



**Verified Carbon  
Standard**

# LINSHU BIOGAS RECOVERY AND POWER GENERATION PROJECT



Document Prepared by Swiss Carbon Value Ltd.

|                      |                                                                                                                    |
|----------------------|--------------------------------------------------------------------------------------------------------------------|
| <b>Project Title</b> | Linshu Biogas Recovery and Power Generation Project                                                                |
| <b>Version</b>       | 3.0                                                                                                                |
| <b>Date of Issue</b> | 19/07/2021                                                                                                         |
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# 1 PROJECT DETAILS

## 1.1 Summary Description of the Project

The Linshu Biogas Recovery and Power Generation Project (hereafter referred to as the proposed Project) is implemented by VPOWER New Energy Technology (LinYi) LTD., (hereafter as VPOWER) located at Linshu Town, Shandong Province, China. The proposed project recovers biogas from the wastewater generated in alcohol production process. The electricity and steam generated by this project will be supplied to Jinyimeng company (hereafter as Jinyimeng).

Prior to the proposed project, the wastewater from alcohol production was treated through a series of deep open anaerobic lagoons without biogas recovery. The methane would have been released into the atmosphere. The equivalent electricity generated by the proposed project would have otherwise been from North China Power Grid (NCPG) which is fossil fuel dominated. The equivalent heat of the proposed project has otherwise been from coal boiler.

The baseline scenario is the same with scenario prior to the project.

The proposed project activity will install wastewater treatment equipment, biogas storage and purification equipment, biogas generator and waste heat boiler to utilize the biogas to generate electricity and heat. The electricity and heat generated will be used for the production of Jinyimeng to replace those from NCPG and coal boilers. Therefore, the proposed project would significantly reduce GHG emissions.

The wastewater treatment amount is about 10000m<sup>3</sup>/day, the inlet COD concentration of anaerobic digester is 55000mg/L, and outlet COD is 1000mg/L. After a series of treatment, the discharge COD will meet the national waste water discharging standard. The total installed capacity of the proposed project is 13.6MW, including 6 units of 1.2MW generators and 4 units of 1.6MW generators, and 1 unit of 1.2MW for backup. The project owner only claims emission reductions from methane recovery and electricity generation. The annual emission reductions by methane avoidance are 290,883tCO<sub>2</sub>e. The annual average estimation of GHG emission reduction from the methane recovery and electricity generation are about 359,691 tCO<sub>2</sub>e. The total GHG emission reductions in the 1st crediting period are 2,517,837 tCO<sub>2</sub>e, and the total GHG emission reductions in the 3\*7 crediting periods are 7,553,511 tCO<sub>2</sub>e.

In case of excessed biogas or emergency, the biogas will be flared using installed open flare system. The project started construction on 01/11/2018 and come into continuous operation on 20/09/2019.

## 1.2 Sectoral Scope and Project Type

The proposed project activity involves recovery of fugitive methane emissions using anaerobic covered lagoon system and utilization of biogas as fuel to generate heat and electricity. Therefore, the following sectoral scopes are applicable to the proposed project activity.

- Sectoral scope 13: Waste handling and disposal
- Sectoral scope 1: Energy industries (renewable - / non-renewable sources)

The proposed project is not AFOLU project and a grouped project.

### 1.3 Project Eligibility

The proposed project activity involves the implementation of anaerobic wastewater treatment system and utilization of biogas captured for electricity and thermal energy generation. Therefore, as per Section 2.1 of the VCS Standard (version 4.0), the proposed project activity is eligible under the scope of the VCS Program.

### 1.4 Project Design

The proposed project has been designed to include a single installation of an activity as per the proposed project description in Section 1.1 and the detail of installed technology in Section 1.11. The proposed project location is described in Section 1.12.

#### Eligibility Criteria

The proposed project activity is not grouped project. This section is not applicable.

### 1.5 Project Proponent

|                   |                                                                                          |
|-------------------|------------------------------------------------------------------------------------------|
| Organization name | VPOWER New Energy Technology (LinYi) LTD                                                 |
| Contact person    | Li Xia                                                                                   |
| Title             | Manager                                                                                  |
| Address           | High-Tech Entrepreneurship Service Center, LinShu County, LinYi City, Shan Dong Province |
| Telephone         | +86 539 60888170                                                                         |
| Email             | psm.ly@vpower.cn                                                                         |

## 1.6 Other Entities Involved in the Project

|                     |                                                                                                |
|---------------------|------------------------------------------------------------------------------------------------|
| Organization name   | Swiss Carbon Value Ltd.                                                                        |
| Role in the project | Project developer for development of emission reductions through the Voluntary Carbon Standard |
| Contact person      | Renat Heuberger                                                                                |
| Title               | CEO                                                                                            |
| Address             | Technoparkstrasse 1, Zurich, Switzerland, 8005                                                 |
| Telephone           | +41 43 501 35 50                                                                               |
| Email               | <a href="mailto:registration@southpole.com">registration@southpole.com</a>                     |

## 1.7 Ownership

The proposed project ownership can be demonstrated by the approval of FSR (Feasibility Study Report) and ERPA (Emission Reductions Purchasing Agreement).

## 1.8 Project Start Date

The proposed project activity started operation on 20/09/2019, which is the date that generates emission reductions.

## 1.9 Project Crediting Period

The 1st crediting period is from 20/09/2019 to 19/09/2026, which is 7 years and can be renewed twice. Therefore, the total crediting period is 21 years, from 20/09/2019 to 19/09/2040.

## 1.10 Project Scale and Estimated GHG Emission Reductions or Removals

| Project Scale |
|---------------|
| Project       |

|               |   |
|---------------|---|
| Large project | √ |
|---------------|---|

| Year                                 | Estimated GHG emission reductions or removals (tCO <sub>2</sub> e) |
|--------------------------------------|--------------------------------------------------------------------|
| 20/09/2019 – 31/12/2019<br>(103days) | 101,502                                                            |
| 01/01/2020 – 31/12/2020              | 359,691                                                            |
| 01/01/2021 – 31/12/2021              | 359,691                                                            |
| 01/01/2022 – 31/12/2022              | 359,691                                                            |
| 01/01/2023 – 31/12/2023              | 359,691                                                            |
| 01/01/2024 – 31/12/2024              | 359,691                                                            |
| 01/01/2025 – 31/12/2025              | 359,691                                                            |
| 01/01/2026 – 31/12/2026              | 359,691                                                            |
| 01/01/2027 – 31/12/2027              | 359,691                                                            |
| 01/01/2028 – 31/12/2028              | 359,691                                                            |
| 01/01/2029 – 31/12/2029              | 359,691                                                            |
| 01/01/2030 – 31/12/2030              | 359,691                                                            |
| 01/01/2031 – 31/12/2031              | 359,691                                                            |
| 01/01/2032 – 31/12/2032              | 359,691                                                            |
| 01/01/2033 – 31/12/2033              | 359,691                                                            |
| 01/01/2034 – 31/12/2034              | 359,691                                                            |
| 01/01/2035 – 31/12/2035              | 359,691                                                            |
| 01/01/2036 – 31/12/2036              | 359,691                                                            |
| 01/01/2037 – 31/12/2037              | 359,691                                                            |
| 01/01/2038 – 31/12/2038              | 359,691                                                            |
| 01/01/2039 – 31/12/2039              | 359,691                                                            |
| 01/01/2040– 19/09/2040<br>(262days)  | 258,189                                                            |
| <b>Total estimated ERs</b>           | <b>7,553,511</b>                                                   |

|                                 |         |
|---------------------------------|---------|
| Total number of crediting years | 21      |
| Average annual ERs              | 359,691 |

## 1.11 Description of the Project Activity

### Technology description

The proposed project installs series of wastewater treatment equipment, and recover the biogas generated during the wastewater treatment process for electricity and heat generation. The electricity and heat will be supplied to Jinyimeng for industrial production via NCPG and steam pipes.

The proposed project activity involves the installation of anaerobic biogas recovery system, consisting of biogas generation system, biogas handling and utilization and post-treatment system.

#### Anaerobic treatment (Biogas generation system)

The effluent from the alcohol production process will be treated by the biogas system using three phase anaerobic fermentation tanks. In these methane reactors, organic compounds in wastewater are transformed mainly into biogas.

#### Biogas handling and utilization

The biogas generated are stored in the biogas tank, and then be treated in Washing tower and desulfurization tower, and purification equipment. After desulfurization, filter, dehydration, pressurization, the biogas will be routed to gas engines and boilers for the generation of power and thermal energy. Gas engines for power generation are installed with a total capacity being about 13.6MW<sub>el</sub>. When the generator set are in malfunction, or excess biogas, if any, will be sent to high temperature open flare to destroy.

#### The post-treatment

The wastewater will continue to flow from the anaerobic digesters to a series of open lagoons. After the whole treatment process, the COD concentration of the wastewater will be low and comply with national integrated wastewater discharge standard. And it is discharged to local wastewater treatment area.

The main equipment and key technical parameters are listed below

Table 1. Key parameters of main equipment

| Equipment | Model | Number | Key technical parameters |
|-----------|-------|--------|--------------------------|
|-----------|-------|--------|--------------------------|

|              |                       |                          |                                                                                                                                              |
|--------------|-----------------------|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| Gas engine   | VGS1169BG             | 7(including<br>1 backup) | Capacity: 1200kW<br>Lifetime: no less than 21 years<br>Year of manufacture: 2017                                                             |
| Gas engine   | PPU1554BG             | 4                        | Capacity: 1600kW<br>Lifetime: no less than 21 years<br>Year of manufacture: 2017                                                             |
| Steam boiler | Q33.4/445-5.0-1.0/220 | 1                        | Evaporation: 5t/h<br>Rated steam pressure: 1.0MPa<br>Rated steam temperature:<br>220°C<br>Lifetime: 25 years<br>Year of manufacture: 2018    |
| Steam boiler | Q24.6/445-3.8-1.0/220 | 1                        | Evaporation: 3.8t/h;<br>Rated steam pressure: 1.0MPa<br>Rated steam temperature:<br>220°C<br>Lifetime: 25 years<br>Year of manufacture: 2018 |

## 1.12 Project Location

The proposed project activity is located at Linshu County, Linyi City, Shandong Province, China. The proposed project activity location is depicted in figure 1 and figure 2.

Project coordinates are 34°54'52.95"N, 118° 34'18.78" E



Figure 1. Location of Shandong province in China



Figure 2. Location of the proposed project

### 1.13 Conditions Prior to Project Initiation

The proposed project activity is implemented in a Greenfield location. In the baseline scenario the wastewater from the starch would have been treated through a series of deep open anaerobic lagoons with the condition of the anaerobic digestion of the organic content and the methane would have been released into the atmosphere. The thermal oil boiler would have used heavy fuel oil as fuel to generate thermal energy and the use of electricity from the national grid, which is fossil-fuel based power plants, would occur.

More details of the baseline scenario can refer to Section 3.4 Baseline Scenario.

## 1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The proposed project activity is in compliance with national laws and regulations, which can be demonstrated by the approval of FSR and EIA.

The main laws and regulations are summarized below:

Renewable Energy Law of the People's Republic of China;

Construction Law of the People's Republic of China;

Electricity Law of the People's Republic of China;

Energy-saving design code for machinery industry;

Environmental Impact Assessment Law of the People's Republic of China;

Regulations on Environmental Protection Management of Construction Projects

## 1.15 Participation under Other GHG Programs

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

The proposed project has not been registered or is seeking registration under any other GHG programs.

### 1.15.2 Projects Rejected by Other GHG Programs

According to Section 1.15.1, the proposed project has not been rejected under by any other GHG programs.

## 1.16 Other Forms of Credit

### 1.16.1 Emissions Trading Programs and Other Binding Limits

The proposed project does not reduce GHG emissions from activities that are included in an emissions trading program or any other mechanism that includes GHG allowance trading.

### 1.16.2 Other Forms of Environmental Credit

The proposed project has not sought or received another form of GHG-related environmental credit, including renewable energy certificates.

## 1.17 Additional Information Relevant to the Project

### Leakage Management

This is not applicable.

### Commercially Sensitive Information

The proposed project has no commercially sensitive information included in the public version of the project description. Thus, this is not applicable.

### Sustainable Development

The project provides many benefits that will help achieve China's Sustainable Development Goals (SDG)<sup>1</sup>, a set of 17 universal goals covering the thematic areas of environmental, economic and social development.



The proposed project will directly contribute to sustainable development in several ways as shown below:

- Provide clean energy. The project makes use of biogas generated from wastewater treatment to generate electricity and heat. The clean electricity generation of this project is supplied to Jinyimeng to replace the same amount of electricity that would have otherwise been supplied by NCPG, which is dominated by fossil fuel fired electricity. This helps diversify power structure of the NCPG and reduce the dependence on fossil fuels. The heat of this project is supplied to Jinyimeng company to replace coal consumption. This contributes to one of the China's actions for promoting the sustainable developing, "By 2030, increase the share of non-fossil fuels in primary energy consumption to about 20 percent"; (SDG 7)

<sup>1</sup> [https://www.fmprc.gov.cn/mfa\\_eng/zxxx\\_662805/W020161014332600482185.pdf](https://www.fmprc.gov.cn/mfa_eng/zxxx_662805/W020161014332600482185.pdf)

- Provide decent work. The project provides employment opportunities related to the operation and maintenance of the power plant, which meets one of the China's action plans *"by 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value."* (SDG 8)
- Reduce CH<sub>4</sub> emissions. The project recovers and utilizes biogas generated during wastewater treatment that would otherwise be released into the atmosphere, effectively reducing GHG emissions and air pollution. That means not only the project will reduce GHG emissions to local environment, but also provide an environmentally sound solution to minimize explosion risks and odour at the project site, which improves the environment around landfills. This contributes to achieving one of China's stated sustainable development priorities *"Actively adapt to climate change and strengthen resistance capacity to climate risks in agriculture, forestry, water resources and other key fields, as well as cities, coastal regions and ecologically vulnerable areas"*; (SDG 13)

#### Further Information

This section is not applicable.

## 2 SAFEGUARDS

### 2.1 No Net Harm

There is no negative environmental and socio-economic impact. The proposed project is a renewable energy biogas based electrical and thermal generation activity, which could reduce GHG emissions thus is good for the environment. The proposed project follows the local and national regulation in order to maintain and prevent the environmental impact. Besides, the project could provide job opportunities for local people, which is beneficial for local people's livelihood.

The EIA of the project has been approved by Linshu County Environmental Protection Bureau on 07/08/2017.

### 2.2 Local Stakeholder Consultation

The stakeholder consultation was held in office of VPOWER on 16/08/2018. The stakeholder consultation was conducted by VPOWER. Participants, including local residents and employees attended the meeting.

Before the stakeholder consultation meeting, stakeholders were identified and informed through oral and written means. Invitation notice were put on the bulletin of local villages and in person

to participants nearby the project site. The invitation process was conducted 3 weeks prior to the meeting date.

### **Meeting Agenda**

- Registration
- Welcome speech and purpose of the meeting by representative of VPOWER.
- Description of the background of the project implementation by VPOWER.
- Description of the project and environmental impacts by VPOWER.
- Questions and Answers session
- Completing questionnaires

### **Compilation of comments received**

The survey was conducted through distributing and collecting responses to the questionnaire. 49 questionnaire were sent and 49 responses were collected.

The questionnaires mainly focus on following issues:

- What do you think is the possible environment problem that the proposed project may generate?
- What do you think is the effect of the proposed project on local environment?
- Are you satisfied about the environment protection measures that the proposed project has made?
- What do you think is the impact of the proposed project on local economy?
- What do you think is the impact of the proposed project on local employment?
- Are you agree or disagree with the construction of the proposed project?
- Do you have any suggestions on this project?

The proposed project activity and its environmental impacts were described to the stakeholders during the meeting. Stakeholders acknowledged that the development of the proposed project reduce odour emissions to the surrounding area. The biogas utilization will also help improve environmental impacts by replacing fossil fuel consumption for electricity and thermal generation.

