y} \\ &= 82,720 \text{ MWh} \times 0.50885 \text{ tCO}_2/\text{MWh} = 42,096 \text{ tCO}_2\text{e} \end{aligned}$$

Therefore, baseline emissions are calculated as follows:

$$BE_y = BE_{MD,y} + BE_{MR,y} + BE_{Use,y} = 0 + 660,352 \text{ tCO}_2\text{e} + 42,096 \text{ tCO}_2\text{e} = 702,444 \text{ tCO}_2\text{e}$$

2. Calculation of the project emissions (based on the total capacity of 17.6 MW)

2.1 Project emissions from the energy use to capture and to use methane

As described in Section 4.2, it is assumed for ex ante estimation that the amount of electricity consumed from the grid is zero ($EC_{PJ,j,y} = 0$), and this parameter will be monitored during the project operation as part of the monitoring plan. Therefore, for ex ante calculation, $PE_{EC,y} = 0$.

2.2 Project emissions from destruction of captured methane

$$\begin{aligned} PE_{MD,y} &= MM_{ELEC,y} \times Eff_{ELEC,y} \times CEF_{CH_4} \\ &= 23,584 \text{ tCH}_4 \times 99.5\% \times 2.75 \text{ tCO}_2/\text{tCH}_4 = 64,532 \text{ tCO}_2\text{e} \end{aligned}$$

2.3 Project emissions from un-combusted methane

$$\begin{aligned} PE_{UM,y} &= GWP_{CH_4} \times MM_{ELEC,y} \times (1 - Eff_{ELEC,y}) \\ &= 28 \text{ tCO}_2/\text{tCH}_4 \times 23,584 \text{ tCH}_4 \times (1 - 99.5\%) = 3,302 \text{ tCO}_2\text{e} \end{aligned}$$

Therefore, project emissions are calculated as follows:

$$PE_y = PE_{EC,y} + PE_{MD,y} + PE_{UM,y} = 0 \text{ tCO}_2\text{e} + 64,532 \text{ tCO}_2\text{e} + 3,302 \text{ tCO}_2\text{e} = 67,834 \text{ tCO}_2\text{e}$$

3. Calculation of leakage

As described in Section 4.3, $LE_y = 0$.

4. Calculation of emission reductions (based on the total capacity of 17.6 MW)

The emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y = 702,444 \text{ tCO}_2\text{e} - 67,834 \text{ tCO}_2\text{e} - 0 \text{ tCO}_2\text{e} = 634,610 \text{ tCO}_2\text{e}.$$

The calculation conducted above was based on the total capacity of 17.6 MW. For initial years of the Project, only 7.6 MW of generators would be in operation; the baseline emissions, the project emissions and the emission reductions are calculated accordingly, as follows:

$$BE_y = 702,444 \text{ tCO}_2\text{e} / 17.6 \text{ MW} \times 7.6 \text{ MW} = 303,328 \text{ tCO}_2\text{e} \text{ (for the capacity of 7.6 MW)}$$

$$PE_y = 67,834 \text{ tCO}_2\text{e} / 17.6 \text{ MW} \times 7.6 \text{ MW} = 29,292 \text{ tCO}_2\text{e} \text{ (for the capacity of 7.6 MW)}$$

$$ER_y = 634,610 \text{ tCO}_2\text{e} / 17.6 \text{ MW} \times 7.6 \text{ MW} = 274,036 \text{ tCO}_2\text{e} \text{ (for the capacity of 7.6 MW)}$$

Year	Estimated baseline emissions or removals (tCO ₂ e)	Estimated project emissions or removals (tCO ₂ e)	Estimated leakage emissions (tCO ₂ e)	Estimated net GHG emission reductions or removals (tCO ₂ e)
26-Sep-2020 to 31-Dec-2020 ³⁹	80,610	7,784	0	72,826
01-Jan-2021 to 31-Dec-2021	303,328	29,292	0	274,036
01-Jan-2022 to 31-Dec-2022	303,328	29,292	0	274,036
01-Jan-2023 to 31-Dec-2023	702,444	67,834	0	634,610
01-Jan-2024 to 31-Dec-2024	702,444	67,834	0	634,610
01-Jan-2025 to 31-Dec-2025	702,444	67,834	0	634,610
01-Jan-2026 to 31-Dec-2026	702,444	67,834	0	634,610
01-Jan-2027 to 31-Dec-2027	702,444	67,834	0	634,610
01-Jan-2028 to 31-Dec-2028	702,444	67,834	0	634,610
01-Jan-2029 to 31-Dec-2029	702,444	67,834	0	634,610
01-Jan-2030 to 25-Sep-2030 ⁴⁰	515,767	49,807	0	465,960
Total	6,120,142	591,013	0	5,529,129
Average per year	612,014	59,101	0	552,913

5 MONITORING

³⁹ The period 26-Sep-2020 to 31-Dec-2020 covers 97 days; the estimated baseline emissions for this period are calculated as follows: (303,328 tCO₂e / 365 days) × 97 days = 80,610 tCO₂e. The estimated project emissions for this period are calculated as follows: (29,292 tCO₂e / 365 days) × 97 days = 7,784 tCO₂e.

