



GUIZHOU PANJIANG LOW CONCENTRATION COAL MINE METHANE POWER GENERATION PROJECT PHASE 3



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CONTENTS

1	PROJECT DETAILS.....	3
1.1	Summary Description of the Implementation Status of the Project.....	3
1.2	Sectoral Scope and Project Type	4
1.3	Project Proponent	4
1.4	Other Entities Involved in the Project.....	4
1.5	Project Start Date	4
1.6	Project Crediting Period.....	5
1.7	Project Location	5
1.8	Title and Reference of Methodology	6
1.9	Participation under other GHG Programs.....	7
1.10	Other Forms of Credit	7
1.11	Sustainable Development	7
2	SAFEGUARDS.....	7
2.3	AFOLU-Specific Safeguards.....	15
3	IMPLEMENTATION STATUS	15
3.1	Implementation Status of the Project Activity.....	15
3.2	Deviations	17
3.3	Grouped Projects.....	17
4	DATA AND PARAMETERS	17
4.1	Data and Parameters Available at Validation	17
4.2	Data and Parameters Monitored	20
4.3	Monitoring Plan	25
5	QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS	31
5.1	Baseline Emissions	31
5.2	Project Emissions	34
5.3	Leakage	36
5.4	Net GHG Emission Reductions and Removals.....	37

1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

Guizhou Panjiang Low Concentration Coal Mine Methane Power Generation Project Phase 3 (hereinafter referred to as the Project) utilizes the low concentration coal mine methane (CMM), that otherwise would be vented into the atmosphere directly, for power generation to supply electricity to the coal mines where the Project is located, replacing the electricity that would otherwise have been supplied by the China Southern Power Grid (CSPG) and the captive power plants. The waste heat from the generators is recovered by waste heat boilers to provide free hot water to the coal mines, which was provided by coal-fired boilers before the implementation of the Project. However, to be conservative, emission reductions for this part are not claimed.

The low concentration CMM is delivered through methane extraction pumps to pre-treatment system for safety treatment, and then goes into the gas engines for power generation. The Project includes three coalmines (Tucheng, Laowuji and Songhe) with five mining areas (Tucheng 13, Tucheng 14, Laowuji Nanyi, Songhe Cai'er, and Songhe Caisan) with total methane resource of 9.8 billion m³ and extractable resources of 3.5 billion m³. 38 CMM power generation units with total capacity of 22.8 MW are involved and 36.3 million m³ of methane is utilized by the project annually. The project is expected to achieve 589,187 tCO₂e of emission reduction annually.

The timeline of the project is shown below:

Start date of construction	15-March-2011
Start date of commissioning	26-May-2011
Registration date	06-December-2012
Start date of the crediting period	

This monitoring period covers the period from 26-February-2018 to 25-December-2019 (actually from 08:00 25-February-2018 to 08:00 25-December-2019). The actual emission reductions achieved in this monitoring period are 793,277 tCO₂e.

During this monitoring period, the power plant Laowuji Nanyi stopped operation at the period of 26-February-2018 to 25-December-2019, and Songhe Cai'er stopped operation at the periods of 02-February-2019 to 05-October-2019 and 11-October-2019 to 25-December-2019 as the concentration of CH₄ in CMM gas from the two power plants was below 6% since their stoppage and can't meet the demand of CMM generators. All the rest three power plants run

continuously during this monitoring period. No events or situations, which may impact the applicability of the applied methodology, occurred during this monitoring period.

1.2 Sectoral Scope and Project Type

Sectoral Scope 08: Mining/mineral production

The project is not a grouped project.

1.3 Project Proponent

Organization name	Guizhou Panjiang CBM Development & Utilization Co., Ltd.
Contact person	Yang Shiliang
Title	General Manager
Address	Shijijinuan Plaza, Commercial Business Centre, Building D 15F, Guiyang, Guizhou Province, China
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1.4 Other Entities Involved in the Project

Organization name	Climate Bridge Ltd.
Role in the project	VCU buyer
Contact person	Gao Zhiwen
Title	General Manager
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1.5 Project Start Date

26-May-2011 (*operation start date*).

1.6 Project Crediting Period

The crediting period under CDM started on 06-December-2012 and expires on 05-December-2022 with 10 years fixed.

The crediting period under CCER started on 26-May-2011 and expires on 05-December-2022.

The VCS crediting period of the Project is from 26-May-2011 to 25-May-2021 totally 10 years.

1.7 Project Location

The project is located in the Panjiang Mining District, Pan County, Liupanshui City, Guizhou Province, P.R. China. The geographic coordinates of the involved power stations are listed in the table below:

Coal mine	Power station	Decimal Longitude	Decimal Latitude
Tucheng	Tucheng 13	104.5466E	26.0644N
	Tucheng 14	104.5667E	26.0593N
Laowuji	Nanyi	104.4908E	25.8661N
Songhe	Cai'er	104.6421E	25.0321N
	Caisan	104.6404E	25.0335N

The geographic locations of the involved coal mines are shown in Figure 1-1.



Figure 1-1 Location of the project

1.8 Title and Reference of Methodology

The applied baseline and monitoring methodology for the project:

ACM0008 "Consolidated methodology for coal bed methane, coal mine methane and ventilation air methane capture and use for power (electrical or motive) and heat and/or destruction through flaring or flameless oxidation"(version 07),

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

Tools applied for the project:

“Tool to calculate the emission factor for an electricity system” (version 02.2.1),

<http://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-07-v2.2.1.pdf>

“Tool for the demonstration and assessment of additionality” (Version 06.0.0),

<http://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-01-v6.0.0.pdf>

1.9 Participation under other GHG Programs

The project has been registered as a CDM project in UNFCCC on 06-December-2012 (UNFCCC Ref. 6957). The crediting period started on 06-December-2012 and expires on 05-December-2022. Please refer to the following link for details: <https://cdm.unfccc.int/Projects/DB/RINA1344516913.29/view>

The project has been registered as a CCER project on 26-May-2014 (Ref. 012). The crediting period started on 26-May-2011 and expires on 05-December-2022.

Except for CDM and CCER, the project did not register under any other GHG program.

1.10 Other Forms of Credit

The GHG emission reductions of 305,485 tCO₂ generated from 26-May-2011 to 05-December-2012 by the project has been issued as CCER used for Chinese allowance trading, while 1,680,035 tCO₂ in the period of 06-December-2012 to 25-February-2018 issued as a CER.

The GHG emission reductions generated by the project from 26-February-2018 to 25-December-2019 will not be used for compliance with emission trading programs or to meet binding limits on GHG emissions.

All credits from 26-February-2018 to 25-December-2019 will be claimed under VCS program as VCU for the project to avoid double counting.

1.11 Sustainable Development

The Project will contribute to sustainable development in the following ways:

- Achieving significant GHG emission reductions and other air pollutant reductions by methane destruction;
- Displacing part of the grid electricity mainly generated by fossil fuel combustion, thus reducing the emission of CO₂ and other air pollutants;
- Creating new job opportunities.

2 SAFEGUARDS

2.1 No Net Harm

The Environmental Impact Assessment (EIA) of the project has been approved by Guizhou Province Environmental Protection Bureau on 26-December-2011. According to the approval comments of the EIA Report by the Guizhou Province Environmental Protection Bureau, the

environmental impacts likely to be caused by the project are analyzed. The environmental impacts of the project in construction period and in operation period are summarized as follows.

1. Construction Phase

1.1 Air pollution

The major air pollutants during construction are dust, tail gas emitted by transport vehicles and construction machinery, and smoke emitted by coal combustion for cooking. The construction site is enclosed to prevent the spread of dust. The storage of sand and cement has been planned to minimize the air pollution caused by transportation. During the processes of surface digging, concrete mixing and vehicle transportation, water is sprayed within the project construction area and along the project construction roads to settle dust. Smoke abatement equipment has been installed to minimize tail gas from construction machinery. Therefore, the ambient air of the project construction area is ensured to satisfy Level 2 standard of “Ambient air quality standard” (GB3095-1996).

1.2 Wastewater

Wastewater in the construction period consists of construction wastewater, equipment washing wastewater and domestic wastewater, all prohibited to be discharged outwards. The wastewater generated in the construction processes is recycled for reuse in ground construction and dust settling. Domestic wastewater discharged from living activities of construction personnel is collected and treated by the sewage disposal plant of Panjiang Coal Mine. The surface water of the environmental evaluation area is ensured to satisfy Category III of “Environmental quality standards for surface water” (GB38382002), and the ground water is ensured to satisfy Category III of “Quality standards for ground water” (GB/T14848-93).

1.3 Noise

Noise in the construction period is mainly generated by construction machinery and transport vehicles. There are few noise sensitive points around the project construction area. To minimize noise pollution, low-noise equipment is employed as much as possible and high-noise equipment is strictly prohibited to work during the night. Noise is controlled to satisfy “Noise limits for construction site” (GB12523-90).