Table 1. Interviewee statistics

| Basic information | Classified items  | Number of Persons | Percentage |
|-------------------|-------------------|-------------------|------------|
| Age               | Younger than 30   | 4                 | 8%         |
|                   | 30-40             | 26                | 53%        |
|                   | >41               | 19                | 39%        |
| Occupation        | Working staff     | 16                | 33%        |
|                   | Farmers           | 10                | 20%        |
|                   | Teachers          | 8                 | 16%        |
|                   | Students          | 3                 | 6%         |
|                   | Others            | 12                | 25%        |
| Education         | Primary school    | 10                | 20%        |
|                   | Middle school     | 18                | 37%        |
|                   | College and above | 21                | 43%        |
| Gender            | Male              | 37                | 76%        |
|                   | Female            | 12                | 24%        |

The responses are concluded as follows:

100% people think the project would not generate environment problem.

- 100% people think the proposed project would improve local environment.

- 100% people are satisfied about the environment protection measures that the proposed project has made.

- 100% people think the proposed project has good impact on local economy.

- 100% people think the proposed project is good for local employment.

- 100% people agree with the construction of the proposed project.

According to the feedback provided both orally during the meeting and in writing through the filled questionnaires by participants, the stakeholders support and have a positive opinion about the proposed project activity and provided environmental and safety measures. Therefore, this project activity is perceived as an environmentally friendly project, which can improve the quality of life of the surrounding community. The proposed project activity is expected to deliver multiple benefits in respect of sustainable development including environmental, social and economic benefits.

Before the stakeholder consultation meeting, the proposed project information in which PO's telephone was included was put on local village's bulletin and near the power plant for public comment.

During the stakeholder consultation meeting, the contact information of the project owner *had been made* public to the attenders.

Through the physical stakeholder meeting and telephone public in local area, all local residents would know how to contact the PO and could give their comments or grievance to this project. Besides, a grievance book is put in the communication room at the main door of the project owner company and local village office. The local stakeholders can provide feedbacks there as well. The village head will reach PO if any comments are received.

## 2.3 Environmental Impact

The "Report on the Environmental Impact Assessment of the proposed project" was completed by Jinan Ji Da Project Consulting Co., Ltd. in 2017, and has been approved by Linshu County Environmental and Protection Bureau in August 2017.

A brief overview of environmental impacts related to the proposed project activity is summarised here.

### 1. Atmosphere

The major air pollution sources during the construction phase are dust. In order to minimize the air pollution, several measures will be taken. Paddock is set up around the construction site. Wheel washing machine and dust barrier are used to reduce dust generation. The vehicles are not overloaded so as to prevent the material from falling down.

Water is frequently sprinkled on the construction site to reduce the dust.

No garbage and soil is permitted on the road.

The daily life garbage is transported to Linshu county garbage treatment plant.

The dust, SO<sub>2</sub> and NO<sub>x</sub> emission are the major atmospheric pollutants during the operation phase.

After biogas combustion, the SO<sub>2</sub> and NO<sub>x</sub> in the gas will be treated through SCR denitration treatment and steam generator cooling, and then emitted into the atmosphere by an 15m-high chimney. The SO<sub>2</sub>, NO<sub>x</sub> and dust concentration comply with local air pollutants emission standard.

The solid impurities of the biogas is filtered before combustion. Therefore, little dust is generated.

## 2. Wastewater

During the construction period, the major wastewater emission sources are domestic sewage. The wastewater will be treated by the wastewater treatment center of the project site and the final flue complied with national discharge standard.

In operation period, wastewater mainly comes from demineralized water workshop, boiler, biogas treatment gas-liquid separation, desulfurization wastewater, and domestic sewage. All these wastewater are treated in the wastewater treatment center of the project site to comply with national standard for discharge.

## 3. Noise

The noise generates mainly from biogas generator and pumps. Several measures have been taken to control and mitigate the noise impact of the proposed project. During the operation period, silencer will be installed to mitigate the noise impacts; for the workers, the proposed project owner will outfit them with the relevant noise reducing equipment in accordance with the national standard. The noise impact on the surrounding residents is acceptable.

## 4. Solid waste

Solid waste mainly includes desulfurization residue, waste filter cartridge, waste lubricant, waste catalyst and daily life garbage.

The desulfurization residue will be collected and treated by professional recycling company. The waste filter cartridge, waste lubricant, waste catalyst will be collected and recycled by qualified third company.

In summary, the proposed project will not bring significant impacts on the environment during the construction period and operation period.

## 2.4 Public Comments

The proposed project was open for public comment period and no comment was received during the public comment period. Therefore, no update was required to the project design.

## 2.5 AFOLU-Specific Safeguards

The proposed project activity is not AFOLU project. Thus, this section is not required.

# 3 APPLICATION OF METHODOLOGY

## 3.1 Title and Reference of Methodology

The following methodology is applicable to the proposed project activity:

ACM0014 “Treatment of wastewater” (version 08.0)

The following methodological tools will also be used in this project activity:

- “Tool for the demonstration and assessment of additionality” (version 07)
- “Tool to calculate the emission factor for an electricity system” (version 07)
- “Project and leakage emissions from anaerobic digesters” (version 02)
- “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (version 03)
- “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 03)
- Project emissions from flaring (version 03.0)

## 3.2 Applicability of Methodology

ACM0014 (version 08) is applicable to the project activity that aims to reduce the methane emission from industrial wastewater treatment. The biogas captured is utilized for electricity and thermal generation purpose. The proposed project activity is applicable to scenario 1 in table B2 of ACM0014, version 08, whereas:

In the baseline scenario the wastewater was treated through a series of deep open anaerobic lagoons with the condition of the anaerobic digestion of the organic content.

In the project activity, the anaerobic digester is installed. There are no solid materials separated before directing wastewater to the covered lagoon system. The biogas captured from the system is utilized in gas engines and boiler for electricity and heat generation. In case of emergency or excessed biogas, the biogas will be flared in the flaring system. For the sludge, it is not expected to generate from the wastewater treatment process. In case sludge is removed, it shall be applied for land application under clearly aerobic conditions.

The proposed project meets applicability conditions of ACM0014 and the analysis is listed below in table 2:

Table 2. Applicability conditions of ACM0014\_v08

| Applicability criteria                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Project situation                                                                                                                                                                                                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Scope: This methodology applies to project activities that include:</p> <p>(a) Treatment of wastewater in a new anaerobic digester with subsequent capture and flaring or utilizing of the generated biogas for electricity or heat generation; or</p> <p>(b) Treatment of wastewater in the same treatment plant as in the baseline situation but treatment of the sludge from primary and/or secondary settler either in a new anaerobic digester or treatment of sludge under clearly aerobic conditions; or</p> <p>(c) Dewatering of sludge and application to land.</p> | <p>This project installs a new anaerobic digester to capture and utilize biogas for electricity and heat generation. Therefore, scenario (a) is applicable.</p>                                                     |
| <p>Paragraph 5(a) of ACM0014</p> <p>The average depth of the open lagoons or sludge pits in the baseline scenario is at least 1m</p>                                                                                                                                                                                                                                                                                                                                                                                                                                            | <p>In the baseline scenario, the wastewater was treated through a series of deep open anaerobic lagoons with the depth of 3 meters under anaerobic condition. Therefore, the open lagoons satisfy the criteria.</p> |
| <p>Paragraph 5(b) of ACM0014</p> <p>The residence time of the organic matter in the open lagoon or sludge pit system should be at least 30 days</p>                                                                                                                                                                                                                                                                                                                                                                                                                             | <p>As per the design of the baseline lagoon, the residence time of the organic matter is than 35 days.</p>                                                                                                          |
| <p>Paragraph 5(c) of ACM0014</p> <p>Inclusion of solid materials in the project activity is only applicable where: (i) Such solid materials are generated by the facility producing the wastewater; and (ii) The solid materials would be generated both in the project and in the baseline scenario;</p>                                                                                                                                                                                                                                                                       | <p>The solid materials are not generated as a part of regular operation of the proposed project activity. Therefore, this scenario is not applicable.</p>                                                           |

| Applicability criteria                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Project situation                                                                                                                                                                                                                                                                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Scope: This methodology applies to project activities that include:</p> <p>(a) Treatment of wastewater in a new anaerobic digester with subsequent capture and flaring or utilizing of the generated biogas for electricity or heat generation; or</p> <p>(b) Treatment of wastewater in the same treatment plant as in the baseline situation but treatment of the sludge from primary and/or secondary settler either in a new anaerobic digester or treatment of sludge under clearly aerobic conditions; or</p> <p>(c) Dewatering of sludge and application to land.</p> | <p>This project installs a new anaerobic digester to capture and utilize biogas for electricity and heat generation. Therefore, scenario (a) is applicable.</p>                                                                                                                       |
| <p>Paragraph 5(d) of ACM0014</p> <p>The sludge produced during the implementation of the project activity is not stored onsite before land application to avoid any possible methane emissions from anaerobic degradation.</p>                                                                                                                                                                                                                                                                                                                                                  | <p>No sludge is expected to be generated from the project. Even generated, the sludge generated by the proposed project activity is applied on the land application under clearly aerobic condition. It will not be stored onsite before being used. This scenario is applicable.</p> |

Applicability of related tools are as follows:

The applicability and analysis for tool of 'Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (version 03.0)' is shown as follows:

Table 3. Applicability conditions of 'Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (version 03.0)'

| Applicability criteria                                                                                                                                                                                                                                                                                                                                                                     | Project situation                                                                                                                                                                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Scope: Depending on their specific scope, methodologies which refer to this tool should:</p> <p>(a) Specify clearly which sources of project, baseline and leakage electricity consumption should be calculated with this tool; and/or</p> <p>(b) Provide the procedures to determine the most likely baseline scenario for each source of baseline electricity consumption; and/or</p> | <p>The baseline is electricity would have been from NCPG, the project electricity consumption is also from NCPG. This is described in section 3.4 of this PDD.</p> <p>Therefore, this scope is applicable.</p> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| <p>(c) Provide the procedures to determine the most likely baseline scenario for electricity generated and supplied by the project power plant to the grid or consumers; and</p> <p>(d) Provide the procedures to determine the baseline CO<sub>2</sub> emission factors for the electricity generated and supplied by the project power plant (<math>EF_{BL,grid,CO_2,y}</math> and <math>EF_{BL,facility,CO_2,i,y}</math>).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                    |
| <p>If emissions are calculated for electricity consumption, the tool is only applicable if one out of the following three scenarios applies to the sources of electricity consumption:</p> <p>(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;</p> <p>(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</p> <p>(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.</p> | <p>The electricity consumption is from grid. Therefore, scenario A is applicable.</p>                              |
| <p>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:</p> <p>(a) Scenario I: Electricity is supplied to the grid;</p> <p>(b) Scenario II: Electricity is supplied to consumers/electricity consuming facilities; or</p> <p>(c) Scenario III: Electricity is supplied to the grid and consumers/electricity consuming facilities.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <p>The electricity generated by the project is supplied to national grid. Therefore, scenario I is applicable.</p> |

|                                                                                                                                                                                                                                                                   |                                                                                                                                                                                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 <sub>2</sub> emissions. | No captive renewable power stations are installed to provide electricity in baseline scenario, or project activity.<br><br>Therefore, this tool is applicable for this project. |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

The applicability and analysis for tool of 'Project and leakage emissions from anaerobic digesters (version 02.0)' is shown as follows:

Table 4. Applicability conditions of 'Project and leakage emissions from anaerobic digesters (version 02.0)'

| Applicability criteria                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Project situation                                                                                                                                                                                                                              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Scope: This tool provides procedures to calculate project and leakage emissions associated with anaerobic digestion in an anaerobic digester. The tool is not applicable to other systems where waste may be decomposed anaerobically, for instances stockpiles, SWDS or un-aerated lagoons.                                                                                                                                                                                                                                                                                                                                                 | This project installs anaerobic digester. Therefore, this tool is applicable to this project.                                                                                                                                                  |
| <p>The following sources of project emissions are accounted for in this tool:</p> <p>(a) CO<sub>2</sub> emissions from consumption of electricity associated with the operation of the anaerobic digester;</p> <p>(b) CO<sub>2</sub> emissions from consumption of fossil fuels associated with the operation of the anaerobic digester;</p> <p>(c) CH<sub>4</sub> 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</p> <p>(d) CH<sub>4</sub> emissions from flaring of biogas.</p> | The CO <sub>2</sub> emissions from consumption of electricity associated with the operation of the anaerobic digester, CH <sub>4</sub> emissions from the digester and CH <sub>4</sub> emissions from flaring (if there is) will be accounted. |
| <p>The following sources of leakage emissions are accounted for in this tool:</p> <p>(a) CH<sub>4</sub> and N<sub>2</sub>O emission from composting of digestate;</p> <p>(b) CH<sub>4</sub> emissions from the anaerobic decay of digestate disposed in a SWDS or subjected to anaerobic storage, such as in a stabilization pond.</p>                                                                                                                                                                                                                                                                                                       | There is no composting in this project. Leakage associated with storage of digestate is accounted in this project.                                                                                                                             |

The applicability and analysis for tool of 'Tool to calculate the emission factor for an electricity system (version 07.0)' is shown as follows:

Table 5. Applicability conditions of ‘Tool to calculate the emission factor for an electricity system (version07.0)’

| Applicability criteria                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Project situation                                                                                                                             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| 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).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | This project results in savings of electricity that would have been provided by the grid. Therefore, this tool is applicable 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 IIa and option IIb. If option IIa is chosen, the conditions specified in “Appendix 1: Procedures related to off-grid power generation” should be met. Namely, the total capacity of off-grid power plants (in MW) should be at least 10 per cent of the total capacity of grid power plants in the electricity system; or the total electricity generation by off-grid power plants (in MWh) should be at least 10 per cent of the total electricity generation by grid power plants in the electricity system; and that factors which negatively affect the reliability and stability of the grid are primarily due to constraints in generation and not to other aspects such as transmission capacity. | Only grid power plants are calculated.                                                                                                        |

Table 6. Applicability conditions and analysis of ‘Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 03)’

| Applicability criteria                                                                                                                                                                                                                                                           | Project situation                                                                                                                                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Typical applications of this tool are methodologies where the flow and composition of residual or flared gases or exhaust gases are measured for the determination of baseline or project emissions.                                                                             | The flow of methane should be determined for baseline emissions and project emissions. Therefore, this tool is applicable.                                                   |
| Methodologies where CO <sub>2</sub> is the particular and only gas of interest should continue to adopt material balances as the means of flow determination and may not adopt this tool as material balances are the cost effective way of monitoring flow of CO <sub>2</sub> . | CO <sub>2</sub> is not the particular and only gas of interest of this project.                                                                                              |
| The underlying methodology should specify:<br>(a) The gaseous stream the tool should be applied to;<br>(b) For which greenhouse gases the mass flow should be determined;                                                                                                        | ACM0014 has specified:<br>(a) F <sub>biogas,y</sub> is determined using the tool;<br>(b) CH <sub>4</sub> is the greenhouse gas for which the mass flow should be determined; |

|                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>(c) In which time intervals the flow of the gaseous stream should be measured; and</p> <p>(d) Situations where the simplification offered for calculating the molecular mass of the gaseous stream (equations (3) or (17)) is not valid (such as the gaseous stream is predominantly composed of a gas other than N<sub>2</sub>).</p> | <p>(c) The flow of the biogas should be calculated on an hourly basis for each hour h in year y;</p> <p>(d) The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations (3) or (17) in the tool).</p> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Table 7. Applicability conditions and analysis of 'Project emissions from flaring (version 03)'

| Applicability criteria                                                                                                                                                                                                                                                                                                                           | Project situation                                                                                                                                                                           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 CDM-PDD the type of flare used in the project activity.                                                                                           | Open flare is installed in the project. Thus this item is applicable for this project                                                                                                       |
| <p>This tool is applicable to the flaring of flammable greenhouse gases where:</p> <p>(a) Methane is the component with the highest concentration in the flammable residual gas; and</p> <p>(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).</p> | Methane is the mainly component in the residual gas of this project. Therefore, it is applicable for this 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.                                                                  | No auxiliary fuels are consumed in the combustion of biogas flaring, and the biogas itself is flammable enough for sustain combustion. Therefore, this tool is applicable for this project. |

### 3.3 Project Boundary

| Source   |                                | Gas              | Included? | Justification/Explanation                                                            |
|----------|--------------------------------|------------------|-----------|--------------------------------------------------------------------------------------|
| Baseline | Wastewater treatment processes | CO <sub>2</sub>  | Excluded  | CO <sub>2</sub> emissions from the decomposition of organic waste are not accounted. |
|          |                                | CH <sub>4</sub>  | Included  | The major source of emissions in the baseline.                                       |
|          |                                | N <sub>2</sub> O | Excluded  | Excluded for simplification.                                                         |
|          |                                | CO <sub>2</sub>  | Included  | Electricity is consumed from the grid in the baseline scenario.                      |

| Source  |                                     | Gas              | Included? | Justification/Explanation                                                                               |
|---------|-------------------------------------|------------------|-----------|---------------------------------------------------------------------------------------------------------|
|         | Electricity consumption /generation | CH <sub>4</sub>  | Excluded  | Excluded for simplification.                                                                            |
|         |                                     | N <sub>2</sub> O | Excluded  | Excluded for simplification.                                                                            |
|         | Thermal energy generation           | CO <sub>2</sub>  | Excluded  | Excluded for simplification <sup>2</sup> .                                                              |
|         |                                     | CH <sub>4</sub>  | Excluded  | Excluded for simplification.                                                                            |
|         |                                     | N <sub>2</sub> O | Excluded  | Excluded for simplification.                                                                            |
| Project | Wastewater treatment processes      | CO <sub>2</sub>  | Excluded  | CO <sub>2</sub> emissions from the decomposition of organic waste are not accounted.                    |
|         |                                     | CH <sub>4</sub>  | Included  | Main source of emissions                                                                                |
|         |                                     | N <sub>2</sub> O | Excluded  | Excluded because the project does not involve land application of sludge                                |
|         | On-site electricity use             | CO <sub>2</sub>  | Included  | Electricity consumed for the operation of the proposed project activity will be supplied from the grid. |
|         |                                     | CH <sub>4</sub>  | Excluded  | Excluded for simplification.                                                                            |
|         |                                     | N <sub>2</sub> O | Excluded  | Excluded for simplification                                                                             |
|         | On-site fossil fuel consumption     | CO <sub>2</sub>  | Excluded  | The proposed project activity does not consume fossil fuels.                                            |
|         |                                     | CH <sub>4</sub>  | Excluded  | Excluded for simplification.                                                                            |
|         |                                     | N <sub>2</sub> O | Excluded  | Excluded for simplification.                                                                            |

The project boundary includes the physical boundary of project area, Jinyimeng (which is the recipient of the electricity and heat of this project), and all power plants connect with NCPG, which is shown in following figure 3.

