GANSU GANZHOU BIOGAS RECOVERY AND UTILIZATION PROJECT

Document Prepared by Climate Bridge (Shanghai) Ltd.

Project Title	Gansu Ganzhou Biogas Recovery and Utilization Project
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1 PROJECT DETAILS

1.1 Summary Description of the Project

Gansu Ganzhou Biogas Recovery and Utilization Project (hereinafter referred to as the Project) locates in Mingyong Town, Ganzhou District, Zhangye City, Gansu Province, P.R China. The project is owned and implemented by Gansu Founder Energy Conservation Sci&Tech Service Co., Ltd.

The project is to build a centralized anaerobic animal manure treatment system which collects manure waste (dairy cow and sheep) from surrounding livestock farms in Ganzhou district. The project uses animal manure waste as ferment material to produce biogas in the Completely Stirred Tank Reactor (CSTR) type anaerobic digesters. The recovered biogas will be used for electricity generation at the project site. The electricity generated by the project will be delivered to Northwest China Power Grid (NWCPG). The residual waste from the CSTR digesters will be used to produce organic fertilizer at the project site.

Prior to the implementation of the project, the animal manure waste was left to decay in anaerobic manure management system (lagoon) at the livestock farms and methane is emitted to the atmosphere directly without any methane recovery and destruction facility. Equivalent amount of electricity was supplied from the NWCPG connected fossil fuel fired power plants.

The project is expected to avoid GHG emission of methane through recovery and destruction of biogas. In addition, the electricity generated from the biogas will be delivered to NWCPG to replace equivalent electricity generated by the fossil fuel fired power plants connected to the grid. The project is expected to achieve an annual emission reduction of 33,991 tCO_2e and a total emission reduction of 237,937 tCO_2e during the first 7-year crediting period.

1.2 Sectoral Scope and Project Type

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

Sectoral Scope 13: Waste handling and disposal.

The project is not a grouped project.

1.3 Project Eligibility

The scope of the VCS Program includes:

1) The six Kyoto Protocol greenhouse gases: The project is expected to avoid two greenhouse gases: 1) Methane (CH_4) emissions from the anaerobic animal manure management system in the baseline scenario, which will be captured and destroyed in the project scenario; 2) CO_2 emissions from the production of the equivalent amount of electricity replaced by the Project that would otherwise be generated by the fossil fuel fired power plants of NWCPG. Thus, the project applicable to this scope.

2) Ozone-depleting substances: Not Applicable.

3) Project activities supported by a methodology approved under the VCS Program through the methodology approval process: Not Applicable.

4) Project activities supported by a methodology approved under a VCS approved GHG program, unless explicitly excluded under the terms of Verra approval: The applied methodology AMS-III.D (Version 21.0) and AMS-I.D (Version 18.0) of the project are methodologies approved under CDM Program, which is a VCS approved GHG program.

5) Jurisdictional REDD+ programs and nested REDD+ projects as set out in the VCS Program document Jurisdictional and Nested REDD+ (JNR) Requirements: Not Applicable.

Furthermore, the project does not belong to the project activities excluded in Table 1 of VCS Standard 4.3.

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

1.4 Project Design

☒ The project includes a single location or installation only

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

☐ The project is a grouped project

Eligibility Criteria

Not applicable, the project is not a grouped project.

1.5 Project Proponent

Organization name	Gansu Founder Energy Conservation Sci&Tech Service Co., Ltd.
Contact person	Du Tianji
Title	Manager
Address	Mingyong Town, Ganzhou District, Zhangye City, Gansu Province, P.R China
Telephone	+86-021 23019950
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1.6 Other Entities Involved in the Project

Organization name	Climate Bridge (Shanghai) Ltd.
Role in the project	VCU buyer
Contact person	Gao Zhiwen
Title	General Manager
Address	Block B, Level 24, Jiangong Mansion, 33 Fushan Road, Pudong New Area, Shanghai, China 200120
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1.7 Ownership

The project owner of the project is Gansu Founder Energy Conservation Sci&Tech Service Co., Ltd. The project approval, approval of Environmental Impact Assessment (EIA) and the business license of the project owner are evidence for legislative right. Besides, the equipment purchasing contract, and the construction contract are the evidence for the ownership of the plant and equipment.

1.8 Project Start Date

01-08-2021 (Operation start date).

1.9 Project Crediting Period

This project adopts a 7-year renewable crediting period, the first crediting period is from 01-08-2021 to 31-07-2028 (both days included).

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)
01-08-2021 to 31-07-2022	33,991
01-08-2022 to 31-07-2023	33,991

01-08-2023 to 31-07-2024	33,991
01-08-2024 to 31-07-2025	33,991
01-08-2025 to 31-07-2026	33,991
01-08-2026 to 31-07-2027	33,991
01-08-2027 to 31-07-2028	33,991
Total estimated ERs	**237,937**
Total number of crediting years	7
Average annual ERs	33,991

1.11 Description of the Project Activity

The project involves construction of a centralized animal manure management system which collects manure waste (dairy cow and sheep) from surrounding livestock farms in Ganzhou district. The project uses animal manure waste as ferment material to produce biogas in the Completely Stirred Tank Reactor (CSTR) type anaerobic digesters. The anaerobic digesters are expected to produce 20,000 m^3 biogas per day. The recovered biogas will be used for electricity generation at the biogas power plant. Waste heat recovery boiler will also be installed at the biogas power plant to recover and supply waste heat to the auxiliary equipment of the project. The emission reductions from waste heat recovery will not be accounted for. The installed capacity of the biogas power plant will be 2MW. The biogas power plant of the project is expected to supply 15,010.758 MWh of electricity to the Northwest China Power Grid annually. The project activity is expected to have a 20-year operational lifetime.

The project is expected to avoid GHG emission of methane through recovery and destruction of biogas. In addition, the electricity generated from the biogas will be delivered to NWCPG to replace equivalent electricity generated by the fossil fuel fired power plants connected to the grid.

The key system involved in the project are as follows:

Anaerobic animal manure management system:

The Completely Stirred Tank Reactor (CSTR) type anaerobic digesters are to be applied in the project activity. The CSTR digester is designed by the project proponent and Beijing University of Chemical Technology. Three CSTR digesters with effective volume of 5,000m^3 each and one dry anaerobic digester with effective volume of 5,000m^3 will be installed. The project is expected to produce 20,000 m^3 biogas per day.

Biogas pre-treatment system

Before electricity generation, combustion or flaring, the biogas will be pre-treated to remove impurities and moisture etc., to prevent the corrosion of the project facility. In addition, biogas should be continuously in a stable condition before it flows into gas engine or flare. The pre-treatment consists of pre-filtration, dehumidification, dewatering, cooling and fine filtration.

Organic fertilizer production plant

The digestate from the anaerobic digesters, both solid and liquid digestate, will be used as material to produce organic fertilizer at the onsite organic fertilizer production plant. Hence proper conditions and procedures (not resulting in methane emissions) for digestate is ensured.

Biogas power generation system

The biogas electricity generation plant will be installed at the project site. The total installed capacity will be 2MW (0.2MW×6+0.4MW×2). The biogas power plant of the project is expected to supply 15,010.758 MWh of electricity to the Northwest China Power Grid annually. Waste heat recovery boiler will also be installed at the biogas power plant to recover and supply waste heat to the auxiliary equipment of the project.

1.12 Project Location

The Project locates in Mingyong Town, Ganzhou District, Zhangye City, Gansu Province, P.R China. The geographical coordinates for the project site are east longitude 100°21′43″ and north latitude 39°0′12″.

The geographic location of the project is shown in Figure 1-1.

Figure 1-1 Location of the project

1.13 Conditions Prior to Project Initiation

The conditions existing prior to project initiation:

1) The animal manure waste was left to decay in anaerobic manure management system (lagoon) at the livestock farms and methane is emitted to the atmosphere directly without any methane recovery and destruction facility.
2) Equivalent amount of electricity was supplied from the NWCPG connected fossil fuel fired power plants.

The conditions existing prior to project initiation is also the baseline scenario of the project.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

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

1. Environmental Protection Law of People's Republic of China;
2. Law of the People's Republic of China on the Prevention and Control of Solid Waste Pollution;
3. Regulations on prevention and control of pollution from large scale livestock and poultry breeding
4. Renewable Energy Law of the People's Republic of China;
5. Catalogue for the Guidance of Industrial Structure Adjustment (2013 revision);

The project has obtained the project approval and EIA approval from local government authorities: Development and Reform Commission of Ganzhou district and Ecology and Environment Bureau of Zhangye City. The two approvals well demonstrate that local government permits the construction of the project. Consequently, the project is compliance with laws, status and other regulatory frameworks.

1.15 Participation under Other GHG Programs

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

The project has neither been registered, nor is 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 never been seeking registration under any other GHG program; hence the project has never been rejected by any other GHG programs.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

Does the project reduce GHG emissions from activities that are included in an emissions trading program or any other mechanism that includes GHG allowance trading?

☐ Yes ☒ No

1.16.2 Other Forms of Environmental Credit

Has the project sought or received another form of GHG-related credit, including renewable energy certificates?

☐ Yes ☒ No

1.17 Sustainable Development Contributions

The project is to build a centralized anaerobic animal manure treatment system which collects manure waste from surrounding livestock farms in Gansu Province, China. The project uses animal manure waste as ferment material to produce biogas in the CSTR anaerobic digesters. The recovered biogas is used for electricity generation which is then delivered to NWCPG. The residual waste from the CSTR digesters is used to produce organic fertilizer at the project site.

The Project contributes to sustainable development in the following ways:

SDG	SDG indicators	Chinese sustainable development priorities	Project activity contribution
7 AFFORDABLE AND CLEAN ENERGY	**SDG 7.2** By 2030, increase substantially the share of renewable energy in the global energy mix	By 2030, the proportion of non-fossil energy in China's primary energy consumption will reach about 25%	The project supplies renewable electricity generated from recovered biogas to NWCPG. Therefore, the project contributes to SDG7.
8 DECENT WORK AND ECONOMIC GROWTH	**SDG 8.5** By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and	The 14th Five-Year Plan strengthens the policy of giving priority to employment, and at the same time promotes employment by promoting entrepreneurship. Implement the policy of equal access to employment services for migrant workers in the place of employment, and help the	The project provides long-term job opportunities for local residents. Therefore, the project contributes to SDG8.

	equal pay for work of equal value	disabled, families with zero employment and other disadvantaged groups to find employment.	
	**SDG 12.5** By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse	The "14th Five-Year Plan" and the 2035 Vision Outline put forward the "widespread formation of green production and lifestyle", which clearly calls for the in-depth implementation of promoting recycling-based production methods, green design and cleaner production, improvement of the recycling network of waste and used materials, and enhance the recycling capacity of renewable resources	The project uses animal manure waste as ferment material to produce biogas for electricity generation. The residual waste from the CSTR digesters is further used to produce organic fertilizer. Therefore, the project contributes to SDG12.
	**SDG13** Take urgent action to combat climate change and its impacts	By 2030, China's carbon dioxide emissions per unit of GDP will drop by more than 65% compared with 2005	The project reduces methane emissions from anaerobic decay of animal manure waste without methane recovery and destruction facility in the baseline scenario. The project also supplies renewable electricity generated to NWCPG to replace electricity supplied by fossil fuel dominated NWCPG. Therefore, the project contributes to SDG13.