1.4 Solid waste

Solid waste consists of construction waste and domestic trash, with little environmental impact. Construction waste is collected and transported to the coal-gangue wasteland of Panjiang Coal Mine for appropriate disposal. Domestic trash is collected and treated along with that of Panjiang Coal Mine according to the requirements of sanitation and hygiene department.

1.5 Impact on the ecosystem

The area of the construction site is not large, and the area does not contain protected species of plant or animal. To minimize water and soil loss, the construction site is strictly limited and

enclosed, and construction period is planned to avoid being exposed to heavy rain and strong wind. The responsibility for water and soil conservation has been clarified, and construction management is strengthened accordingly. After the construction finishes, woods and bushes will be planted in time to ensure the minimum impact caused on the stability and completeness of the surrounding ecosystem.

2. Operation Phase

2.1 Air pollution

The air pollutants during operation are mainly from the tail gas emitted by waste heat boilers. H₂S concentration in CMM is extremely low, thus very little SO₂ will be emitted after the combustion in CMM generators. The low-concentration CMM generators are designed with low-nitrogen combustion technology to control the formation of NO₂. Therefore, the tail gas from CMM generators has little environmental impact, and complies with the standard requirements of Period IV of the regulation "Limits and measurement methods for exhaust pollutants from compression ignition and gas fuelled positive ignition engines of vehicles (III, IV, V)" (GB17691-2005).

2.2 Wastewater

Wastewater during operation consists of condensate water, equipment discharge, water and domestic wastewater. Condensate water and equipment discharge water contain no pollutant, thus discharged into the drainage ditch. Domestic wastewater is prohibited to be discharged outwards, but collected and then treated by the sewage disposal plant of Panjiang Coal Mine to satisfy Level 1 requirements of "Integrated Wastewater Discharge Standard" (GB8978-1996). The surface water of the environmental evaluation area is ensured to satisfy Category III of "Environmental quality standards for surface water" (GB3838-2002), and the ground water is ensured to satisfy Category III of "Quality standards for ground water" (GB/T14848-93).

2.3 Noise

Noise during operation is generated by the low-concentration CMM generators, waste heat boilers, circulating cooling tower and pumps. The plant buildings that contain machinery are all built from reinforced concrete, with soundproof materials installed inside, atop and at the openings. Mufflers and vibration damper bases have been designed for machinery. There are few noise sensitive points around the project site. To minimize noise pollution to the only one residential settlement near the project site, green belt with woods and bushes have been designed. Noise emission from the project operation complies with the standard requirements of Category 2 of "Emission standard for industrial enterprise noise at boundary" (GB12348-2008), and the environmental noise at the residential settlement satisfies Category 2 of "Environmental quality standard for noise" (GB3096-2008).

2.4 Solid waste

The project operation does not produce solid waste except domestic trash. Working personnel of the project live outside the project site. Their domestic trash is collected and treated together with that of Panjiang Coal Mine, according to the requirements of sanitation and hygiene department. In conclusion, the environmental impact during the project construction will be temporary and not significant, and the environmental impact during the project operation will be minor. The proposed project can reduce greenhouse gas emissions and environmental pollution caused by methane release and coal-fired power generation. The project owner takes appropriate measures to minimize adverse environmental impacts.

In this monitoring period, no negative environmental impacts are expected to result from the project activity. In fact, the implementation of the project will turn harm into treasure and safeguard coal mine safety, save energy, fulfill reductions of greenhouse gas emission and protect the ecological environment.

Meanwhile, the implementation of the project will improve local socio-economic development through creating career opportunities and paying taxes.

2.2 Local Stakeholder Consultation

Local Stakeholder Consultation during the project preparation stage:

The Project owner collected comments by local stakeholders on the proposed project. The Project owner posted the announcement of the stakeholder meeting on the notice board of Pan County on 11-April-2011 informing the time and location of the stakeholder meeting, as well as the questionnaire distribution.

The stakeholder meeting was held on 19-April-2011 in the conference room of Panjiang Coal Mine, presided over by the representative of the Project owner. Representatives of relevant personnel of the Panjiang Coal Mine, local villagers and local government were invited to attend the meeting.

Survey questionnaires were distributed to the relevant personnel of the Panjiang Coal Mine, local villagers and government officials by the Project owner from 12-April-2011 and recollected by 19-April-2011. Seventy-five questionnaires were sent and seventy were returned, which were designed to assess the project impacts on the local environment and social economic development. The structure of the survey respondents is listed in Table 2-1 below.

Table 2-1 Structure of stakeholders surveyed

Item	Distribution		Quantity	Percentage
	Male	Female		
Amount of stakeholders surveyed	Male		51	73%
	Female		19	27%

Age	<25	13	19%
	25-45	42	60%
	45-55	10	14%
	>55	5	7%
Education	Junior high school or below	45	64%
	Senior high school	18	26%
	College or above	7	10%
Occupation	Worker	38	54%
	Peasant	15	21%
	Management personnel	9	13%
	Civil servant	6	9%
	Unspecified	2	3%

Seventy questionnaires were distributed to local stakeholders, and all questionnaires have been recollected. Comments from these questionnaires are summarized in Table 2-2 below:

Table 2-2 Summary of stakeholders' comments

No.	Questions	Attitude or Opinion	Amount	Percentage
1	Do you know about the proposed project?	Quite much	48	69%
		Heard of	22	31%
		Nothing	0	0
2	What is your attitude towards the project construction?	Supportive	68	97%
		Against	0	0
		Indifferent	2	3%

3	What is the most probable environmental impact do you think the project will cause after the construction finish? (multiple choice)	None	62	89%
		Air pollution	0	0
		Water pollution	2	3%
		Noise pollution	4	6%
		Harm to indigenous animals and plants	1	1%
		No idea	1	1%
4	Do you think the project operation will bring about more benefits than loss?	Yes	70	100%
		No	0	0
		About the same	0	0
5	Are you willing to participate in the project construction or operation?	Yes	58	83%
		No	4	6%
		Indifferent	8	11%
6	What influence do you think the project will bring about to you and your family?	Positive	60	86%
		None	10	14%
		Negative	0	0
7	Do you think the project operation will affect the production safety of the coal mine?	Positive effect	52	74%
		None	18	26%
		Negative effect	0	0

8	What impact do you think the project will bring to local community? (multiple choice)	Employment	Increase	70	100%
			Decrease	0	0
			No change	0	0
		Economy	Rise	69	99%
			Fall	0	0
			No change	1	1%
		Power Supply	Increase	70	100%
			Decrease	0	0
			No change	0	0
11	Any other comments	Very good and reasonable to utilize methane that would otherwise be wasted to generate electricity, and the sooner the project operation started the better		62	89%
		The power supply will be increased, while the electricity price for consumers should better not rise.		54	77%
		Hope more job opportunities could be created.		68	97%
		Hope to work for this company.		38	54%
		Better to organize promotion for such projects and spread the knowledge to ordinary		12	17%

		people to gain general support		
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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 think the Project will bring more benefit than loss. Eighty three percent of the respondents are willing to participate in the construction and operation of the Project.

Eighty nine percent of the respondents believe that the Project will not have any environmental impact, but there are a few respondents who showed their concern about the potential noise pollution and water pollution caused by the Project. Then the Project Owner explained about this in the stakeholder meeting, and brought up with corresponding approaches to minimize the impact of the Project on the environment.

Eighty six percent of the respondents recognize the positive impact of the Project on individuals and families. They think the Project will improve the local employment and increasing the residential income, thus greatly reducing family burden. No one thinks that the Project will have a negative impact on the local life. In the aspect of coal mine production safety, 26% of the respondents believe the Project will not have any impact on coal mine safety, and 74% of the respondents consider the Project improve the operational safety of the coal mines to some extent.

In general, local stakeholders are supportive of the project construction. The survey shows that a majority of local stakeholders think the Project will help improve the life of local people and promote local economic development without much adverse environmental impact. The survey shows that almost all of the stakeholders are supportive to the proposed project, believing that the Project will provide more employment opportunities, help local economic development, and increase local power supply. Therefore, the implementation of the Project is regarded as beneficial by most of the local stakeholders.

Local Stakeholder Consultation during the project implementation stage:

Communications with Local stakeholders were carried out on 28-May-2013 and 14-July-2017 at periodic intervals. Key implementation schedules or changes of the project will be communicated to the local authority, who will inform the neighbourhood committee and the local residents, the comments and suggestions from residents will be collected by the local authority meanwhile. And the local government agencies and competent authorities will conduct spot checks on the implementation of the project from time to time, and give suggestions on the involved rectification problems. There are no negative comments received for the project. In line with VCS requirements all the processes have been implemented to receive comments from local stakeholders as well as communicate with them at periodic intervals.

