CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Annexes

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

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Boxing Biogas Recovery and Utilization Project in Shandong Province
Version 7.3
22/12/2011

A.2. Description of the small-scale project activity:

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The Boxing Biogas Recovery and Utilization Project in Shandong Province (hereafter referred to as the Project) is developed by Boxing Yuantong Bio-energy Co., Ltd. The Project is a wastewater methane recovery project implemented in the existing wastewater treatment facility in the Boxing County, Binzhou City, Shandong Province, China.

The biogas is generated from the wastewater of Shandong Xiangchi Group, a company mainly engaged in maize and soybean deep processing. The wastewater generated in the production of starch is treated by a combination of anaerobic and aerobic processes in an integrated plant. Four anaerobic UASB reactors are installed to ferment the waste water and biogas (65% methane volume fraction of the gas) is generated from the UASB and vented to the air without any recovery. It is also the baseline scenario.

The purpose of the Project is to capture the methane generated on the existing anaerobic wastewater treatment facility and utilize the captured methane for thermal generation. The captured biogas (about 21,600Nm^3/d) will be purified by compression, desulfurization and decarburization, and upgraded methane compression system and14,040Nm^3/d upgraded biogas with at least 90% [1]methane concentration fraction will be produced. The upgraded biogas will be injected into civil natural gas distribution grid through pipeline and/or sold to local natural gas company after bottling.

The Project will reduce greenhouse gas (GHG) emission by recovering and utilizing the methane from the wastewater treatment that otherwise would be vented to the atmosphere; on the other hand, the project can achieve GHG emission reduction by displacing fossil natural gas in the natural gas distribution grid and bottled fossil natural gas. The Project is expected to reduce GHG emissions of 54,875tCO_2 per year.

The Project is contributing to sustainable development of the Host Country by the following aspects:

- Reducing GHG by recovery and utilization the biogas resources.
- Providing high quality bio-energy for local resident, alleviating the dependence to the fossil-fuel and increasing diversity of the energy.
- Improving the air condition by reducing toxic gas in the biogas.
- Providing 12 employment opportunities.

A.3. Project participants:

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The parties involved in the project are shown in Table A.1:

[1] The upgraded gas concentration standard in the technical agreement of PSA.

Table A.1 Project participants

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
China (host)	Boxing Yuantong Bio-energy Co.,Ltd. (project owner)	No
Sweden	Swedish CDM and JI Programme International Climate Policy Section Swedish Energy Agency	No

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

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A.4.1.1. Host Party(ies):

>> China

A.4.1.2. Region/State/Province etc.:

>>Shandong Province

A.4.1.3. City/Town/Community etc:

>>Binzhou City

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :

>>The Project is located in the site of Shandong Xiangchi Group in Boxing County, Binzhou city, Shandong Province, China. The exact location of the Project is 117.9919°E and 37.4208°N. The location of the Project is shown as Figure A.1.

The location of Shandong Province in China

The location of Binzhou City in Shandong Province

Figure A.1 The location of the Project

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

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Type and category:

According to Appendix B of the "Simplified modalities and procedures for small-scale clean development mechanism project activity, the category of this project activity is:
Type III-Other Project Activity
Category III.H.-Methane Recovery in Wastewater Treatment

Technology:

The Project will introduce methane recovery facilities to the existing anaerobic wastewater treatment system, in which biogas would be discharged into the atmosphere directly without recovery in absence of the Project.

The scenario existing prior to the project activity

About 5,000 m^3/d waste water from the maize and soybean deep process is treated in an UASB anaerobic system, in which the COD of the waste water decreased from 15,000mg/L to 1,050mg/L, and the removal efficiency is approximately 93%.[2]. In the absence of the project, all of biogas would be vented to the atmosphere directly.
This is also the baseline scenario.
The flow chart of the existing scenario (baseline scenario) is shown in the following figure:

[2] The data are from ten-day measurement campaign report.

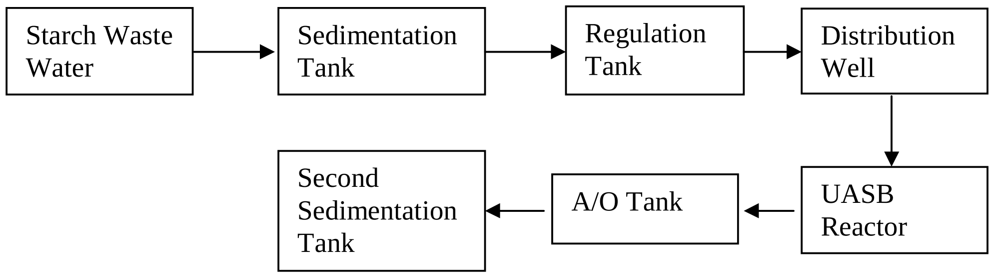

Fig.A.2 The flow chart of the existing scenario (baseline scenario)

The project activity

The Project recovers the biogas generated from existing anaerobic reactor as the source biogas to produce natural gas. The purification process includes Biogas Compression, Desulfurization, Decarburization, and Upgraded Methane Dehydration and Compression.

Decarburization is the main processing in the purification of the gas. The Project employs the Pressure Swing Adsorption (PSA) technology to separate CO_2 from biogas under pressure according to the species' molecular characteristics and affinity for an adsorbent material.

4,633,200Nm^3/year upgraded biogas with at least 90% methane concentration fraction will be produced. The upgraded biogas will be injected into civil natural gas distribution grid through pipeline and/or sold to a local natural gas station after bottling. The quality of the upgraded biogas accords with the national standard of <Natural Gas Standard of People's Republic of China> GB17820-1999. The local natural gas distribution grid is covered the whole Boxing County, and serve for the residents in Boxing County. The construction of the gas pipeline from the existing distribution grid to the plant site will be taken by both of the natural gas company, Shanghe Jutongcheng Natural Gas Engineering Co., Ltd. and the project owner, Boxing Yuantong Bio-energy Co., Ltd. The construction work is expected to finish in the second half of year 2014[3]. Before the natural gas distribution grid put into operation, all the upgraded biogas generated will be bottled and sold.

The Project will reduce greenhouse gas (GHG) emission by partially recovering and utilizing the methane from the wastewater treatment that otherwise would be vented to the atmosphere, and by displacing natural gas in the natural gas distribution grid after the natural gas distribution grid put into operation. The Project is expected to reduce emissions of GHG by an estimated 56,819tCO_2 per year.

The Chart below provides summarises the Project technical process.

[3] Confirmed by the natural gas grid company, Shanghe Jutongcheng Natural Gas Engineering Co.