1.18 Additional Information Relevant to the Project

Leakage Management

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 Environmental Impact Assessment (EIA) of the project has been conducted, and EIA report has been approved by Ecology and Environment Bureau of Zhangye City on 12-07-2019 (Approval No. “Zhanghuanpingfa [2019] No.25”). The EIA report has assessed every possible aspect of environmental impact of the project and recommended corresponding measures, where applicable. No net harm has been detected. Meanwhile, the implementation of the project will improve local socio-economic development through creating career opportunities and paying taxes. The project will also contribute to the sustainable development of local community as described in section 1.17 above.

In conclusion, the project has no negative impacts on local environment and socio-economy. No net harm on local environment and social community has been detected for the project.

2.2 Local Stakeholder Consultation

The Project owner collected comments by local stakeholders on the project activity. Survey questionnaires were distributed to relevant personnel of the livestock farms, local villagers and government officials by the Project owner on 17-11-2019. The survey questionnaire was 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 stakeholder survey

Item	Distribution	Quantity	Percentage
Amount of stakeholders surveyed	Male	16	53%
	Female	14	47%
Age	<25	6	20%

	25-55	18	60%
	>55	6	20%
Education	Junior high school or below	10	33%
	Senior high school	12	40%
	College or above	8	27%
Occupation	Worker	16	53%
	Peasant	9	30%
	Management personnel	2	7%
	Civil servant	2	7%
	Unspecified	1	3%

Thirty 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 project activity?	Very much	21	70%
		Heard of	5	17%
		Nothing	4	13%
2	Do you think the project will improve the current situation of livestock farms?	Yes	27	90%
		No	0	0
		Don't know	3	10%
3		Yes	20	67%

	Do you think the project will improve the local employment situation?	No	0	0
		Don't know	10	33%
4	Do you think the project will improve the local social community?	Yes	19	63%
		No	0	0
		Don't know	11	37%
5	Do you think the project will promote local economic development?	Positive impact	20	67%
		No impact	10	33%
		Negative impact	0	0%
6	What is the most probable environmental impact do you think the project will cause after the construction finish? (multiple choice)	None	23	77%
		Air pollution	0	0%
		Water pollution	0	0
		Noise pollution	0	0%
		Harm to indigenous animals and plants	0	0%
		Don't know	7	23%
7	What is your attitude to the project activity?	Support	26	87%
		Against	0	0
		Indifferent	4	13%

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 are being carried out 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 Environmental Impact

As per the EIA report, the environmental impacts of the project in construction period and operation period are summarized as follows.

1. Construction Phase

1.1 Air pollution

Construction dust and road dust during the construction has a certain effect to the surrounding areas of construction site, these adverse effects are accidental, temporary and partial, as long as to take effective measures and strengthen management, the scope of its influence is generally limited to the surrounding area of the construction site and will disappear along with the end of construction.

1.2 Wastewater

Wastewater during the construction period mainly includes construction wastewater and domestic sewage. The following measures are taken to prevent and control the pollution of construction wastewater: construct temporary diversion ditches on the construction site; Set up a sedimentation tank, and reuse the washing water for construction machinery as much as possible after simple treatment of equipment and vehicles;

Domestic sewage can be collected and processed by setting up mobile toilets, and regularly handed over to the sanitation department to remove garbage and excrement, which can effectively prevent the sewage generated by construction workers from polluting the water environment.

1.3 Noise

The noise generated by the project construction has a slight impact on the surrounding sensitive points, and its pollution impact is localized and short-term. After adopting a reasonable construction organization method, its impact on the surrounding area can be reduced to acceptable range.

1.4 Solid waste

During the construction period, a certain amount of construction waste and domestic waste from construction workers will be generated, of which part of the construction waste will be recycled, and the unusable waste will be handed over to the sanitation department for disposal. After the above measures are taken, the solid waste of the project will not cause pollution to the surrounding environment.

2. Operation Phase

2.1 Air pollution

The air pollution during the operation mainly includes the exhaust gas of the biogas generator and the flare, and dust from organic fertilizer plant. The exhaust gas is to be treated through 2 stage purification equipment before being discharged through exhaust cylinders with 20m high. The dust from organic fertilizer plant is to be filtered by dust collector and reused in the organic fertilizer plant. The NO_x, sulfur dioxide, H_2S, NH_3 and particulate matter in all the exhaust gas by the project meets Grade 2 emission standard of "Integrated Emission Standard of Air Pollutants" (GB16297).

2.2 Wastewater

The wastewater during operation is mainly domestic sewage and biogas slurry from anaerobic digesters. The domestic sewage of the project is pretreated in a septic tank and reused in anaerobic digesters. Most biogas slurry will also be recycled in anaerobic digesters, surplus biogas slurry will be used as material for organic fertilizer production. No wastewater will be discharged to the environment.

2.3 Noise

The noise of this project comes from noise from various mechanical operation and vibration. All production equipment is placed in the workshop or steel container, and measures are taken to reduce vibration and noise. The operating noise is effectively attenuated after being blocked by the solid wall.

2.4 Solid waste

The solid waste of the project is mainly domestic garbage, filtered dust. The domestic garbage and filtered dust are collected uniformly and then sent to landfill site for landfill treatment.

Hazardous waste: The hazardous waste, e.g. mineral oil, generated by the project mechanical facilities shall be properly collected and stored in the hazardous waste temporary deposit, and shall be submitted to the qualified entities for centralized treatment regularly.

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 project activity 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.

2.4 Public Comments

This project will open for public comment on the verra website.

2.5 AFOLU-Specific Safeguards

Not applicable.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

The methodologies applied to the project are small scale CDM methodologies:

AMS-III.D Methane recovery in animal manure management systems (version 21.0);

AMS-I.D Grid connected renewable electricity generation (version 18.0).

This methodology also refers to the latest approved version of the following tools:

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

Project emissions from flaring (version 04.0);

Project and leakage emissions from anaerobic digesters (version 02.0);

Project and leakage emissions from transportation of freight (version 01.1.0);

Tool to calculate the emission factor for an electricity system (version 07.0);

Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion (version 03.0);

For more detail information about the methodology and tools, please reference to the following link:

https://cdm.unfccc.int/methodologies/DB/H9DVSB24O7GEZQYLYNWUX23YS6G4RC https://cdm.unfccc.int/methodologies/DB/W3TINZ7KKWCK7L8WTXFQQOFQQH4SBK

3.2 Applicability of Methodology

The project satisfies all the applicability criteria of the methodology AMS-III.D (Version 21.0) and AMS-I.D (version 18.0), of which the detailed description is listed in Table 3-1 below:

Table 3-1 Applicability of AMS-III.D

No.	Applicability conditions of the methodology	The project
1	This methodology covers project activities involving the replacement or modification of anaerobic animal manure management systems in livestock farms to achieve methane recovery and destruction by flaring/combustion or gainful use of the recovered methane. It also covers treatment of manure collected from several farms in a centralized plant	Applicable. The project is a centralized plant treats animal manure waste collected from surrounding livestock farms. The project replaces existing anaerobic animal manure management systems (open lagoon) in livestock farms to achieve methane recovery and destruction by flaring/combustion or gainful use of the recovered methane.
2	This methodology is only applicable under the following conditions: a) The livestock population in the farm is managed under confined conditions	Applicable. All the livestock population in the farms within the project boundary is managed under confined conditions
	b) Manure or the streams obtained after treatment are not discharged into natural water resources (e.g. river or estuaries), otherwise “AMS-III.H Methane recovery in wastewater treatment" shall be applied	Applicable. As per the EIA report, manure or the streams obtained after treatment are not discharged into natural water resources (e.g. river or estuaries)
	c) The annual average temperature of baseline site where anaerobic manure treatment facility is located is higher than 5°C	Applicable. The annual average temperature of baseline site where anaerobic manure treatment facility is located is higher than 5°C.
	d) In the baseline scenario the retention time of manure waste in the anaerobic treatment system is greater than one month, and if anaerobic	Applicable. In the baseline scenario the retention time of manure waste in the anaerobic lagoons

	lagoons are used in the baseline, their depths are at least 1 m	is greater than one month, and their depths are at least 1 m.
	e) No methane recovery and destruction by flaring or combustion for gainful use takes place in the baseline scenario	Applicable. No methane recovery and destruction by flaring or combustion for gainful use takes place in the baseline scenario.
3	The project activity shall satisfy the following conditions: (a) The residual waste from the animal manure management system shall be handled aerobically, otherwise the related emissions shall be taken into account as per relevant procedures of "AMS-III.AO Methane recovery through controlled anaerobic digestion". In the case of soil application, proper conditions and procedures (not resulting in methane emissions) must be ensured;	Applicable. The residual waste from the animal manure management system of the project will be used to produce organic fertilizer, which is handled aerobically and will not result in methane emissions.
	(b) Technical measures shall be used (including a flare for exigencies) to ensure that all biogas produced by the digester is used or flared;	Applicable. Biogas produced by the project are used directly to produce electricity, the emergency flare ensure biogas would be destroyed while exigencies happened
	(c) The storage time of the manure after removal from the animal barns, including transportation, should not exceed 45 days before being fed into the anaerobic digester. If the project proponent can demonstrate that the dry matter content of the manure when removed from the animal barns is larger than 20%, this time constraint will not apply.	Applicable. The storage time of the manure after removal from the animal barns, including transportation will not exceed 45 days before being fed into the anaerobic digester.
4	Projects that recover methane from landfills shall use "AMS-III.G Landfill methane recovery" and projects for wastewater treatment shall use AMS-III.H. Projects for composting of animal manure shall use "AMS-III.F Avoidance of methane emissions through composting". Project activities involving co-digestion of animal manure and other organic matters shall use the methodology	Irrelevant. The project does not involve landfill methane recovery, wastewater treatment, composting animal manure, or co-digestion of animal manure and other organic matters.