2.3 AFOLU-Specific Safeguards

The project is a non-AFOLU project.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

The project is implemented in accordance with the description of the registered CDM PDD (version 05) . All five power plants have started operation prior to the start date of this monitoring period. However, only six sets of CMM power generators (unit capacity: 600kW) have been installed in power plant Songhe cai'er while the registered PDD states that 10 sets of CMM power generator with unit capacity of 600kW are to be installed in power plant Songhe cai'er. This is because the CMM gas extracted from the coal mine can only meet the demand of six sets of CMM power generator. The rest four sets of CMM power generator will be installed in power plant Songhe cai'er when the CMM gas stream can meet the demand of 10 sets of CMM power generator in the future.

The commissioning date of the five power plants is listed in the table below.

Table 3-1 Commission date of the project

Power plant	Construction date	Commissioning date
Tucheng 14	15-March-2011	26-May-2011
Tucheng 13	10-April-2011	26-July-2011
Songhe Caisan	10-May-2011	18-January-2012
Laowuji nanyi	04-March-2013	24-July-2013
Songhe Cai'er	08-August-2013	18-January-2014

During this monitoring period, the power plant Laowuji Nanyi stopped operation at the period of 26-February-2018 to 25-December-2019, and Songhe Cai'er stopped operation at the periods of 02-February-2019 to 05-October-2019 and 11-October-2019 to 25-December-2019 as the concentration of CH₄ in CMM gas from the two power plants was below 6% since their stoppage and can't meet the demand of CMM generators. All the rest three power plants run continuously during this monitoring period. No events or situations, which may impact the applicability of the applied methodology, occurred during this monitoring period.

The technical process of the Project is shown in Figure 3-1. The low concentration CMM is delivered through methane extraction pumps to pre-treatment system for safety treatment, and then goes into the gas engines for power generation. The generated electricity is for internal coal mine consumption. The waste heat from the generators is recovered by the waste heat

boilers and supplied to coal mines. Table 3-2, 3-3 shows the key technical specifications of CMM gas generators and waste heat boilers installed.

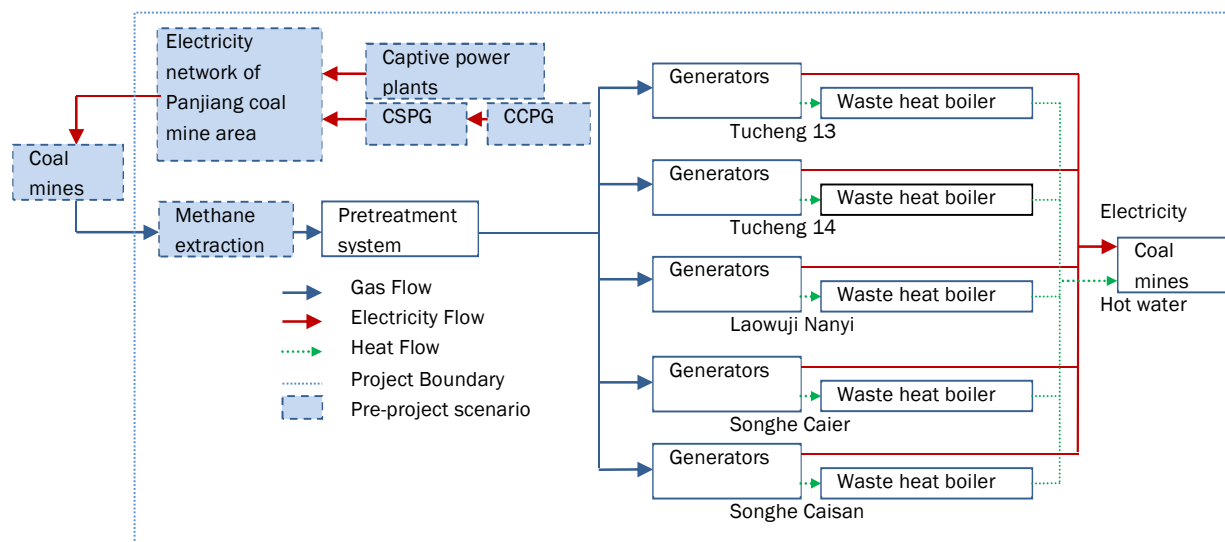


Figure 3-1 Diagram of the project boundary and flow

Table 3-2 Quantity & Capacity of power generators and waste heat boilers

Coal mine/mining area		Quantity	Capacity (kw)
Tucheng	Tucheng 13	8×600 (600GF ₁ -1RW _D)	4,800
	Tucheng 14	4×600 (600GJZ ₁ -1PWW _D)	2,400
Laowuji	Nanyi	4×600 (600GJZ ₁ -1PWW _D)	2,400
Songhe	Cai'er ¹	6×600 (600GJZ ₁ -1PWW _D)	3,600
	Caisan	12×600 (600GF ₁ -1RW _D)	7,200
Total		34 installed (38 planned)	20,400 installed (22,800 planned)

Table 3-3 Specifications of generators installed

Type	600GJZ ₁ -1PWW _D	600GF ₁ -1RW _D
Supplier	Shangdong Oil Field Shengli Power Machinery Group CO. Ltd.	
Rated power (kw)	600	600
Continuous power (kW)	480	480
Rated current (A)	1,083	1,083

¹ Only six sets of CMM power generator with unit capacity of 600kW have been installed in power plant songhe cai'er as the CMM gas extracted from the coal mine can only meet the demand of six sets of CMM power generator. The rest four sets of CMM power generator will be installed in power plant songhe cai'er when the CMM gas stream can meet the demand of 10 sets of CMM power generator in the future.

Rated voltage (V)	400	400
Rated speed (r/min)	1,000	1,000
Frequency (Hz)	50	50
Life time (year)	10	10

3.2 Deviations

2.3.1 Methodology Deviations

There is no methodology deviation applied to this monitoring period.

2.3.2 Project Description Deviations

There is no project description deviation applied to this monitoring period.

3.3 Grouped Projects

The Project is not a grouped project.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	$CMM_{BL,i,y}$
Data unit	tCH ₄
Description	Pre-mining CMM that would have been captured, sent to and destroyed by use i in the baseline scenario in year y .
Source of data	Data provided by the project owner
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	The captured CMM is released into the atmosphere unused under the baseline scenario. Hence, $CMM_{BL,i,y}$ is 0.
Purpose of Data	Baseline emission calculation
Comments	-

Data / Parameter	$PMM_{BL,i,y}$
Data unit	tCH ₄
Description	Post-mining CMM that would have been captured, sent to and

	destroyed by use i in the baseline scenario in year y .
Source of data	Data provided by the project owner
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	The captured PMM is released into the atmosphere unused under the baseline scenario. Hence, $PMM_{BL,i,y}$ is 0.
Purpose of Data	Baseline emission calculation
Comments	-

Data / Parameter	Eff_{ELEC}
Data unit	%
Description	Efficiency of methane destruction in power plant
Source of data	ACM0008 (Version 07)
Value applied	99.5
Justification of choice of data or description of measurement methods and procedures applied	IPCC reference
Purpose of Data	Project emission calculation
Comments	-

Data / Parameter	CEF_{CH_4}
Data unit	tCO_2e/tCH_4
Description	Carbon emission factor for combusted methane
Source of data	ACM0008 (Version 07)
Value applied	2.75
Justification of choice of data or description of measurement methods and procedures applied	ACM0008 (Version 07) default value
Purpose of Data	Baseline emission calculation
Comments	$44/16 = 2.75tCO_2e/tCH_4$

Data / Parameter	D_{CH_4}
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Data unit	kg/m ³
Description	Density of methane under normal conditions of temperature and pressure
Source of data	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	IPCC reference
Purpose of Data	Baseline emission and project emission calculation
Comments	Applies at atmospheric pressure and 20 °C

Data / Parameter	GWP _{CH4}
Data unit	tCO ₂ e/ tCH ₄
Description	Global warming potential of methane
Source of data	EB69 Annex 3/ IPCC Fourth Assessment Report: Climate Change 2007 (AR4)
Value applied	25
Justification of choice of data or description of measurement methods and procedures applied	EB69 Annex 3/ IPCC Fourth Assessment Report: Climate Change 2007 (AR4)
Purpose of Data	Baseline emission and project emission calculation
Comments	-

Data / Parameter	EF _{ELEC}
Data unit	tCO ₂ /MWh
Description	CO ₂ emission factor of the grid (CSPG)
Source of data	DNA of China
Value applied	0.6323
Justification of choice of data or description of measurement methods and procedures applied	Calculated as per "Tool to calculate the emission factor for an electricity system"
Purpose of Data	Baseline emission calculation
Comments	-