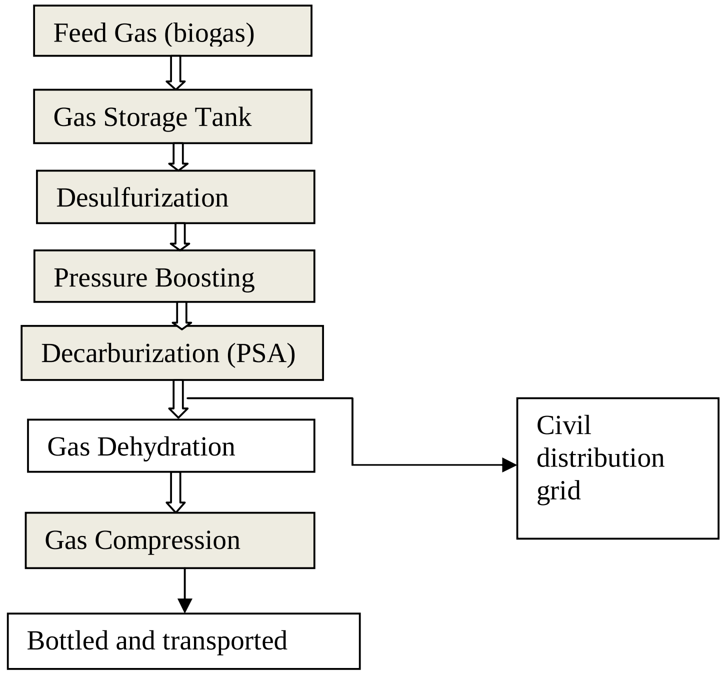

Figure A.3 the process chart of the Project

The expected characteristics of the biogas generation facilities and related wastewater treatment process are shown in table A.2. The main equipments are shown in Table A.3

Table A.2 Main technical parameters of the project[4]

Item	Unit	Value
Annual utilization days	d/yr	330
Biogas recovery capacity	kNm^3/d	21,600
Upgraded biogas production capacity	kNm^3/d	14,040
Lifespan	yr	10
Energy consumption	MWh/yr	2230

Table A.3 Parameters of the Main equipments

Item	Equipment	number	Parameter
1	Desulfurization tower[5]	1	The serial number of the product: SC2008-43;
			Designed temperature:50℃
			Volume:$13.65m^3$
			Designed Press:0.1MPa
			Wet desulfurization process efficiency:95%~98%[6]
			Dry desulfurization process efficiency:95%~97%[7]

[4] From the FSR
[5] The parameters come from the nameplate written explanation from the equipment manufacture.
[6] Base on the statement about the efficiency and lifetime of equipment
[7] Base on the statement about the efficiency and lifetime of equipment

			Lifetime:10 years[8]
2	Biogas compressor[9] (Alternative)	2	Type: 3LW-6.7/7
			Exhaust pressure:0.7Mpa
			Inlet gas pressure: normal pressure
			Inlet gas temperature: normal temperature
			Exhaust temperature:≤40℃
			Exhaust quantity:400Nm^3/h
			Leakage coefficient: ≤500mL/s
			Lifetime:10 years
3	Biogas compressor[10]	1	Type: VW-15/7
			Exhaust pressure:0.7Mpa
			Inlet gas pressure: normal pressure
			Inlet gas temperature: ≤40℃
			Exhaust temperature:≤50℃
			Design gas quantity:15m^3/min
			Leakage coefficient: ≤0.04%
			Lifetime:10 years
4	Decarbonisation system[11]	1	Flow of feed gas:24000Nm^3/d
			Pressure of feed gas: normal pressure
			Flow of upgraded gas:600 Nm^3/h
			Pressure of upgraded gas:0.5Mpa
			Concentration in Upgraded Biogas：CH_4≥90%;CO_2≤3.0%.
			Efficiency: ≥90%
			Lifetime:10 years
5	Natural gas compressor[12]	1	Type: L-1.6/6-250
			Exhaust pressure: 25Mpa
			Inlet pressure:0.6MPa
			Rotate speed:590r/min
			Supply squatum:610Nm^3/h
			Leakage coefficient: ≤0.35Nm^3/h
			Lifetime:10 years
6	Natural gas compressor[13] (Alternative)	1	Type: LF-0.9/6-250
			Exhaust pressure: 25Mpa
			Inlet pressure:0.6MPa
			Rotate speed:740r/min
			Supply squatum:350Nm^3/h
			Leakage coefficient: ≤0.35Nm^3/h
			Lifetime:10 years

[8] Base on the statement about the efficiency and lifetime of equipment
[9] The parameters of Feed gas compressor are from the <Technical Agreement of Biogas Gas Compressor>
[10] The parameters of Feed gas compressor are from the <Technical Agreement of Biogas Gas Compressor>
[11]The parameters of Decarbonisation system are from the <Technical Agreement of Biogas Decarburization Equipment>
[12] The parameters of Natural gas compressor are from the <Technical Agreement of Natural Gas Compressor>
[13] The parameters of Natural gas compressor are from the <Technical Agreement of Natural Gas Compressor>

All the equipments employed are domestically manufactured and therefore does not involve the transfer of technology from an Annex I country.

Monitoring

The parameters which should be monitored includes the volume of wastewater treated in the treatment system, the COD of untreated wastewater and treated wastewater, the quantity of biogas captured and utilized and the concentration of the biogas captured and utilized. One flow meter installed in-line of the influent pipe to the UASB of the wastewater treatment system. Weekly sampling of the influent into the UASB and outfluent from the UASB will be conducted in the lab. Continuous gas flow meters installed on-site to weekly record the biogas captured and utilized. One is installed at the biogas recover site; one is installed at the inlet of the injection into natural gas; one is installed at the inlet of the injection into bottles.
Beside, an (emergency) flare will be installed to ensure that the captured biogas is flared at the site of its capture during the periods when the biogas upgrading facility is closed due to scheduled maintenance or repair of equipment or during exigencies.

More information can be referred to B7.2.

Training
When all of the employees reported for duty at the company, they were trained about the basic knowledge about the project and the company for a week.
Then, the employees of the project were trained by equipment supplier about the operation of the project and maintenance of the equipment for four weeks.
After that, the employees will be trained by the experienced staff about the practical operation for two weeks.
When the training above finished, all of the staff practised on post for a month.