⁴⁰ The period 01-Jan-2030 to 25-Sep-2030 covers 268 days; the estimated baseline emissions for this period are calculated as follows: (702,444 tCO₂e / 365 days) × 268 days = 515,767 tCO₂e. The estimated project emissions for this period are calculated as follows: (67,834 tCO₂e / 365 days) × 268 days = 49,807 tCO₂e.

5.1 Data and Parameters Available at Validation

Data / Parameter	$MT_{BL,s,i,y}$
Data unit	tCH ₄
Description	Methane from source s that would have been captured and destroyed by use i in the baseline scenario in the year y
Source of data	Data provided by the project proponent
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	In the baseline scenario, no CMM from any source would have been captured or destroyed by any use. Therefore, $MT_{BL,s,i,y}$ is 0.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$EF_{EL,k,y}, EF_{EL,j,y} (EF_{grid,CM,y})$
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 ⁴¹ , Calculation Instructions for 2019 Baseline OM Emission Factors for Regional Power Grids in China ⁴² and Calculation Instructions for 2019 Baseline BM Emission Factors for Regional Power Grids in China ⁴³ published by the Ministry of Ecology and Environment of China; 2. TOOL07 (version 07.0)
Value applied	0.50885
Justification of choice of data or description of measurement methods and procedures applied	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 and project emissions
Comments	According to Section 4.1, 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.

⁴¹ <http://mee.gov.cn/ywgz/ydqbhb/hsqtkz/202012/W020201229610353340851.pdf>

⁴² <http://mee.gov.cn/ywgz/ydqbhb/hsqtkz/202012/W020201229610353816665.pdf>

⁴³ <http://mee.gov.cn/ywgz/ydqbhb/hsqtkz/202012/W020201229610354442145.pdf>

Data / Parameter	$TDL_{j,y}$
Data unit	%
Description	Average technical transmission and distribution losses for providing electricity to source j in year y
Source of data	TOOL05 (version 03.0)
Value applied	3
Justification of choice of data or description of measurement methods and procedures applied	As per TOOL05 (version 03.0), the default value of 3% shall be used for project and leakage electricity consumption sources if the electricity consumption by all project and leakage electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies is smaller than the electricity consumption of all baseline electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies. The Project corresponds to Scenario A (Electricity consumption from the grid) described in TOOL05 (version 03.0); the electricity consumption by all project and leakage electricity consumption sources (which is 0 for ex ante estimation, which will be monitored during the project operation as per the monitoring plan) is smaller than the electricity consumption of all baseline electricity consumption sources (39,360 MWh annually according to the FSR), which justifies the use of 3% as default values for project and leakage electricity consumption sources for the project.
Purpose of Data	Calculation of project emissions.
Comments	The parameter will be updated according to the latest version of TOOL05.

Data / Parameter	CEF_{CH_4}
Data unit	tCO ₂ e/tCH ₄
Description	Carbon emission factor for combusted methane
Source of data	ACM0008 (Version 08.0)
Value applied	2.75
Justification of choice of data or description of measurement methods and procedures applied	Default value set out in ACM0008 (version 08.0)
Purpose of Data	Calculation of project emissions
Comments	44/16 = 2.75 tCO ₂ e/tCH ₄

Data / Parameter	D_{CH_4}
Data unit	kg/m ³
Description	Density of methane under normal conditions of temperature and pressure
Source of data	2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied	0.67
Justification of choice of data or description of measurement methods and procedures applied	2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Purpose of Data	Used to convert the parameter $MT_{PJ,s,i,y}$ from volume unit to mass unit. $MT_{PJ,s,i,y}$ (the amount of methane from source s captured and destroyed by use i in the project activity in year y) is monitored and recorded in volume (m ³) and then converted to mass (t) based on the parameter D_{CH_4} .
Comments	Normal conditions of temperature and pressure are defined as 1 atm and 293.15K.

5.2 Data and Parameters Monitored

Data / Parameter	$MT_{PJ,s,i,y}$
Data unit	tCH ₄
Description	Methane from source s captured and destroyed by use i in the project activity in year y
Source of data	Calculated from the monitored data
Description of measurement methods and procedures to be applied	A multi-parameter measuring instrument for gas drainage simultaneously measures the CMM flow, temperature and pressure; a gas analyzer measures the methane concentration; the amount of methane utilized in power generation is thus calculated based on the monitored data.
Frequency of monitoring/recording	Measured continuously and recorded regularly
Value applied	23,584 (for ex ante estimation)
Monitoring equipment	A multi-parameter measuring instrument for gas drainage simultaneously measures the CMM flow, temperature and pressure; a gas analyzer measures the methane concentration.