4.2 Data and Parameters Monitored

Data / Parameter	MM _{ELEC}								
Data unit	t CH ₄								
Description	Methane sent to the power generators								
Source of data	Calculated from the monitored data								
Description of measurement methods and procedures to be applied	MM _{ELEC} is calculated by the gas flow rate, pressure, temperature, and CH ₄ concentration of CMM, which will be continuously measured by flow meters and gas analyzers. All electronic data and paper documents will be archived for two years following the end of the crediting period								
Frequency of monitoring/recording	Measuring continuously and recording hourly								
Value monitored	<table border="1"> <thead> <tr> <th>Year</th><th>Value</th></tr> </thead> <tbody> <tr> <td>26-February-2018~31-December-2018</td><td>16,440.16</td></tr> <tr> <td>01-January-2019~25-December-2019</td><td>15,661.59</td></tr> <tr> <td>Total</td><td>32,101.75</td></tr> </tbody> </table> Please refer to ER spreadsheet for monthly values.	Year	Value	26-February-2018~31-December-2018	16,440.16	01-January-2019~25-December-2019	15,661.59	Total	32,101.75
Year	Value								
26-February-2018~31-December-2018	16,440.16								
01-January-2019~25-December-2019	15,661.59								
Total	32,101.75								
Monitoring equipment	Flow meters, Pressure Transmitters, Temperature Transmitters and Gas Analyzers Calibration frequency: annual The information of meters please refers to Table 4-1.								
QA/QC procedures to be applied	The flow meters, temperature and pressure transducer are calibrated annually according to the relevant standard "Verification regulation of different pressure type flow meter (JJG640-2016)". All electronic data and paper documents will be archived for two years following the end of the crediting period.								
Purpose of the data	Calculation of baseline emission from methane released into atmosphere; project emission from use of captured methane and from un-combusted methane from project activity.								
Calculation method	-								

Comments	-
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Data / Parameter	CONS _{ELEC,PJ}								
Data unit	MWh								
Description	Additional electricity consumption for capture and use or destruction of methane, which is imported electricity from the coal mine electricity network								
Source of data	From the electricity meters installed at project site								
Description of measurement methods and procedures to be applied	The additional electricity consumption at the power plant site will be continuously measured by electricity meter and monthly recorded. All electronic data and paper documents will be archived for two years following the end of the crediting period.								
Frequency of monitoring/recording	Measuring continuously and recording monthly								
Value monitored	<table border="1"> <thead> <tr> <th>Year</th><th>Value</th></tr> </thead> <tbody> <tr> <td>26-February-2018~31-December-2018</td><td>68.736</td></tr> <tr> <td>01-January-2019~25-December-2019</td><td>99.528</td></tr> <tr> <td>Total</td><td>168.264</td></tr> </tbody> </table> Please refer to ER spreadsheet for monthly values.	Year	Value	26-February-2018~31-December-2018	68.736	01-January-2019~25-December-2019	99.528	Total	168.264
Year	Value								
26-February-2018~31-December-2018	68.736								
01-January-2019~25-December-2019	99.528								
Total	168.264								
Monitoring equipment	The monitoring meters are bidirectional electricity meters. Calibration frequency: annual Please refer to Table 4-1 for details of meters.								
QA/QC procedures to be applied	The electricity meters are calibrated according to the industrial standard “Technical administrative code of electric energy metering (DL/T448-2016)”.								
Purpose of the data	Project emissions from combustion emission from additional energy required for CMM capture and use.								
Calculation method	-								
Comments	Electricity transaction notes (ETNs) have been provided for crosscheck.								

Data / Parameter	GEN _y								
Data unit	MWh								
Description	Electricity generation by the project activity in year y								
Source of data	From the electricity meters installed at project site								
Description of measurement methods and procedures to be applied	Electricity generated in the Project will be continuously measured by electricity meter and monthly recorded. All electronic data and paper documents will be archived for two years following the end of the crediting period.								
Frequency of monitoring/recording	Measuring continuously and recording monthly								
Value monitored	<table border="1"> <thead> <tr> <th>Year</th><th>Value</th></tr> </thead> <tbody> <tr> <td>26-February-2018~31-December-2018</td><td>67,499.688</td></tr> <tr> <td>01-January-2019~25-December-2019</td><td>63,285.216</td></tr> <tr> <td>Total</td><td>130,784.904</td></tr> </tbody> </table> Please refer to ER spreadsheet for monthly values.	Year	Value	26-February-2018~31-December-2018	67,499.688	01-January-2019~25-December-2019	63,285.216	Total	130,784.904
Year	Value								
26-February-2018~31-December-2018	67,499.688								
01-January-2019~25-December-2019	63,285.216								
Total	130,784.904								
Monitoring equipment	The monitoring meters are bidirectional electricity meters. Calibration frequency: annual Please refer to Table 4-1 for details of meters.								
QA/QC procedures to be applied	The electricity meters are calibrated according to the industrial standard "Technical administrative code of electric energy metering (DL/T448-2016)".								
Purpose of the data	Calculation of baseline emission from power generation replaced by the project.								
Calculation method	-								
Comments	Electricity transaction notes (ETNs) have been provided for crosscheck.								

Data / Parameter	CEF _{NMHC}
Data unit	tCO ₂ /tNMHC
Description	Carbon emission factor for combusted non methane hydrocarbons (various)

Source of data	Composition analysis report by Laboratory of Coal Mine Exploration of Guizhou Province.
Description of measurement methods and procedures to be applied	NMHC concentration monitored and analysed annually. In case the NMHC concentration is above 1%, the carbon emission factors of the different components shall be determined.
Frequency of monitoring/recording	Annually
Value monitored	Not applicable since $PC_{NMHC} < 1\%$
Monitoring equipment	-
QA/QC procedures to be applied	Gas sampled and analyzed annually.
Purpose of the data	Calculation of project emission from methane released into atmosphere.
Calculation method	-
Comments	-

Data / Parameter	PC_{CH_4}
Data unit	%
Description	Concentration (in mass) of methane in extracted gas (%), measured on wet basis.
Source of data	Monitoring data by Gas Analyzers on project site
Description of measurement methods and procedures to be applied	Methane concentration will be monitored continuously by gas analyzer at each CMM power plant. All electronic data and paper documents will be archived for two years following the end of the crediting period.
Frequency of monitoring/recording	Measuring continuously and recording hourly
Value monitored	The concentration of methane in extracted gas is continuously measured and recorded hourly through the monitoring system. Please refer to ER spreadsheet for details of monthly values (weighted average of the month).
Monitoring equipment	Gas Analysers Calibration frequency: annual Please refer to Table 4-1 for details of meters.
QA/QC procedures to be applied	The Gas Analyzers are periodically checked and calibrated in compliance with the monitoring requirements.

Purpose of the data	Calculation of baseline emission from methane released into atmosphere.
Calculation method	-
Comments	-

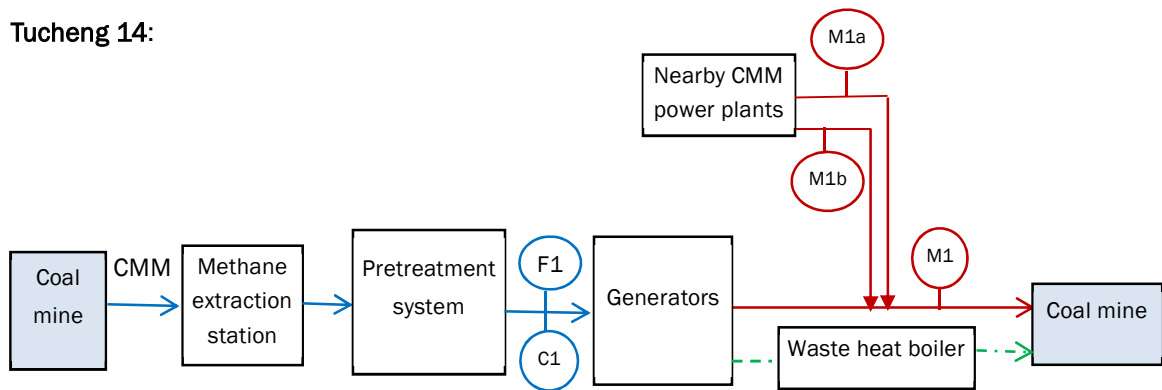
Data / Parameter	PC _{NMHC}																											
Data unit	%																											
Description	NMHC concentration (in mass) in extracted gas.																											
Source of data	Obtained through annual composition analysis of the extracted gas dated 05-January-2018, 09-June-2018 and 22-February-2019.																											
Description of measurement methods and procedures to be applied	Gas sample will be taken once a year and analyzed. All electronic data and paper documents will be archived for two years following the end of the crediting period.																											
Frequency of monitoring/recording	Annually.																											
Value monitored	<table><tr><td>Power Plant</td><td>PC_{NMHC} In Jan.2018</td><td>PC_{NMHC} In June.2018</td><td>PC_{NMHC} In Feb.2019</td></tr><tr><td>Tucheng 14</td><td>0.100%</td><td>0.190%</td><td>0.330%</td></tr><tr><td>Tucheng 13</td><td>0.050%</td><td>0.240%</td><td>0.440%</td></tr><tr><td>Laowuji Nanyi</td><td>N.D.</td><td>N.D.</td><td>N.D.</td></tr><tr><td>Songhe Cansan</td><td>0.080%</td><td>0.260%</td><td>0.210%</td></tr><tr><td>Songhe Cai'er</td><td>0.060%</td><td>0.050%</td><td>0.280%</td></tr></table> Note: N.D. means not detected. The trace NMHC in the gas stream is below the detection limit of the lab equipment, hence the testing result shows not detected. This means the concentration of NMHC is significantly lower than 1%. The test results of NMHC concentration in extracted gas of all power plants are below 1%.				Power Plant	PC _{NMHC} In Jan.2018	PC _{NMHC} In June.2018	PC _{NMHC} In Feb.2019	Tucheng 14	0.100%	0.190%	0.330%	Tucheng 13	0.050%	0.240%	0.440%	Laowuji Nanyi	N.D.	N.D.	N.D.	Songhe Cansan	0.080%	0.260%	0.210%	Songhe Cai'er	0.060%	0.050%	0.280%
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Laowuji Nanyi	N.D.	N.D.	N.D.																									
Songhe Cansan	0.080%	0.260%	0.210%																									
Songhe Cai'er	0.060%	0.050%	0.280%																									
Monitoring equipment	Tested by the Laboratory of Coal Mine Exploration of Guizhou Province. No onsite monitoring equipment required.																											
QA/QC procedures to be applied	Sampling and analysing annually																											