Project implementation:

Table A.4 Timeline of the Project implementation[14]

Time	Events
09/2008	FSR which revenue of CER has been accounted in the revenue to improve the financial situation of the Project.
06/10/2008	The EIA was finished by Binzhou City Environmental Protection Science Research Institute.
14/10/2008	EIA was approved by the Boxing County Environmental Protection Bureau.
09/10/2008	FSR was approved by Boxing City Development and Reform Committee.
31/10/2008	Construction contract was signed.
03/11/2008	The construction was started.
05/11/2008	Main equipment contract has been signed.
06/2010	The Project put into operation (except the process of injection to the local natural gas grid, that is, all the upgraded biogas is bottled in the initial several years).
10/2014	The gas pipeline from the natural gas distribution grid to the

[14] All of the documents have sent to DOE for validation

	project site put into operation

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

It is expected that the project activities will generate emission reduction for about 54,875tCO_2e per year over a 10-year fixed crediting period from 01/10/2011-30/09/2021. The estimation of the emission reductions in the crediting period is presented in Table A.5

Table A.5 The estimation of the emission reductions in crediting period

Year	Annual estimation of emission reductions in tonnes of CO_2e
01/10/2011-30/09/2012	50,340
01/10/2012-30/09/2013	50,340
01/10/2013-30/09/2014	50,340
01/10/2014-30/09/2015	56,819
01/10/2015-30/09/2016	56,819
01/10/2016-30/09/2017	56,819
01/10/2017-30/09/2018	56,819
01/10/2018-30/09/2019	56,819
01/10/2019-30/09/2020	56,819
01/10/2020-30/09//2021	56,819
Total estimated reductions (tons of CO_2e)	548,753
Total number	10
Annual average over the crediting period of estimated reductions (tons of CO_2e)	54,875

A.4.4. Public funding of the small-scale project activity:

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There is no public funding from Annex I countries available to the proposed project.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

According to *"the Simplified Modalities and Procedures for Small-scale CDM Project Activities, Attachment C*[15]*"*, the project participants confirm that no project with same type and technology, whose boundary is within 1 kilometer of the proposed small-scale activity at the closest point, has been registered or is applying to register CDM project by same project owner. So the Project is not a debundled component of a larger project activity.

[15] http://cdm.unfccc.int/Projects/pac/howto/SmallScalePA/sscdebund.pdf

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the small-scale project activity:

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AMS.III.H (version 15)-"Methane Recovery in Wastewater Treatment".
For more information, please refer to:
http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html

AMS.III.H (version 15) also refers to the following tools:

"Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (ver.1)
For more information, please refer to:
http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v1.pdf/history_view

Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (ver.2)
For more information, please refer to:
http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v2.pdf/history_view

"Tool to calculate the emission factor for an electricity system" (ver.02.1.0)
For more information, please refer to:
http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.1.0.pdf

B.2 Justification of the choice of the project category:

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The Project meets all the relevant applicability conditions of the AMS-III.H. as following Table:

Table B.1 Application condition of methodology

No.	Application condition	Project activity
1	This methodology comprises measures that recover biogas from biogenic organic matter in waste waters by several options, including: (d)Introduction of biogas recovery and combustion to an anaerobic wastewater treatment system such as anaerobic reactor, lagoon, septic tank or an on site industrial plant.	The project will introduce a biogas recovery system to an existing anaerobic reactor wastewater treatment system (UASB), which accords to (d) of 1st paragraph in the methodology.
2	In cases where baseline system is anaerobic lagoon the methodology is applicable if it fulfils the conditions indicated in 2nd para. of AMS-III.H (ver.15)	The baseline system of the Project is anaerobic reactor but not the anaerobic lagoon. Therefore, this condition is not applicable for the Project.
3	The recovered biogas from the above measures may also be utilised for the following applications instead of combustion/flaring: (a) Thermal or electrical energy generation directly; or (b) Thermal or electrical energy generation after bottling of upgraded biogas; or	The recovered biogas of the Project will be utilized for thermal energy by two ways: Sold to natural gas company after bottling of upgraded biogas and injection of biogas into the natural gas distribution grid of Boxing City which is a grid with

	(c) Thermal or electrical energy generation after upgrading and distribution: (i) Upgrading and injection of biogas into a natural gas distribution grid with no significant transmission constraint; or (ii) Upgrading and transportation of biogas via a dedicated piped network to a group of end users; or (d) Hydrogen production.	no significant transmission constraint. However, before the gas pipeline from the project site to the existing natural gas distribution grid of Boxing City put into operation, all the upgraded biogas would be bottled. Therefore, the project activity covers (b) and (ci).
4	If the recovered biogas is used for project activities covered under paragraph 3 (a), that component of the project activity can use a corresponding methodology under Type I.	N/A
5	If the recovered biogas is utilized for the production of hydrogen (project activities covered under paragraph 3 (d)), that component of the project activity shall use corresponding methodology AMS-III.O.	N/A
6	For project activity covered under paragraph 3(b) if bottles with upgraded biogas are sold outside the project boundary the end-use of the biogas shall be ensured via a contract between the bottled biogas vendor and the end-user. No emission reductions may be claimed from the displacement of fuels from the end use of bottled biogas in such situation. If however the end use of the bottled biogas is included in the project boundary and is monitored during the crediting period CO_2 emissions avoided by the displacement of fossil fuel can be claimed under the corresponding Type I methodology, e.g. AMS-I.C.	For the biogas used for thermal after bottling, each end user will be ensured via contracts between bottled biogas vendor and end-user. At present, all the upgraded bottled is sold to Shandong Dongxu Heat Energy Science & Technology Development Co., Ltd. and then sold to Shandong Jiacheng Steel Co., Ltd. the only end user. And the clauses that no emission reduction may be claimed by from the displacement of fuels from the end use of bottled biogas are specified in two contracts[16].
7	For project activities covered under paragraph 3(c)(i), emission reductions from the displacement of the use of natural gas are eligible under this methodology, provided the geographical extent of the natural gas distribution grid is within the host country boundaries.	The geographical extent of the natural gas is Boxing County, within the host country boundary, so the emission reduction from the displacement of the use of natural gas is eligible under this methodology.
8	For project activities covered under paragraph 3 (c) (ii), emission reductions for the displacement of the use of fuels can be claimed following the provision in the corresponding Type I methodology, e.g. AMS-I.C.	N/A
9	For project activities covered under paragraph 3 (b) and (c), this methodology is applicable if upgrade is done by one of following technologies such that the methane content of the upgraded biogas is in	The Project will use Pressure Swing Absorption (short for PSA) technology to upgrade the biogas. The quality of the upgraded biogas will be in accordance