	“AMS-III.AO Methane recovery through controlled anaerobic digestion".	
5	Utilization of the recovered biogas in one of the options detailed in AMS-III.H is also eligible under this methodology. The respective procedures in AMS-III.H shall be followed in this regard. If the recovered biogas is used to power auxiliary equipment of the project activity, it should be taken into account accordingly, using zero as its emission factor; however, energy used for such purposes is not eligible as an SSC CDM Type I project component.	Applicable. Part of the recovered biogas is used to produce and deliver electricity to the power grid, therefore AMS.I.D is applied. Part of the biogas is used to power auxiliary equipment of the project activity, zero is used as its emission factor, and this part of biogas is not eligible as an SSC CDM Type I project component, which means no emission reductions will be claimed for this part of biogas utilization.
6	New facilities (Greenfield projects) and project activities involving capacity additions compared to the baseline scenario are only eligible if they comply with the related and relevant requirements in the "General guidelines for SSC CDM methodologies".	Applicable. The project is a Greenfield project. The emission reduction sourced from methane recovery is 28,596 tCO_2e/yr, which is lower than the threshold of 60,000 tCO_2e/yr; the installed capacity of the project is 2.0MW, which is lower than the threshold of 15MW. Therefore, the Project is in line with ” General Guidelines to SSC CDM methodologies”
7	The requirements concerning demonstration of the remaining lifetime of the replaced equipment shall be met as described in the "General guidelines for SSC CDM methodologies".	The project is a Greenfield project, does not involve the replaced equipment; therefore, this is irrelevant.
8	Measures are limited to those that result in aggregate emission reductions of less than or equal to 60 kt CO_2 equivalent annually from all Type III components of the project activity.	Applicable. The emission reductions from the recovery and destruction of methane (viz. Type III components of the project) is 28,596 tCO_2e/yr, which is less than 60 kt CO_2 equivalent.

Table 3-2 Applicability of AMS-I.D

No.	Applicability conditions of the methodology	The project

1	This methodology comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass: (a) Supplying electricity to a national or a regional grid; or (b) Supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling.	Applicable. The project will use biogas to generate electricity, and the electricity will be supplied to Northwest China Power Grid.
2	Illustration of respective situations under which each of the methodology (i.e. “AMS-I.D.: Grid connected renewable electricity generation”, “AMS-I.F.: Renewable electricity generation for captive use and mini-grid” and “AMS-I.A.: Electricity generation by the user) applies is included in the appendix.	The Illustration of respective situations for AMS-I.D stated in the appendix is the same as applicability condition No. 1 above. No need for further justification.
3	This methodology is applicable to project activities that: (a) Install a Greenfield plant; (b) Involve a capacity addition in (an) existing plant(s); (c) Involve a retrofit of (an) existing plant(s); (d) Involve a rehabilitation of (an) existing plant(s)/unit(s); or (e) Involve a replacement of (an) existing plant(s).	Applicable. The project is a greenfield plant.
4	Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology: (a) The project activity is implemented in an existing reservoir with no change in the volume of reservoir; (b) The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the project emissions section, is greater than 4 W/m2; (c) The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the project emissions section, is greater than 4 W/m2.	Irrelevant. The project is not a hydro power plant.

5	If the new unit has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the new unit co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW.	Irrelevant. The project does not involve non-renewable components.
6	Combined heat and power (co-generation) systems are not eligible under this category.	According to the FSR, the only output for the project is electricity and the project does not involve co-generation system.
7	In the case of project activities that involve the capacity addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct1 from the existing units.	Irrelevant. The project does not involve capacity addition.
8	In the case of retrofit, rehabilitation or replacement, to qualify as a small-scale project, the total output of the retrofitted, rehabilitated or replacement power plant/unit shall not exceed the limit of 15 MW.	Irrelevant. The project does not involve retrofit, rehabilitation or replacement.
9	In the case of landfill gas, waste gas, wastewater treatment and agro-industries projects, recovered methane emissions are eligible under a relevant Type III category. If the recovered methane is used for electricity generation for supply to a grid then the baseline for the electricity component shall be in accordance with procedure prescribed under this methodology. If the recovered methane is used for heat generation or cogeneration other applicable Type-I methodologies such as “AMS-I.C.: Thermal energy production with or without electricity” shall be explored.	Irrelevant. The project does not involve landfill gas, waste gas, wastewater treatment and agro-industries projects.
10	In case biomass is sourced from dedicated plantations, the applicability criteria in the tool “Project emissions from cultivation of biomass” shall apply.	Irrelevant. The project does not involve biomass.

In addition, the project meets the applicability conditions of the applied tools applied in the PD as follows:

Table 3-3 Applicability of applied tools

Tool	Applicability	The project
Tool to calculate the emission factor for an electricity system (version 07.0)	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 biogas for power generation to supply electricity to NWCPG that dominated by fossil-fuel plants. Therefore the tool is applied to estimate the OM, BM and/or CM when calculating baseline emissions for the project.
	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.	In the host country as off-grid power generation is not significant. Therefore, emission factor for the project electricity system is calculated only for the grid power plants. Thus, this applicability criterion is satisfied.
	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 located in a non-Annex I country.
	Under this tool, the value applied to the CO_2 emission factor of biofuels is zero.	The project is not involved in biofuels.
Baseline, project and/or leakage	If emissions are calculated for electricity consumption, the tool is only applicable if one out	Applicable. The source of electricity consumption of the project is

emissions from electricity consumption and monitoring of electricity generation (version 03.0)	of the following three scenarios applies to the sources of electricity consumption: (a) Scenario A: Electricity consumption from the grid. The electricity is purchased from the grid only, and either no captive power plant(s) is/are installed at the site of electricity consumption or, if any captive power plant exists on site, it is either not operating or it is not physically able to provide electricity to the electricity consumer; (b) Scenario B: Electricity consumption from (an) off-grid fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants are installed at the site of the electricity consumer and supply the consumer with electricity. The captive power plant(s) is/are not connected to the electricity grid; or (c) Scenario C: Electricity consumption from the grid and (a) fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants operate at the site of the electricity consumer. The captive power plant(s) can provide electricity to the electricity consumer. The captive power plant(s) is/are also connected to the electricity grid. Hence, the electricity consumer can be provided with electricity from the captive power plant(s) and the grid.	Scenario A: Electricity consumption from the grid
	This tool can be referred to in methodologies to provide procedures to monitor amount of electricity generated in the project scenario, only if one out of the following three project scenarios applies to the recipient of the electricity generated: (a) Scenario I: Electricity is supplied to the grid; (b) Scenario II: Electricity is supplied to consumers/electricity consuming facilities; or (c) Scenario III: Electricity is supplied to the grid and consumers/electricity consuming facilities.	Applicable. The electricity generated by the project is supplied to the NWCPG (Scenario I).
	This tool is not applicable in cases where captive renewable power generation technologies are installed to provide electricity in the project activity, in the baseline scenario or to sources of leakage. The tool only accounts for CO_2 emissions.	NA. No captive renewable power generation technologies are installed to provide electricity in the project activity, in the

		baseline scenario or to sources of leakage.
Project emissions from flaring (version 04.0)	This tool provides procedures to calculate project emissions from flaring of a residual gas. The tool is applicable to enclosed or open flares and project participants should document in the PD the type of flare used in the project activity.	Applicable. The project will use enclosed flare system.
	This tool is applicable to the flaring of flammable greenhouse gases where: (a) Methane is the component with the highest concentration in the flammable residual gas; and (b) The source of the residual gas is coal mine methane or a gas from a biogenic source (e.g. biogas, landfill gas or wastewater treatment gas).	Applicable. Methane is the component with the highest concentration in the biogas flared in the project.
	The tool is not applicable to the use of auxiliary fuels and therefore the residual gas must have sufficient flammable gas present to sustain combustion. For the case of an enclosed flare, there shall be operating specifications provided by the manufacturer of the flare.	Applicable. The project does not use auxiliary fuels.
Project and leakage emissions from anaerobic digesters (version 02.0)	The following sources of project emissions are accounted for in this tool: (a) CO_2 emissions from consumption of electricity associated with the operation of the anaerobic digester; (b) CO_2 emissions from consumption of fossil fuels associated with the operation of the anaerobic digester; (c) CH_4 emissions from the digester (emissions during maintenance of the digester, physical leaks through the roof and side walls, and release through safety valves due to excess pressure in the digester); and (d) CH_4 emissions from flaring of biogas.	Applicable. All sources of project emissions have been accounted.

	The following sources of leakage emissions are accounted for in this tool: (a) CH_4 and N_2O emission from composting of digestate; (b) CH_4 emissions from the anaerobic decay of digestate disposed in a SWDS or subjected to anaerobic storage, such as in a stabilization pond.	Irrelevant. The project does not involve composting or anaerobic storage.
	Emission sources associated with N_2O emissions from physical leakages from the digester, transportation of feed material and digestate or any other on-site transportation, piped distribution of the biogas, aerobic treatment of liquid digestate and land application of the digestate are neglected because these are minor emission sources or because they are accounted in the methodologies referring to this tool.	Applicable. As per the applied methodology, N_2O emissions are neglected because these are minor emission sources .
Project and leakage emissions from transportation of freight (version 01.1.0)	This tool is applicable to project activities which involve freight transportation by road and where transportation is not the main project activity. This tool is not applicable to project activities where transportation is the main source of greenhouse gases emissions. This tool does not provide procedures to estimate baseline emissions from road transportation of freight. The tool only provides to determine CO_2 emissions. CH_4 and N_2O emissions are excluded for simplification as they are small compared to CO_2 emissions.	Applicable. The project involves freight transportation by road and transportation is not the main project activity.
	In addition, the tool is applicable for the determination of project or leakage emissions from freight transportation by rail in project activities where transportation is not the main project activity.	Irrelevant. The project does not involve rail transportation.
Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion (version 03.0)	This tool provides procedures to calculate project and/or leakage CO_2 emissions from the combustion of fossil fuels. It can be used in cases where CO_2 emissions from fossil fuel combustion are calculated based on the quantity of fuel combusted and its properties. Methodologies using this tool	Applicable. The tool is used to calculate project emissions from the combustion of fossil fuels by transportation vehicles based

	should specify to which combustion process j this tool is being applied.	on the quantity of fuel combusted and its properties.

3.3 Project Boundary

According to the methodology AMS-III.D, the project boundary includes the physical, geographical site(s) of (a) The livestock; (b) Animal manure management systems (including centralised manure treatment plant where applicable); (c) Facilities which recover and flare/combust or use methane.

According to the methodology AMS-I.D, the spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to.

Hence, the project boundary of Gansu Ganzhou Biogas Recovery and Utilization Project includes the physical and geographical sites of the livestock, the centralized animal manure management system, the biogas power plant and all the power plants connected into the NWCPG.

Figure 3-1 describes the project boundary of the Project Activity.