Purpose of the data	Calculation of project emission from NMHC destruction.
Calculation method	-
Comments	-

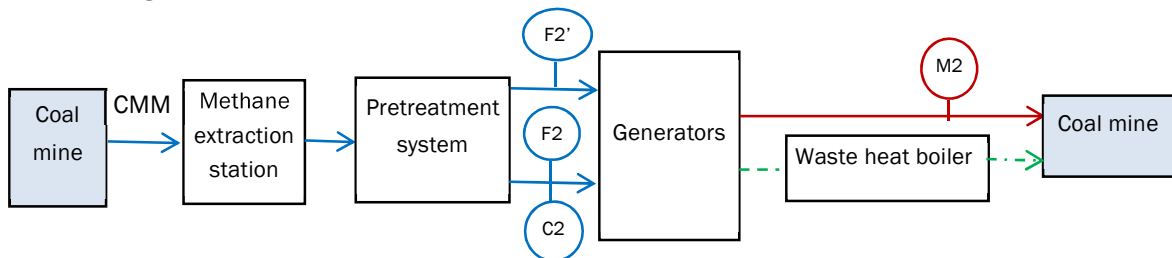
4.3 Monitoring Plan

Figure 4-1 below shows the positions of the monitoring instruments and Table 4-1 lists the information of monitoring equipment installed for the four power plants in operation in this monitoring period:

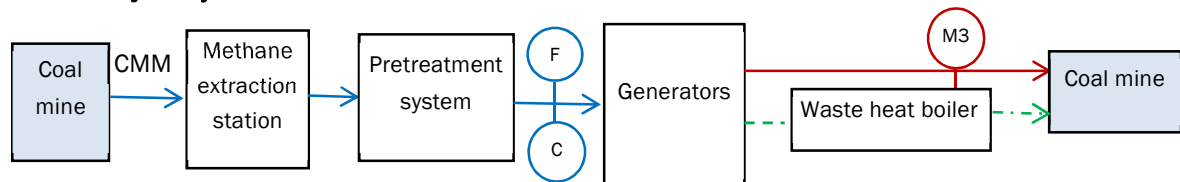
Tucheng 14:



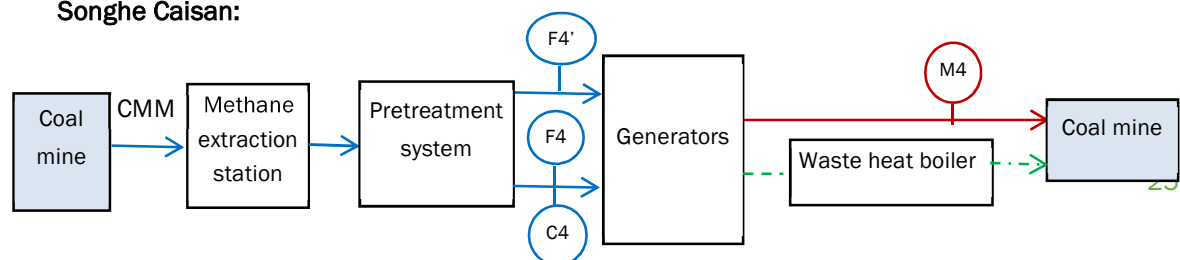
Tucheng 13:

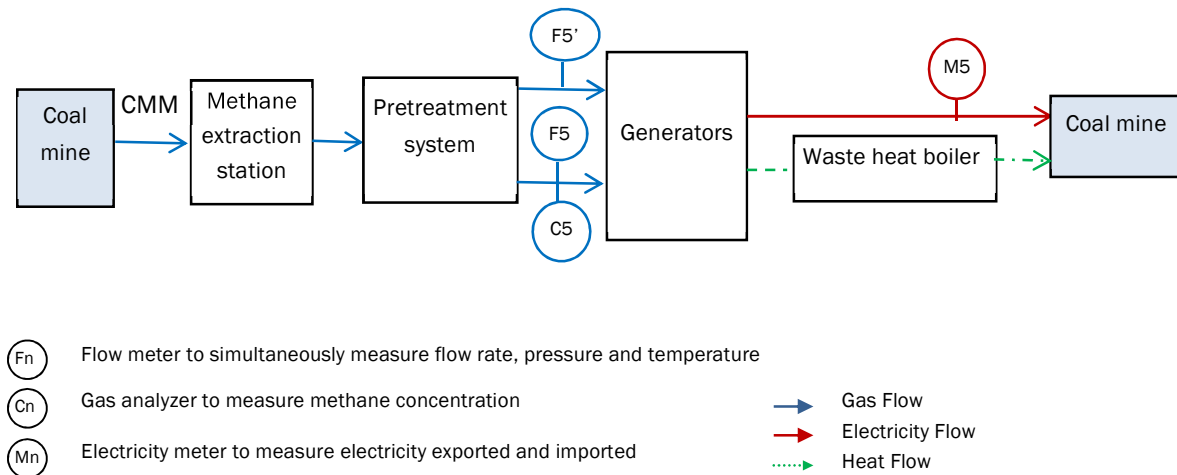


Laowuji Nanyi:



Songhe Caisan:



Songhe Cai'er:**Figure 4-1 Project monitoring diagram**

There're two gas pipelines in power plant Tucheng 13, Songhe Cai'er and Songhe Caisan. Each gas pipeline is equipped with one flow meter. That means there're two flow meters and one gas analyser in each of the three power plants. The meter installation of the three power plants is in accordance with the monitoring plan and the applied methodology, and the monitoring system can accurately monitor the amount of methane sent to the generator, because the methane concentration is the same in both pipelines as will be explained in the following paragraph:

The monitoring system of methane is designed and built by a qualified third-party China Coal Technology Engineering Group Chongqing Research Institute (CQCCRI), which have provided methane monitoring system for multiple coal mines and CMM power stations in China. The CMM gas flow of power plant Tucheng 13, Songhe Cai'er and Songhe Caisan is extracted from the coal mine and sent to the pre-treatment system of the CMM power plants through one gas pipeline, the CMM is then treated in the pre-treatment system and lead to the CMM generator through two gas pipelines with identical parameters (diameter, build material, etc.). Since the CMM gas has been sufficiently mixed during the pre-treatment process, the components and corresponding concentration (including methane concentration) of the CMM in the two gas pipelines leading to the generator are identical, based on CQCCRI's expertise, one gas analyser is sufficient and the installation of a second gas analyser would add additional costs to the project without increasing the accuracy. That the gas concentration is identical in the two gas pipelines has been proven by the fact that the methane concentration of the three CMM samples (sampled from the sampling points set in the outlet of pre-treatment system and the installation point of flow meters at the two gas pipelines) are the same. The samples are regularly (at least once a day) tested by the project owner using portable methane analysers during daily operation. In conclusion, appropriate flow and concentration meters have been installed by the project owner to directly measure the amount of methane delivered to the CMM generators. Hence the CMM monitoring system of the project is in accordance with paragraph 1, page 15 of the applied methodology.

Furthermore, the amount of methane is automatically calculated by the DCS system in the central control room of the project site. The DCS system automatically collects the gas flow rate, pressure and temperature measured by the two flow meters and methane concentration measured by the gas analyser; the two sets of data (gas flow rate, pressure and temperature) are calculated by the DCS system and then integrated into one set. The amount of methane is then calculated by the DCS system and can be exported as excel form. Hence there is no separate data for the two flow meters. The amount of methane

delivered to the generator has been correctly reported in the MR and ER spreadsheet. Besides, the monitoring team of the project owner regularly check the energy balance to identify any abnormal data if any, the accuracy of the monitoring data can be guaranteed.