[16] The two contracts have been submitted to DOE

	accordance with national regulations (where these exist) or, in the absence of national regulations, a minimum of 96% (by volume). These conditions are necessary to ensure that the recovered biogas is completely destroyed through combustion in an end use. • Pressure Swing Adsorption; • Absorption with/without water circulation; • Absorption with water, with or without water recirculation (with or without recovery of methane emissions from discharge)	with national regulations, the II type of GB17820-1999[17].
10	New facilities (Greenfield projects) and project activities involving a change of equipment resulting in a capacity addition of the wastewater or sludge treatment system compared to designed capacity of the baseline treatment system are only eligible to apply this methodology if they comply with the requirements in the General Guidance for SSC methodologies concerning these topics. In addition the requirements for demonstration of the remaining lifetime of the equipment replaced as described in the general guidance shall be followed.	The project is implemented on an existing wastewater system and doesn't involve a change of equipment resulting in a capacity addition of the wastewater or sludge treatment system. Therefore, this term is not applicable for the project.
11	For project activities covered under paragraph 2(b) and (c) additional guidance provided in annex 1 shall be followed for the calculations in addition to the procedures in the relevant sections below.	For the project activity covered under 2(b) and (c), annex 1 will be followed for calculation. Before the gas pipeline from the project site to the existing natural gas distribution grid put into operation, all the upgraded biogas would be bottled. The emission reduction due to the upgraded biogas injected into local natural gas distribution grid is calculated as 0.
12	The location of the wastewater treatment plant shall be uniquely defined as well as the source generating the wastewater and described in the PDD.	The Project will be located in the site of Shandong Xiangchi Group in Boxing County, Binzhou city, Shandong Province, China. The exact location of the Project is 117.9919°E and 37.4208°N and the UASB reactors is located at around 10m away from the project in the south. Hence, the location of the

[17] According to the parameters listed in the Type II of GB17820-1999, the higher calorific value of the natural gas is required to be higher than 31.4MJ/m^3. The upgraded biogas's NCV can be determined by the methane content multiplying the NCV of methane. According to the FSR, the concentration of the upgraded biogas is 90%, hence, the NCV of the biogas can be calculated conservatively as 90%*35.9MJ/m^3 (NCV of CH_4). The result is 32.31 MJ/m^3 which is higher than the requirement listed in the regulation. Therefore the calorific value of the upgraded biogas is consistent with the national regulation. According to page 22 of FSR, the concentration of H_2S will be lower than 20mg/m^3, which is also consistent with the regulation. The regulation has been submitted to DOE.

		wastewater treatment plant and the source generating the wastewater is uniquely defined and described in PDD.
13	Measures are limited to those that result in aggregate emission reductions of less than or equal to 60kt CO_2 equivalent annually from all type III components of the project activity.	The expected emission of the Project is 54,875tCO_2, which is less than 60kt CO_2.

B.3. Description of the project boundary:

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According to AMS-III.H, the project boundary is the physical, geographical site where the wastewater treatment takes place in baseline and project situation. It covers all facilities affected by the project activity including sites where the processing, transportation and application or disposal of waste products as well as biogas takes place.

For the project, the wastewater treatment system including UASB will be operated with the same qty. of feed in flow, volume (retention time), and temperature as in the baseline scenario, so the waste water treatment can be considered as not affected.

For the Project, the project boundary includes the following aspects:

1. The site where wastewater treatment takes place.
2. The biogas upgrading process and relevant facilities and devices.
3. As the Project involves upgraded biogas injection to natural gas distribution grid after the gas pipeline from the project site to the existing natural gas distribution grid put into operation, the natural gas distribution grid for distribution of biogas to the end user sites and all the relevant facilities and devices are included into project boundary.
4. As the Project involves bottling of biogas, the upgrade and compression installation involved in bottling are included into the project boundary.

The emission sources and corresponding gases included in the boundary are shown in the following table:

Table B.2 Emission sources included in the Project boundary

	Source	Gas		Justification/Explanation
Baseline	Electricity or fossil fuel used	CO_2	Excluded	For the project only involves biogas recovery and the wastewater treatment system will not be affected by the project activity, the electricity consumed by the wastewater treatment system, including the UASB reactors, keeps the same before and after the Project. Therefore, this part of emission isn't considered.
		N_2O	Excluded	Excluded for simplification. This is conservative.
		CH_4	Excluded	Excluded for simplification. This is conservative.
	Wastewater treatment system	CH_4	Included	The major source of emissions in the baseline.
		N_2O	Excluded	Excluded for simplification. This is conservative.
		CO_2	Excluded	Excluded for simplification. This is

				conservative.
	Sludge treatment system	CH_4	Excluded	For the project doesn't involve sludge treatment, this part of emission isn't considered.
		N_2O	Excluded	Excluded for simplification. This is conservative.
		CO_2	Excluded	Excluded for simplification. This is conservative.
	Degradable organic carbon in treated wastewater discharged into sea/river/lake	CH_4	Excluded	For the project only involves biogas recovery and the wastewater treatment system will not be affected by the project activity, the methane emissions from degradable organic carbon in treated wastewater discharged keeps the same before and after the Project. Therefore, this part of emission isn't considered.
		N_2O	Excluded	Excluded for simplification. This is conservative.
		CO_2	Excluded	Excluded for simplification. This is conservative.
	Anaerobic decay of the final sludge	CH_4	Excluded	For the project doesn't involve sludge treatment, this part of emission isn't considered.
		N_2O	Excluded	Excluded for simplification. This is conservative.
		CO_2	Excluded	Excluded for simplification. This is conservative.
	Upgraded biogas injection which replace the fossil-fuel sourced natural gas	CO_2	Included	May be an important emission source after the gas pipeline from the project site to the existing natural gas distribution grid put into operation.
		N_2O	Excluded	Excluded for simplification. This is conservative.
		CH_4	Excluded	Excluded for simplification. This is conservative.
Project activity	Electricity or fossil fuel used	CO_2	Included	May be an important emission source due to the electricity and fossil fuel used by the biogas recovery and upgrading system
		N_2O	Excluded	Excluded for simplification. This is conservative.
		CH_4	Excluded	Excluded for simplification. This is conservative.
	Wastewater treatment system affected by the	CH_4	Excluded	The project doesn't affect the wastewater treatment system, therefore this part of emission isn't