QA/QC procedures to be applied	The multi-parameter measuring instrument for gas drainage and the gas analyzer are calibrated annually in compliance with relevant standards. All electronic data and paper documents must be archived and kept for at least two years after the end of the project crediting period.
Purpose of the data	Calculation of baseline emissions.
Calculation method	-
Comments	-

Data / Parameter	$MM_{ELEC,y}$
Data unit	tCH ₄
Description	Methane measured sent to use of power generation in year y
Source of data	Calculated from the monitored data
Description of measurement methods and procedures to be applied	A multi-parameter measuring instrument for gas drainage simultaneously measures the CMM flow, temperature and pressure; a gas analyzer measures the methane concentration; the amount of methane utilized in power generation is thus calculated based on the monitored data.
Frequency of monitoring/recording	Measured continuously and recorded regularly
Value applied	23,584 (for ex ante estimation)
Monitoring equipment	A multi-parameter measuring instrument for gas drainage simultaneously measures the CMM flow, temperature and pressure; a gas analyzer measures the methane concentration.
QA/QC procedures to be applied	The multi-parameter measuring instrument for gas drainage and the gas analyzer are calibrated annually in compliance with relevant standards. All electronic data and paper documents must be archived and kept for at least two years after the end of the project crediting period.
Purpose of the data	Calculation of project emissions
Calculation method	-
Comments	-

Data / Parameter	GWP_{CH_4}
Data unit	tCO ₂ e/tCH ₄
Description	Global warming potential of methane
Source of data	IPCC Fifth Assessment Report

Description of measurement methods and procedures to be applied	As per VCS Standard v4.2, for GHG emission reductions occurring on or after 01/01/2021, all ex-ante estimates and ex-post calculations shall be converted to CO ₂ e using GWP values from the IPCC <i>Fifth Assessment Report</i> (AR5); for GHG emission reductions occurring on or before 31/12/2020, all ex-ante estimates and ex-post calculations may be converted to CO ₂ e using either the GWP values from the IPCC <i>Fourth Assessment Report</i> (AR4) or those from AR5. The Project applies GWP_{CH_4} value from AR5 for both ex-ante estimates and ex-post calculations and for GHG emission reductions occurring both before and after 01/01/2021. According to AR5, the 100-year GWP value of methane is 28 tCO ₂ e/CH ₄ .
Frequency of monitoring/recording	The parameter will be updated by referring to the latest requirement of VCS Standard as well as the IPCC report.
Value applied	28
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of the data	Calculation of baseline emissions and project emissions
Calculation method	-
Comments	-

Data / Parameter	$EG_{use,k,y}$ ($EG_{PJ,y}$)
Data unit	MWh
Description	Energy of type k displaced by the project activity in year y
Source of data	Monitored
Description of measurement methods and procedures to be applied	A bidirectional electricity meter is applied to measure the amount of electricity exported by the project activity. All electronic data and paper documents must be archived and kept for at least two years following the end of the project crediting period.
Frequency of monitoring/recording	Measured continuously and recorded monthly
Value monitored	82,720 (for ex ante estimation)
Monitoring equipment	Bidirectional electricity meter.
QA/QC procedures to be applied	The electricity meter is calibrated annually in compliance with the industry standard <i>Technical administrative code of electric energy metering</i> (DL/T448-2016).
Purpose of the data	Calculation of baseline emissions

Calculation method	-
Comments	Electricity transaction notes (ETNs) will be used for cross-check, and the conservative values will be selected.

Data / Parameter	$EC_{PJ,j,y}$
Data unit	MWh
Description	Quantity of electricity consumed by the project electricity consumption source j in year y
Source of data	Monitored
Description of measurement methods and procedures to be applied	A bidirectional electricity meter is applied to measure the amount of electricity imported by the project activity. All electronic data and paper documents must be archived and kept for at least two years following the end of the project crediting period.
Frequency of monitoring/recording	Measured continuously and recorded monthly
Value applied	0 (for ex ante estimation)
Monitoring equipment	Bidirectional electricity meter.
QA/QC procedures to be applied	The electricity meter is calibrated annually in compliance with the industry standard <i>Technical administrative code of electric energy metering</i> (DL/T448-2016).
Purpose of the data	Calculation of project emissions
Calculation method	-
Comments	Electricity transaction notes (ETNs) will be used for cross-check, and the conservative values will be selected.