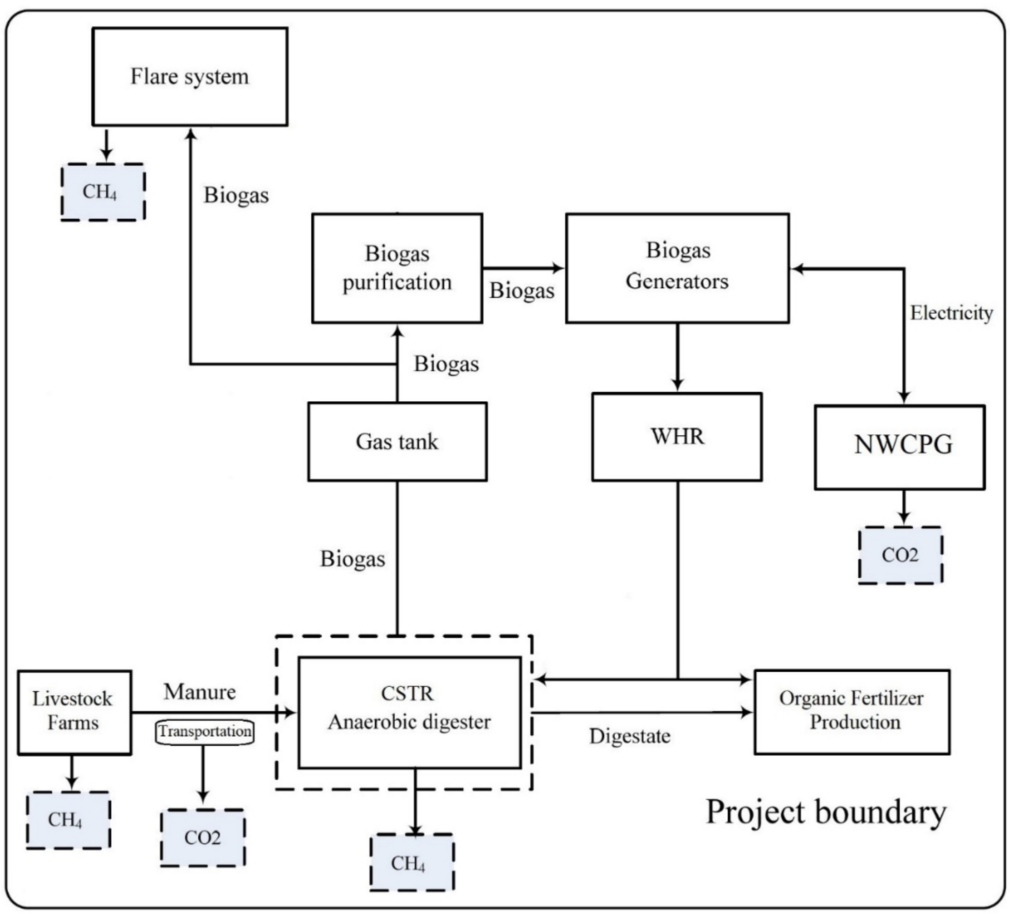

Figure 3-1 Project boundary of the project

Table 3-4 Emission sources included in or excluded from the project boundary

Source		Gas	Included?	Justification/Explanation
Baseline	Direct emissions from the manure treatment processes	CO_2	No	Excluded for simplification.
		CH_4	Yes	The major source of emissions in the baseline
		N_2O	No	Excluded for simplification.
	Emissions from electricity consumption /generation	CO_2	Yes	The major source of emissions in the baseline
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.
Project	Physical leakage of biogas in the manure management systems	CO_2	No	Excluded for simplification.
		CH_4	Yes	Main emission source.
		N_2O	No	Excluded for simplification.
	Emissions from flaring or combustion of the gas stream	CO_2	No	Excluded for simplification.
		CH_4	No	Excluded for simplification. The enclosed flare is installed for emergency, the emissions are assumed to be very small. The project will not claim this part of emission reduction
		N_2O	No	Excluded for simplification.
	Emissions from use of fossil fuels or electricity	CO_2	Yes	The project consumes electricity during operation, so Emission from use of electricity is the main emission source. The project does not involve fossil fuel consumption, so the emission from use of fossil fuels is not included.
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.
	Emissions from incremental transportation distances	CO_2	Yes	Main emission source.
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.
	Emissions from the storage of manure	CO_2	No	Excluded for simplification.
		CH_4	No	The storage time of the manure after removal from the animal barns, including transportation, is within 24 hours before being fed into the anaerobic digester, hence Emissions from the storage of manure is not accounted for.

Source		Gas	Included?	Justification/Explanation
		N_2O	No	Excluded for simplification.

3.4 Baseline Scenario

As per para. 17 of AMS-III.D, the baseline scenario is the situation where, in the absence of the project activity, animal manure is left to decay anaerobically within the project boundary and methane is emitted to the atmosphere.

As per para. 19 of AMS-I.D, the baseline scenario is that the electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources into the grid.

Hence, the baseline scenario of the project is the animal manure waste was left to decay in anaerobic manure management system (lagoon) at the livestock farms and methane is emitted to the atmosphere directly without any methane recovery and destruction facility; equivalent amount of electricity was supplied from the NWCPG connected fossil fuel fired power plants.

3.5 Additionality

As per para. 15-16 of applied methodology AMS-III.D, project activities may demonstrate the additionality by showing that there is no regulation in the host country, applicable to the project site, that requires the collection and destruction of methane from livestock manure. If so, it is not required to apply the “Guidelines on the demonstration of additionality of small-scale project activities”. This additionality condition also applies to Greenfield project activities. Furthermore, for project activities applying this methodology in combination with a Type I methodology, that has an energy component whose installed capacity is less than 5 MW, this procedure for additionality demonstration also applies to that component.

In line with AMS-III.D, the project recovers biogas to generate electricity with a total installed capacity of 2MW, which is lower than 5MW. The regulations relative to the project in China are identified as below.

a) Law of the People's Republic of China on Environment Protection;

b) Law of the People's Republic of China on the Prevention and Control of Solid Waste Pollution;

c) Law of the People's Republic of China on the Prevention and Control of Atmospheric Pollution;

d) Regulations on prevention and control of pollution from large scale livestock and poultry breeding;

e) Discharge standard of pollutants for livestock and poultry breeding (GB/T 18596);

f) Technical standard of pollution prevention for livestock and poultry breeding (HJ/T 81).

It has been identified that all the above laws and regulations in China **do not** require the collection and destruction of methane from livestock manure. In line with AMS-III.D, the project is deemed automatically additional.

3.6 Methodology Deviations

Not applicable.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

According to the methodology AMS-III.D and AMS-I.D, baseline emissions are determined according to equation (1) and comprise the following sources:

$$BE_y = BE_{CH4,y} + BE_{Elec,y} \quad (1)$$

Where:

BE_y	Baseline emissions in year *y* (t CO_2e/yr)
$BE_{CH4,y}$	Baseline emissions from the manure treatment processes in year *y* (t CO_2e/yr)
$BE_{Elec,y}$	Baseline emissions associated with electricity generation in year *y* (t CO_2/yr)

1. Baseline emissions from the manure treatment processes in year y ($BE_{CH4,y}$)

As per AMS-III.D, Baseline emissions ($BE_{CH4,y}$) are calculated by using one of the following two options:

(a) Using the amount of the waste or raw material that would decay anaerobically in the absence of the project activity, with the most recent IPCC Tier 2 approach (please refer to the chapter 'Emissions from Livestock and Manure Management' under the volume 'Agriculture, Forestry and other Land use' of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories). For this calculation, information about the characteristics of the manure and of the management systems in the baseline is required. Manure characteristics include the amount of volatile solids (VS) produced by the livestock and the maximum amount of methane that can be potentially produced from that manure (Bo);

(b) Using the amount of manure that would decay anaerobically in the absence of the project activity based on direct measurement of the quantity of manure treated together with its specific volatile solids (SVS) content.

The project applies option (b) to calculate baseline emissions from the manure treatment processes ($BE_{CH4,y}$).

$$BE_{CH4,y} = GWP_{CH4} \times D_{CH4} \times UF_b \times \sum_{j,LT} MCF_j \times B_{0,LT} \times Q_{manure,j,LT,y} \times SVS_{j,LT,y} \quad (2)$$

Where:

GWP_{CH4}	Global Warming Potential (GWP) of CH_4 applicable to the crediting period (t CO_2e/t CH_4)
D_{CH4}	CH_4 density (0.00067 t/m^3 at room temperature (20 ºC) and 1 atm pressure)
UF_b	Model correction factor to account for model uncertainties (0.94)
LT	Index for all types of livestock
j	Index for animal manure management system
$Q_{manure,j,LT,y}$	Quantity of manure treated from livestock type *LT* at animal manure management system *j* (tonnes/year, dry basis)
$SVS_{j,LT,y}$	Specific volatile solids content of animal manure from livestock type *LT* and animal manure management system *j* in year *y* (tonnes/tonnes, dry basis)
MCF_j	Annual methane conversion factor (MCF) for the baseline animal manure management system *j*, as per paragraph 18 of AMS-III.D
$B_{0,LT}$	Maximum methane producing potential of the volatile solid generated for animal type *LT* (m^3 CH_4/kg-VS), as per paragraph 18 of AMS-III.D

a) The maximum methane-producing capacity of the manure ($B_{o,LT}$) varies by species and diet. The preferred method to obtain $B_{o,LT}$ measurement values is to use data from country-specific published sources, measured with a standardised method ($B_{o,LT}$ shall be based on total as-excreted VS). These values shall be compared to IPCC default values and any significant differences shall be explained. If country specific Bo values are not available, default values from tables 10 A-4 to 10 A-9 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10 can be used, provided that the project participants assess the suitability of those data to the specific situation of the treatment site.

b) $B_{o,LT}$ values applicable to developed countries can be used provided the following four conditions are satisfied:

   i. The genetic source of the livestock originates from an Annex I Party;

   ii. The farm uses formulated feed rations (FFR) which are optimized for the various animal(s), stage of growth, category, weight gain/productivity and/or genetics;

   iii. The use of FFR can be validated (through on-farm record keeping, feed supplier, etc.);

   iv. The project specific animal weights are more similar to developed country IPCC default values.

c) Methane Conversion Factors (MCF) values are determined for a specific manure management system and represent the degree to which Bo is achieved. Where available country-specific MCF values that reflect the specific management systems used in particular countries or regions shall be used. Alternatively, the IPCC default values provided in table 10.17 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 10 can be used. The site annual average temperature is taken from official data at the nearest meteorological station, or from data available from historical on site observations.