Table 4-1 Information of installed monitoring instruments

Power plants	Equipment	Model	Serial No.	Accuracy	Date of calibration	Validity	Parameter monitored
Tucheng 14	Flow meter	GLY80	10300 (F1)	1.5%	03-Sep-2017 03-Sep-2018 03-Sep-2019	02-Sep-2018 02-Sep-2019 02-Sep-2020	MM _{ELEC}
	Pressure transmitter			1.5%			
	Temperature transmitter			2.5%			
	Gas analyzer	GJG100 H(C)	4548 (C1)	0~1%: $\pm 0.07\%$; 1%~100%: $\pm 7\%$	18-Jul-2017 29-May-2018 29-May-2019	17-Jul-2018 28-May-2019 28-May-2020	MM _{ELEC} PC _{CH4}
	Electricity meter	DSSD13 2	83336 (M1)	0.5S	13-Dec-2017 31-Aug-2018 30-Aug-2019	12-Dec-2018 30-Aug-2019 29-Aug-2020	GEN _y CONS _{ELEC,PJ}
		DSSD66 6	64465(M1a) , 64469(M1b) (for nearby power plant)	0.5S	13-Dec-2017 31-Aug-2018 30-Aug-2019	12-Dec-2018 30-Aug-2019 29-Aug-2020	
Tucheng 13	Flow meter	GLY80(A)	121613 (F2) 121614 (F2')	1.5%	28-Aug-2017 28-Aug-2018 28-Aug-2019	27-Aug-2018 27-Aug-2019 27-Aug-2020	MM _{ELEC}
	Pressure transmitter			1.5%			
	Temperature transmitter			2.5%			
	Gas analyzer	GJG100 H(C)	4560 (C2)	0~1%: $\pm 0.07\%$; 1%~100%: $\pm 7\%$	18-Jul-2017 29-May-2018 29-May-2019	17-Jul-2018 28-May-2019 28-May-2020	MM _{ELEC} PC _{CH4}
	Electricity meter	DSSD13 2	93649 (M2)	0.5S	13-Dec-2017 31-Aug-2018 30-Aug-2019	12-Dec-2018 30-Aug-2019 29-Aug-2020	GEN _y CONS _{ELEC,PJ}
Songhe Caisan	Flow meter	GLY80(A)	121611(F4') 121612(F4)	1.5%	28-Aug-2017 28-Aug-2018 28-Aug-2019	27-Aug-2018 27-Aug-2019 27-Aug-2020	MM _{ELEC}
	Pressure transmitter			1.5%			
	Temperature transmitter			2.5%			
	Gas analyzer	GJG100 H(C)	4571 (C4)	0~1%: $\pm 0.07\%$; 1%~100%: $\pm 7\%$	18-Jul-2017 29-May-2018 29-May-2019	17-Jul-2018 28-May-2019 28-May-2020	MM _{ELEC} PC _{CH4}
	Electricity meter	DSSD66 6	64467 (M4)	0.5S	13-Dec-2017 31-Aug-2018 30-Aug-2019	12-Dec-2018 30-Aug-2019 29-Aug-2020	GEN _y CONS _{ELEC,PJ}
Laowuji Nanyi	Flow meter	GLY80(A)	121610 (F3)	1.5%	28-Aug-2017 28-Aug-2018 28-Aug-2019	27-Aug-2018 27-Aug-2019 27-Aug-2020	MM _{ELEC}
	Pressure transmitter			1.5%			
	Temperature transmitter			2.5%			
	Gas analyzer	GJG100 H(B)	5659 (C3)	0~1%: $\pm 0.07\%$; 1%~100%: $\pm 7\%$	18-Jul-2017 29-May-2018 29-May-2019	17-Jul-2018 28-May-2019 28-May-2020	MM _{ELEC} PC _{CH4}
	Electricity meter	DSSD79 -GF	30278 (M3)	0.5S	13-Dec-2017 31-Aug-2018 30-Aug-2019	12-Dec-2018 30-Aug-2019 29-Aug-2020	GEN _y CONS _{ELEC,PJ}
Songhe Cai'er	Flow meter	GLY80(A)	131539 (F5) 131540 (F5')	1.5%	15-Sep-2017 15-Sep-2018 15-Sep-2019	14-Sep-2018 14-Sep-2019 14-Sep-2020	MM _{ELEC}
	Pressure transmitter			1.5%			
	Temperature transmitter			2.5%			
	Gas analyzer	GJG100 H(B)	1528 (C5)	0~1%: $\pm 0.07\%$; 1%~100%: $\pm 7\%$	18-Jul-2017 29-May-2018 29-May-2019	17-Jul-2018 28-May-2019 28-May-2020	MM _{ELEC} PC _{CH4}
	Electricity meter	DSSD79 -GF	02217 (M5)	0.5S	13-Dec-2017 31-Aug-2018 30-Aug-2019	12-Dec-2018 30-Aug-2019 29-Aug-2020	GEN _y CONS _{ELEC,PJ}

(A) Data and parameters to be monitored

Table 4 2 Corresponding parameters monitored

Parameter	Meters used	Data Collection	Description	
MM_{ELEC} PC_{CH4}	Flow meter Gas analyser	Continuously monitored and automatically recorded by computer	Methane concentration measured by gas analyser, gas flow rate, pressure and temperature measured by the flow meter are used to calculate mass of the methane sent to the generators.	
PC_{NMHC} CEF_{NMHC}	Sent to Lab (no onsite meter involved)	Sampled and analysed annually	If the concentration of NMHC in the extracted gas is less than 1%, emission from NMHC destruction is considered to be zero in the emission calculation according to ACM0008 (Version 07).	
GEN_y $CONS_{ELEC,PJ}$	Electricity Meter	Continuously monitored and recorded monthly	Power plant	Measurement method
			Tucheng 14	M1-(M1a+M1b)
			Tucheng 13	M2
			Laowuji Nanyi	M3
			Songhe Caisan	M4
			Songhe Caier	M5
			There exists a nearby power plant at the project site of power plant Tucheng 14. The two power plants share the same meter M1, which measures the total electricity generation and consumption by the two power plants. The electricity generation and consumption by the nearby power plant is measured by meter M1a (SN 64465) and M1b (SN 64469) and should be deducted from the measured values of meter M1 in order to get the net electricity generation and consumption by power plant Tucheng 14.	

(B) Management Structure

The Project owner organized a specific VCS team in project development department to be responsible for data collection, supervision and witness the whole process of data measuring and recording. A VCS manager has been appointed to take full responsibility for the overall monitoring of the project. The monitoring and measurement of extracted gas, electricity generation and consumption etc. is carried out by designated monitoring officers. In addition, the Project developer appointed internal verifiers who are responsible for internal check of the measurement, collection of relevant receipts and invoices, and the calculation of the emission reductions. A monitoring and management manual of the project that identifies detailed duties and responsibilities of the relevant parties has been developed and serves as the basis of the project monitoring. Figure 4-2 shows the operation and management structure of the Project.

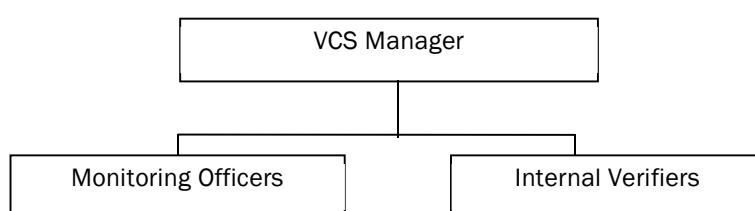


Figure 4-2 Operation and management structure of the project

The responsibilities of different roles in the management structure are summarized in Table 4-3.

Table 4-3 Role and responsibility of the monitoring team

Role	Responsibility
VCS manager	- Coordinate with external consultant to design and execute the monitoring plan - Supervise the Monitoring section to ensure a timely, adequate and accurate data recording - Ensure the enforcement of QA/QC plan performed by the Audit section - Calculate emission reductions and make regular summary following requirements as VCS projects - Work with external consultant to prepare the monitoring report - Assist with emission reduction issuance and DOE communication
Monitoring officer	- Collect, record and archive the monitoring data - Maintain the monitoring meters
Internal verifier	- Perform the routine QA/QC procedure to ensure data accuracy - Ensure timely calibration of the monitoring meters

(C) Data collection

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

Continuous data collecting (PC_{CH_4} , MM_{ELEC} , GEN_y , and $CONS_{ELEC,PJ}$)

The computer system automatically monitors and records relevant meter data. The concentration (in mass) of methane in extracted gas (PC_{CH_4}) is monitored by gas analyzers. The methane sent to the power generators (MM_{ELEC}) is calculated based on gas flow rate, pressure, temperature measured by flow meters and methane concentration of CMM measured by gas analyzers. The monitored hourly data of gas flow rate, pressure, temperature and CH_4 concentration are automatically collected and recorded by the DCS system. The DCS system then converts the monitored pressure and temperature to reference conditions (1 atm and 20°C) and calculates the hourly value of MM_{ELEC} . The monthly aggregated value of MM_{ELEC} is reported in the monitoring report and ER calculation spreadsheet.