Data / Parameter	$Eff_{i,y} (Eff_{ELEC,y})$
Data unit	%
Description	Efficiency of methane destruction in use i (for the Project, i represents power generation)
Source of data	2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Description of measurement methods and procedures to be applied	IPCC reference
Frequency of monitoring/recording	-

Value applied	99.5
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of the data	Calculation of project emissions
Calculation method	-
Comments	The parameter will be updated according to the latest IPCC reference.

5.3 Monitoring Plan

(A) Data and parameters to be monitored and the monitoring equipment

Figure 5.1 shows the positions of the monitoring instruments in the technical process of the Project; Table 5.1 and Table 5.2 list the corresponding parameters monitored and the technical information of the monitoring instruments installed, respectively.

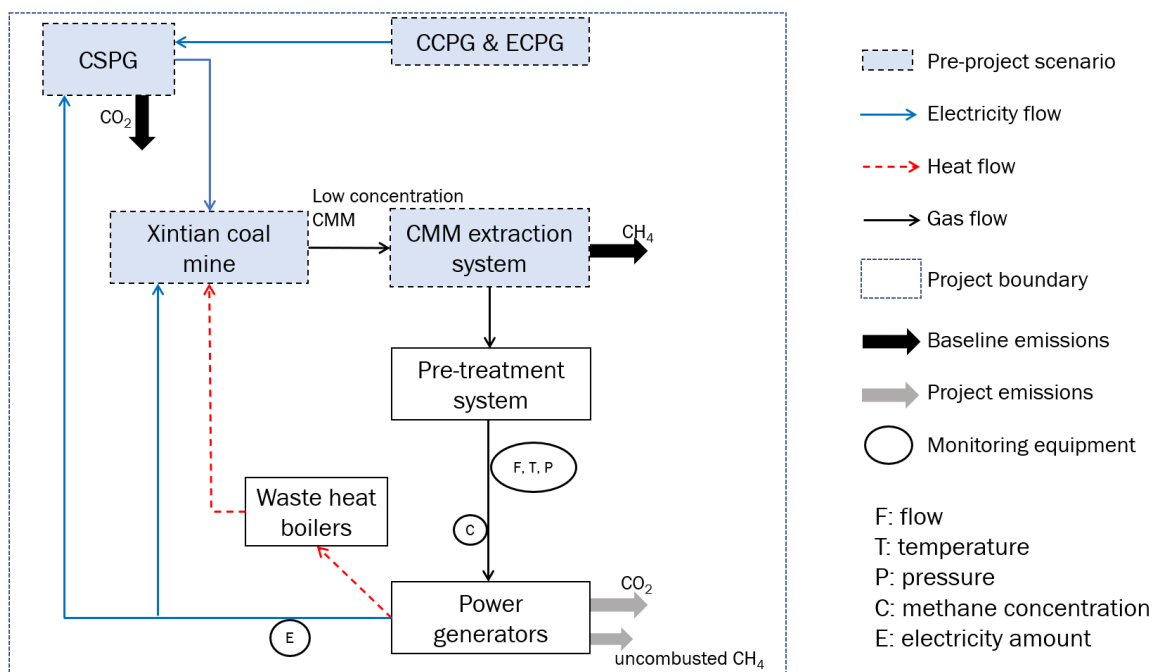


Figure 5.1 Technical process of the Project (with monitoring instruments shown in ovals)

Table 5.1 Corresponding parameters monitored

Position	Parameter(s)	Description
CMM inflow monitoring	$MT_{PJ,s,i,y}$ and $MM_{ELEC,y}$	Methane concentration, gas flow rate, pressure and temperature are continuously monitored on-site and are used to calculate methane from source s captured and destroyed by use of power generation and methane measured sent to use of power generation.
Electricity monitoring	$EG_{Use,k,y}$ ($EG_{PJ,y}$) and $EC_{PJ,j,y}$	Electricity generation by the project and electricity consumption for the project activity are continuously monitored.
/	GWP_{CH_4}	Global warming potential of methane, which will be updated according to relevant data sources.
/	$Eff_{i,y}$ ($Eff_{ELEC,y}$)	Efficiency of methane destruction in use i , which will be updated according to relevant data sources.

Table 5.2 Technical information of the monitoring instruments installed

Equipment		Position	Model	Serial No.	Accuracy
Multi-parameter measuring instrument for methane	Flow meter	CMM inlet of the power generators	GD3(B)	2020020737	0.10
	Pressure transmitter				0.03
	Temperature transmitter				0.05
Gas analyzer		CMM inlet of the power generators	GJG100H(C)	200001224	$\pm 0.07\% \text{ CH}_4$ or $\pm 7.0\%$ of the measured value ⁴⁴
Electricity meter		At the power supply line out of the power plant	DSZ535	20012450414 2	0.5 S

(B) Management Structure

The project proponent has appointed a specific VCS team in charge of data recording and collection to ensure the successful implementation of the monitoring activities. **Figure 5.2** shows the operation and management structure of the monitoring team.