2. Baseline emissions associated with electricity generation in year y ($BE_{elec,y}$)

As per AMS-I.D, baseline emissions associated with electricity generation in year y is calculated according to equation (3) as below:

$$BE_{elec,y} = EG_{PJ,y} \times EF_{grid,y} \quad (3)$$

Where:

$EG_{PJ,y}$	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the project activity in year y (MWh)
$EF_{grid,y}$	Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (t CO_2/MWh)

Calculation of combined margin CO_2 emission factor for grid ($EF_{grid,y}$)

According to "Tool to calculate the emission factor for an electricity system" (version 07.0). The following six steps are applied to determine OM, BM, and CM used for calculating the project baseline emissions:

Step 1. Identify the relevant electricity systems

According to the Tool to calculate the emission factor for an electricity system, project participants may delineate the project electricity system using any of the following options:

Option 1. A delineation of the project electricity system and connected electricity systems published by the DNA or the group of the DNAs of the host country(ies), In case a delineation is provided by a group of DNAs, the same delineation should be used by all the project participants applying the tool in these countries;

Option 2. A delineation of the project electricity system defined by the dispatch area of the dispatch centre responsible for scheduling and dispatching electricity generated by the project activity. Where the dispatch area is controlled by more than one dispatch centre, i.e. layered dispatch area, the higher level area shall be used as a delineation of the project electricity system (e.g. where regional dispatch centres are required to comply with dispatch orders of the national dispatch centre then area controlled by the national dispatch centre shall be used);

Option 3. A delineation of the project electricity system defined by more than one independent dispatch areas, e.g. multi-national power pools.

The Chinese DNA has published a delineation of the project electricity system and connected electricity systems, Option 1 is applied for the project. According to the delineations, the Northwest China Power Grid (NWCPG) is identified as the relevant electric power system of the project, which includes Shaanxi, Gansu, Qinghai, Ningxia and Xinjiang Provincial Power Grids.

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

Based on China's actual situation, 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, specific data from the grid or each power plant is treated as business confidential and thus not public available. Therefore, method (b) and method (c) is not suitable for the project.

The Simple OM method (a) can only be applied when low-cost/must run resources constitute less than 50% of total grid generation in average of the five most recent years. According to the data from China Electric Power Yearbook 2014-2018, from year 2013 to year 2017, for the NWCPG the project activity connected to, the low-cost/must-run electric power resources generation accounts for the total grid total are lower than 50%, which satisfied the applicability of the method (a), therefore, the simple OM method is chosen for the calculation of the OM emission factor $EF_{grid,OM,y}$.

As per the latest version of "Tool to calculate the emission factor for an electricity system" (version 07.0), one of the following methods should be chosen to calculate the simple OM emission factor:

- 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 VCS-PD to the DOE for validation, or
- Ex post option: If the ex post option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated

annually during monitoring. If the data required calculating the emission factor for year y is usually only available later than six months after the end of year y, alternatively the emission factor of the previous year (y-1) may be used. If the data is usually only available 18 months after the end of year y, the emission factor of the year 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.

Here the ex ante option is selected, and the $EF_{grid,OM}$ is fixed during the crediting period.

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

Based on the analysis of the step 3, the simple OM method is used to calculate the NWCPG OM emission factor in this step. The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/ units.

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

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

Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

For the project activity, the required data for the exercise of Option A is not available and those of Option B can be obtained from official sources, and off-grid power plants are not included in the calculation, therefore, Option B is chosen to calculate the operating margin emission factor:

For Option B, 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:

$$EF_{grid,OMsimple,y} = \frac{\sum_{i}(FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y})}{EG_y} \quad (4)$$

Where:

$EF_{grid,OMsimple,y}$	Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)
$FC_{i,y}$	Amount of fuel type i consumed in the project electricity system in year y (mass or volume unit)
$NCV_{i,y}$	Net calorific value (energy content) of fuel type i in year (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
y	The three most recent years for which data is available at the time of submission of the PD to the DOE for validation.

If available, $NCV_{i,y}$ and $EF_{CO2,i,y}$ from the fuel supplier of the power plants in invoices may be used; or, regional or national average default values may be used. In this PD, $NCV_{i,y}$ of different fuels are obtained from China Energy Statistical Yearbook 2018. Emission factors ($EF_{CO2,i,y}$) of each type of fossil fuel come from IPCC 2006 default values.

The Simple OM Emission Factor ($EF_{grid,OMsimple,y}$) of the project is calculated on the basis of the fuel consumption data for electricity generation of the Northwest China Power Grid, not including those of low-operating cost and must-run power plants, such as wind power, hydropower and nuclear etc. These data are obtained from the China Electric Power Yearbook (2016~2018, published annually) and China Energy Statistical Yearbook (2016~2018). Based on these data, the Simple OM Emission Factor ($EF_{grid,OMsimple,y}$) of the Northwest China Power Grid is calculated as 0.8922 tCO_2/MWh. Details of the calculations and the published data from the Chinese DNA[1], which uses official national statistics.

Step 5. Calculate the build margin (BM) emission factor

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

Option 1: For the first crediting period, calculate the build margin emission factor ex ante based on the most recent information available on units already built for sample group m at the time of 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.

[1] "2019 Baseline Emission Factors for Regional Power Grids in China", http://www.mee.gov.cn/ywgz/ydqhbh/wsqtkz/202012/t20201229_815386.shtml

The PD chooses Option 1, which requires the project participant to calculate the Build Margin Emission Factor $EF_{grid,BM,y}$, ex-ante based on the most recent information available on units already built for sample group m at the time of PD submission.

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

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

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

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

Under the current circumstances in China, the power plants consider the Build Margin data as important business data and will not have them published. Therefore, it is difficult to obtain the data of five power plants that have been put into operation most recently or the newly installed power plant capacity additions in the electricity system that comprise 20% of the system generation.

According to the instructions of China DNA, for the determination of the set of samples, a sample merging processing in some degree has been adopted due to that the power generation data, energy consumption data or thermal efficiency data of each plant cannot be consulted in the public statistical data. In this calculation, the newly-installed power units in the past years are classified by year, province and power generation technology, and the same type of newly-installed power units in the same province and in the same year are bundled as a "newly-installed power units".

The power generation of each “newly-installed power units” in the most recent year y is estimated based on its installed capacity and the number of power generation utilization hours in year y. The formula is as follows:

$$EG_{m,y} = CAP_m \times H_{m,y} \quad (5)$$

Where:

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

CAP_m	Installed capacity of electricity generated and delivered to the grid by power unit *m* in year *y* (MW)
$H_{m,y}$	The number of power utilization hours (h) of electricity generated and delivered to the grid by power unit *m* in year y. And it selects the average utilization hours of similar units in the province in which it is located in year *y*;
y	Most recent year for which data is available.
m	The sample group of power units.

The power unit m is selected from the "newly-installed power plants" in the most recent year y (For the calculation of the grid BM in 2019, the y is equal to 2017) to the "newly-installed power plants" in the earlier year, until the cumulative power generation reaches 20% of the total power generation in the year y (y=2017).

Since the newly-installed power units of the same type (k) in the same province (A) and the same year (t) are bundled into the "newly-installed power units", the CAPm is equal to the statistical data of recent installed capacity of a given unit type(k) in a given year(t) in a given province (A).

$$CAP_m = CAP_m |_{m=(A,t,k)} = CAP_{A,t,k} \quad (6)$$

Where:

CAP_m	Installed capacity of electricity generated and delivered to the grid by power unit *m* in year *y* (MW), and *m* is equivalent to an established combination of (A, t, k);
$CAP_{A,t,k}$	Capacity of newly-installed power units of a given province (A), given year (t), and given unit type (k) (MW)
A	It is the various provincial regions covered by the regional power grid
t	It is the sampling year of the "newly-installed power units". For the calculation of the grid BM in 2019, t is equal to 2017, 2016, ..., until the units that comprise at least 20 percent of the system generation in 2017.
k	It is the power generation technology classification of "newly-installed power units", which is divided into: hydro-power, coal-thermal power, gas-thermal power, oil-thermal power, Waste-thermal power plant, other thermal power[2], nuclear power, wind power, solar power, and others[3].

As per tool, the CO_2 emission factor of each power unit m ($EF_{EL,m,y}$) should be determined as per the tool in Step 4 section 6.4.1 for the simple OM, using Options A1, A2 or A3, using for y the most recent historical year for which electricity generation data is available, and using for m the power units included in the build margin.

Because current statistics data cannot separate each power plant, for a power unit m, only data on electricity generation and the fuel types used is available. So, the option A2 is selected, the

[2] refers to waste heat and pressure, straw, bagasse, forest wood power generation.

[3] refers to power generation such as geothermal energy and ocean energy.

emission factor should be determined based on the CO_2 emission factor of the fuel type used and the efficiency of the power unit, as follows:

$$EF_{EL.m.y} = \frac{EF_{CO2,m,i,y} \times 3.6}{\eta_{m,y}} \tag{7}$$

Where:

$EF_{EL.m.y}$	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$EF_{CO2,m,i,y}$	Average CO_2 emission factor of fuel type *i* used in power unit *m* in year *y* (tCO_2/GJ)
$\eta_{m,y}$	Average net energy conversion efficiency of power unit *m* in year y (ratio)
3.6	Conversion coefficient of thermal work equivalent of electricity (GJ/MWh)

According to formula (7), the unit electricity emission factor of the hydro-power, nuclear power, wind power, solar power, other thermal power[4], and others power generation technology[5] in the "newly-installed power units" samples are is zero. The emission factor per unit of electricity for power generation from coal, gas, oil and waste power is calculated based on formula (7). Since the average net energy conversion efficiency of each sample($\eta_{m,y}$) cannot be obtained, the power supply thermal efficiency of the best commercialized technology of coal, gas, oil and waste power ($\eta_{Best,m,y}$) is better than $\eta_{m,y}$. It is conservative to use $\eta_{Best,m,y}$ for the calculation of $EF_{EL,m,y}$.

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

$$EF_{grid,BM,y} = \frac{\sum_{m} EG_{m,y} \times EF_{EL,m,y}}{\sum_{m} EG_{m,y}} \tag{8}$$

Where,

$EF_{grid,BM,y}$	Build Margin CO_2 emission factor in year y (tCO_2/MWh)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit m in year y
$EF_{EL,m,y}$	CO_2 emission factor of power unit m in year *y* (tCO_2/MWh)
m	Power units included in the Build Margin

[4] Other thermal power mainly refers to waste heat and pressure, straw, bagasse and forest power generation.

[5] Others power generation technology mainly refers to geothermal energy, ocean energy and other power generation.

y The most recent year for which data is available

Outcome of STEP5:

According to the latest and available data at the time of this PD submission, $EF_{grid,BM,y}$ is calculated to be 0.4407 tCO_2/MWh.

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

As per the "tool to calculate the emission factor for an electricity system", 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 (option A) should be used as the preferred option.

The simplified CM method (option b) can only be used if:

The project activity is located in: (i) a Least Developed Country (LDC); or in (ii) a country with less than 10 registered CDM projects at the starting date of validation; or (iii) a Small Island Developing States (SIDS); and

The data requirements for the application of step 5 above cannot be met.

The PD choose option (a).