<sup>2</sup> For simplification, the project owner will not claim credits generated from steam generation.

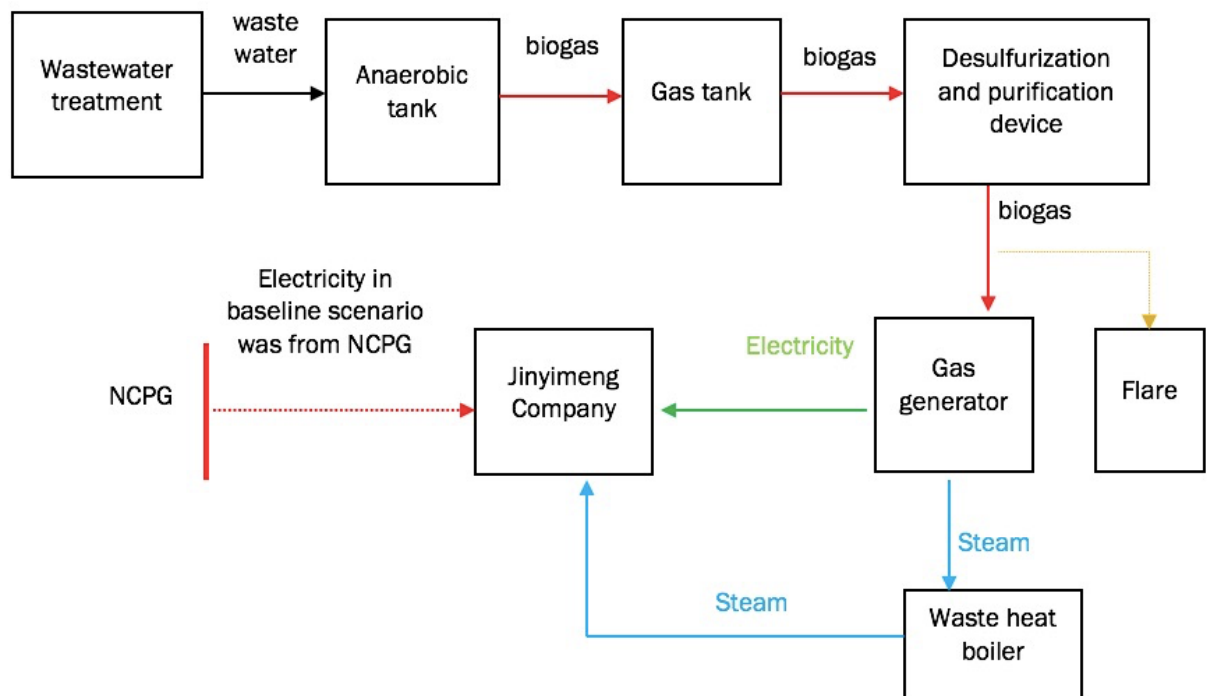


Figure 3. Project boundary

### 3.4 Baseline Scenario

#### Baseline for methane avoidance component

ACM0014 (version 08) outlines the procedure for the identification of the most plausible baseline scenario following steps.

##### **Step 5.2.1 Simplified procedures to identify the baseline scenario and demonstrate additionality**

The proposed project activity does not fall under any of technologies listed under the “Tool 32: Positive lists of technologies”, therefore, this Step is not applicable.

##### **Step 5.2.2 Procedure for the identification of the most plausible baseline scenario**

The most plausible baseline scenario is determined through the application of the following steps:

##### **Step 1: Identification of alternative scenarios**

Wastewater (W):

The plausible alternative scenarios for the treatment of wastewater (W) for this project include:

W1: The use of open lagoons for the treatment of the wastewater;

W2: Direct release of wastewater to a nearby water body;

W3: Aerobic wastewater treatment facilities (e.g. activated sludge or filter bed type treatment);

W4: Anaerobic digester with methane recovery and flaring;

W5: Anaerobic digester with methane recovery and utilization for electricity or heat generation;

W6: Wastewater is directed to land application without dewatering;

W7: Wastewater is dewatered and directed to land application/used as fuel in energy applications.

W8: Wastewater is not treated.

|    | Alternative Scenarios of wastewater treatment                                                 | Applicability Analysis                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----|-----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| W1 | The use of open lagoons for the treatment of the wastewater                                   | This scenario complies with Chinese regulations and is most commonly used in practice. Therefore, the scenario W1 is the plausible baseline scenario.                                                                                                                                                                                                                                                                                                                                                                         |
| W2 | Direct release of wastewater to a nearby water body;                                          | As the alcohol wastewater is high concentrated organic wastewater, it is forbidden to discharge directly on the basis of the "The People's Republic of China Water Pollution Prevention Law" and "The People's Republic of China Integrated Wastewater Discharge Standard". So, the scenario W2 is not the plausible baseline scenario.                                                                                                                                                                                       |
| W3 | Aerobic wastewater treatment facilities (e.g. activated sludge or filter bed type treatment); | Aerobic treatment is appropriate only when the concentration of organic matter in wastewater is low. As the proposed project activity generates high concentrated organic wastewater, aerobic treatment is not appropriate in view of the technology <sup>3</sup> . Therefore, the scenario W3 is not the plausible baseline scenario.                                                                                                                                                                                        |
| W4 | Anaerobic digester with methane recovery and flaring;                                         | There is no incentive for the project owner of industrial facility to install such system as there are no laws and regulations in the host country which forbid methane emission from wastewater treatment facilities. And the scenario W4 needs much higher investment (Anaerobic reactors are extremely expensive than lagoon system) and operational cost than anaerobic open lagoons. Therefore, this option is very unlikely to occur compared to W1 and thus the scenario W4 is not the plausible alternative scenario. |

<sup>3</sup> "Organic industry wastewater treatment theory and technology", P24, Yangjian, Feijuan Zhang and Rongzhi Yu, Chemical Industry Press.

|    |                                                                                               |                                                                                                                                                                                                                                                                                                                   |
|----|-----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| W5 | Anaerobic digester with methane recovery and utilization for electricity or heat generation;  | This scenario is the proposed project activity undertaken without being registered as a VCS project activity. The investment barrier results for the high investment and operational cost. It is encouraged as well as complying with Chinese regulations. Therefore, it is included in the alternative scenario. |
| W6 | Wastewater is directed to land application without dewatering;                                | As the wastewater is high concentrated organic wastewater, it is not complied with standards for direct land application without dewatering. Therefore, W6 is not plausible alternative scenario.                                                                                                                 |
| W7 | Wastewater is dewatered and directed to land application/used as fuel in energy applications. | After meeting local standard, the wastewater is discharged to the local wastewater treatment area. W7 is not plausible alternative scenario.                                                                                                                                                                      |
| W8 | Wastewater is not treated.                                                                    | The analysis is same with W2. Therefore, W8 is not plausible alternative scenario.                                                                                                                                                                                                                                |

Through above analysis, the plausible baseline scenario is W1, which is also the scenario prior to the proposed project activity.

#### *The treatment of sludge (S):*

The proposed project activity is not applicable to scenario 2, the plausible alternative scenarios for the treatment of sludge (S1-S6) are not considered.

#### *The generation of electricity (E):*

As the proposed project activity involves the generation of electricity using biogas from the covered lagoon system, plausible alternative scenarios from the generation of electricity have been determined. These include following plausible alternatives:

|  |                                               |                        |
|--|-----------------------------------------------|------------------------|
|  | Alternative Scenarios of wastewater treatment | Applicability Analysis |
|--|-----------------------------------------------|------------------------|

|    |                                                               |                                                                                                                                                                                                                                                                                                                                            |
|----|---------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| E1 | Power generation using fossil fuels in a captive power plant; | The installation of a captive power plant based on fossil fuel is not required as the grid power can be easily accessed within the local area. As per the existing situation at the project site, the grid electricity is used. Therefore, E1 is not plausible alternative.                                                                |
| E2 | Electricity generation in the grid;                           | This scenario does not require additional investment and currently is a common practice for industrial facilities that have a demand for electricity. Therefore, E2 is plausible alternative.                                                                                                                                              |
| E3 | Electricity generation using renewable sources.               | Electricity generation using renewable sources incur additional and substantial investment cost together with annual O&M cost. And renewable power plant needs enough renewable resource, the project area does not have enough wind, solar energy or waste biomass for a 13.6MW power plant. Therefore, E3 is not plausible alternatives. |

Through above analysis, the plausible baseline scenario for electricity is E2, which is also the scenario prior to the project activity, i.e in absence of the project, the same equivalent electricity was from national power grid.

*The generation of heat (H):*

As the proposed project activity involves heat generation with biogas, plausible alternative scenarios for the generation of heat should been determined. These include following alternatives:

|    | Alternative Scenarios of wastewater treatment                                  | Applicability Analysis                                                                                                                                                                                                                                                                                                                                                                 |
|----|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| H1 | Co-generation of heat using fossil fuels in a captive cogeneration power plant | H1 is eliminated as the Chinese regulation “Interim Regulations on the control of combined heat and power generation projects” (NDRC, No. 141[2007]) prohibits construction of a cogeneration plant which is not included in provincial/local development plan. It means that a private company cannot freely install a cogeneration plant.<br><br>Therefore, scenario H1 is excluded. |

|    |                                                |                                                                                                                                                                                                                                                                                                                                                                                                        |
|----|------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| H2 | Heat generation using fossil fuels in a boiler | This is possible baseline scenario.                                                                                                                                                                                                                                                                                                                                                                    |
| H3 | Heat generation using renewable sources        | Same reason with E3. Heat generation using renewable sources incur additional and substantial investment cost together with annual O&M cost. And renewable heat power plant needs enough renewable resource, the project area does not have enough wind, solar energy or waste biomass to generate the equivalent amount of heat as the project activity. Therefore, H3 is not plausible alternatives. |

In absence of the project, the same equivalent heat was from coal boiler. Therefore, H2 is the plausible alternative.

*The treatment of solid materials (SM):*

The proposed project activity does not involve generation of any solid materials, which need to be treated or disposed. Thereby, the plausible alternative scenarios for the treatment of solid materials (SM1-SM4) are not considered.

From above analysis, the plausible baseline scenario is W1, W5, E2, H2.

| Alternative of scenarios | Alternative baseline scenario |                        |                 | Description of the scenario                                                                                                                                   |
|--------------------------|-------------------------------|------------------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                          | Wastewater treatment          | Electricity generation | Heat generation |                                                                                                                                                               |
| 1                        | W1                            | E2                     | H2              | Keep on using the existing open lagoons system.<br><br>Continue to use electricity from national power grid and use coal fired boilers for heat generation.   |
| 2                        | W5                            | W5                     | W5              | Construct the anaerobic digester and biogas treatment and utilization system to recover methane generated from the anaerobic treatment. The recovered methane |

|  |  |  |  |                                                                                                                                |
|--|--|--|--|--------------------------------------------------------------------------------------------------------------------------------|
|  |  |  |  | <p>is used to generate electricity and heat.</p> <p>This scenario is same to the project but is not a VCS project activity</p> |
|--|--|--|--|--------------------------------------------------------------------------------------------------------------------------------|

**Step 2: Eliminate alternatives that are not complying with applicable laws and regulations**

Through the analysis in step 1, the plausible alternatives include scenario 1 and 2 are both compliance with applicable laws and regulations.

Therefore, the remaining combinations of alternatives to be considered in the next steps are as following

| Alternative of scenarios | Alternative baseline scenario |                        |                 | Description of the scenario                                                                                                                                                                                                                     |
|--------------------------|-------------------------------|------------------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                          | Wastewater treatment          | Electricity generation | Heat generation |                                                                                                                                                                                                                                                 |
| 1                        | W1                            | E2                     | H2              | <p>Keep on using the existing open lagoons system.</p> <p>Continue to use electricity from national power grid and use coal fired boilers for heat generation.</p>                                                                              |
| 2                        | W5                            | W5                     | W5              | <p>Construct the anaerobic reactor to recover methane generated from the anaerobic treatment. The recovered methane is used to generate electricity and heat.</p> <p>This scenario is same to the project but is not a VCS project activity</p> |

**Step 3: Eliminate alternative that face prohibitive barriers:**

As analyzed in following Section 3.5, the proposed project activity is not financially attractive without the VCS revenues. It can be concluded that in the absence of VCS income, the proposed project is not financially attractive to the proposed project owner. Hence scenario W5 is eliminated.

In conclusion, the plausible alternative scenarios for the proposed project are:

- For wastewater treatment: W1
- For power generation: E2
- For heat generation: H2

### 3.5 Additionality

As required by ACM0014, step 2 (investment analysis) from the “*Tool for the demonstration and assessment of additionality (version 07)*” is applied to eliminate alternatives that face prohibitive barriers.

The investment analysis tool recommends three analysis methods, namely simple cost analysis (Option I), investment comparison analysis (Option II) and the benchmark analysis (Option III).

Since the proposed project can receive revenue from electricity and heat sales, and can also receive revenue from VER. So, Option I isn’t appropriate.

The Option II is only applicable when alternatives are also investment projects. However, the alternative baseline scenario of the proposed project (W1+E2+H2) is not a new investment project, so the Option II isn’t appropriate.

According to the above, this PDD will use the benchmark analysis (Option III) to analyse whether the proposed project is less economically or financially attractive than the alternatives without the revenue from VER.

The proposed project adopts project IRR as the financial indicator. According to table 2.13-2 of the ‘Economic evaluation methods and parameters of construction projects (version 3.0)’ , the financial benchmark for Project IRR (post-tax) of 10% is adopted widely in the thermal power station of China. Thus, 10% is adopted as the benchmark of the proposed project.

In accordance with the feasibility study report (FSR) of the proposed project, the basic parameters for calculation of financial indicator are shown in Table 3.