⁴⁴ For methane concentration between 0 and 1%, the margin of error is 0.04%; for methane concentration between 1% and 100%, the margin of error is 4% of the measured value.

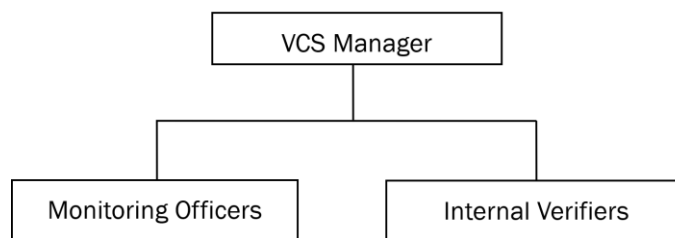


Figure 5.2 Management structure of the monitoring team

A VCS manager has been appointed to take full responsibility for the overall monitoring plan in the corresponding CMM power plant. The monitoring activities, including measurement of extracted gas volume and recording of electricity generation and consumption, are carried out by a team of monitoring officers. In addition, the project proponent has also appointed internal verifiers in charge of internal check of the measured data, collection of relevant receipts and invoices, and calculation of the emission reductions. A monitoring manual regarding the Project, which stipulates detailed duties and responsibilities of all members of the monitoring team, has been developed and serves as the basis of the monitoring plan.

(C) Data collection

The monitoring officers are responsible for data collection. They read and collect the monitored data regularly. The computer system automatically monitors and records relevant data. The automatic records serve as the main data source for the calculation of emission reductions. All data files, relevant purchase invoices and sales receipts will be collected by a designated monitoring officer, who shall prepare backup in time and archive all documents in a proper and secure manner.

(D) Quality assurance

All monitoring instruments for monitoring have been chosen in accordance with VCS requirements and are calibrated regularly for accuracy by a qualified third party in compliance with relevant industry standards. To facilitate verifications, the monitoring team archives and keeps the calibration records, along with the data files of project monitoring.

Routine error checks are conducted on site at the point of data storage to detect data measuring/transmission failures or malfunctions. In the case of malfunction of the monitoring instrument, the equipment supplier will provide technical support to engage in the problem promptly, and emission reductions during the corresponding period will be calculated conservatively.

The installation of the electricity metering equipment fulfills the requirements of the industry standard *Technical Administrative Code of Electric Energy Metering* (DL/T 448–2016).

The installation of the multi-parameter measuring instrument for gas drainage and the gas analyzer fulfills the industry standards *Technical Specifications for Multi-parameter Measuring Equipment of Pipeline Gas Drainage* (MT/T 642-1996) and *Non-dispersive Infrared Methane*

Transmitters for Coal Mine (JJG 1138-2017).

(E) Data file management

All monitored data are electronically archived 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.

(F) Emergency procedure

In case of any failure or malfunction of any monitoring instrument, the project participant and the equipment suppliers will repair or displace it as soon as possible, and the emission reductions achieved during the troubleshooting period will be calculated conservatively.

During the reported monitoring period, no emergency occurred, and on event, which might impact the monitoring plan, the applied methodology or the calculation of emission reductions, occurred.

6 ACHIEVED GHG EMISSION REDUCTIONS AND REMOVALS

6.1 Data and Parameters Monitored

Data / Parameter	$MT_{PJ,s,i,y}$	
Data unit	tCH ₄	
Description	Methane from source <i>s</i> captured and destroyed by use <i>i</i> in the project activity in year <i>y</i>	
Value applied:	Monitoring period	Value
	26-Sep-2020 to 31-Dec-2020	2,351.14
	01-Jan-2021 to 31-Dec-2021	8,984.98
	01-Jan-2022 to 28-Feb-2022	1,590.11
	Total (26-Sep-2020 to 28-Feb-2022)	12,926.23
Please refer to the ER spreadsheet for monthly values.		

Comments

A multi-parameter measuring instrument for methane simultaneously measures the CMM flow, temperature, pressure; a gas analyzer measures the methane concentration of the CMM flow; the amount of methane utilized in power generation was thus calculated by the computer based on the monitored data. For detailed information of the monitoring instruments, please refer to Table 5.2. The monitoring instruments were calibrated annually in compliance with relevant standards.

The calibration dates and the validity of the multi-parameter measuring instrument for methane are shown in the table below.

Serial number	Calibration date	Validity
2020020737	21-Sep-2020	21-Sep-2020 to 20-Sep-2021
2020020737	19-Sep-2021	19-Sep-2021 to 18-Sep-2022

The calibration dates and the validity of the gas analyzer are shown in the table below.