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = \omega_{OM} \times EF_{grid,OM,y} + \omega_{BM} \times EF_{grid,BM,y} \quad (9)$$

Where,

$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$	Operating margin CO_2 emission factor in year y (tCO_2/MWh)
ω_{OM}	Weighting of operating margin emissions factor (per cent)
ω_{BM}	Weighting of build margin emissions factor (per cent)

The combined margin emissions factor $EF_{grid,CM,y}$ should be calculated as the weighted average of the Operating Margin emission factor ($EF_{grid,OM,y}$) and the Build Margin emission factor ($EF_{grid,BM,y}$), where ω_{OM} = 0.5 and ω_{BM} = 0.5 for all other projects (owing to their intermittent and non-dispatchable nature) for the first crediting period and ω_{OM}=0.25 and ω_{BM} =0.75 for the second and third crediting period.

For the project, the weight ω_{OM} and ω_{BM} are both 0.5 by default for the fixed crediting period. Thus, $EF_{grid,CM,y}$=0.8922 tCO_2/MWh *0.5+0.4407 tCO_2/MWh *0.5 = 0.6665 tCO_2/MWh

4.2 Project Emissions

According to the methodology AMS-III.D and AMS-I.D, project emissions consist of:

(a) Physical leakage of biogas in the manure management systems which includes production, collection and transport of biogas to the point of flaring/combustion or gainful use ($PE_{PL,y}$);

(b) Emissions from flaring or combustion of the gas stream ($PE_{flare,y}$);

(c) CO_2 emissions from use of fossil fuels or electricity for the operation of all the installed facilities ($PE_{power,y}$);

(d) CO_2 emissions from incremental transportation distances;

(e) Emissions from the storage of manure before being fed into the anaerobic digester ($PE_{storage,y}$).

$$PE_y = PE_{PL,y} + PE_{flare,y} + PE_{power,y} + PE_{transp,y} + PE_{storage,y} \quad (10)$$

Where:

PE_y	Project emissions in year *y* (t CO_2e)
$PE_{PL,y}$	Emissions due to physical leakage of biogas in year *y* (t CO_2e)
$PE_{flare,y}$	Emissions from flaring or combustion of the biogas stream in the year *y* (t CO_2e)
$PE_{power,y}$	Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year *y* (t CO_2e)
$PE_{transp,y}$	Emissions from incremental transportation in the year *y* (t CO_2e), as per relevant paragraph in AMS-III.AO
$PE_{storage,y}$	Emissions from the storage of manure (t CO_2e)

1. Emissions due to physical leakage of biogas in year y

Project emissions due to physical leakage of biogas from the animal manure management systems used to produce, collect and transport the biogas to the point of flaring or gainful use are estimated as:

$$PE_{PL,y} = 0.10 \times GWP_{CH4} \times D_{CH4} \times \sum_{i,LT} B_{0,LT} \times Q_{manure,LT,y} \times SVS_{LT,y} \times MS\%_{i,y} \quad (11)$$

Where:

GWP_{CH4}	Global Warming Potential (GWP) of CH_4 applicable to the crediting period (t CO_2e/t CH_4)
D_{CH4}	CH_4 density (0.00067 t/m^3 at room temperature (20 ºC) and 1 atm pressure)
LT	Index for all types of livestock
j	Index for animal manure management system

$Q_{manure,j,LT,y}$	Quantity of manure treated from livestock type *LT* at animal manure management system *j* (tonnes/year, dry basis)
$SVS_{j,LT,y}$	Specific volatile solids content of animal manure from livestock type *LT* and animal manure management system *j* in year *y* (tonnes/tonnes, dry basis)
$MS\%_{i,y}$	Fraction of manure handled in system i in year y. If the project activity involves sequential manure management systems, the procedure specified in paragraph 18(e) of AMS-III.D shall be used to estimate the project emissions due to physical leakage of biogas in each stage
$B_{0,LT}$	Maximum methane producing potential of the volatile solid generated for animal type *LT* (m^3 CH_4/kg-VS), as per paragraph 18 of AMS-III.D

2. Emissions from flaring or combustion of the biogas stream in the year y

In the case of flaring of the recovered biogas, project emissions are estimated using the procedures described in the methodological tool "Project emissions from flaring" (version 04.0).

Based on the FSR, all the methane generated by the project will be used as energy supply. In order to ensure no biogas is released under exigencies, an emergency flare system is installed at the project site, this emergency flare system is not used under normal operation. In addition, in case this emergency flare system operated, the emissions reductions during this period will be excluded for conservativeness, thus $PE_{flare,y}$ is excluded as well, so $PE_{flare,y}$ = 0 tCO_2e.

3. Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year y

Project emissions from electricity and fossil fuel consumption are determined by following the methodological tool "Project and leakage emissions from anaerobic digesters" (version 02.0), where $PE_{Power,y}$ is the sum of $PE_{EC,y}$ and $PE_{FC,y}$ in the tool.

The project does not use any fossil fuel, so $PE_{FC,y}$ is not included in the project emission.

According to methodological tool "Project and leakage emissions from anaerobic digesters", $PE_{EC,y}$ shall be calculated using the "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0) as follows:

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{j,y}) \quad (12)$$

Where:

$PE_{EC,y}$	Project emissions from electricity consumption in year y (t CO_2 / yr)
$EC_{PJ,j,y}$	Quantity of electricity consumed by the project electricity consumption source j in year y (MWh/yr)
$EF_{EL,j,y}$	Emission factor for electricity generation for source j in year y (t CO_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

As stated above, according to the tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”(version 03.0), for the project is in the case of Scenario A: Electricity consumption from the grid, the project participants choose Option A1: Calculate the combined margin emission factor of the applicable electricity system, using the procedures in the latest approved version of the “Tool to calculate the emission factor for an electricity system” (version 07.0) ($EF_{EL,j,y} = EF_{grid,CM,y}$).

According to the tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (version 03.0), the project belongs to the case of Scenario A, use as default values of 20% for project emission, i.e. $TDL_{j,y}$ =20%.

$EC_{PJ,j,y}$ is ex ante determined as 0 in the PD and will be monitored ex post in the verification period.

4. Emissions from incremental transportation in the year y

According to AMS-III.D, emission from transportation of animal manure between livestock farms and the project site is calculated using “option A: Monitoring fuel consumption” of the methodological tool “Project and leakage emissions from transportation of freight” (version 01.1.0). Based on the amount of fuel consumed by the vehicles, project emissions are determined using the latest version of the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion” (version 03.0). Parameter $PE_{FC,j,y}$ in the tool corresponds to the parameter $PE_{transp,y}$ of the project, which is calculated as follows:

$$PE_{transp,y} = \sum FC_{i,j,y} \times NCV_{i,y} \times EF_{CO2,i,y} \quad (13)$$

Where:

$PE_{transp,y}$	Emissions from incremental transportation in the year y (tCO_2)
$FC_{i,j,y}$	The quantity of fuel type i combusted in process j during the year y (mass or volume unit/yr)
$EF_{CO2,i,y}$	The weighted average CO_2 emission factor of fuel type i in year y (tCO_2/GJ)
$NCV_{i,y}$	The weighted average net calorific value of the fuel type i in year y (GJ/mass or volume unit)

$PE_{transp,y}$ is ex ante determined as 0 in the PD and will be monitored ex post in the verification period.

5. Emissions from the storage of manure

Project emissions on account of storage of manure before being fed into the anaerobic digester shall be accounted for if both condition (a) and condition (b) below are satisfied:

(a) The storage time of the manure after removal from the animal barns, including transportation, exceeds 24 hours before being fed into the anaerobic digester;

(b) The dry matter content of the manure when removed from the animal barns is less than 20%.

The storage time of the manure after removal from the animal barns, including transportation, is within 24 hours before being fed into the anaerobic digester, hence emissions from the storage of manure is not accounted for, $PE_{storage,y}$ = 0 tCO_2e.

4.3 Leakage

As per "Project and leakage emissions from anaerobic digesters" (version 02.0), the leakage emissions associated with the anaerobic digester depend on how the digestate is managed. The leakage emissions include emissions associated with storage of digestate and composting of the digestate.

Digestate from the anaerobic digesters of the project will be used to produce organic fertilizer as soon as digestate is removed from the digesters. Digestate will not be stored under anaerobic conditions. In addition, the project does not involve composting of digestate. Therefore, leakage emissions of the project associated with the anaerobic digester is not accounted for.

4.4 Net GHG Emission Reductions and Removals

The emission reductions achieved by the project activity will be determined ex post through direct measurement of the amount of methane fuelled, flared or gainfully used. It is likely that the project activity involves manure treatment steps with higher methane conversion factors (MCF) than the MCF for the manure treatment systems used in the baseline situation, therefore the emission reductions achieved by the project activity are limited to the ex post calculated baseline emissions minus the project emissions using the actual monitored data for the project activity (i.e. $N_{LT,y}$, MS% $_{i,y}$, MS% $_{l}$, AI_l, as well as $VS_{LT,y}$ in cases where adjusted values for animal weight are used). The emission reductions achieved in any year are the lowest value of the following:

$$ER_{y,ex\,post} = min\left[\left(BE_{y,ex\,post} - PE_{y,ex\,post}\right), \left(MD_y - PE_{power,y,ex\,post}\right)\right] \tag{14}$$

Where:

$ER_{y,ex\,post}$	Emission reductions achieved by the project activity based on monitored values for year *y* (t CO_2e)
$BE_{y,ex\,post}$	Baseline emissions calculated using equation 1 (for projects using option in paragraph 17(a)) using ex post monitored values of $N_{LT,y}$ and if applicable $VS_{LT,y}$. For projects using option in paragraph 17(b), the ex post monitored values for $Q_{manure,j,LT,y}$ and $SVS_{j,LT,y}$ are used
$PE_{y,ex\,post}$	Project emissions calculated using equation 6 using ex post monitored values of $N_{LT,y}$,*MS%* $_{i,y}$, *MS%* $_{l}$, AI_l, $Q_{res\ waste,y}$ and if applicable $VS_{LT,y}$
MD_y	Methane captured and destroyed or used gainfully by the project activity in year *y* (t CO_2e)
$PE_{power,y,ex\,post}$	Emissions from the use of fossil fuel or electricity for the operation of the installed facilities based on monitored values in the year *y* (t CO_2e)

As per para.30 of AMS-III.D, if project activities utilize the recovered methane for power generation, may be calculated as follows, based on the amount of monitored electricity generation, without monitoring methane flow and concentration:

$$MD_y = \frac{EG_y \times 3600}{NCV_{CH4} \times EE_y} \times D_{CH4} \times GWP_{CH4} \quad (15)$$

Where:

EG_y	Total electricity generated from the recovered biogas in year *y* (MWh)
3600	Conversion factor (1 MWh = 3600 MJ)
NCV_{CH4}	NCV of methane (MJ/Nm^3) (use default value: 35.9 MJ/Nm^3)
EE_y	Energy conversion efficiency of the project equipment, which is determined by adopting one of the following criteria: - Specification provided by the equipment manufacture. The equipment shall be designed to utilize biogas as fuel, and efficiency specification is for this fuel. If the specification provides a range of efficiency values, the highest value of the range shall be used for the calculation; - Default efficiency of 40 %.