Table 3. Basic parameters for IRR calculation

| No. | Parameters                          | Value  | Data source |
|-----|-------------------------------------|--------|-------------|
| 1   | Installed capacity (MW)             | 13.6   | Nameplates  |
| 2   | Static total investment (10,000RMB) | 13,803 | FSR         |
| 3   | O&M cost (10,000RMB)                | 1,279  | FSR         |
| 3.1 | Labor cost and welfare (10,000RMB)  | 148    | FSR         |
| 3.2 | Management cost (10,000RMB)         | 74     | FSR         |

|     |                                                          |        |     |
|-----|----------------------------------------------------------|--------|-----|
| 3.3 | Maintenance cost (10,000RMB)                             | 414    | FSR |
| 3.4 | Equipment insurance (10,000RMB)                          | 56     | FSR |
| 3.5 | Biogas treatment cost (10,000RMB)                        | 450    | FSR |
| 3.6 | Machine oil cost (10,000RMB)                             | 138    | FSR |
| 4   | Construction period (yr)                                 | 2      | FSR |
| 5   | Operation period (yr)                                    | 20     | FSR |
| 6   | Net annual electricity generation (MWh)                  | 93,840 | FSR |
| 7   | Electricity tariff (RMB/KWh, including VAT)              | 0.27   | FSR |
| 8   | Heat tariff (RMB/t, including VAT)                       | 60     | FSR |
| 9   | Annual heat generation (t)                               | 54,000 | FSR |
| 10  | VAT for electricity, equipment, material and maintenance | 17%    | FSR |
| 11  | VAT for steam and water                                  | 11%    | FSR |
| 14  | Urban construction tax                                   | 5%     | FSR |
| 13  | Education surcharges                                     | 3%     | FSR |
| 14  | Income tax                                               | 25%    | FSR |

The project IRR is calculated according to the basic parameters from feasibility study report (FSR) of the proposed project, and the comparison of the proposed project IRR with and without VER are shown below:

|                    | Project IRR (%) |
|--------------------|-----------------|
| Without VER income | 3.68            |
| With VER income    | 13.44           |

From the calculation, it can be seen that without considering VER revenue, the proposed project IRR is 3.68%, lower than the benchmark of 10%. With VER carbon revenue, the project IRR is larger than the benchmark of 10%.

### Sensitivity analysis

According to investment analysis-v9.0, “Variables, including the initial investment cost, that constitute more than 20% of either total project costs or total project revenues should be subjected to reasonable variation (all parameters varied need not necessarily be subjected to both negative and positive variations of the same magnitude)”

- 1) Electricity tariff
- 2) Electricity generation
- 3) Heat price
- 4) Heat generation
- 5) Static total investment

| Parameters              | -10%  | -5%   | 0     | 5%    | 10%   |
|-------------------------|-------|-------|-------|-------|-------|
| Electricity tariff      | 2.16% | 2.93% | 3.68% | 4.39% | 5.09% |
| Electricity generation  | 2.16% | 2.93% | 3.68% | 4.39% | 5.09% |
| Heat price              | 3.48% | 3.58% | 3.68% | 3.78% | 3.87% |
| Heat generation         | 3.48% | 3.58% | 3.68% | 3.78% | 3.87% |
| Static total investment | 4.56% | 4.10% | 3.68% | 3.28% | 2.91% |
| Biogas treatment cost   | 3.99% | 3.83% | 3.68% | 3.52% | 3.36% |

It can be seen that when electricity tariff, electricity generation, heat price, heat generation, static total investment change within  $\pm 10\%$ , the proposed project IRR (post-tax) of the proposed project is always lower than benchmark IRR.

From above analysis, it can be concluded that without the VER revenues the proposed project is not economically and financially attractive.

It is calculated that under the following variations of the above parameters, the proposed project IRR will reach benchmark.

| Parameters | Variation of IRR reach benchmark |
|------------|----------------------------------|
|------------|----------------------------------|

|                         |               |
|-------------------------|---------------|
| Electricity tariff      | +49.7%        |
| Electricity generation  | +49.7%        |
| Heat price              | +367%         |
| Heat generation         | +367%         |
| Static total investment | -49.5%        |
| Biogas treatment cost   | 0 (IRR=6.63%) |

Justification why the above variations of each parameter is unlikely in the realistic practice?

#### As for electricity tariff and electricity generation

The electricity tariff is fixed after negotiation between VPOWER and Jinyimeng. Jinyimeng supplies land, wastewater and chemical water to VPOWER New Energy Technology. VPOWER uses the resources to generate electricity and heat and sells them to Jinyimeng in a lower price than market price. VPOWER and Jinyimeng has signed business contract. It is unlikely to increase electricity tariff.

The electricity generation is determined based on the COD and biogas amount. As there is no plan to increase the alcohol production capacity. Besides, the operation hours at present are 7500h. Even when the operation hours are 8760h, the IRR is 5.85%, less than benchmark. Therefore, the biogas amount will not increase greatly and the electricity generation will not increase 49.7%.

#### As for heat revenue and heat price

The heat revenue mainly depends on the heat generation. The heat generation mainly depends on biogas amount and electricity generation amount. Since the biogas amount and electricity generation amount is stable, the heat generation amount is also stable and will not increase 367%.

The heat price is fixed within 20 years, which is determined by VPOWER and Jinyimeng. VPOWER and Jinyimeng has signed business contract. It is unlikely to increase the heat price.

#### As for the static total investment

When the Static total investment decreases more than 49.5%, the IRR would reach benchmark. According to statistical data issued by National Bureau of Statistics of China, the prices of construction materials kept increasing in the construction period of the proposed project.

#### Biogas treatment cost

The biogas treatment cost mainly depends on the biogas consumption. The biogas consumption is related with the wastewater amount and electricity generation. According to the sensitivity analysis, even when the biogas treatment cost becomes 0, the IRR is 6.63%, still less than the benchmark. Of course, the biogas treatment cost will not be 0. Therefore, the change of biogas treatment cost will not make IRR reach benchmark.

### Step 4. Common practice analysis

In line with the *“Tool of common practice (version 03.1)”*, four types of measures are currently covered in the framework:

- (a) Fuel and feedstock switch (example: switch from naphtha to natural gas for energy generation, or switch from limestone to gypsum in cement clinker production);
- (b) Switch of technology with or without change of energy source including energy efficiency improvement as well as use of renewable energies (example: energy efficiency improvements, power generation based on renewable energy);
- (c) Methane destruction (example: landfill gas flaring);
- (d) Methane formation avoidance (example: use of biomass that would have been left to decay in a solid waste disposal site resulting in the formation and emission of methane, for energy generation).

As a wastewater treatment for methane recovery project, the proposed project is not a first-of-its kind project in China and belongs to the type (c) of measures above.

The common practice analysis is conducted by section 5 of *“tool of common practice (version 03.1)”*.

### ***Step 1: Calculate applicable capacity or output range as +/-50% of the total design capacity or output of the proposed project activity.***

The total design capacity of the Proposed Project Activity is about 13.6MW, therefore the applicable output range is 6.8MW to 20.4MW.

**Step 2: identify similar projects (both CDM and non-CDM) which fulfill all of the following conditions:**

- (a) The proposed projects are located in the applicable geographical area;
- (b) The proposed projects apply the same measure as the proposed project activity;
- (c) The proposed projects use the same energy source/fuel and feedstock as the proposed project activity, if a technology switch measure is implemented by the proposed project activity;
- (d) The plants in which the proposed projects are implemented produce goods or services with comparable, properties and applications areas (e.g., clinker) as the proposed project plant;
- (e) The capacity or output of the proposed projects is within the applicable capacity or output range calculated in Step 1;
- (f) The proposed projects started commercial operation before the proposed project design document (CDM-PDD) is published for global stakeholder consultation or before the start date of proposed project activity, whichever is earlier for the proposed project activity.

In China, the regulatory framework and investment climate for biogas projects are only similar and comparable in the same Province/Autonomous Region. Because each province has its unique economic and cultural environment. So, Shandong province is chosen for the proposed project geographical province.

The proposed project is a biogas recovery project in Alcohol wastewater treatment. Therefore, only biogas recovery project in Alcohol wastewater treatment projects are considered.

The project start date of proposed project activity is 27/08/2018 when the EPC contract was signed, therefore only projects which started commercial operation before 27/08/2018 are considered.

Therefore, all biogas recovery for power generation in Alcohol wastewater treatment plants, located in Shandong Province which are delivering the capacity within the applicable output range between 6.8 MW and 20.4MW and starting commercial operation before August of 2018 are identified as the similar projects.

**Step 3: within the projects identified in Step 2, identify those that are neither registered CDM project activities, project activities submitted for registration, nor project activities undergoing validation. Note their number Null.**

After research China's public website, UNFCCC/ Verra/ Gold Standard/CCER related website<sup>4</sup>, no similar project is existed.

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<sup>4</sup> UNFCCC: <https://cdm.unfccc.int/Projects/projsearch.html>, Verra: <https://www.vcsprojectdatabase.org/#/vcs>, Gold Standard: <https://registry.goldstandard.org/projects>, CCER: <http://cdm.ccchina.org.cn/ccer.aspx>

Therefore,  $N_{all}=0$

**Step 4: within similar projects identified in Step 2, identify those that apply technologies that are different to the technology applied in the proposed project activity. Note their number  $N_{diff}$ .**

After research, no similar project is existed.

$N_{diff}=0$

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

Since  $N_{all}=0$ .  $F=1- N_{diff}/N_{all} =0$ .

The proposed project activity is a “common practice” within a sector in the applicable geographical area if the factor  $F$  is greater than 0.2 and  $N_{all}-N_{diff}$  is greater than 3.

Through above,  $N_{all}-N_{diff}<3$ .

Therefore, this project is not a common practice.

### 3.6 Methodology Deviations

There are no methodology deviations for the proposed project activity. Thus, this section is not applicable.

## 4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

### 4.1 Baseline Emissions

The proposed project activity involves the installation of new anaerobic digester for the treatment of wastewater. This corresponds to scenario 1 of ACM0014 and therefore all data and terms used in the calculation of the baseline and project activity emissions relate to scenario 1.

Baseline emissions are calculated using the following formula:

$$BE_y = BE_{CH_4,y} + BE_{EL,y} + BE_{HG,y} \quad \text{Equation (1)}$$

Where:

$BE_y$  = Baseline emissions in year  $y$  (t CO<sub>2</sub>e/yr)

$BE_{CH_4,y}$  = Methane emissions from anaerobic treatment of the wastewater in open lagoons (Scenario 1) in the absence of the project activity in year  $y$  (t CO<sub>2</sub>e/yr)

$BE_{EL,y}$  = CO<sub>2</sub> emissions associated with electricity generation that is displaced by the project activity and/or electricity consumption in the absence of the project activity in year  $y$  (t CO<sub>2</sub>/yr)

$BE_{HG,y}$  = CO<sub>2</sub> emissions associated with fossil fuel combustion for heating equipment that is displaced by the project in year  $y$  (t CO<sub>2</sub>/yr).

This project does not consider the emission reductions of heating section for simplification. Therefore,  $BE_{HG,y}=0$

$$\begin{aligned} BE_y &= BE_{CH_4,y} + BE_{EL,y} + BE_{HG,y} \\ &= BE_{CH_4,y} + BE_{EL,y} \end{aligned} \quad \text{Equation (2)}$$

**Step 1: Calculation of baseline emissions from anaerobic treatment of the wastewater ( $BE_{CH_4,y}$ )**

$$BE_{CH_4,y} = \min \{Q_{CH_4,y} ; BE_{CH_4,MCF,y}\} \quad \text{Equation (3)}$$

$Q_{CH_4,y}$ : Methane produced after the implementation of the proposed project activity. **For ex-ante estimation,  $Q_{CH_4,y}$  is based on the value from FSR. For ex-post calculation, the monitoring data after the implementation will be used.**

$BE_{CH_4,MCF,y}$ : Methane conversion factor method for the estimation of methane emissions from open lagoons. **For ex-ante estimation,  $BE_{CH_4,MCF,y}$  is based on the value from FSR. For ex-post calculation, the monitoring data after the implementation will be used.**

#### **Determination of $Q_{CH_4,y}$**

The process to determine  $Q_{CH_4,y}$  is as follows:

Use Step 1" Determination of the quantity of methane produced in the digester ( $Q_{CH_4,y}$ )" of the latest version of the tool "*Project and leakage emissions from anaerobic digesters*" to determine the amount of methane produced after the implementation of the project activity ( $Q_{CH_4,y}$ ).

The proposed project is a large scale project. Therefore, option 1 (Procedure using monitoring data) of the "*Project and leakage emissions from anaerobic digesters (v2.0)*" shall be used.

According to option 1,  $Q_{CH_4,y}$  shall be measured using the "*Tool to determine the mass flow of greenhouse gas in a gaseous stream*". When applying the tool, the following applies:

- (a) The gaseous stream to which the tool is applied is the biogas collected from the digester;
- (b)  $CH_4$  is the greenhouse gas  $i$  for which the mass flow should be determined; and
- (c) The flow of the gaseous stream should be measured on an hourly basis or a smaller time interval; and then accumulated for the year  $y$ . Please note that units need to be converted to tons, when applying the results in this tool.

As per paragraph 13 of the "*Tool to determine the mass flow of a greenhouse gas in a gaseous stream (v03.0)*", the mass flow of methane ( $F_{CH_4,t}$ ) can be determined through measurement of the flow and volumetric fraction of the gaseous stream.

The proposed project proponent chooses the 'measurement option A (volume flow)' as per table 2 of '*Tool to determine the mass flow of a greenhouse gas in a gaseous stream (v03.0)*'. The volume flow and the volumetric fraction of the gaseous stream will be determined according to the option A under option 2 "simplified calculation without measurement of the moisture content".

There are two ways in option A:

- (a) Measure the moisture content of the gaseous stream ( $C_{H_2O,t,db,n}$ ) and demonstrate that this is less or equal to 0.05 kg  $H_2O/m^3$  dry gas; or
- (b) Demonstrate that the temperature of the gaseous stream ( $T_t$ ) is less than 60°C (333.15 K) at the flow measurement point.

Option (b) is chosen because the temperature of the gaseous stream is less than 60°C at the flow measuring point.  $F_{CH_4,t}$  is determined as following equation of the tool;

$$F_{CH_4,t} = V_{t,db} * v_{CH_4,t,db} * \rho_{CH_4,t} \quad \text{Equation (4)}$$

Where:

$F_{CH_4,t}$  = Mass flow of greenhouse gas CH<sub>4</sub> in the gaseous stream in time interval t (kg/h)

$V_{t,db}$  = Volumetric flow of the gaseous stream in time interval t on a dry basis (m<sup>3</sup>dry gas)

$v_{CH_4,t,db}$  = Volumetric fraction of the greenhouse gas CH<sub>4</sub> in the gaseous stream in time interval t on a dry basis (m<sup>3</sup> CH<sub>4</sub>/m<sup>3</sup> dry gas)

$\rho_{CH_4,t}$  = Density of greenhouse gas CH<sub>4</sub> in the gaseous stream in time interval t (kgCH<sub>4</sub>/m<sup>3</sup>CH<sub>4</sub>)

Density of methane ( $\rho_{CH_4,t}$ ) is determined at the normal condition in line with below equation.

$$\rho_{CH_4,t} = (P_t \times MM_{CH_4}) / (R_u \times T_t) \quad \text{Equation (5)}$$

Where:

$\rho_{CH_4,t}$  = Density of greenhouse gas (CH<sub>4</sub>) in the gaseous stream in time interval t (kgCH<sub>4</sub>/m<sup>3</sup>CH<sub>4</sub>).