Serial number	Calibration date	Validity
200001224	21-Sep-2020	21-Sep-2020 to 20-Sep-2021
200001224	19-Sep-2021	19-Sep-2021 to 18-Sep-2022

All electronic data and paper documents must be archived and kept for at least two years after the end of the project crediting period.

Data / Parameter	$MM_{ELEC,y}$	
Data unit	tCH ₄	
Description	Methane measured sent to use of power generation in year y	
Value applied:	Monitoring period	Value (tCH ₄)
	26-Sep-2020 to 31-Dec-2020	2,351.14
	01-Jan-2021 to 31-Dec-2021	8,984.98
	01-Jan-2022 to 28-Feb-2022	1,590.11
	Total	12,926.23

	(26-Sep-2020 to 28-Feb-2022)																			
	Please refer to the ER spreadsheet for monthly values.																			
Comments	A multi-parameter measuring instrument for methane simultaneously measures the CMM flow, temperature, pressure; a gas analyzer measures the methane concentration of the CMM flow; the amount of methane utilized in power generation was thus calculated by the computer based on the monitored data. For detailed information of the monitoring instruments, please refer to Table 5.2. The monitoring instruments were calibrated annually in compliance with relevant standards. The calibration dates and the validity of the multi-parameter measuring instrument for methane are shown in the table below. <table border="1"> <thead> <tr> <th>Serial number</th><th>Calibration date</th><th>Validity</th></tr> </thead> <tbody> <tr> <td>2020020737</td><td>21-Sep-2020</td><td>21-Sep-2020 to 20-Sep-2021</td></tr> <tr> <td>2020020737</td><td>19-Sep-2021</td><td>19-Sep-2021 to 18-Sep-2022</td></tr> </tbody> </table> The calibration dates and the validity of the gas analyzer are shown in the table below. <table border="1"> <thead> <tr> <th>Serial number</th><th>Calibration date</th><th>Validity</th></tr> </thead> <tbody> <tr> <td>200001224</td><td>21-Sep-2020</td><td>21-Sep-2020 to 20-Sep-2021</td></tr> <tr> <td>200001224</td><td>19-Sep-2021</td><td>19-Sep-2021 to 18-Sep-2022</td></tr> </tbody> </table> All electronic data and paper documents must be archived and kept for at least two years after the end of the project crediting period.		Serial number	Calibration date	Validity	2020020737	21-Sep-2020	21-Sep-2020 to 20-Sep-2021	2020020737	19-Sep-2021	19-Sep-2021 to 18-Sep-2022	Serial number	Calibration date	Validity	200001224	21-Sep-2020	21-Sep-2020 to 20-Sep-2021	200001224	19-Sep-2021	19-Sep-2021 to 18-Sep-2022
Serial number	Calibration date	Validity																		
2020020737	21-Sep-2020	21-Sep-2020 to 20-Sep-2021																		
2020020737	19-Sep-2021	19-Sep-2021 to 18-Sep-2022																		
Serial number	Calibration date	Validity																		
200001224	21-Sep-2020	21-Sep-2020 to 20-Sep-2021																		
200001224	19-Sep-2021	19-Sep-2021 to 18-Sep-2022																		

Data / Parameter	GWP_{CH_4}
Data unit	tCO ₂ e/tCH ₄
Description	Global warming potential of methane
Value applied:	28
Comments	In compliance with VCS Standard v4.2, the value from the IPCC Fifth Assessment Report (AR5) was applied.

Data / Parameter	$EG_{use,k,y}$ ($EG_{PJ,y}$)		
Data unit	MWh		
Description	Energy of type k displaced by the project activity in year y		
Value applied:	Monitoring period	Value (MWh)	
	26-Sep-2020 to 31-Dec-2020	9,345.160	
	01-Jan-2021 to 31-Dec-2021	35,187.140	
	01-Jan-2022 to 28-Feb-2022	6,019.600	
	Total	50,551.900	
	Please refer to the ER spreadsheet for monthly values.		
Comments	A bidirectional electricity meter measures the amount of electricity supplied by the power plant to the coal mine and to the grid; the values were monthly recorded. For detailed information of the meter, please refer to Table 5.2.		
	Electricity transaction notes (ETNs) between the power plant and the coal mine as well as the ETNs between the power plant and the grid have been provided by the project proponent for cross-check, and the combined value of the ETNs in every month is the same as the monitored value.		
	The electricity meter was calibrated annually in compliance with the industry standard <i>Technical administrative code of electric energy metering</i> (DL/T448-2016); the calibration dates and the validity are shown in the table below.		
	Serial number	Calibration date	Validity
	200124504142	22-Sep-2020	22-Sep-2020 to 21-Sep-2021
200124504142	20-Sep-2021	20-Sep-2021 to 19-Sep-2022	
All electronic data and paper documents have been archived and will be kept for at least two years following the end of the project crediting period.			