	project activity, and not equipment with biogas recovery in the project situation			considered.
		N_2O	Excluded	Excluded for simplification. This is conservative.
		CO_2	Excluded	Excluded for simplification. This is conservative.
	Sludge treatment system affected by the project activity, and not equipment with biogas recovery in the project situation	CH_4	Excluded	The Project doesn't involve sludge treatment, therefore, this part of emission isn't considered.
		N_2O	Excluded	Excluded for simplification. This is conservative.
		CO_2	Excluded	Excluded for simplification. This is conservative.
	Degradable organic carbon in treated wastewater discharged into sea/river/lake	CH_4	Excluded	The project doesn't affect the wastewater treatment system, therefore this part of emission isn't considered.
		N_2O	Excluded	Excluded for simplification. This is conservative.
		CO_2	Excluded	Excluded for simplification. This is conservative.
	Fugitive emissions on account of inefficiencies in capture systems	CH_4	Included	May be an important emission source.
		N_2O	Excluded	Excluded for simplification. This is conservative.
		CO_2	Excluded	Excluded for simplification. This is conservative.
	Incomplete flaring	CH_4	Excluded	The project doesn't involve flaring, therefore, this part of emission isn't considered.
		N_2O	Excluded	Excluded for simplification. This is conservative.
		CO_2	Excluded	Excluded for simplification. This is conservative.
	Biomass stored under anaerobic conditions	CH_4	Excluded	This part is not affected by the project activity, therefore, this part of emission isn't considered.
		N_2O	Excluded	Excluded for simplification. This is conservative.
		CO_2	Excluded	Excluded for simplification. This is conservative.
	Upgrading and compression of the biogas	CH_4	Included	May be an important emission source.
		N_2O	Excluded	Excluded for simplification. This is conservative.
		CO_2	Excluded	Excluded for simplification. This is conservative.

The Project boundary is shown as Figure B.1:

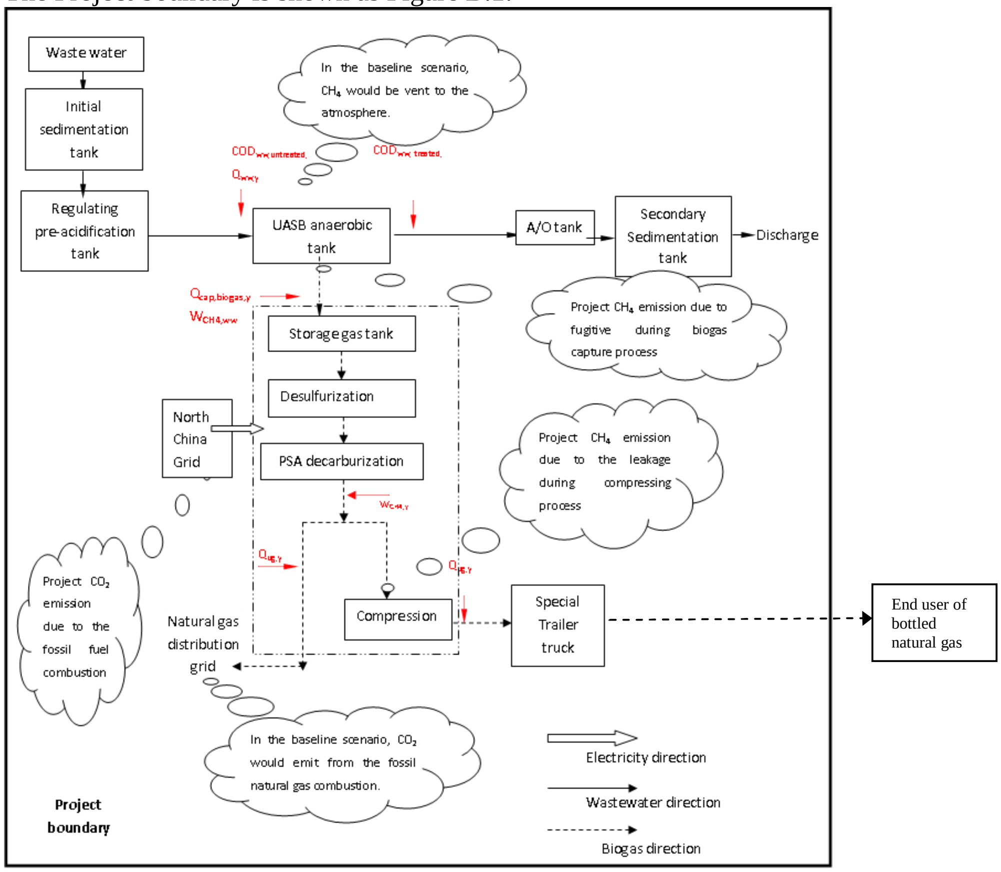

Fig B.1 the boundary of the Project

B.4. Description of baseline and its development:

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The paragraph 17 of AMS-III.H and paragraph 2 of its annex clearly delineate the baseline emissions, which indicate the baseline of the Project is to continue current wastewater treatment and fossil natural gas consumption, that is, the waste water from the maize and soybean deep process is treated in an UASB anaerobic system, and the generated biogas is vented to the atmosphere directly; the fossil natural gas in the local natural gas distribution grid will be used in the absence of the project activity.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

Additionality of the Project is demonstrated based on the requirement of Attachment A to Appendix B: the *Simplified Modalities and Procedures for Small-scale CDM Project Activities*. Four alternative options are provided in Attachment A: investment barrier, technology barrier, barrier due to prevailing practice and other barriers. The Project adopts investment barrier analysis.

Investment barriers analysis:
Determine appropriate analysis method

According to the "Tool for the demonstration and assessment of additionality (version 05.2)", three

options can be applied to conduct the investment analysis. These are the simple cost analysis (Option I), the investment comparison analysis (Option II) and the benchmark analysis (Option III).
In this case, since upgraded biogas will be sold which generate revenue, Option I (Simple Cost Analysis) is not applicable. Option II (Investment comparison analysis) is only applicable to projects whose alternatives are similar investment projects. The alternative baseline scenario of the project is the existing scenario rather than a new investment project. Therefore option II is not applicable. Therefore, the Option II is not applicable. Therefore, benchmark analysis is applied in the following investment analysis.

Option III-Apply benchmark analysis[18]

The financial attractiveness of this project will be determined by comparing the project IRR (without CERs revenues) with the benchmark rate applied in China's urban natural gas supplying industry. According to the 'Methodology and Parameters applying in Constructive Project Economic Analysis' issued by China Planning Publisher, the pre-tax Project IRR of urban natural gas supplying is 8%[19]. If the pre-tax Project IRR of the Project is less than 8%, the project is considered not be financially attractive in the absence of CDM revenues, and is therefore considered to be additional.

Calculation and comparison of financial indicators

(1) Basic parameters for calculation of financial indicators

All the input values for IRR calculation are sourced from FSR[20], and listed as follows:

Table B.3 Basic parameters for calculations of financial indicators

Main parameters	Unit	Data	Source
Quantity of upgraded biogas	Nm^3	4,633,200	Feasible Study Report[21] (FSR)
Price of the upgraded biogas injected into the grid (with VAT)	RMB/Nm^3	1.7	The note of Annex table 1 in FSR
Price of upgraded biogas bottled(with VAT)	RMB/Nm^3	1.82	The note of Annex table 1 in FSR
Total investment	10,000RMB	1,422	FSR
Fixed assets investment	10,000RMB	1,412	FSR
Fluid capital	10,000RMB	10	FSR
Equity	10,000RMB	1,412	FSR
Loan	10,000RMB	0	FSR
Construction period	months	6	FSR
Operational lifetime[22]	years	10	FSR
Operating cost	10,000RMB/a	651.53	FSR

[18] The investment analysis is based on "*Guidelines on the Assessment of Investment Analysis (version 05)*".