$P_t$  = Absolute pressure of the gaseous stream in time interval t (Pa). 101,325

$MM_{CH_4}$  = Molecular mass of CH<sub>4</sub> (kg/kmol) . 16.04

$R_u$  = Universal ideal gases constant (Pa.m<sup>3</sup>/kmol.K). 8314

$T_t$  = Temperature of the gaseous stream in time interval t(K) . 273.15

According to the default value in 'Tool to determine the mass flow of a greenhouse gas in a gaseous stream (v03.0)'

$$\rho_{i,t} = (P_t \times MM_{CH_4}) / (R_u \times T_t)$$

$$= 101325 \times 16.04 / 8314 / 273.15 = 0.716$$

#### **Determination of $BE_{CH_4, MCF, y}$**

The baseline methane emissions from anaerobic treatment of the wastewater in open lagoons (Scenario 1) is estimated based on the chemical oxygen demand (COD) of the wastewater that would enter the lagoon in the absence of the proposed project activity ( $COD_{BL, y}$ ), the maximum methane producing capacity ( $B_0$ ) and a methane conversion factor ( $MCF_{BL, y}$ ) which expresses the proportion of the wastewater that would decay to methane, as follows:

$$BE_{CH_4, MCF, y} = GWP_{CH_4} * MCF_{BL, y} * B_0 * COD_{BL, y} \quad \text{Equation (6)}$$

Where:

- $GWP_{CH_4}$  = Global Warming Potential of methane valid for the commitment period (t  $CO_2e/tCH_4$ )
- $B_0$  = Maximum methane producing capacity, expressing the maximum amount of  $CH_4$  that can be produced from a given quantity of chemical oxygen demand (t  $CH_4/tCOD$ )
- $MCF_{BL, y}$  = Average baseline methane conversion factor (fraction) in year y, representing the fraction of ( $COD_{PJ, y} \times B_0$ ) that would be degraded to  $CH_4$  in the absence of the project activity
- $COD_{BL, y}$  = Quantity of chemical oxygen demand that would be treated in open lagoons (Scenario 1) in the absence of the project activity in year y (tCOD/yr)

#### **Determination of $COD_{BL, y}$**

The baseline chemical oxygen demand ( $COD_{BL, y}$ ) is equal to the chemical oxygen demand that is treated under the project activity ( $COD_{PJ, y}$ ), unless there would have been effluent from the

lagoons (Scenario 1) in the baseline, in this case the  $COD_{PJ}$  should be adjusted by an adjustment factor which relates the COD supplied to the lagoon with the COD in the effluent.

$$COD_{BL,y} = \rho * (1 - (COD_{out,x}/COD_{in,x})) \times COD_{PJ,y} \quad \text{Equation (7)}$$

Where:

$COD_{BL,y}$  = Quantity of chemical oxygen demand that would be treated in open lagoons (Scenario 1) in the absence of the project activity in year  $y$  (t COD/yr)

$COD_{out,x}$  = COD of the effluent in the period  $x$  (t COD)

$COD_{in,x}$  = COD directed to the open lagoons (Scenario 1) in the period  $x$  (t COD)

$x$  = Representative historical reference period

$\rho$  = Discount factor for historical information

$COD_{PJ,y}$  is determined as follows:

$$COD_{PJ,y} = \sum_{m=1}^{12} F_{PJ,dig,m} \times COD_{dig,m} \quad \text{Equation (8)}$$

Where:

$COD_{PJ,y}$  = Quantity of chemical oxygen demand that is treated in the anaerobic digester in the project activity in year  $y$  (t COD/yr)

$F_{PJ,dig,m}$  = Quantity of wastewater that is treated in the anaerobic digester in the project activity in month  $m$  (m<sup>3</sup>/month)

$COD_{dig,m}$  = Chemical oxygen demand in the wastewater that is treated in the anaerobic digester in the project activity in month  $m$  (t COD/m<sup>3</sup>)

$m$  = Months of year  $y$  of the crediting period

#### Determination of $MCF_{BL,y}$

The quantity of methane generated from COD disposed to the open lagoon (Scenario 1) depends mainly on the temperature and the depth of the lagoon. Accordingly, the methane conversion factor is calculated based on a factor  $f_d$ , expressing the influence of the depth of the lagoon on methane generation, and a factor  $f_{T,y}$  expressing the influence of the temperature on the methane generation. In addition, a conservativeness factor of 0.89 is applied to account for the considerable uncertainty associated with this approach.  $MCF_{BL,y}$  is calculated as follows:

$$MCF_{BL,y} = f_d * f_{T,y} * 0.89 \quad \text{Equation (9)}$$

Where:

$MCF_{BL,y}$  = Average baseline methane conversion factor (fraction) in year  $y$ , representing the fraction of  $(COD_{PJ,y} \times B_0)$  that would be degraded to  $CH_4$  in the absence of the project activity

$f_d$  = Factor expressing the influence of the depth of the lagoon on methane generation

$f_{T,y}$  = Factor expressing the influence of the temperature on the methane generation in year  $y$

0.89 = Conservativeness factor

#### Determination of $f_d$

$f_d$  represents the influence of the average depth of the lagoons on methane generation.

$$f_d = \begin{cases} 0; & \text{if } D < 1 \text{ m} \\ 0.5; & \text{if } 1 \text{ m} \leq D < 2 \text{ m} \\ 0.7; & \text{if } D \geq 2 \text{ m} \end{cases} \quad \text{Equation (10)}$$

Where:

$f_d$  = Factor expressing the influence of the depth of the lagoons on methane generation

$D$  = Average depth of the lagoons (m)

The value of  $f_d$  is determined from the average depth of the anaerobic open lagoon. In the baseline scenario, the depth of open lagoon is 3 meters. Therefore, a value of 0.7 has been applied.

#### Determination of $f_{r,y}$

An increase in temperature in the lagoon has several benefits to generate more methane, including an increasing solubility of the organic compounds, enhanced biological and chemical reaction rates. The factor  $f_{r,y}$  is calculated using a monthly stock change model which aims at assessing how much COD degrades in each month.

For each month  $m$ , the quantity of wastewater directed to the lagoon, the quantity of organic compounds that decay and the quantity of any effluent water from the lagoon is balanced, giving the quantity of COD that is available for degradation in the next month: the amount of organic matter available for degradation to methane ( $COD_{available,m}$ ) is assumed to be equal to the amount of organic matter directed to the open lagoon, less any effluent, plus the COD that may have remained in the lagoon from previous months, as follows:

$$COD_{available,m} = COD_{BL,m} + (1 - f_{r,m-1}) * COD_{available,m-1} \quad \text{Equation (11)}$$

Where:

$COD_{available,m}$  = Quantity of chemical oxygen demand available for degradation in the open lagoon in month  $m$  (t COD/month)

$COD_{BL,m}$  = Quantity of chemical oxygen demand that would be treated in open lagoons (Scenario 1) in the absence of the project activity in month  $m$  (t COD/month)

- $f_{T,m-1}$  = Factor expressing the influence of the temperature on the methane generation in previous month ( $m-1$ )
- $m$  = Months of year  $y$  of the crediting period
- $T$  = Temperature of the lagoon in the month (deg K)
- $COD_{available, m-1}$  = Quantity of chemical oxygen demand that may have remained in the lagoon from previous month  $m-1$  (tCOD/month)

$$COD_{BL,y} = (1 - (COD_{out,x}/COD_{in,x})) \times COD_{PJ,m} \quad \text{Equation (12)}$$

Where:

- $COD_{out,x}$  = COD of the effluent in the period  $x$  (t COD)
- $COD_{in,x}$  = COD directed to the open lagoons (Scenario 1) in the period  $x$  (t COD)
- $COD_{PJ,m}$  = Quantity of chemical oxygen demand that is treated in the anaerobic digester or in the project activity in month  $m$  (t COD/month)
- $x$  = Representative historical reference period

and

$$COD_{PJ,m} = F_{PJ,dig,m} * COD_{dig,m} \quad \text{Equation (13)}$$

Where:

- $COD_{PJ,m}$  = Quantity of chemical oxygen demand that is treated in the anaerobic digester or in the project activity in month  $m$  (t COD/month)

$F_{PJ,dig,m}$  = Quantity of wastewater that is treated in the anaerobic digester or under clearly aerobic conditions in the project activity in month  $m$  ( $m^3$ /month)

$COD_{dig,m}$  = Chemical oxygen demand in the wastewater that is treated in the anaerobic digester in the project activity in month  $m$  (t COD/ $m^3$ )

In case of emptying the lagoon, the accumulation of organic matter restarts with the next inflow and the COD available from the previous month should be set to zero. The monthly factor to account for the influence of the temperature on methane generation is calculated based on the following “van’t Hoff – Arrhenius” approach:

$$f_{T,m} = \begin{cases} 0 & \text{if } T_{2,m} < 278K \\ e^{\left(\frac{E \times (T_{2,m} - T_1)}{R \times T_1 \times T_{2,m}}\right)} & \text{if } 278K \leq T_{2,m} \leq 302.5K \\ 0.95 & \text{if } T_{2,m} > 302.5K \end{cases}$$

Equation (14)

Where:

$f_{T,m}$  = Factor expressing the influence of the temperature on the methane generation in month  $m$

$E$  = Activation energy constant (15,175 cal/mol)

$T_{2,m}$  = Average temperature at the project site in month  $m$  (K)

$T_1$  = 303.16 K (273.16 K + 30 K)

$R$  = Ideal gas constant (1.987 cal/K mol)

$m$  = Months of year  $y$  of the crediting period

The annual value  $f_{T,y}$  is calculated as follows:

$$f_{T,y} = \frac{\sum_{m=1}^{12} f_{T,m} \times COD_{available,m}}{\sum_{m=1}^{12} COD_{BL,m}}$$

Equation (15)

Where:

- $f_{T,y}$  = Factor expressing the influence of the temperature on the methane generation in year  $y$
- $f_{T,m}$  = Factor expressing the influence of the temperature on the methane generation in month  $m$
- $COD_{available,m}$  = Quantity of chemical oxygen demand available for degradation in the open lagoon in month  $m$  (t COD/month)
- $COD_{BL,m}$  = Quantity of chemical oxygen demand that would be treated in open lagoons (Scenario 1) in the absence of the project activity in month  $m$  (t COD/month)
- $m$  = Months of year  $y$  of the crediting period

### Step 2: Baseline emissions from generation and/or consumption of electricity ( $BE_{EL,y}$ )

In this step, baseline emissions from the following sources are estimated:

- Baseline emissions from consumption of electricity associated with the treatment of wastewater (Scenario 1)
- Baseline emissions from the generation of electricity in the grid (E2) in the absence of the electricity generation with biogas.

Therefore, baseline emissions from the generation and/or consumption of electricity can be simplified as follows:

$$BE_{EL,y} = (EC_{BL} \times EF_{BL,EL,y}) + (EG_{PJ,y} \times EF_{PJ,EL,y})$$

Equation (16)

Where:

- $BE_{EL,y}$  = CO<sub>2</sub> emissions associated with electricity generation that is displaced by the project activity and/or electricity consumption in the absence of the project activity in year  $y$  (t CO<sub>2</sub>/yr)
- $EC_{BL}$  = Annual quantity of electricity that would be consumed in the absence of the project activity for the treatment of the wastewater (Scenario 1) and which is displaced by electricity produced from the project activity (MWh/yr).
- $EF_{BL,EL,y}$  = Baseline emission factor for electricity consumed in the baseline in the absence of the project activity in year  $y$  (t CO<sub>2</sub>/MWh)
- $EG_{PJ,y}$  = Net quantity of electricity generated in year  $y$  with biogas from the new anaerobic biodigester (MWh/yr)
- $EF_{PJ,EL,y}$  = Baseline emission factor for electricity generated by the project activity in year  $y$  (t CO<sub>2</sub>/MWh).

For simplification, project participants neglect (a). Therefore,  $EC_{BL}=0$

$$BE_{EL,y} = (EC_{BL} \times EF_{BL,EL,y}) + (EG_{PJ,y} \times EF_{PJ,EL,y})$$

$$= (EG_{PJ,y} \times EF_{PJ,EL,y})$$

The electricity prior to the project was from NCPG. Therefore,  $EF_{PJ,EL,y}=EF_{grid,CM,y}$

$$BE_{EL,y}= EG_{PJ,y} \times EF_{grid,CM,y}$$

According to the “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation(v03.0)”,

$$BE_{EL,y}= EG_{PJ,y} \times EF_{grid,CM,y} \times (1+TDL_{k,y}). \quad \text{Equation (17)}$$

Where

$EF_{grid,CM,y}$ . Emission factors of NCPG

$TDL_{k,y}$ . Average technical transmission and distribution losses for providing electricity to source  $k$  in year  $y$

### **Determination of $EF_{PJ,EL,y}$ ( $EF_{grid,CM,y}$ )**

$EF_{grid,CM,y}$  is calculated using “Tool to calculate the emission factor for an electricity system (version 07.0)”. The source of data is referred to China’s DNA<sup>5</sup>. The detail of calculations are shown in appendix I.

Through the national published data by China’s DNA,

$$EF_{grid,CM,y}=0.7119tCO_2/MWh$$

## 4.2 Project Emissions

### **4.2.1 Project emissions associated with anaerobic digester ( $PE_{AD,y}$ )**

The project activity introduces the anaerobic digester for the treatment of wastewater. The treated wastewater will be sent to the open lagoon system as secondary treatment. The sludge is not expected to be generated with significant amount under the project activity. In case of excess sludge, it may be used for soil application under aerobic conditions. As per paragraph 63 of the applied methodology, the emissions attributed to the project activity for scenario 1 involves following conditions.

- (a) In the case of project activities that introduce an anaerobic digester for the treatment of wastewater, solid materials or sludge. Use the latest approved version of the tool “*Project and leakage emissions from anaerobic digesters (v2.0)*” to calculate project emissions; and
- (b) In the case of project activities that introduce a treatment of sludge or land application of wastewater. Estimate methane and nitrous oxide emissions from land application of sludge following step below,

#### **For Condition (a) In the case of project activities that introduce an anaerobic digester for the treatment of wastewater, solid materials or sludge**

In case of project activity under scenario 1, the introduction of anaerobic digester for the treatment of wastewater. The calculation as per the latest approved version of the tool “Project and leakage emissions from anaerobic digesters” shall be applied for project emissions estimation.

According to paragraph 13 of the “*Project and leakage emissions from anaerobic digesters (v2.0)*”, the project emissions associated with the anaerobic digester ( $PE_{AD,y}$ ) are determined as follows:

<sup>5</sup> <http://www.mee.gov.cn/ywgz/ydqhbh/wsqtz/>

$$PE_{AD,y} = PE_{EC,y} + PE_{FC,y} + PE_{CH4,y} + PE_{flare,y} \quad \text{Equation (18)}$$

Where:

$PE_{AD,y}$  = Project emissions associated with the anaerobic digester in year y (t CO<sub>2</sub>e)

$PE_{EC,y}$  = Project emissions from electricity consumption associated with the anaerobic digester in year y (t CO<sub>2</sub>e)

$PE_{FC,y}$  = Project emissions from fossil fuel consumption associated with the anaerobic digester in year y (t CO<sub>2</sub>e)

$PE_{CH4,y}$  = Project emissions of methane from the anaerobic digester in year y (t CO<sub>2</sub>e)

$PE_{flare,y}$  = Project emissions from flaring of biogas in year y (t CO<sub>2</sub>e)

These parameters are determined through the steps outlined below.

**Step 1: Determination of the quantity of methane produced in the digester ( $Q_{CH4,y}$ )**

The determination of  $Q_{CH4,y}$  is described in step 1 of section 4.1 baseline emission of this PDD.

**Step 2: Determination of project emissions of methane from the anaerobic digester ( $PE_{CH4,y}$ )**

Project emission of methane from the anaerobic digester include 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. These emissions are calculated using a default emission factor ( $EF_{CH4,default}$ ), as follows:

$$PE_{CH4,y} = Q_{CH4,y} \times EF_{CH4,default} \times GWP_{CH4} \quad \text{Equation (19)}$$

Where:

$PE_{CH_4,y}$  = Project emissions of methane from anaerobic digester in year y (t CO<sub>2</sub>e)

$Q_{CH_4,y}$  = Quantity of methane produced in the anaerobic digester in year y (t CH<sub>4</sub>)

$EF_{CH_4,default}$  = Default emission factor for the fraction of CH<sub>4</sub> produced that leaks from the anaerobic digester (fraction)

$GWP_{CH_4}$  = Global warming potential of CH<sub>4</sub> (t CO<sub>2</sub>/t CH<sub>4</sub>)

For the  $EF_{CH_4,default}$ , as the project activity installs three phase anaerobic treatment equipment, including UASB, the  $EF_{CH_4,default}$  is determined as 0.05.