Data / Parameter	$EC_{PJ,j,y}$
Data unit	MWh

Description	Quantity of electricity consumed by the project electricity consumption source j in year y	
Value applied:	Monitoring period	Value (MWh)
	26-Sep-2020 to 31-Dec-2020	0
	01-Jan-2021 to 31-Dec-2021	0
	01-Jan-2022 to 28-Feb-2022	0
	Total	0
	Please refer to the ER spreadsheet for monthly values.	
Comments	A bidirectional electricity meter measures the amount of electricity imported by the power plant from the grid; the values were monthly recorded. For detailed information of the meter, please refer to Table 5.2.	
	No ETNs of imported electricity were available because the Project did not import any electricity during this monitoring period.	
	The electricity meter was calibrated annually in compliance with the industry standard <i>Technical administrative code of electric energy metering</i> (DL/T448-2016); the calibration dates and the validity are shown in the table below.	
	Serial number	Calibration date
	200124504142	22-Sep-2020
	200124504142	20-Sep-2021
	All electronic data and paper documents have been archived and will be kept for at least two years following the end of the project crediting period.	

Data / Parameter	$Eff_{i,y} (Eff_{ELEC,y})$
Data unit	%
Description	Efficiency of methane destruction in use i (for the Project, i represents power generation)
Value applied:	99.5
Comments	The parameter has been updated according to the latest IPCC reference.

6.2 Baseline Emissions

Please refer to Section 4.1 for equations used for the calculation of baseline emissions. Please refer to the ER spreadsheet for monthly data.

1. Baseline emissions from methane destroyed

As described in Section 4.1, $BE_{MD,y} = 0$.

2. Baseline emissions from release of methane into the atmosphere

$BE_{MR,y}$ is calculated as follows: $BE_{MR,y} = GWP_{CH_4} \times MT_{PJ,s,i,y}$ (please refer to Equation (3) in Section 4.1).

Monitoring period	$MT_{PJ,s,i,y}$ tCH ₄	GWP_{CH_4} tCO ₂ e/tCH ₄	$BE_{MR,y}$ tCO ₂ e
26-Sep-2020 to 31-Dec-2020	2,351.14	28	65,831
01-Jan-2021 to 31-Dec-2021	8,984.98	28	251,579
01-Jan-2022 to 28-Feb-2022	1,590.11	28	44,523
Total (26-Sep-2020 to 28-Feb-2022)	12,926.23	28	361,933

3. Baseline emissions from power generation replaced by the project

$BE_{Use,y}$ is calculated as follows: $BE_{Use,y} = EG_{PJ,grid,y} \times EF_{ELEC,y}$ (please refer to Equation (5) in Section 4.1).

Monitoring period	$EF_{ELEC,y}$ MWh	$EG_{PJ,grid,y}$ tCO ₂ e/MWh	$BE_{Use,y}$ tCO ₂ e
26-Sep-2020 to 31-Dec-2020	9,345.160	0.50885	4,755
01-Jan-2021 to 31-Dec-2021	35,187.140	0.50885	17,904
01-Jan-2022 to 28-Feb-2022	6,019.600	0.50885	3,063
Total (26-Sep-2020 to 28-Feb-2022)	50,551.900	0.50885	25,722

Therefore, baseline emissions are calculated as follows:

Monitoring period	$BE_{MD,y}$ tCO ₂ e	$BE_{MR,y}$ tCO ₂ e	$BE_{Use,y}$ tCO ₂ e	$BE_y =$ $BE_{MD,y} + BE_{MR,y} + BE_{Use,y}$ tCO ₂ e
26-Sep-2020 to 31-Dec-2020	0	65,831	4,755	70,586
01-Jan-2021 to 31-Dec-2021	0	251,579	17,904	269,483
01-Jan-2022 to 28-Feb-2022	0	44,523	3,063	47,586
Total (26-Sep-2020 to 28-Feb-2022)	0	361,933	25,722	387,655

6.3 Project Emissions

Please refer to Section 4.2 for equations used for the calculation of project emissions. Please refer to the ER spreadsheet for monthly data.

1. Project emissions from the energy use to capture and to use methane

The values of $EC_{PJ,j,y}$ (quantity of electricity consumed by the project electricity consumption source j in year y) are monitored as part of the monitoring plan. The project emissions from the energy use to capture and to use methane are calculated as follows: $PE_{ME,y} = PE_{EC,y} = EC_{PJ,j,y} \times EF_{grid,CM,y} \times (1 + TDL_{j,y})$ (please refer to Equation (15) in Section 4.2).