Electricity generated (GEN_y) and consumed ($CONS_{ELEC,PI}$) by the project are monitored continuously by bidirectional electricity meters and recorded monthly. The data was recorded on the monthly report and the sales receipts are issued based on the monthly data confirmed by the both parties.

Periodical sampling data (PC_{NMHC} and CEF_{NMHC}).

The NMHC concentration (in mass) in extracted gas (PC_{NMHC}) is monitored through sampling once a year by a qualified third party in accordance with “Analysis of natural gas by Gas Chromatography” (GB/T 13610-2014).

As per the applied methodology, the carbon emission factor for combusted non methane hydrocarbons (CEF_{NMHC}) shall be monitored by gas sampled and analyzed annually only if PC_{NMHC} is larger than 1%. In this monitoring period the parameter of PC_{NMHC} is less than 1% for all power plants. According to the methodology ACM0008 (version 07), if NMHC accounts for less than 1% of extracted gas in volume, under normal operating conditions, emission from NMHC destruction can be ignored. Thus, the parameter of CEF_{NMHC} does not need to be monitored in this monitoring period.

(D) Quality assurance & Emergency Procedure

All monitoring equipment was installed as per relevant industrial standards and good practice, and was calibrated regularly for accuracy (please refer to Table 4-1). NMHC in the extracted gas for each power plant are sampled regularly each year and analysed. The Project owner preserves the calibration records and NMHC analysis results, along with the data files of project monitoring.

Error check routine has been established onsite and at the point of data storage to detect data measuring/transmission failures as well as malfunctions. In the case of meter malfunctioning, the meter supplier will provide technical support to engage the problem promptly and emission reductions during the corresponding period will be calculated conservatively.

No emergency occurred in this monitoring period.

(E) Data file management

All monitoring data are well kept with both electronic copy and hard copy. All data collected as part of monitoring will be archived and be kept at least for 2 years after the end of the crediting period.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

According to the methodology ACM0008 (version 07), baseline emissions are given by the following equation:

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

Where:

- BE_y = Baseline emissions in year y (tCO₂);
- $BE_{MD,y}$ = Baseline emissions from destruction of methane in the baseline scenario in year y (tCO₂);
- $BE_{MR,y}$ = Baseline emissions from release of methane into the atmosphere in year y that is avoided by the project activity (tCO₂e);
- $BE_{Use,y}$ = Baseline emissions from the production of power replaced by the project activity in year y (tCO₂e).

1. Baseline emissions from methane destroyed

The baseline scenario does not involve any flaring or usage of CMM, therefore, there is no methane destruction in the baseline. So, destruction of methane in the baseline scenario is 0.

2. Baseline emission from methane released into the atmosphere

This methane would have been emitted to the atmosphere in the baseline scenario, unless some capture and use activities form part of the baseline:

$$BE_{MR,y} = GWP_{CH_4} \times [(CMM_{PJ,y} - CMM_{BLi,y}) + (PMM_{PJ,y} - PMM_{BLi,y})] \quad (2)$$

Where:

- $BE_{MR,y}$ = Baseline emissions from release of methane into the atmosphere in year y that is avoided by the project activity (tCO₂e);
- $CMM_{PJ,y}$ = Pre-mining CMM captured, sent to and destroyed by power generation in the project activity in year y (expressed in tCH₄); not distinguishable from $PMM_{PJ,y}$;

- $CMM_{BL,y}$ = Pre-mining CMM that would have been captured, sent to and destroyed by use i in the baseline scenario in year y (expressed in tCH_4);
- $PMM_{PJ,y}$ = Post-mining CMM captured, sent to and destroyed by power generation in the project activity in year y (tCH_4); not distinguishable from $CMM_{PJ,y}$;
- $PMM_{BL,y}$ = Post-mining CMM that would have been captured, sent to and destroyed by use i in the baseline scenario in year y (tCH_4);
- GWP_{CH_4} = Global warming potential of methane ($25\ tCO_2e/tCH_4$).

In the baseline scenario, there is no CMM captured, sent to and destroyed, thus $CMM_{BL,y}$ and $PMM_{BL,y}$ is 0; $CMM_{PJ,y}$ and $PMM_{PJ,y}$ will together be directly monitored and measured as MM_{ELEC} , given that the common extraction system is located in the underground mine.

$$BE_{MR,y} = GWP_{CH_4} \times (CMM_{PJ,y} + PMM_{PJ,y}) = GWP_{CH_4} \times MM_{ELEC}$$

Thus, the calculation result of $BE_{MR,y}$ is as the following table 5-1.

Table 5-1 Calculation of $BE_{MR,y}$

Year	MM_{ELEC}	GWP_{CH_4}	$BE_{MR,y}$
	tCH_4	tCO_2/tCH_4	tCO_2
26-February-2018~31-December-2018	16,440.16	25	411,004
01-January-2019~25-December-2019	15,661.59	25	391,539
Total			802,543

3. Baseline emission from power generation replaced by project

The total potential emissions reductions from displacement of power generation are given by the following equation:

$$BE_{Use,y} = (GEN_y - CONS_{ELEC,PJ}) \times EF_{ELEC} + HEAT_y \times EF_{HEAT} + VFUEL_y \times EF_v \quad (3)$$

Where:

- $BE_{Use,y}$ = Potential total baseline emissions from the production of power replaced by the project activity in year y (tCO_2e);

- GEN_y = Electricity generated by project activity in year y (MWh);
 $CONS_{ELEC,PJ}$ = Additional electricity consumption for capture and use or destruction of methane, if any (MWh);
 EF_{ELEC} = Emissions factor of electricity replaced by project (tCO_2/MWh);
 $HEAT_y$ = Heat generation by project activity in year y (GJ), including through the use of CBM;
 EF_{HEAT} = Emissions factor for heat production replaced by project activity (tCO_2/GJ);
 $VFUEL_y$ = Vehicle fuel provided by the project activity in year y (GJ);
 EF_v = Emissions factor for vehicle operation replaced by project activity (tCO_2/GJ);

Since the Project does not claim the emission from heat or provide vehicle fuel, the equation can be simplified as followed:

$$BE_{Use,y} = (GEN_y - CONS_{ELEC,PJ}) \times EF_{ELEC}$$

The calculation result of $BE_{Use,y}$ is as table 5-2.

Table 5-2 Calculation of $BE_{Use,y}$ ²

Year	GEN_y	$CONS_{ELEC,PJ}$	EF_{ELEC}	$BE_{Use,y}$
	MWh	MWh	tCO_2/MWh	tCO_2
26-February-2018~31-December-2018	67,499.688	68.736	0.6323	42,636
01-January-2019~25-December-2019	63,285.216	99.528	0.6323	39,952
Total				82,588

As a summary, the baseline emission is as table 5-3.

Table 5-3 Summary of baseline emission

Year	$BE_{MD,y}$	$BE_{MR,y}$	$BE_{Use,y}$	BE_y
	tCO_2	tCO_2	tCO_2	tCO_2

² According to power purchase agreement, the time of meter reading for GEN_y and $CONS_{ELEC,PJ}$, y with the Coal Mine is at 8:00 of 25th of every month. The electricity for the period from 26-December-2018 to 31-December-2018 (actual from 8:00 25-December-2018 to 8:00 31-December-2018) is from the monthly report by the project owner based on the meter reading data every day.

26-February-2018~31-December-2018	0	411,004	42,636	453,640
01-January-2019~25-December-2019	0	391,539	39,952	431,491
Total	0	802,543	82,588	885,131

5.2 Project Emissions

Project emissions are defined by following equations:

$$PE_y = PE_{ME} + PE_{MD} + PE_{UM} \quad (4)$$

Where:

PE_y	Project emissions in year y (tCO ₂ e);
PE_{ME}	Project emissions from energy use to capture and use methane (tCO ₂ e);
PE_{MD}	Project emissions from methane destroyed (tCO ₂ e);
PE_{UM}	Project emissions from un-combusted methane (tCO ₂ e).

1. Combustion emissions from additional energy required for CMM capture and use

According to the registered PDD, there is no additional energy required for CMM capture compared with the baseline scenario. The energy use for power plant is considered in the baseline emission calculation. Therefore, PE_{ME} is calculated as 0.

$$PE_{ME}=0 \quad (5)$$

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. In addition, if NMHC account for more than 1% by volume of the extracted CMM, combustion emission from these gases should also be included.

$$PE_{MD} = (MD_{FL} + MD_{OX} + MD_{ELEC} + MD_{HEAT} + MD_{GAS}) \times (CEF_{CH_4} + r \times CEF_{NMHC}) \quad (6)$$

with:

$$r = PC_{NMHC} / PC_{CH_4} \quad (7)$$

Where:³

PE_{MD}	Project emissions from CMM and VAM destroyed (tCO ₂ e);
MD_{FL}	Methane destroyed through flaring (tCH ₄);
MD_{OX}	Methane destroyed through flameless oxidation (tCH ₄);
MD_{ELEC}	Methane destroyed through power generation (tCH ₄);

³ Note that throughout this baseline methodology, it is assumed that measured quantities of coal mine gas are converted to tonnes of methane using the measured methane concentration of the coal mine gas and the density of methane.