### **Step 3: Determination of project emissions from electricity consumption ( $PE_{EC,y}$ )**

The project emissions from electricity consumption ( $PE_{EC,y}$ ) shall be determined using the “Baseline, project and/or leakage emission from electricity consumption and monitoring of electricity generation(v03.0)”. The approach is complied with the Option 1: Procedure using monitored data of the tool “Project and leakage emissions from anaerobic digesters”. In the generic approach, the project emissions from consumption of electricity are calculated based on the quantity of electricity consumed, an emission factor for electricity generation and a factor to account for transmission losses, as follows:

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{j,y}) \quad \text{Equation (20)}$$

Where:

$PE_{power,y}$  = Project emissions from electricity consumption in year y (t CO<sub>2</sub>/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 source j in year y (t CO<sub>2</sub>/MWh).

Through the national published data by China’s DNA, and calculation in appendix I,  $EF_{grid,CM,y}=0.7119tCO_2/MWh$

$TDL_{j,y}$  = Average technical transmission and distribution losses for providing electricity to source  $j$  in year  $y$ . A default value of 20% shall be assumed as conservative assumption as per applied tool.

$j$  = Source of electricity consumption in the project

For the project activity, the electricity from the national grid is consumed.

The electricity that anaerobic digester consumes is from the electricity generated by the project. The project activity may consume electricity from the national grid when in emergency.  $PE_{EC,y}$  is 0 for ex-ante estimation, and the actual will be monitored and calculated according to “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation-v3.0 ”

#### **Step 4: Determination of project emissions from fossil fuel consumption ( $PE_{FC,y}$ )**

Where the anaerobic digester facility uses fossil fuels, project participants shall calculate  $PE_{FC,y}$  using the “Tool to calculate project or leakage  $CO_2$  emissions from fossil fuel combustion”. The project emission source  $j$  referred to in the tool is fossil fuel consumption associated with the anaerobic digestion facility (not including fossil fuels consumed for transportation of feed material and digestate or any other on-site transportation).

The project activity is designed to not consume fossil fuel. In case of fuel oil used, the project emissions from fossil fuel consumption ( $PE_{FC,y}$ ) and the determination of the  $CO_2$  emission coefficient ( $COEF_{i,y}$ ) is referred to Option B based on net calorific value and  $CO_2$  Emission factor of the fuel type  $i$  will be calculated as follows:

$$PE_{FC,j,y} = \sum_i FC_{i,j,y} \times NCV_{i,y} \times EF_{CO2,i,y} \quad \text{Equation (21)}$$

Where:

$PE_{FC,j,y}$  =  $CO_2$  emissions from fossil fuel combustion in process  $j$  (the boiler) during the year  $y$  ( $tCO_2/yr$ )

$FC_{i,j,y}$  = Quantity of fossil fuel type  $i$  combusted in process  $j$  (the boiler) during the year  $y$  (mass or volume unit/yr)

|             |   |                                                                                                      |
|-------------|---|------------------------------------------------------------------------------------------------------|
| $NCV_{i,y}$ | = | Weighted average net calorific value of the fuel type i in year y (GJ/mass or volume unit)           |
| $EF_{i,y}$  | = | Weighted average CO <sub>2</sub> emission factor of fuel type i in the year y (tCO <sub>2</sub> /GJ) |
| i           | = | Fuel types combusted in process j (the boiler) during the year y                                     |

#### Step 5: Determination of project emissions from flaring of biogas ( $PE_{flare,y}$ )

In the case of unscheduled events; such as the engine failure or malfunction, result in biogas being unable to be sent to the gas engines, or if there is an excess of biogas, the open flaring system will be used for such emergency case.

Then project emissions from flaring of biogas ( $PE_{flare,y}$ ) shall be estimated using the “*Project emissions from flaring*”. The following applies:

- The tool provides default factors for the flare efficiency, which can be used for large scale project as described below;

The calculation procedures provided the determination of the project emissions from flaring the residual gas ( $PE_{flare,y}$ ) based on the flare efficiency ( $\eta_{flare,m}$ ) and the mass flow of methane to flare ( $F_{CH4,m}$ ). The project emissions calculation procedure is given in the following steps:

##### 1) Determination of the methane mass flow rate in the residual gas

This step determines the mass flow of methane ( $F_{CH4,m}$ ) as kg unit in the residue gaseous stream in the time interval t as per the guidance given in the “*Tool to determine the mass flow of a greenhouse gas in a gaseous stream(v3.0)*”.

$F_{CH4,m}$ , which is measured as the mass flow during minute m, shall then be used to determine the mass of methane in kilograms fed to the flare in minute m ( $F_{CH4,RG,m}$ ).  $F_{CH4,RG,m}$  shall be determined on a dry basis. Therefore, the measurement option A as per the table 2 of the “*Tool to determine the mass flow of greenhouse gas in a gaseous stream(V03.0)*” is selected in order to determine the volume flow and the volumetric fraction of the residue gaseous stream on the dry basis. The temperature of the gaseous stream is less than 60 deg C at the flow measurement point. Therefore, as per Option A (b), the gaseous stream is considered dry.

$F_{CH_4, RG, m}$  is determined as following equation;

$$F_{CH_4, RG, m} = V_{RG, m} \times V_{CH_4, m, db} \times \rho_{CH_4, m} \quad \text{Equation (22)}$$

Where:

$F_{CH_4, RG, m}$  = Mass flow of greenhouse gas  $CH_4$  in the residual gaseous stream in the minute  $m$

$V_{(RG, m)/(t, db)}$  = Volumetric flow of the residual gaseous in minute  $m$  on dry basis ( $Nm^3$ )

$V_{CH_4, m, db}$  = Volumetric fraction of the greenhouse gas  $CH_4$  in the gaseous stream in minute  $m$  on dry basis (%).

$\rho_{CH_4, m}$  = Density of greenhouse gas  $CH_4$  in the gaseous stream in minute  $m$  ( $0.716 \text{ kg}/m^3$ ) at reference conditions

## 2) Determination of flare efficiency

As per the tool, for the open flare, the default value must be applied. In the case of open flare, the flare efficiency in the minute  $m$  ( $\eta_{flare, m}$ ) is 50% when the flame is detected in the minute  $m$  ( $Flame_m$ ), otherwise  $\eta_{flare, m}$  is 0%.

## 3) Calculation of project emissions from flaring

Project emissions from flaring are calculated as the sum of emissions for each minute  $m$  in year  $y$ , based on the methane mass flow in the residue gas ( $F_{CH_4, RG, m}$ ) and the flare efficiency ( $\eta_{flare, m}$ ), as follow:

$$PE_{flare, y} = GWP_{CH_4} * \sum_{m=1}^{525600} F_{CH_4, RG, m} * (1 - \eta_{flare, m}) * 10^{-3} \quad \text{Equation (23)}$$

Where:

|                  |   |                                                                                                            |
|------------------|---|------------------------------------------------------------------------------------------------------------|
| $PE_{flare,y}$   | = | Project emissions from flaring of the residual gas in year y (tCO <sub>2</sub> e)                          |
| $GWP_{CH_4}$     | = | Global warming potential of methane valid for the commitment period (tCO <sub>2</sub> e/tCH <sub>4</sub> ) |
| $F_{CH_4,RG,m}$  | = | Mass flow of methane in the residue gas in the minute m (kg)                                               |
| $\eta_{flare,m}$ | = | Flare efficiency in minute m                                                                               |

**For Condition (b) In the case of project activities that introduce a treatment of sludge or land application of wastewater**

Not applicable

#### 4.2.2 Project emissions from leakage associated with storage of digestate ( $LE_{storage,y}$ )

The proposed project activity introduces an anaerobic digester for the treatment of wastewater. As per ACM0014, the latest approved version of the tool “Project and leakage emissions from anaerobic digesters (v2.0)” is applied to calculate leakage emissions

*As per “Project and leakage emissions from anaerobic digesters (v2.0)”, If the storage of digestate or the composting of digestate is occurring within the project boundary, these emissions will be considered as project emissions.*

The proposed project does not contain composting. The storage of digestate is occurring within the project boundary. Therefore, these emissions will be considered as project emissions.

$$LE_y = LE_{AD,y} = LE_{storage,y} + LE_{comp,y} \quad \text{Equation (24)}$$

Where:

|                  |   |                                                                                            |
|------------------|---|--------------------------------------------------------------------------------------------|
| $LE_{AD,y}$      | = | Leakage emissions associated with the anaerobic digester in year y (tCO <sub>2</sub> e/yr) |
| $LE_{storage,y}$ | = | Leakage emissions associated with storage of digestate in year y (tCO <sub>2</sub> e/yr)   |
| $LE_{comp,y}$    | = | Leakage emissions associated with composting digestate in year y (tCO <sub>2</sub> e/yr)   |

As per the tool, the leakage emissions associated with the anaerobic digester ( $LE_{AD,y}$ ) depend on how the digestate is managed. In the project activity, the effluent treated is the liquid digestate. Therefore, the leakage emission is associated with storage of digestate ( $LE_{storage,y}$ ). In order to determine  $LE_{storage,y}$  for liquid digestate, the Option 2 of procedure using a default value is chosen as following equation.

$$LE_{AD} = LE_{storage} = F_{ww,CH4,default} \times Q_{CH4,y} \times GWP_{CH4} \quad \text{Equation (25)}$$

Where:

|                      |                                                                                                        |
|----------------------|--------------------------------------------------------------------------------------------------------|
| $LE_{AD}$            | = Leakage emissions associated with the anaerobic digester in year y (tCO <sub>2</sub> e/yr)           |
| $LE_{storage}$       | = Leakage emissions associated with storage of digestate in year y (tCO <sub>2</sub> e/yr)             |
| $F_{ww,CH4,default}$ | = Default factor representing the remaining methane production capacity of liquid digestate (fraction) |
| $Q_{CH4,y}$          | = Quantity of methane produced in the digester in year y (tCH <sub>4</sub> )                           |
| $GWP_{CH4}$          | = Global warming potential of CH <sub>4</sub> (t CO <sub>2</sub> e/t CH <sub>4</sub> )                 |

### 4.3 Leakage

As per “Project and leakage emissions from anaerobic digesters (v2.0)”, If the storage of digestate or the composting of digestate is occurring within the project boundary, these emissions will be considered as project emissions.

The storage of digestate is occurring within the project boundary. Therefore, these emissions will be considered as project emissions.

No leakage is included in the project. Therefore,  $LE_y=0$

### 4.4 Net GHG Emission Reductions and Removals

Emission reductions for any given year of the crediting period are obtained by subtracting project emissions from baseline emissions:

$$ER_y = BE_y - PE_y - LE_y$$

Equation (26)

Where:

 $ER_y$  = Emissions reductions in year  $y$  (tCO<sub>2</sub>e/year)

 $BE_y$  = Baseline emissions in year  $y$  (tCO<sub>2</sub>e/year)

 $PE_y$  = Project emissions in year  $y$  (tCO<sub>2</sub>e/year)

 $LE_y$  = Leakage emissions in year  $y$  (tCO<sub>2</sub>e/year)

| Year                              | Estimated baseline emissions or removals (tCO <sub>2</sub> e) | Estimated project emissions or removals (tCO <sub>2</sub> e) | Estimated leakage emissions (tCO <sub>2</sub> e) | Estimated net GHG emission reductions or removals (tCO <sub>2</sub> e) |
|-----------------------------------|---------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------|------------------------------------------------------------------------|
| 20/09/2019 - 31/12/2019 (103days) | 115,140                                                       | 13,638                                                       | 0                                                | 101,502                                                                |
| 01/01/2020 - 31/12/2020           | 408,021                                                       | 48,330                                                       | 0                                                | 359,691                                                                |
| 01/01/2021 - 31/12/2021           | 408,021                                                       | 48,330                                                       | 0                                                | 359,691                                                                |
| 01/01/2022 - 31/12/2022           | 408,021                                                       | 48,330                                                       | 0                                                | 359,691                                                                |
| 01/01/2023 - 31/12/2023           | 408,021                                                       | 48,330                                                       | 0                                                | 359,691                                                                |
| 01/01/2024 - 31/12/2024           | 408,021                                                       | 48,330                                                       | 0                                                | 359,691                                                                |
| 01/01/2025 - 31/12/2025           | 408,021                                                       | 48,330                                                       | 0                                                | 359,691                                                                |
| 01/01/2026-19/09/2026 (262days)   | 292,881                                                       | 34,692                                                       | 0                                                | 258,189                                                                |
| <b>Total</b>                      | <b>2,856,147</b>                                              | <b>338,310</b>                                               | <b>0</b>                                         | <b>2,517,837</b>                                                       |

|         |         |        |   |         |
|---------|---------|--------|---|---------|
| Average | 408,021 | 48,330 | 0 | 359,691 |
|---------|---------|--------|---|---------|

## 5 MONITORING

### 5.1 Data and Parameters Available at Validation

|                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter</b>                                                                             | COD <sub>out,x</sub>                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Data unit</b>                                                                                    | t COD                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Description</b>                                                                                  | COD of the effluent in the period x                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Source of data</b>                                                                               | The design COD inflow for COD in and the design effluent COD flow for COD out corresponding to the design features of the lagoon system identified in the procedure for the selection of the baseline scenario.                                                                                                                                                                                                        |
| <b>Value applied</b>                                                                                | 3130t/yr                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Justification of choice of data or description of measurement methods and procedures applied</b> | No measurement procedures are required.<br><br>The proposed project activity involves installation of new anaerobic wastewater treatment and biogas utilization as Greenfield facilities. As per ACM0014 (version 08), the value applied for Greenfield project shall be as per the design value in the lagoon system identified for the selection of the baseline scenario. The unit mg/l will be converted to t COD. |
| <b>Purpose of Data</b>                                                                              | Calculation of baseline emissions.                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Comments</b>                                                                                     | -                                                                                                                                                                                                                                                                                                                                                                                                                      |

|                         |                                                                                                                                                                                                                 |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Data / Parameter</b> | COD <sub>in,x</sub>                                                                                                                                                                                             |
| <b>Data unit</b>        | t COD                                                                                                                                                                                                           |
| <b>Description</b>      | COD directed to the open lagoons (Scenario 1) in the period x                                                                                                                                                   |
| <b>Source of data</b>   | The design COD inflow for COD in and the design effluent COD flow for COD out corresponding to the design features of the lagoon system identified in the procedure for the selection of the baseline scenario. |

|                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Value applied                                                                                | 172,150t/yr                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Justification of choice of data or description of measurement methods and procedures applied | <p>No measurement procedures are required.</p> <p>The proposed project activity involves installation of new anaerobic wastewater treatment and biogas utilization as Greenfield facilities. As per ACM0014 (version 08), the value applied for Greenfield project shall be as per the design value in the lagoon system identified for the selection of the baseline scenario. The unit mg/l will be converted to t COD.</p> |
| Purpose of Data                                                                              | The design COD inflow for COD in and the design effluent COD flow for COD out corresponding to the design features of the lagoon system identified in the procedure for the selection of the baseline scenario.                                                                                                                                                                                                               |
| Comments                                                                                     | -                                                                                                                                                                                                                                                                                                                                                                                                                             |

|                                                                                              |                                                                                                                                   |
|----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| Data / Parameter                                                                             | $\rho$                                                                                                                            |
| Data unit                                                                                    | -                                                                                                                                 |
| Description                                                                                  | Discount factor for historical information                                                                                        |
| Source of data                                                                               | As per ACM0014, version 08, for the existing plants, if one year of historical data is available, $\rho = 1$ .                    |
| Value applied                                                                                | 1                                                                                                                                 |
| Justification of choice of data or description of measurement methods and procedures applied | <p>No measurement procedures are required.</p> <p>The value is applied as per ACM0014, version 08 for the Greenfield project.</p> |
| Purpose of Data                                                                              | Calculation of project emissions.                                                                                                 |
| Comments                                                                                     | -                                                                                                                                 |

|                  |                                                                                                                                                                 |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data / Parameter | $B_0$                                                                                                                                                           |
| Data unit        | t CH <sub>4</sub> /tCOD                                                                                                                                         |
| Description      | Maximum methane producing capacity, expressing the maximum amount of CH <sub>4</sub> that can be produced from a given quantity of chemical oxygen demand (COD) |
| Source of data   | 2006 IPCC Guidelines                                                                                                                                            |

|                                                                                              |                                                                                              |
|----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| Value applied                                                                                | 0.21                                                                                         |
| Justification of choice of data or description of measurement methods and procedures applied | No measurement procedures are required.<br>The value is applied as per 2006 IPCC Guidelines. |
| Purpose of Data                                                                              | Calculation of baseline and project emissions.                                               |
| Comments                                                                                     | -                                                                                            |