Ex-ante calculation of GHG emission reductions

1. Calculation of baseline emissions:

The baseline emissions are calculated as follows:

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

1.1 Baseline emissions of methane from the manure treatment processes

Table 4-1 Ex-ante value of parameters to calculate $BE_{CH4,y}$

Parameter	Value	Data sources
D_{CH4}	0.00067 t/m^3	AMS-III.D
UF_b	0.94	AMS-III.D
MCF_j	66%	Table 10.17 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 10
$B_{0,LT}$	Dairy Cows:0.24 m^3/kg VS Sheep: 0.19 m^3/kg VS	Tables 10 A-4 to 10 A-9 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10
GWP_{CH4}	28	IPCC AR5
$Q_{manure,j,LT,y}$	Dairy Cows: 7,500,000 kg dm	Feasibility Study Report of the project

	Sheep: 10,500,000 kg dm	
$SVS_{j,LT,y}$	Dairy Cows: 0.7 kg VS/kg dm Sheep: 0.6 kg VS/kg dm	Feasibility Study Report of the project

Hence, the ex-ante calculated baseline emissions of methane from the manure treatment processes of the project are:

$$BE_{CH4,y} = GWP_{CH4} \times D_{CH4} \times UF_b \times \sum_{j,LT} MCF_j \times B_{0,LT} \times Q_{manure,j,LT,y} \times SVS_{j,LT,y}$$

= 28×0.00067×0.94×(66%×0.24×7,500,000×0.7+66%×0.19×10,500,000×0.6)

= 28,596 tCO_2

1.2 Baseline emissions associated with electricity generation

As pre the FSR, the annual exported electricity to the NWCPG of the project is expected to be 15,010.758 MWh, the combined margin CO_2 emission factor for the grid is 0.6665 tCO_2/MWh, hence the expected annual baseline emissions associated with electricity generation of the project is calculated as follows:

$BE_{elec,y} = EG_{PJ,y} \times EF_{grid,y}$ = 15,010.758 MWh× 0.6665 tCO_2/MWh = 10,004 tCO_2

Hence, the baseline emission of the project is: $BE_y = BE_{CH4,y} + BE_{EC,y}$= 38,600 tCO_2

2. Calculation of project emissions

2.1 Emissions due to physical leakage of biogas in year y

As described in 4.2, project emissions due to physical leakage of biogas is calculated as below:

$$PE_{PL,y} = 0.10 \times GWP_{CH4} \times D_{CH4} \times \sum_{i,LT} B_{0,LT} \times Q_{manure,LT,y} \times SVS_{LT,y} \times MS\%_{i,y}$$

= 0.1×28×0.00067×(0.24×*7,500,000*×0.7×100%+*0.19*×*10,500,000*×0.6×100%)

= 4,609 tCO_2

2.2 Emissions from flaring or combustion of the biogas stream in the year y

As described in 4.2, $PE_{flare,y}$ is excluded, hence $PE_{flare,y}$ = 0 tCO_2.

2.3 Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year y

As described above, it is assumed the electricity for the operation of the project is 0 for ex-ante calculation, hence $PE_{power,y}$ = 0 tCO_2.

2.4 Emissions from incremental transportation in the year y

As described above, $PE_{transp,y}$ is ex ante determined as 0.

3. Calculation of emission reductions

Annual emission reductions of the project can be calculated as follows:

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
01-08-2021 to 31-07-2022	38,600	4,609	0	33,991
01-08-2022 to 31-07-2023	38,600	4,609	0	33,991
01-08-2023 to 31-07-2024	38,600	4,609	0	33,991
01-08-2024 to 31-07-2025	38,600	4,609	0	33,991
01-08-2025 to 31-07-2026	38,600	4,609	0	33,991
01-08-2026 to 31-07-2027	38,600	4,609	0	33,991
01-08-2027 to 31-07-2028	38,600	4,609	0	33,991
Total	**270,200**	**32,263**	**0**	**237,937**

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	GWP_{CH4}
Data unit	$t\ CO_2e/t\ CH_4$
Description	Global Warming Potential (GWP) of CH_4 applicable to the crediting period
Source of data	IPCC
Value applied	28
Justification of choice of data or description of measurement methods and procedures applied	Default value of 28 from IPCC Fifth Assessment Report (AR5). Shall be updated according to any future COP/MOP decisions.

Purpose of Data	Calculation of baseline emissions and project emissions
Comments	-

Data / Parameter	D_{CH4}
Data unit	t/m³
Description	CH4 density
Source of data	AMS-III.D
Value applied	0.00067 (at 20 °C and 1 atm pressure)
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline emissions and project emissions
Comments	-

Data / Parameter	UF_b
Data unit	-
Description	Model correction factor to account for model uncertainties
Source of data	AMS-III.D
Value applied	0.94
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline emissions and project emissions
Comments	-

Data / Parameter	MCF_j
Data unit	-

Description	*Annual methane conversion factor (MCF) for the baseline animal manure management system j*
Source of data	*2006 IPCC Guidelines for National Greenhouse Gas Inventories*
Value applied	*66%*
Justification of choice of data or description of measurement methods and procedures applied	*No country or regional specific value is available. Default value from table 10.17 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 10 is applied.* *The annual average temperature of baseline site where anaerobic manure treatment facility is located is higher than 5°C and lower than 10°C, the corresponding annual methane conversion factor (MCF) is 66%.*
Purpose of Data	Calculation of baseline emissions and project emissions
Comments	-

Data / Parameter	$B_{0,LT}$
Data unit	m^3 CH_4/kg-VS
Description	Maximum methane producing potential of the volatile solid generated for animal type LT
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied	Animal type: $B_{0,LT}$ Dairy Cows: 0.24 Sheep: 0.19
Justification of choice of data or description of measurement methods and procedures applied	No country or regional specific value is available. Default values from tables 10 A-4 to 10 A-9 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10 are applied. B_o values applicable to developed countries are used for the project as the following conditions are satisfied: (i) The genetic source of the livestock originates from an Annex I Party; (ii) The farm uses formulated feed rations (FFR) which are optimized for the various animal(s), stage of growth, category, weight gain/productivity and/or genetics; (iii) The use of FFR can be validated (through on-farm record keeping, feed supplier, etc.);

	(iv) The project specific animal weights are more similar to developed country IPCC default values
Purpose of Data	Calculation of baseline emissions and project emissions
Comments	-

Data / Parameter	$MS\%_{i,y}$
Data unit	-
Description	Fraction of manure handled in system i in year y
Source of data	AMS-III.D
Value applied	100%
Justification of choice of data or description of measurement methods and procedures applied	The project does not involve sequential manure management system, hence all manure would be handled in system i, 100% is applied for $MS\%_{i,y}$
Purpose of Data	Calculation of project emissions
Comments	-

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	Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (version 03.0)
Value applied	20%
Justification of choice of data or description of measurement methods and procedures applied	Default value of 20% is applied
Purpose of Data	Calculation of project emissions
Comments	-

Data / Parameter	$NCV_{i,y}$
Data unit	GJ/ton
Description	Weighted average net calorific value of fuel type i in year y
Source of data	upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC
Value applied	Diesel: 43.3
Justification of choice of data or description of measurement methods and procedures applied	Default value of IPCC are applied. Any future revision of the IPCC Guidelines should be taken into account.
Purpose of Data	Calculation of project emissions
Comments	-

Data / Parameter	$EF_{CO2,f}$
Data unit	tCO_2/GJ
Description	Weighted average CO_2 emission factor of fuel type i in year y
Source of data	upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC
Value applied	Diesel: 0.0748
Justification of choice of data or description of measurement methods and procedures applied	Default value of IPCC are applied. Any future revision of the IPCC Guidelines should be taken into account.
Purpose of Data	Calculation of project emissions
Comments	-

Data / Parameter	NCV_{CH4}
Data unit	MJ/Nm^3

Description	NCV of methane
Source of data	AMS-III.D
Value applied	35.9
Justification of choice of data or description of measurement methods and procedures applied	Default value from methodology is applied
Purpose of Data	Calculation of emission reductions
Comments	-

Data / Parameter	EE_y
Data unit	%
Description	Energy Conversion Efficiency of the project equipment
Source of data	AMS-III.D
Value applied	40%
Justification of choice of data or description of measurement methods and procedures applied	Default value from methodology is applied
Purpose of Data	Calculation of emission reductions
Comments	-

Data / Parameter	$EF_{grid,OM,y}$
Data unit	t CO_2/MWh
Description	Operating margin CO_2 emission factor in year y
Source of data	"2019 Baseline Emission Factors for Regional Power Grids in China" published by Ministry of Ecology and Environment of China
Value applied	0.8922
Justification of choice of data or description of	Official and authoritative statistic data.

measurement methods and procedures applied	
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 fixed in the crediting period.

Data / Parameter	$EF_{grid,BM,y}$
Data unit	t CO_2/MWh
Description	Build margin CO_2 emission factor in year y
Source of data	"2019 Baseline Emission Factors for Regional Power Grids in China" published by Ministry of Ecology and Environment of China
Value applied	0.4407
Justification of choice of data or description of measurement methods and procedures applied	Official and authoritative statistic data.
Purpose of Data	Calculation of baseline emissions and project emissions
Comments	According to section 4.1, the ex ante option is selected to calculate $EF_{grid,BM,y}$ and fixed in the crediting period.

Data / Parameter	$EF_{grid,CM,y}$ ($EF_{grid,y}$, $EF_{EL,j,y}$)
Data unit	t CO_2/MWh
Description	Combined margin emission factor for the grid in year y
Source of data	Calculated based on "Tool to calculate the emission factor for an electricity system" (version 07.0).
Value applied	0.6665
Justification of choice of data or description of measurement methods and procedures applied	$EF_{grid,CM,y}$ is calculated based on $EF_{grid,OM,y}$ and $EF_{grid,BM,y}$ as per the latest version of "Tool to calculate the emission factor for an electricity system"
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 fixed in the crediting period, thus the $EF_{grid,CM,y}$ is fixed during the crediting period.