MD_{HEAT}	Methane destroyed through heat generation (tCH ₄);
MD_{GAS}	Methane destroyed after being supplied to gas grid or for vehicle use (tCH ₄);
CEF_{CH_4}	Carbon emission factor for combusted methane (2.75 tCO ₂ /tCH ₄);
CEF_{NMHC}	Carbon emission factor for combusted non methane hydrocarbons (the concentration varies and, therefore, to be obtained through periodical analysis of captured methane) (tCO ₂ /tNMHC);
r	Relative proportion of NMHC compared to methane;
PC_{CH_4}	Concentration (in mass) of methane in extracted gas (%), measured on wet basis;
PC_{NMHC}	NMHC concentration (in mass) in extracted gas (%).

The Project doesn't involve flaring, flameless oxidation, heating and supplying to gas grid, thus MD_{FL} , MD_{OX} , MD_{HEAT} and MD_{GAS} is 0. According to the gas composition test report by the third party, the concentration of NMHC accounts for less than 1% by volume of extracted coal mine gas, thus emission from NMHC destruction is not calculated.

$$\text{Thus, } PE_{MD} = MD_{ELEC} \times CEF_{CH_4} \quad (8)$$

$$\text{Where } MD_{ELEC} = MM_{ELEC} \times Eff_{ELEC} \quad (9)$$

MD_{ELEC}	Methane destroyed through power generation (tCH ₄);
MM_{ELEC}	Methane measured sent to power plant (tCH ₄);
Eff_{ELEC}	Efficiency of methane destruction/oxidation in power plant (taken as 99.5% from (IPCC)).

Therefore, $PE_{MD} = MM_{ELEC} \times Eff_{ELEC} \times CEF_{CH_4}$, which is calculated as the follows.

Table 5-4 Calculation of PE_{MD}

Year	MM_{ELEC}	Eff_{ELEC}	CEF_{CH_4}	PE_{MD}
	tCH ₄	%	tCO ₂ / tCH ₄	tCO ₂
26-February-2018~31-December-2018	16,440.16	99.5	2.75	44,985
01-January-2019~25-December-2019	15,661.59	99.5	2.75	42,855
Total				87,840

3. Un-combusted methane from project activity

Not all of the methane used to generate power will be combusted, so a small amount will escape to the atmosphere. These emissions are calculated using the following:

$$PE_{UM} = GWP_{CH_4} \times MM_{ELEC} \times (1 - Eff_{ELEC}) + PE_{flare} + PE_{OX} \times GWP_{CH_4} \quad (10)$$

Where:

PE_{UM}	=	Project emissions from un-combusted methane (tCO_2e);
GWP_{CH_4}	=	Global warming potential of methane ($25 tCO_2e/tCH_4$);
MM_{ELEC}	=	Methane measured sent to the power plant (tCH_4);
Eff_{ELEC}	=	Efficiency of methane destruction in the power plant (%) (taken as 99.5% from IPCC);
PE_{flare}	=	Project emissions of non-combusted CH_4 expressed in terms of CO_2e from flaring of the residual gas stream (tCO_2e);
PE_{ox}	=	Project emissions of non-oxidized CH_4 from flameless oxidation of the VAM stream (tCH_4).

As discussed above, $PE_{flare}=0$, $PE_{ox}=0$,

thus, $PE_{UM}=GWP_{CH_4} \times MM_{ELEC} \times (1-Eff_{ELEC})$, is calculated as the following table.

Table 5-5 Calculation of PE_{UM}

Year	MM_{ELEC}	Eff_{ELEC}	GWP_{CH_4}	PE_{UM}
	tCH_4	%	tCO_2/tCH_4	tCO_2
26-February-2018~31-December-2018	16,440.16	99.5	25	2,056
01-January-2019~25-December-2019	15,661.59	99.5	25	1,958
Total				4,014

Hence, the project emission is summarized as follows.

Table 5-6 Summary of project emission

Year	PE_{ME}	PE_{MD}	PE_{UM}	PE_y
	tCO_2	tCO_2	tCO_2	tCO_2
26-February-2018~31-December-2018	0	44,985	2,056	47,041
01-January-2019~25-December-2019	0	42,855	1,958	44,813
Total	0	87,840	4,014	91,854

5.3 Leakage

The formula for leakage is given as follows:

$$LE_y = LE_{d,y} + LE_{o,y} \quad (11)$$

Where:

- LE_y = Leakage emissions in year y (tCO₂e);
- LE_{d,y} = Leakage emissions due to displacement of other baseline thermal energy uses of methane in year y (tCO₂e);
- LE_{o,y} = Leakage emissions due to other uncertainties in year y (tCO₂e)

Since the baseline scenario does not include thermal energy use, LE_y = LE_{o,y}

The leakage of the project activity does not result from:

- Impact of VCS project activity on coal production - the VCS project activity is not designed to affect the on-going coal production, with the gas extraction and ventilation systems as part of the baseline scenario, and therefore leakage from this is zero;
- Impact of VCS project activity on coal prices and market dynamics - according to the methodology ACM0008 (Version 07), the proposed project is considered having no impact on coal price and market dynamics ex ante, unless the EB instruct otherwise in future.

Therefore, LE_y=0.

5.4 Net GHG Emission Reductions and Removals

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-February-2018~31-December-2018	453,640	47,041	0	406,599
01-January-2019~25-December-2019	431,491	44,813	0	386,678
Total	885,131	91,854	0	793,277

Comparison of actual emission reductions with estimates during validation:

The actual emission reductions of 793,277 tCO₂e achieved in this monitoring period is 28.33%⁴ lower than the estimated emission reductions 1,106,827 tCO₂e⁵ which is calculated in line with the VCS PD.

Since the actual installed capacity of the project during this monitoring period is 20.4MW (only 6 sets of CMM generators have been installed at power plant Songhe Cai'er, instead of 10 sets, please refer to section B.1 for details), while the designed installed capacity of the project is 22.8MW, the estimated emission reductions for this monitoring period was re-calculated based

⁴ (793,277 tCO₂e-1,106,827 tCO₂e)/ 1,106,827 tCO₂e=-28.33%

⁵ As per the VCS PD, the annual emission reduction in 2018-2019 is 604,778 tCO₂e, thus the estimated emission reduction in the monitoring period (covering 668 days) is 1,106,827 tCO₂e, ie. 1,106,827 tCO₂e=604,778 tCO₂e*668 days/365 days.

on the actual installed capacity. The re-calculated estimated emission reductions for this monitoring period are 990,319 tCO₂e (=1,106,827 tCO₂e × 20.4MW / 22.8MW). The actual emission reductions achieved in this monitoring period are 19.90%⁶ lower than the re-calculated estimated emission reductions. The main reason is that Laowuji Nanyi power plant was at the status of equipment halting at whole the monitoring period, Songhe Cai'er power plant stopped operation at the period of 02-February-2019 to 05-October-2019 and 11-October-2019 to 25-December-2019 due to the concentration of CH₄ in CMM gas was not enough for electricity generation. Taking the stopped operation of Laowuji Nanyi and Songhe Caier power plants into consideration, the estimated emission reductions achieved in this monitoring period are 789,569 tCO₂e⁷, thus, the actual emission reductions achieved in this monitoring period is 0.47%⁸ more than the estimated emission reductions, which is in the normal fluctuation range.

⁶ $(793,277\text{tCO}_2\text{e} - 990,319\text{ tCO}_2\text{e}) / 990,319\text{tCO}_2\text{e} = -19.90\%$

⁷ In this monitoring period, the power plants of Tucheng 13 (4.8MW), Tucheng 14 (2.4MW), and Songhe Caisan (7.2MW) operated 668 days, Songhe Caier (3.6MW) operated 346 days (668 days minus the equipment halting days 322 days, 246 days from 02-February-2019 to 05-October-2019, and 76 days from 11-October-2019 to 25-December-2019), thus, the estimated emission reductions are calculated as 789,569 tCO₂e, ie. $789,569\text{tCO}_2\text{e} = 1,106,827\text{ tCO}_2\text{e} \times 14.4\text{ MW} / 22.8\text{MW} + 1,106,827\text{ tCO}_2\text{e} \times 3.6\text{MW} / 22.8\text{MW} \times 346\text{ days} / 668\text{days}$.

⁸ $(793,277\text{ tCO}_2\text{e} - 789,569\text{ tCO}_2\text{e}) / 789,569\text{ tCO}_2\text{e} = 0.47\%$