[19] The benchmark IRR is published officially, which is based on the parameters that are standard in the market and investigated by industry experts. So it is consistent with Para.13 of "*Guidelines on the Assessment of Investment Analysis*"

[20] The stage of FSR is the timing of investment decision, and all the input values are sourced from FSR, which is officially approved. So all the input values are valid and applicable. This is consistent with Para 6 of "*Guidelines on the Assessment of Investment Analysis*".

[21] The FSR is approved by Boxing Development and Reform Commission in 09/10/2008.

[22] The technical life time of the project and main equipments utilized is 10 years, so 10 years is adopted as crediting period, which is consistent with Para.3 of "*Guidelines on the Assessment of Investment Analysis*".

Education tax	%	4	FSR
Urban maintenance and construction tax	%	5	FSR
VAT	%	13	FSR
Income tax	%	25	FSR
Rate of depreciation residue[23]	%	5	FSR

(2) Comparison of the financial benchmark of Project IRR for the Project

In accordance with the benchmark analysis (Option III), if the financial indicators (such as Project IRR) of a project are lower than the benchmark, the project is not considered as financially attractive. Based on the data above, without CERs sales revenues, the Project IRR (pre-tax) is -10.71%[24], which is lower than the benchmark (8%). The Project is not financially attractive.

Sensitivity analysis

Only those 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, so following financial parameters were taken as uncertain factors for sensitive analysis of financial attractiveness:

- Fixed assets investment
- Annual O&M cost (98% of total cash outflow)
- Price of upgraded biogas (100% of total revenue)
- Quality of upgraded biogas (100% of total revenue)

The results of sensitive analysis of four indicators of the Project are shown in TableB.4 and FigureB.2.

Table B.4 Project IRR (pre tax) to different financial parameters of the Project (Without CERs sales revenues)

	the rate when reach the benchmark	-10%	0	+10%	the rate when reach the benchmark
Fixed assets investment	-63.00%	-9.06%	-10.71%	-	-
Annual O&M cost	-22.60%	-1.15%	-10.71%	-	-
price of upgraded biogas	-	-	-10.71%	-0.44%	20.70%

[23] The residue value is considered in the IRR calculation, which is reasonable and consistent with the Para.4 of "*Guidelines on the Assessment of Investment Analysis*".

[24] The project IRR calculation is consistent with Para. 5, 8, 12 of "*Guidelines on the Assessment of Investment Analysis*", the IRR calculated is pre-tax project IRR, which is the same type of benchmark, and the depreciation is not deemed as actual expense involved in cash outflow. Please refer to IRR calculation spreadsheet, which is presented in a transparent manner.

quantity of upgraded biogas		-	-10.71%	-0.44%	20.70%

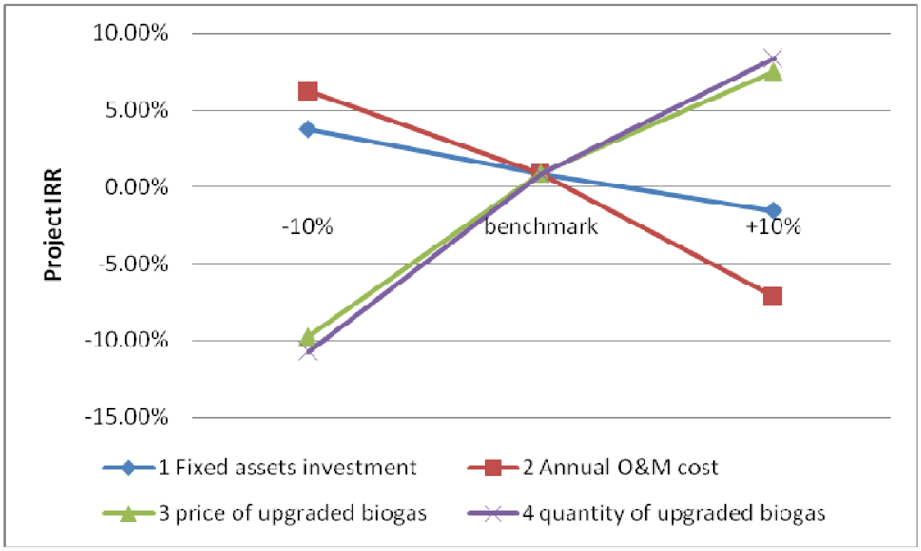

Figure B.2 Results of the sensitivity analysis for IRR

From the Table B.2 above, it can be seen that if the IRR reach to the benchmark, the total investment has to decrease by 63.0%, O&M cost has to decrease by 22.60%, price of upgraded biogas need to increase by 20.7%, and amount of upgraded biogas need to increase by 20.7%.

However, these conditions are impossible.
Investment costs: According to the relevant contracts, the main contracts already account for 99% of the total investment expected in FSR[25]. This shows that a decrease by 63.0% in investment costs is extremely unrealistic and that the IRR can't reach the benchmark.

Operating costs: The main component of operating cost is the raw biogas cost which constitutes 50% of the total operating cost. The actual amount of biogas captured is about 22000m^3 per day and the price of the raw biogas is 0.46 Yuan/Nm^3 according to <the contract of Biogas deodorization and comprehensive utilization project>. Therefore, the calculated raw biogas cost is as the same as the price indicted in FSR[26].

Another main component of operation cost is electricity consumption, which constitutes 23% of the total operating cost. The power consumption is assumed according to the operation time and power of equipments and the price is fixed in the contract[27].

As a result, a 20.7% of decrease in operating costs is very unlikely to happen.

[25] All of the contracts including equipments and construction contracts have been submitted to DOE for validation.
[26] The contract of Biogas deodorization and comprehensive utilization project
[27] Total power of the equipments is 282kw and the operation hours of the equipments are 330*24. Therefore, the electricity consumed is equal to 282*330*24=2233MWh.The electricity price in <the contract of Biogas deodorization and comprehensive utilization project> is 0.6776Yuan.

Revenue: For the Project, the revenue is influenced by the price of the upgraded biogas and the amount of upgraded biogas. According to the ten-day measurement, the biogas generated is 4.39 million Nm^3 [28]which is less than the data of upgraded biogas (4.63 million Nm^3) in FSR. Hence, the amount of upgraded biogas used to calculate IRR is very conservative. Therefore, any increase in the amount of biogas is impossibly reached.