5.2 Data and Parameters Monitored

Data / Parameter	$Q_{manure,j,LT,y}$
Data unit	kg-dm/year
Description	Quantity of manure treated from livestock type LT at animal manure management system j (dry basis)
Source of data	Measured by electronic truck scale and electric scale
Description of measurement methods and procedures to be applied	Quantity of manure (wet basis) is measured by electric truck scale. Water content of manure (wet basis) is measured by electric scale as per GB/T25169 Technical specifications for monitoring of animal manure
Frequency of monitoring/recording	Annually, based on daily measurement and monthly aggregation
Value applied	Dairy Cow: 7,500,000 Sheep: 10,500,000
Monitoring equipment	Electric truck scale, electric scale
QA/QC procedures to be applied	-
Purpose of data	Calculation of baseline emissions and project emissions
Calculation method	Quantity of manure (dry basis) = quantity of manure (wet basis)×(1-water content of manure (wet basis))
Comments	-

Data / Parameter	$SVS_{j,LT,y}$
Data unit	Kg VS/kg-dm
Description	Specific volatile solids content of animal manure from livestock type LT and animal manure management system j in year y
Source of data	Measured as per the guideline in annex 2 of AM0073

Description of measurement methods and procedures to be applied	**Method for determination of Volatile Solids in animal waste** From: USDA. Agricultural Waste Management Field Handbook. Chapter 4 - Agricultural Waste Characteristics. Page 2. Definitions • Total Solids: Residue remaining after water is removed from waste material by evaporation; dry matter; • Volatile Solids: The part of total solids driven off as volatile (combustible) gases when heated to 600°C; organic matter; • Fixed Solids: The part of total solids remaining after volatile gases driven off at 600°C; ashes. Determination method 1 - Evaporate free water on steam able and dry in oven at 103 ° C for 24 hours or until constant weight to obtain the Total Solids. 2 - Place Total Solids residue in furnace at 600°C for at least 1 hour. Volatile Solids are determined from weight difference of total and Fixed Solids. $Volatile\, matter\ (dry\, basis) = \frac{W_2 - W_f}{W_2 - W_1}$ Where W1 is the weight of sample container, W2 is combined weight of the sample container and oven dried sample, Wf is the combined constant weight of the sample container and sample after heating at 600°C
Frequency of monitoring/recording	Annually, based on daily measurement and monthly aggregation
Value applied	Dairy Cow: 0.7 Sheep: 0.6
Monitoring equipment	Electric scales
QA/QC procedures to be applied	-
Purpose of data	Calculation of baseline emissions and project emissions
Calculation method	-
Comments	-

Data / Parameter	$EG_{PJ,y}$

Data unit	MWh
Description	Quantity of electricity generation supplied by the project to the grid in year y
Source of data	Electricity meter
Description of measurement methods and procedures to be applied	Measured by electricity meter continuously and monthly recorded
Frequency of monitoring/recording	Continuous monitoring and at least monthly recording
Value applied	0
Monitoring equipment	Electricity meter
QA/QC procedures to be applied	Sales receipts are to be used for crosscheck
Purpose of data	Calculation of baseline emissions
Calculation method	-
Comments	Electricity imported from the grid will be used to calculate project emission using equation (12), hence electricity imported from the grid will not be deducted from electricity supplied to the grid by the project directly

Data / Parameter	$EC_{PJ,j,y}$
Data unit	MWh
Description	Quantity of electricity consumed by the project in year y
Source of data	Electricity meter
Description of measurement methods and procedures to be applied	Continuously measured by electricity meter and at least monthly recorded
Frequency of monitoring/recording	Continuously measured and at least monthly recorded
Value applied	0
Monitoring equipment	Electricity meter

QA/QC procedures to be applied	-
Purpose of data	Calculation of project emissions
Calculation method	-
Comments	-

Data / Parameter	$FC_{i,j,y}$
Data unit	tonne
Description	Quantity of fuel type i combusted during transportation in year y
Source of data	Purchase invoice of fuels
Description of measurement methods and procedures to be applied	Monitored by gas stations
Frequency of monitoring/recording	Daily monitored and monthly recorded
Value applied	0
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of project emissions
Calculation method	-
Comments	-

Data / Parameter	EG_y
Data unit	MWh
Description	Total electricity generated from the recovered biogas in year y
Source of data	Electricity meter
Description of measurement methods	Measured by electricity meter installed at the outlet of biogas generators

and procedures to be applied	
Frequency of monitoring/recording	Continuously monitored and monthly recorded
Value applied	-
Monitoring equipment	Electricity meter
QA/QC procedures to be applied	Monitoring equipment will be calibrated as per national regulation at periodic intervals.
Purpose of data	Calculation of emission reductions
Calculation method	-
Comments	-

5.3 Monitoring Plan

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

(A) Monitoring structure

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

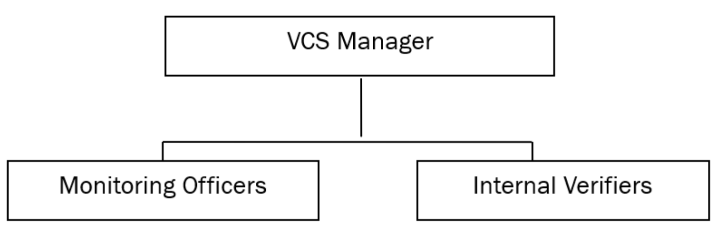

Figure 5-1 Operation and management structure of the project

(B) Data and parameters to be monitored

Data and parameters to be monitored are listed below. Figure 5-2 shows the positions of the monitoring instruments and Table 5-1 lists the corresponding parameters monitored:

Table 5-1 Data and parameters to be monitored

Equipment No.	Parameter to be Monitored	Description
E1	$Q_{manure,j,LT,y}$	Quantity of manure treated from livestock type LT at animal manure management system j (dry basis), *calculated as follows:* Quantity of manure (dry basis) = quantity of manure (wet basis)×(1-water content of manure (wet basis)) Quantity of manure (wet basis) is measured by electric truck scale. Water content of manure (wet basis) is measured by electric scale as per GB/T25169 Technical specifications for monitoring of animal manure
E2	$SVS_{j,LT,y}$	Specific volatile solids content of animal manure from livestock type LT and animal manure management system j in year y is measured as per the guideline in annex 2 of AM0073
E3	$EG_{PJ,y}$	Quantity of net electricity generation supplied by the project to the grid in year y is measured by electricity meter continuously and monthly recorded
E4	$EC_{PJ,j,y}$	Quantity of electricity consumed by the project in year y is continuously measured by electricity meter and at least monthly recorded
E5	$FC_{i,j,y}$	Quantity of fuel type i combusted during transportation in year y is monitored by gas station and monthly recorded.
E6	EG_y	Total electricity generated from the recovered biogas in year y is continuously measured by electricity meter and at least monthly recorded

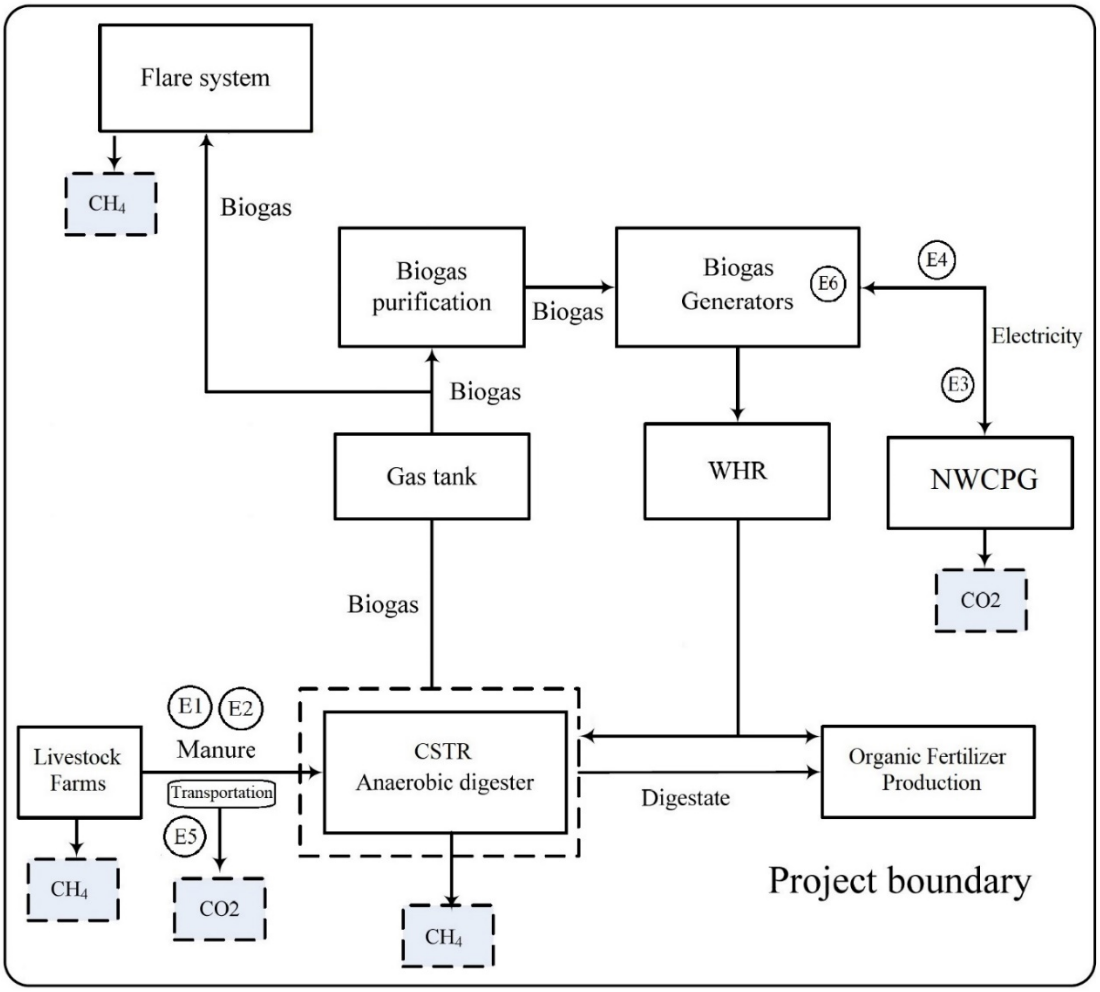

Figure 5-2 Project monitoring diagram

(C) Data collection

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

(D) Quality assurance

All metering equipment for monitoring will be chosen in accordance with VCS requirements and will be calibrated regularly for accuracy by qualified party according to the national regulations. To assist in future verifications, the Project owner will preserve the calibration records, along with the data files of project monitoring.

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

The installation of the electricity metering equipment will fulfill the requirements of "*DL/T448–2016 Technical Administrative Code of Electric Energy Metering*". The accuracy should not be less than 0.5. All the meters will be checked and maintained periodically.

(E) Data file management

All monitoring data will be electronically filed by the end of each month and the electronic data files will be archived in both disk copy and printed hard copy. Other documents in paper e.g. forms and environment assessment reports will be preserved as well. All data collected as part of monitoring will be archived electronically and be kept at least for 2 years after the end of the crediting period. The Project owner will provide original records and documents if necessary.