|                                                                                              |                                                                                                                                                                                                                                                                                                                                                    |
|----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data / Parameter                                                                             | D                                                                                                                                                                                                                                                                                                                                                  |
| Data unit                                                                                    | m                                                                                                                                                                                                                                                                                                                                                  |
| Description                                                                                  | Average depth of the lagoons                                                                                                                                                                                                                                                                                                                       |
| Source of data                                                                               | For project activity implemented in Greenfield facility, the data shall be as per the baseline lagoon design as identified for the selection of the baseline scenario.                                                                                                                                                                             |
| Value applied                                                                                | 3.0                                                                                                                                                                                                                                                                                                                                                |
| Justification of choice of data or description of measurement methods and procedures applied | No measurement is required.<br><br>The proposed project activity involves installation of new anaerobic wastewater treatment and biogas utilization facilities. As per ACM0014 (version 08), the value applied for Greenfield project shall be as per the design value in the lagoon system identified for the selection of the baseline scenario. |
| Purpose of Data                                                                              | Calculation of baseline emissions.                                                                                                                                                                                                                                                                                                                 |
| Comments                                                                                     | -                                                                                                                                                                                                                                                                                                                                                  |

|                                                   |                                                                          |
|---------------------------------------------------|--------------------------------------------------------------------------|
| Data / Parameter                                  | GWP <sub>CH4</sub>                                                       |
| Data unit                                         | t CO <sub>2</sub> e/t CH <sub>4</sub>                                    |
| Description                                       | Global warming potential for CH <sub>4</sub>                             |
| Source of data                                    | IPCC Fourth Assessment Report                                            |
| Value applied                                     | 25                                                                       |
| Justification of choice of data or description of | IPCC default value for the 1 <sup>st</sup> commitment period is applied. |

|                                            |                                                                      |
|--------------------------------------------|----------------------------------------------------------------------|
| measurement methods and procedures applied |                                                                      |
| Purpose of Data                            | Calculation of baseline and project emissions                        |
| Comments                                   | The data shall be updated according to any future COP/MOP decisions. |

|                                                                                              |                                                                                                              |
|----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| Data / Parameter                                                                             | $f_d$                                                                                                        |
| Data unit                                                                                    | -                                                                                                            |
| Description                                                                                  | Factor expressing the influence of the depth of the lagoon or sludge pit on methane generation               |
| Source of data                                                                               | ACM0014, version 08<br>If the average depth of the lagoon or sludge pits (D) is greater than 2m, $f_d = 0.7$ |
| Value applied                                                                                | 0.7                                                                                                          |
| Justification of choice of data or description of measurement methods and procedures applied | Discount factor for Greenfield project as per ACM0014, version 08 is applied.                                |
| Purpose of Data                                                                              | Calculation of baseline emissions                                                                            |
| Comments                                                                                     | -                                                                                                            |

|                                                                                              |                                                                                                                                                                 |
|----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data / Parameter                                                                             | $EF_{EL,j,y}$ or $EF_{grid,CM,y}$                                                                                                                               |
| Data unit                                                                                    | tCO <sub>2</sub> /MWh                                                                                                                                           |
| Description                                                                                  | Emission factor for electricity generation for source j (NCPG) in year y.                                                                                       |
| Source of data                                                                               | National public official data                                                                                                                                   |
| Value applied                                                                                | 0.7119                                                                                                                                                          |
| Justification of choice of data or description of measurement methods and procedures applied | The data source is from China's DNA. And the $EF_{grid,CM,y}$ is calculated according to "Tool to calculate the emission factor for an electricity system-v7.0" |

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

|                                                                                              |                                                                                                                                               |
|----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Data / Parameter                                                                             | $TDL_{k,y}$                                                                                                                                   |
| Data unit                                                                                    | %                                                                                                                                             |
| Description                                                                                  | Average technical transmission and distribution losses for providing electricity to NCPG in year y                                            |
| Source of data                                                                               | Default value from 'baseline, project and or leakage emissions from electricity consumption and monitoring of electricity generation (v03.0)' |
| Value applied                                                                                | 3                                                                                                                                             |
| Justification of choice of data or description of measurement methods and procedures applied | Default value from 'baseline, project and or leakage emissions from electricity consumption and monitoring of electricity generation (v03.0)' |
| Purpose of Data                                                                              | Calculation of baseline 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                                                                               | Default value from 'baseline, project and or leakage emissions from electricity consumption and monitoring of electricity generation (v03.0)' |
| Value applied                                                                                | 20                                                                                                                                            |
| Justification of choice of data or description of measurement methods and procedures applied | Default value from 'baseline, project and or leakage emissions from electricity consumption and monitoring of electricity generation (v03.0)' |
| Purpose of Data                                                                              | Calculation of project emissions                                                                                                              |

|          |   |
|----------|---|
| Comments | - |
|----------|---|

|                                                                                              |                                                                                                                                                                         |
|----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data / Parameter                                                                             | F <sub>ww,CH4,default</sub>                                                                                                                                             |
| Data unit                                                                                    | Fraction                                                                                                                                                                |
| Description                                                                                  | Default factor representing the remaining CH <sub>4</sub> production capacity of liquid digestate                                                                       |
| Source of data                                                                               | Default value as per the tool                                                                                                                                           |
| Value applied                                                                                | 0.05 for UASB                                                                                                                                                           |
| Justification of choice of data or description of measurement methods and procedures applied | The project involves with the installation of three-phase digesters. The choice of data is based on the tool of project and leakage emissions from anaerobic digesters. |
| Purpose of Data                                                                              | Calculation of project emissions                                                                                                                                        |
| Comments                                                                                     | -                                                                                                                                                                       |

|                                                                                              |                                                                                                                                                                |
|----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data / Parameter                                                                             | EF <sub>CH4,default</sub>                                                                                                                                      |
| Data unit                                                                                    | t CH <sub>4</sub> leaked / t CH <sub>4</sub> produced                                                                                                          |
| Description                                                                                  | Default emission factor for the fraction of CH <sub>4</sub> produced that leaks from the anaerobic digester                                                    |
| Source of data                                                                               | IPCC (2006), Flesch et al. (2011) and Kurup (2003)                                                                                                             |
| Value applied                                                                                | 0.05                                                                                                                                                           |
| Justification of choice of data or description of measurement methods and procedures applied | The project involves with the installation of UASB. The choice of data is based on the <i>tool of project and leakage emissions from anaerobic digesters</i> . |
| Purpose of Data                                                                              | Calculation of project emissions                                                                                                                               |
| Comments                                                                                     | -                                                                                                                                                              |

|                                                                                              |                                                                                      |
|----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Data / Parameter                                                                             | $R_u$                                                                                |
| Data unit                                                                                    | Pa.m <sup>3</sup> /kmol.K                                                            |
| Description                                                                                  | Universal ideal gases constant                                                       |
| Source of data                                                                               | Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 03) |
| Value applied                                                                                | 8,314                                                                                |
| Justification of choice of data or description of measurement methods and procedures applied | -                                                                                    |
| Purpose of Data                                                                              | Calculation of baseline and project emissions                                        |
| Comments                                                                                     | -                                                                                    |

|                                                                                              |                                                                                      |
|----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Data / Parameter                                                                             | $MM_i$                                                                               |
| Data unit                                                                                    | kg/kmol                                                                              |
| Description                                                                                  | Molecular mass of greenhouse gas i (CH <sub>4</sub> )                                |
| Source of data                                                                               | Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 03) |
| Value applied                                                                                | 16.04                                                                                |
| Justification of choice of data or description of measurement methods and procedures applied | Default value                                                                        |
| Purpose of Data                                                                              | Calculation of baseline and project emission                                         |
| Comments                                                                                     |                                                                                      |

|                  |                                     |
|------------------|-------------------------------------|
| Data / Parameter | $P_n$                               |
| Data unit        | Pa                                  |
| Description      | Total pressure at normal conditions |

|                                                                                              |                                                                                      |
|----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Source of data                                                                               | Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 03) |
| Value applied                                                                                | 101,325 Pa                                                                           |
| Justification of choice of data or description of measurement methods and procedures applied | -                                                                                    |
| Purpose of Data                                                                              | Calculation of baseline and project emissions                                        |
| Comments                                                                                     | -                                                                                    |

|                                                                                              |                                                                                      |
|----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Data / Parameter                                                                             | $T_n$                                                                                |
| Data unit                                                                                    | K                                                                                    |
| Description                                                                                  | Temperature at normal conditions                                                     |
| Source of data                                                                               | Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 03) |
| Value applied                                                                                | 273.15                                                                               |
| Justification of choice of data or description of measurement methods and procedures applied | -                                                                                    |
| Purpose of Data                                                                              | Calculation of baseline and project emissions                                        |
| Comments                                                                                     | -                                                                                    |

## 5.2 Data and Parameters Monitored

|                  |                                                                                                                                                |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| Data / Parameter | $F_{PJ,dig,m}$                                                                                                                                 |
| Data unit        | m <sup>3</sup> /month                                                                                                                          |
| Description      | Quantity of wastewater that is treated in the anaerobic digester or under clearly aerobic conditions in the project activity in month <i>m</i> |
| Source of data   | Water flow meters                                                                                                                              |

|                                                                 |                                                                                                                                                                                                                                                                          |
|-----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description of measurement methods and procedures to be applied | Flow meter will be installed at the inlet of digester for measurement of the influent wastewater. The flow of wastewater will be monitored continuously, and measurements will be recorded by the operators. The measurements will be aggregated to give monthly values. |
| Frequency of monitoring/recording                               | The monitoring will be done continuously and aggregated monthly.                                                                                                                                                                                                         |
| Value applied                                                   | 260,000                                                                                                                                                                                                                                                                  |
| Monitoring equipment                                            | Flow meter for wastewater                                                                                                                                                                                                                                                |
| QA/QC procedures to be applied                                  | The flow meter will undergo maintenance / calibration in accordance with the national standard.                                                                                                                                                                          |
| Purpose of data                                                 | Calculation of baseline and project emissions                                                                                                                                                                                                                            |
| Calculation method                                              | -                                                                                                                                                                                                                                                                        |
| Comments                                                        | -                                                                                                                                                                                                                                                                        |

|                                                                 |                                                                                                                                                                                                          |
|-----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data / Parameter                                                | COD <sub>dig,m</sub>                                                                                                                                                                                     |
| Data unit                                                       | t COD/m <sup>3</sup>                                                                                                                                                                                     |
| Description                                                     | Chemical oxygen demand in the wastewater that is treated in the anaerobic digester in the project activity in month <i>m</i>                                                                             |
| Source of data                                                  | Measurements                                                                                                                                                                                             |
| Description of measurement methods and procedures to be applied | The COD content will be analyzed using a national standard by the inhouse laboratory of the treatment plant. The results will be logged by the operators in the plant. Average value will be calculated. |
| Frequency of monitoring/recording                               | The monitoring and recording will be conducted regularly and calculate average monthly.                                                                                                                  |
| Value applied                                                   | 0.055                                                                                                                                                                                                    |
| Monitoring equipment                                            | The monitoring equipment is in line with the requirement of national standards.                                                                                                                          |
| QA/QC procedures to be applied                                  | Sampling and analysis process will be carried out by plant technicians adhering to internationally recognized procedures.                                                                                |

|                    |                                               |
|--------------------|-----------------------------------------------|
| Purpose of data    | Calculation of baseline and project emissions |
| Calculation method | -                                             |
| Comments           | -                                             |

|                                                                 |                                                                                                                                                                                                |
|-----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data / Parameter                                                | $T_{2,m}$                                                                                                                                                                                      |
| Data unit                                                       | K                                                                                                                                                                                              |
| Description                                                     | Average temperature at the project site in month $m$                                                                                                                                           |
| Source of data                                                  | National or regional weather statistics                                                                                                                                                        |
| Description of measurement methods and procedures to be applied | National or regional weather statistics                                                                                                                                                        |
| Frequency of monitoring/recording                               | Continuously, aggregated in monthly average values                                                                                                                                             |
| Value applied                                                   | -                                                                                                                                                                                              |
| Monitoring equipment                                            | -                                                                                                                                                                                              |
| QA/QC procedures to be applied                                  | -                                                                                                                                                                                              |
| Purpose of data                                                 | Calculation of baseline emissions                                                                                                                                                              |
| Calculation method                                              | The national or regional weather statistics is applied. In case of the temperature is available in Celsius, it shall be calculated as follows:<br>$T_{2,m} (K) = 273.15 K + T_{2,m} (Celsius)$ |
| Comments                                                        | -                                                                                                                                                                                              |

|                  |                                                                                                  |
|------------------|--------------------------------------------------------------------------------------------------|
| Data / Parameter | $EG_{PJ,y}$                                                                                      |
| Data unit        | MWh/year                                                                                         |
| Description      | Net quantity of electricity generated in year $y$ with biogas from the new anaerobic biodigester |

|                                                                 |                                                                                                |
|-----------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| Source of data                                                  | Electricity meters                                                                             |
| Description of measurement methods and procedures to be applied | Net quantity of electricity generated is monitored by the electricity meter.                   |
| Frequency of monitoring/recording                               | Continuous measurement and at least monthly recording                                          |
| Value applied                                                   | 93,840                                                                                         |
| Monitoring equipment                                            | Electricity meters                                                                             |
| QA/QC procedures to be applied                                  | The electricity meter shall be subject to periodic calibration according to national standard. |
| Purpose of data                                                 | Calculation of baseline emissions                                                              |
| Calculation method                                              | -                                                                                              |
| Comments                                                        | -                                                                                              |

|                                                                 |                                                                                                                                                         |
|-----------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data / Parameter                                                | EC <sub>y</sub>                                                                                                                                         |
| Data unit                                                       | MWh/year                                                                                                                                                |
| Description                                                     | Net quantity of grid electricity consumed by the project in year y                                                                                      |
| Source of data                                                  | Record from the project owner                                                                                                                           |
| Description of measurement methods and procedures to be applied | The electricity consumption will be based on the grid electricity imported by the project. This will be continuously measured by the electricity meter. |
| Frequency of monitoring/recording                               | Continuous measurement and at least monthly recording                                                                                                   |
| Value applied                                                   | 0 for ex-ante estimation. And the actual will be monitored.                                                                                             |
| Monitoring equipment                                            | Electricity meter                                                                                                                                       |
| QA/QC procedures to be applied                                  | The electricity meter will be calibrated as per national standard.                                                                                      |

|                    |                                  |
|--------------------|----------------------------------|
| Purpose of data    | Calculation of project emissions |
| Calculation method | -                                |
| Comments           | -                                |

|                                                                 |                                                                                                                                                              |
|-----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data / Parameter                                                | $F_{\text{biogas},y} (V_{t,\text{db}})$                                                                                                                      |
| Data unit                                                       | m <sup>3</sup> /yr                                                                                                                                           |
| Description                                                     | Total amount of biogas collected in the outlet of the new digester in year y                                                                                 |
| Source of data                                                  | Measured                                                                                                                                                     |
| Description of measurement methods and procedures to be applied | A volumetric flow meter will be installed at the outlet to the digester. The volumetric gas flow rate will be monitored continuously and aggregated monthly. |
| Frequency of monitoring/recording                               | Parameter monitored continuously but aggregated monthly for calculations.                                                                                    |
| Value applied                                                   | 45,000,000                                                                                                                                                   |
| Monitoring equipment                                            | Gas flow meter                                                                                                                                               |
| QA/QC procedures to be applied                                  | The meters will undergo calibration as per national standard.                                                                                                |
| Purpose of data                                                 | Calculation of baseline and project emissions                                                                                                                |
| Calculation method                                              | -                                                                                                                                                            |
| Comments                                                        | -                                                                                                                                                            |

|                  |                                                                                                               |
|------------------|---------------------------------------------------------------------------------------------------------------|
| Data / Parameter | $W_{\text{CH}_4,\text{biogas},y} (V_{\text{CH}_4,t,\text{db}})$                                               |
| Data unit        | kg CH <sub>4</sub> /m <sup>3</sup>                                                                            |
| Description      | Concentration of methane in the total biogas supply in the outlet of the new digester at reference conditions |
| Source of data   | Measured                                                                                                      |

|                                                                        |                                                                                                                                                                                 |
|------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Description of measurement methods and procedures to be applied</b> | A gas analyzer will record the methane content in the biogas, with the measurements recorded monthly.                                                                           |
| <b>Frequency of monitoring/recording</b>                               | The monitoring and recording will be conducted on monthly basis.                                                                                                                |
| <b>Value applied</b>                                                   | 0.4296 kgCH <sub>4</sub> /m <sup>3</sup><br>Based on technology provider, methane fraction in produced biogas is 60% multiply with density of methane 0.716 kg/m <sup>3</sup> . |
| <b>Monitoring equipment</b>                                            | gas analyzer                                                                                                                                                                    |
| <b>QA/QC procedures to be applied</b>                                  | The meters will undergo calibration as per national standard.                                                                                                                   |
| <b>Purpose of data</b>                                                 | Calculation of baseline and project emissions                                                                                                                                   |
| <b>Calculation method</b>                                              | -                                                                                                                                                                               |
| <b>Comments</b>                                                        | -                                                                                                                                                                               |

## 5.3 Monitoring Plan

### 1. Monitoring Management

The required monitoring equipment is installed by the technology provider. Monitoring meters are regularly calibrated according to recognized procedures by the plant operator and sampling is carried out by the onsite chief of the wastewater monitoring department according to appropriate industrial standards.