Monitoring period	$EC_{PJ,j,y}$ MWh	$EF_{grid,CM,y}$ tCO ₂ e/MWh	$TDL_{j,y}$	$PE_{EC,y}$ tCO ₂ e
26-Sep-2020 to 31-Dec-2020	0	0.50885	3%	0
01-Jan-2021 to 31-Dec-2021	0	0.50885	3%	0
01-Jan-2022 to 28-Feb-2022	0	0.50885	3%	0
Total (26-Sep-2020 to 28-Feb-2022)	0	0.50885	3%	0

2. Project emissions from destruction of captured methane

The values of $MM_{ELEC,y}$ (methane measured sent to use of power generation in year y) are monitored as part of the monitoring plan. The project emissions from destruction of captured methane are calculated as follows: $PE_{MD,y} = MM_{ELEC,y} \times Eff_{ELEC,y} \times CEF_{CH_4}$ (please refer to Equation (18) in Section 4.2).

Monitoring period	$MM_{ELEC,y}$ tCH ₄	$Eff_{ELEC,y}$	CEF_{CH_4} tCO ₂ e/tCH ₄	$PE_{MD,y}$ tCO ₂ e
26-Sep-2020 to 31-Dec-2020	2,351.14	99.5%	2.75	6,434
01-Jan-2021 to 31-Dec-2021	8,984.98	99.5%	2.75	24,586
01-Jan-2022 to 28-Feb-2022	1,590.11	99.5%	2.75	4,351
Total (26-Sep-2020 to 28-Feb-2022)	12,926.23	99.5%	2.75	35,371

3. Project emissions from un-combusted methane

$PE_{UM,y}$ is calculated as follows: $PE_{UM,y} = GWP_{CH_4} \times MM_{ELEC,y} \times (1 - Eff_{ELEC,y})$ (please refer to Equation (19) in Section 4.2).

Monitoring period	$MM_{ELEC,y}$ tCH ₄	$Eff_{ELEC,y}$	GWP_{CH_4} tCO ₂ e/tCH ₄	$PE_{UM,y}$ tCO ₂ e
26-Sep-2020 to 31-Dec-2020	2,351.14	99.5%	28	330
01-Jan-2021 to 31-Dec-2021	8,984.98	99.5%	28	1,258
01-Jan-2022 to 28-Feb-2022	1,590.11	99.5%	28	223
Total (26-Sep-2020 to 28-Feb-2022)	12,926.23	99.5%	28	1,811

Therefore, project emissions are calculated as follows:

Monitoring period	$PE_{EC,y}$ tCO ₂ e	$PE_{MD,y}$ tCO ₂ e	$PE_{UM,y}$ tCO ₂ e	$PE_y =$ $PE_{EC,y} + PE_{MD,y} + PE_{UM,y}$ tCO ₂ e
26-Sep-2020 to 31-Dec-2020	0	6,434	330	6,764
01-Jan-2021 to 31-Dec-2021	0	24,586	1,258	25,844
01-Jan-2022 to 28-Feb-2022	0	4,351	223	4,574
Total (26-Sep-2020 to 28-Feb-2022)	0	35,371	1,811	37,182

6.4 Leakage

As per the methodology ACM0008 (version 08.0), leakage may occur if the project activity prevents methane from being used to meet baseline thermal energy demand, whether as a result of physical constraints on delivery, or price changes.

Since the baseline scenario does not include thermal energy use, the leakage is taken as zero, i.e., $LE_y = 0$.

6.5 Net GHG Emission Reductions and Removals

Based on calculations in Section 6.2 and Section 6.3, the net GHG emission reductions are calculated as follows:

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
26-Sep-2020 to 31-Dec-2020	70,586	6,764	0	63,822
01-Jan-2021 to 31-Dec-2021	269,483	25,844	0	243,639
01-Jan-2022 to 28-Feb-2022	47,586	4,574	0	43,012
Total (26-Sep-2020 to 28-Feb-2022)	387,655	37,182	0	350,473

Comparison of actual emission reductions with ex ante estimates:

The monitoring period 26-September-2020 to 28-February-2022 covers 521 days, and the emission reductions during this period would have been 391,158 tCO₂e⁴⁵ based on the ex ante estimates. The actual emission reductions achieved during this monitoring period are 350,473 tCO₂e, which is 10.4% lower⁴⁶ than the estimated emission reductions, which is reasonable.

⁴⁵ $(274,036 \text{ tCO}_2\text{e} / 365 \text{ days}) \times 521 \text{ days} = 391,158 \text{ tCO}_2\text{e}$.

⁴⁶ $(350,473 \text{ tCO}_2\text{e} - 391,158 \text{ tCO}_2\text{e}) / 391,158 \text{ tCO}_2\text{e} = -10.4\%$

APPENDIX

Not applicable.