For the price of the upgraded biogas, the price indicated in the FSR is a weighted average value calculated by 60% of upgraded gas injected into grid and 40% bottled. The price of upgraded gas injected into grid is 1.7 Yuan/Nm^3, and the price of gas bottled is 1.82 Yuan/Nm^3. At present, the natural gas distribution grid still hasn't been constructed yet and the upgraded biogas is all bottled for sale. According to the bottled biogas purchase contracts, the actual price of biogas bottled is 1.82 Yuan/Nm^3 for the whole project 10-years lifetime. Furthermore, even assuming all of the upgraded biogas bottled for conservative consideration, that is using 1.82Yuan/Nm^3 to calculated IRR, the IRR is -6.04%, which is still much lower than the benchmark.

For the upgraded biogas injected to grid, the Natural Gas Company has many stable sources of natural gas, while for the project, the quantity of natural gas supply is small and limited compare with other suppliers, so the project owner play an insignificant role in the price fixing. Moreover, the natural gas sales price for end user is determined by the government authority, and the natural gas sales price for end user will affect the price of gas supplied to the Gas Company, so the price of biogas supplied to Gas Company will be affected by the government.

For the upgraded biogas bottled, the price will also be affected by the market competition; therefore, the price cannot change greatly.

For 100% upgraded biogas bottled:
However, given that the gas pipeline from the project site to the existing natural gas distribution grid has not been constructed yet, and all the upgraded biogas is bottled, so the the IRR under this circumstance should be assessed.

Firstly, investment dedicate to the process of injection to natural gas grid should be deducted under this circumstance. Secondly, 1.82 RMB per m^3 of bottled natural gas is applied as unit price of upgraded biogas. The O&M cost will keep the same.

According to the FSR, the fixed assets investment includes equipments purchasing, construction, and installation. The construction investment dedicated to the process of injection to natural gas grid is 400,000 RMB. The installation investment dedicated to the grid is 800,000 RMB (the pipe and other necessary material are included). There is no main equipments purchased dedicated to the grid, because the upgraded biogas could be injected to the natural gas grid directly without compression like bottling process, and the cost of some meters dedicated to the grid is very small and could be neglected. Therefore, the investment cost need to be deducted is 1,200,000 RMB.

The IRR calculated under this circumstance is -4.49%, still much lower than benchmark.

We can conclude that the IRR is lower than the benchmark for a realistic range of assumptions for the input parameters of the sensitivity analysis, and therefore the Project is not financially/economically attractive. This demonstrates that the project activity would not be implemented without the CDM.

[28] More information please refer to the ER calculation sheet "baseline emission" cell C17.

Based on the Investment Analysis above, the Project is not financially attractive without consideration of CERs sales revenues.

If the Project can be successfully registered as a CDM project, considering of the CERs sales revenues, the IRR of the Project will reached to 36.64%, which is significantly improved to reach the benchmark.

Based on the analysis above, the Project is additional.

Consideration of CDM:

CDM revenue has been considered in the chapter of financial analysis of FSR. Without the revenue of CER, the IRR of the Project will be financially unattractive. The timeline of the Project is summarized in Table B.5.

Table B.5 Timeline of the Project[29]

Time	Events
09/2008	FSR, in which revenue of CER has been accounted in the revenue to improve the financial situation of the Project.
22/09/2008	The CDM decision was made by director board
09/10/2008	FSR was approved by Boxing City Development and Reform Committee.
31/10/2008	Construction contract was signed.
03/11/2008	The construction was started.
05/11/2008	Main equipment contract has been signed
04/12/2008	CDM consultant contract was signed.
20/03/2009	The notification of starting date inform has been submitted to NDRC
31/05/2009	EPPA was signed by buyer
06/2009	LOA of NDRC has been issued
06/2010	The Project put into operation (except the process of injection to the local natural gas grid, that is, all the upgraded biogas is bottled in the initial several years).
10/2014	The gas pipeline from the natural gas distribution grid to the project site put into operation

According to the glossary of CDM terms, the earliest date of a CDM project activity is the earliest date at which either the implementation or construction or real action of a project activity begins[30]. Therefore, based on the table above, the construction contract is the starting date of the project.

According to the "Guidance on the Demonstration and Assessment of Prior Consideration of the CDM (ver.01)"[31], for project activities with a starting date on or after 02 August 2008, the project participant must inform a Host Party DNA and/or the UNFCCC secretariat in writing of the commencement of the project activity and of their intention to seek CDM status.

For the Project, the project owner submitted such notification in 20 March 2009 which was approved by China DNA in 03April 2009[32].

[29] All of the documents have sent to DOE for validation

[30] http://cdm.unfccc.int/Reference/Guidclarif/glos_CDM_v04.pdf

[31] Annex 46 of 41st meeting of EB.

[32] This Notification has been submitted to the DOE.

Therefore, the project owner considered CDM early before the starting date of the Project and ensures the status of CDM actively.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

According to AMS-III.H, emission reductions shall be estimated ex ante in the PDD using the formulas provided in the baseline, project and leakage emissions sections in the methodology. Ex post emission reductions shall be determined by ex-post monitored.

I. Baseline Emission

The Project involves introducing biogas recovery system to an existing anaerobic wastewater treatment system. The recovered biogas will be bottled or injected into a natural gas distribution grid. Therefore, the baseline emission includes following two aspects:

(1) $BE_{avoidance,y}$:The baseline emission of methane avoidance that would be emitted to the atmosphere in absence of the Project which is estimated as per AMS III.H.

(2) $BE_{injection,y}$: The baseline emission on account of heat displacement which is estimated as Annex in AMS III.H.

Calculation of $BE_{avoidance,y}$:

$$BE_{avoidance,y}= BE_{power,y}+BE_{ww,treatment,y}+BE_{s,treatment,y}+BE_{ww,discharge,y}+BE_{s,final,y} \quad (1)$$

Where:

$BE_{avoidance,y}$	Baseline emissions of methane avoidance in year y (tCO_2e)
$BE_{power,y}$	Baseline emissions from electricity or fuel consumption in year y (tCO2e)
$BE_{ww,treatment,y}$	Baseline emissions of the wastewater treatment systems affected by the project activity in year y (tCO_2e) This parameter is calculated as per formula(3)
$BE_{s,treatment,y}$	Baseline emissions of the sludge treatment systems affected by the project activity in year y (tCO_2e)
$BE_{ww,discharge,y}$	Baseline methane emissions from degradable organic carbon in treated wastewater discharged into sea/river/lake in year y (tCO_2e).
$BE_{s,final,y}$	Baseline methane emissions from anaerobic decay of the final sludge produced in year y (tCO_2e). If the sludge is controlled combusted, disposed in a landfill with biogas recovery, or used for soil application in the baseline scenario, this term shall be neglected.