Data acquisition from the gas, wastewater and power flow meters are executed through log-book system and record by on-site operators, while COD of wastewater at sampling point is monitored and reported by on-site environmental laboratory.

The collected data must be approved and supervised by the plant manager who is in charge of data processing.

### 2. Quality Assurance and Quality Control

The plant manager monitors overall performance of the plant, ensures proper and timely calibration, data acquisition and storage.

A monitoring team is built, consisted with team manager, monitoring staff, data verifier.

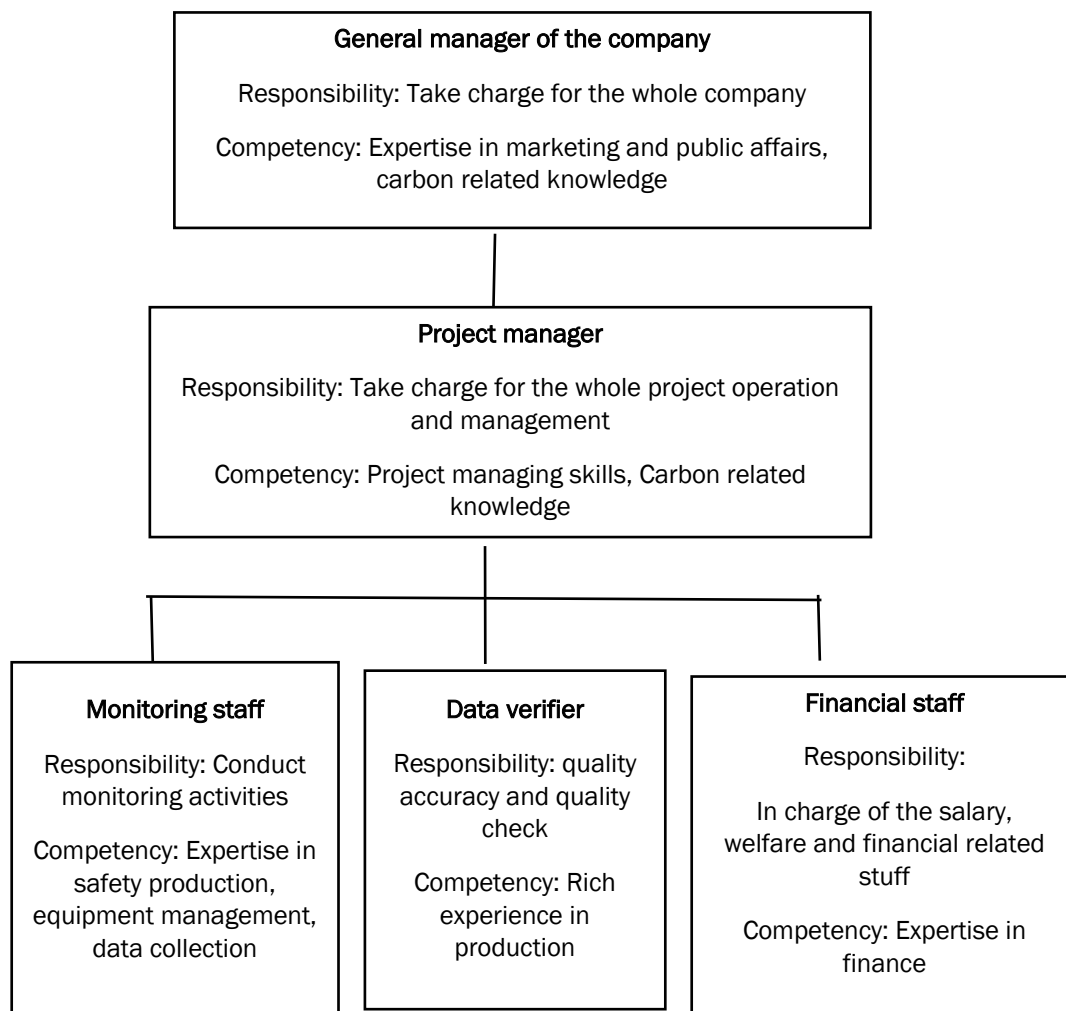


Figure 4. Monitoring structure

### 3. Data record and Storage

All relevant data is are stored manually in operational log sheets or electronically in a computer unit. All parameters monitored under the monitoring plan will be kept for at least two years after the end of the crediting period or the last issuance of VERs for the project activity, whichever occurs later.

### 4. Emergency preparedness

The project activity does not result in any unidentified activity that can result in substantial emissions from the project activity.

However, the leakages, if any, in the piping or digester shall come under notice of plant operator either instantly on the control screens else at the time of data logging, due to mismatch between expected biogas generation from wastewater quantities processed or other way around.

## APPENDIX 1. CALCULATION OF $EF_{GRID,CM,Y}$

### Step 1 Identify the relevant electric power system

The delineation of the proposed project electricity system and connected electricity system as defined by the Host Country DNA has been used to define the relevant electric power system. As explained in section 3.4 above, the power generated by the proposed project activity will be transferred to the North China Power Grid (NCPG). Therefore, the NCPG is identified as the electric power system of the proposed project.

### Step 2. Choose whether to include off-grid power plants in the proposed project electricity system

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.

Following the calculations of the DNA, and the statistical data available, Option I is chosen.

### 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.

Detailed information to carry out a dispatch data analysis is not publicly available; therefore, method (b) and method (c) is not suitable for the proposed project.

According to “Tool to calculate the emission factor for an electricity system”, the Simple OM method is applicable to the proposed project if low-cost resources<sup>6</sup> constitute less than 50% of total grid generation (excluding electricity generated by off-grid power plants) in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production.

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<sup>6</sup> Low-cost/must-run resources are defined as power plants with low marginal generation costs or dispatched independently of the daily or seasonal load of the grid. They include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. If a fossil fuel plant is dispatched independently of the daily or seasonal load of the grid and if this can be demonstrated based on the publicly available data, it should be considered as a low-cost/must-run.

The approach 1) was chosen for calculation and low-cost/must-run resources constitute less than 50% of total grid generation in average of the five most recent years<sup>7</sup>. Therefore, Method (a) Simple OM was selected.

The Simple OM can be calculated using either of the two following data vintages:

(a) Ex ante option: If the ex-ante option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of the PD to the DOE for validation.

(b) Ex post option: If the ex post option is chosen, the emission factor is determined for the year in which the proposed project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring.

Here ex-ante vintage is chosen, and the  $EF_{grid,OM,y}$  is fixed during the first crediting period. The date of the publication of the most recent official data for the calculation of the emission factor prior to the start of validation was 29/12/2020.

Power plants registered as CARBON project activities should be included in the sample group that is used to calculate the operating margin if the criteria for including the power source in the sample group apply.

Details of the calculations and data follow the published data from the Chinese DNA, which uses official national statistics. This data does not exclude CARBON projects.

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

The simple OM emission factor is calculated as the generation-weighted average CO<sub>2</sub> emissions per unit net electricity generation (t CO<sub>2</sub>/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units.

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

- (a) **Option A:** Based on the net electricity generation and a CO<sub>2</sub> emission factor of each power unit;  
or
- (b) **Option B:** Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the proposed project electricity system.

Option B can only be used if:

- (a) The necessary data for Option A is not available; and

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<sup>7</sup> <http://www.mee.gov.cn/ywgz/ycqhbh/wsqtkz/>

- (b) Only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is known; and
- (c) Off-grid power plants are not included in the calculation (i.e. if Option I has been chosen in Step 1.7.2).

Following the calculations of the DNA, Option B is chosen. The criteria for Option B are met:

- (a) The necessary data for Option A is not available, as indicated in the calculations of the DNA; and
- (b) Only nuclear and renewable power generation are considered as low-cost/must-run power sources, and the quantity of electricity supplied to the grid by these sources is known; and
- (c) Option I is chosen in Step 1.7.2.

The proposed project uses Option B for calculating the simple OM emission factor as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_i FC_{i,y} \times NCV_{i,y} \times EF_{CO_2,i,y}}{EG_y} \quad (4)$$

Where:

- $EF_{grid,OMsimple,y}$  = Simple operating margin CO<sub>2</sub> emission factor in year  $y$  (t CO<sub>2</sub>/MWh);
- $FC_{i,y}$  = Amount of fuel type  $i$  consumed in the proposed project electricity system in year  $y$  (mass or volume unit);
- $NCV_{i,y}$  = Net calorific value (energy content) of fuel type  $i$  in year  $y$  (GJ/mass or volume unit);
- $EF_{CO_2,i,y}$  = CO<sub>2</sub> emission factor of fuel type  $i$  in year  $y$  (tCO<sub>2</sub>/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 proposed project electricity system in year  $y$ ;
- $y$  = The relevant year as per the data vintage chosen in Step 3.

Based on the data available, the three-year average operating margin emission factor is calculated as a full-generation-weighted average of the emission factors. Details of the calculations and data follow the published data from the Chinese DNA<sup>8</sup>, which uses official national statistics.

<sup>8</sup> <http://qhs.mee.gov.cn/kzwsqtpf/201812/P020181220579925103092.pdf>

$$EF_{grid, OMsimple, y} = 0.9419 \text{ tCO}_2/\text{MWh}$$

#### 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:

- (a) **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.
- (b) **Option 2:** for the first crediting period, the build margin emission factor shall be updated annually, *ex post*, including those units built up to the year of registration of the proposed 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.

For the proposed project, option 1 is chosen to calculate Build Margin emission factor ( $EF_{grid, BM, y}$ ).

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

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

- (c) From  $SET_{5\text{-units}}$  and  $SET_{\geq 20\%}$  select the set of power units that comprises the larger annual electricity generation ( $SET_{\text{sample}}$ );

Otherwise:

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

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

Otherwise:

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

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

The Build Margin Emission Factor ( $EF_{\text{grid, BM, } y}$ ) is calculated as follows:

$$EF_{\text{grid, BM, } y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad (5)$$

Where:

- $EF_{\text{grid, BM, } y}$  = Build margin CO<sub>2</sub> emission factor in year  $y$  (tCO<sub>2</sub>/MWh);
- $EG_{m,y}$  = Net quantity of electricity generated and delivered to the grid by power unit  $m$  in year  $y$  (MWh);

|               |   |                                                                                    |
|---------------|---|------------------------------------------------------------------------------------|
| $EF_{EL,m,y}$ | = | CO <sub>2</sub> emission factor of power unit m in year y (tCO <sub>2</sub> /MWh); |
| $m$           | = | Power units included in the build margin;                                          |
| $y$           | = | Most recent historical year for which electricity generation data is available.    |

Due to data's unavailability, the BM calculation follows the guidance provided by CDM EB in the deviation. First, calculate the newly installed capacity and its power generation technology mix, then the weights of different power technologies in the newly installed capacity, finally the BM emission factor base on the emission factors of different types of most advanced commercial generation technologies.<sup>9</sup>

Because the generating capacity of the coal-fired, oil-fired and gas-fired power plants cannot be separated from the existing statistical data, the BM calculation adopts the following method: First, use the available data in the energy balance tables on the most recent year to calculate the proportion of CO<sub>2</sub> emissions from solid, liquid and gaseous fuels corresponding to the total emissions of CO<sub>2</sub> emissions. Second, calculate the emission factor of the fossil fuel fired power generation in each grid using the above proportions as the weights and the emission factors of the most advanced commercial generation technologies as the reference. Finally, the BM emission factor is multiplied by the proportion of fossil fuel fired power generation and the proportion of fossil fuel fired power plants in the newly added 20% capacity. Concrete steps and the formula for BM are as follows:

**Sub-step 5a: Calculating the share of CO<sub>2</sub> emissions of different fuel-fired power plants in the total CO<sub>2</sub> emissions**

$$\lambda_{Coal,y} = \frac{\sum_{i \in COAL,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (6)$$

$$\lambda_{Oil,y} = \frac{\sum_{i \in OIL,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (7)$$

<sup>9</sup><http://www.mee.gov.cn/ywgz/ycqhbh/wsqtzk/>

$$\lambda_{Gas,y} = \frac{\sum_{i \in GAS,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (8)$$

Where:

- $F_{i,j,y}$  = The amount of fuel  $i$  (in a mass or volume unit) consumed by project  $j$  in year  $y$ ;
- $NCV_{i,j}$  = Net calorific value (energy content) of fossil fuel type  $i$  consumed by province  $j$  (GJ/mass or volume unit)
- $EF_{CO_2,i,j,y}$  = CO<sub>2</sub> emission coefficient of fossil fuel type  $i$  (tCO<sub>2</sub>/mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant provincial sub-grids  $j$  and the percent oxidation of fuel in year  $y$ ;

COAL, OIL, and GAS refers to all forms of coal, oil and gas.

#### Sub-step 5b: Calculating the Emission Factor of fuel-fired power technology

$$EF_{Thermal,y} = \lambda_{Coal,y} \times EF_{Coal,Adv,y} + \lambda_{Oil,y} \times EF_{Oil,Adv,y} + \lambda_{Gas,y} \times EF_{Gas,Adv,y} \quad (9)$$

Where:

$EF_{Coal,Adv,y}$ ,  $EF_{Oil,Adv,y}$  and  $EF_{Gas,Adv,y}$  are emission factor proxies of efficiency level of the best coal-fired, oil based and gas-based power generation technology commercially available in China.

#### Sub-step 5c: Calculating the $EF_{grid, BM, y}$

$$EF_{grid, BM, y} = \frac{CAP_{Thermal,y}}{CAP_{Total,y}} \times EF_{Thermal,y} \quad (10)$$

Where:

$CAP_{Total,y}$  = the newly increment of total installed capacity;

$CAP_{Thermal,y}$  = the newly increment of fuel-fired installed capacity.

Details of the calculations and data follow the published data from the Chinese DNA<sup>10</sup>, which uses official national statistics.

$$EF_{grid,BM,y} = 0.4819 \text{ tCO}_2/\text{MWh}$$

The  $EF_{grid,OM,y}$  and  $EF_{grid,BM,y}$  of the first crediting period of the proposed project is calculated ex-ante and will not change during the first crediting period, but will be updated once the first crediting period is over.

#### STEP 5. Calculate the combined margin emission factor

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

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \quad (11)$$

Where

- $EF_{grid,OM,y}$  = Operating margin CO<sub>2</sub> emission factor in year y (t CO<sub>2</sub>/MWh)
- $EF_{grid,BM,y}$  = Build margin CO<sub>2</sub> emission factor in year y (t CO<sub>2</sub>/MWh)

According to 'Tool to calculate the emission factor for an electricity system', the weights of OM and BM for hydropower projects are as follows:

$$w_{OM} = 0.5, w_{BM} = 0.5$$

Therefore, the combined baseline emission factor is:

$$EF_{EG,GR,y} = EF_{grid,CM,y} = 0.9419 \times 0.5 + 0.4819 \times 0.5 = 0.7119 \text{ tCO}_2/\text{MWh}$$

<sup>10</sup> <http://www.mee.gov.cn/ywgz/ymqhbh/wsqtzk/>