The sludge treatment will not be affected by the project activity, and will keep the same before and after the project implementation. So the process of sludge treatment is excluded in the project boundary and $BE_{s,treatment,y}$ and $BE_{s,final,y}$ will not to be considered.

For the project only involves biogas recovery and the wastewater treatment system will not be affected by the project activity, the electricity consumed and methane emissions from degradable organic carbon in treated wastewater discharged keep the same before and after the Project. Therefore, $BE_{power,y}$ and $BE_{ww,discharge,y}$ will not to be considered.

Therefore, in this project, the formula (1) for baseline emission can be simplified into formula (2)

$$BE_{generate,y}= BE_{ww,treatment,y} \quad (2)$$

$$BE_{ww,treatment,y}=\sum_i Q_{ww,i,y}*COD_{removed,i,y}*MCF_{ww,treatment,BL,i}*B_{o,ww}*UF_{BL}*GWP_{CH4} \quad (3)$$

Where:

$Q_{ww,i,y}$	Volume of wastewater treated in baseline wastewater treatment system *i* in year *y* (m^3)
$COD_{removed,i,y}$	Chemical oxygen demand removed by baseline treatment system *i* in year *y*(tonnes/m3), measured as the difference between inflow COD and the outflow COD in system *i* In determining $Q_{ww,i,y}$ and $COD_{removed,i,y}$, historical records of at least one year prior to the project implementation shall be used. In case one year of historical data is not available, the parameters shall be determined by a measurement campaign in the baseline wastewater systems for at least 10 days. The measurements should be undertaken during a period that is representative for the typical operation conditions of the systems and ambient conditions of the site (temperature, etc). Average values from the measurement campaign shall be used and the result shall be multiplied by 0.89 to account for the uncertainty range (30% to 50%) associated with this approach as compared to one-year historical data.
$MCF_{ww,treatment,BL,i}$	Methane correction factor for baseline wastewater treatment systems *i* (MCF values as per table B.6.)
i	Index for baseline wastewater treatment system
$B_{o,ww}$	Methane producing capacity of the wastewater (IPCC value for 0.25 kg CH4/kg COD)
UF_{BL}	Model correction factor to account for model uncertainties (0.89)
GWP_{CH4}	Global Warming Potential for methane (value of 21)

Table B.6 IPCC default values for Methane Correction Factor (MCF)[33]

Type of wastewater treatment and discharge pathway or system	**MCF value**
Discharge of wastewater to sea, river or lake	0.1
Aerobic treatment, well managed	0.0
Aerobic treatment, poorly managed or overloaded	0.3
Anaerobic digester for sludge without methane recovery	0.8
Anaerobic reactor without methane recovery	0.8
Anaerobic shallow lagoon (depth less than 2 meters)	0.2
Anaerobic deep lagoon (depth more than 2 meters)	0.8
Septic system	0.5

Calculation of $BE_{injection,y}$ (after the gas pipeline from the natural gas distribution grid to the project site put into operation)*:*

According to Annex I in AMS-III.H, in case of project activities involves biogas injected into the natural gas grid, the baseline emissions for upgraded biogas injection ($BE_{injection,y}$) are determined as follows:

$$BE_{injection,y}=E_{ug,y}*CEF_{NG} \quad (4)$$

$BE_{injection,y}$: Baseline emission for injection of upgraded biogas into a natural gas distribution grid in year y (tCO_2e)

$E_{ug,y}$: Energy delivered from the upgraded biogas in the project activity to the natural gas distribution grid in year y (TJ)

CEF_{NG}: Carbon emission factor of natural gas (tCO_2e/TJ)

[33]Page 6 in AMS.III.H./Version 15

$E_{ug,y}=Q_{ug,y}*NCV_{ug,y}$ (5)

$Q_{ug,y}$: Quantity of upgraded biogas displacing the use of natural gas in the natural gas distribution grid in year y (m^3)

$Q_{ug,y}$ in the AMS.III.H is the smaller one between quantity of upgraded biogas injected into the natural gas distribution grid and quantity of methane captured at the wastewater treatment source facility, that is, the upgraded biogas injected is considered as pure methane to compare with the methane in biogas captured. But for the project, concentration of methane in biogas injected into the grid is 90% not 100%, so in order to compare equally, $Q_{ug,y}$ is considered as the smaller amount of methane between injected and captured.

$NCV_{ug,y}$: Net calorific value of the upgraded biogas in year y (TJ/m^3)

NCV of methane (NCV_{CH4})is used due to $Q_{ug,y}$ is considered as the amount of methane in the biogas.

$Q_{ug,y}=min(Q_{ug,in,y},Q_{cap,CH4,y})$ (6)

$Q_{ug,in,y}$ Quantity of upgraded biogas injected into the natural gas distribution grid in year y (m^3)

$Q_{cap,CH4,y}$ Quantity of methane captured at the wastewater treatment source facility in year y

$Q_{cap,CH4,y}=w_{CH4,ww}*Q_{cap,biogas,y}$ (7)

$w_{CH4,ww}$: Methane fraction of biogas as monitored at the outlet of the wastewater treatment source facility (m^3 CH_4/m^3 biogas)

$Q_{cap,biogas,y}$: Monitored amount of biogas captured at the source facility in year y (m^3)

Project Emission

According to AMS-III.H (including Annex I in AMS-III.H), the project activity emission is calculated as following equations:

$PE_y=PE_{power,y}+PE_{ww,treatment,y}+PE_{s,treatment,y}+PE_{ww,discharge,y}+PE_{s,final,y}+PE_{fugitive,y}+PE_{biomass,y}+PE_{flaring,y}+PE_{process,y}$ (8)

Where:

PE_y	Project activity emissions in the year *y* (tCO_{2e})
$PE_{power,y}$	Emissions from electricity or fuel consumption in the year *y* (tCO_{2e}). As explained in $BE_{power,y}$, electricity consumed for UASB keeps the same before and after the Project, i.e. $BE_{electricity,UASB,y}=PE_{electricity,UASB,y}$, so the electricity consumed in the Project only consist of new additional biogas capture system and biogas treatment system. Besides, there is the project use steam to heat process to keep warm, therefore, this part has to be included in.
$PE_{ww,treatment,y}$	Methane emissions from wastewater treatment systems affected by the project activity, and not equipped with biogas recovery, in year *y* (tCO_{2e}).
$PE_{s,treatment,y}$	Methane emissions from sludge treatment systems affected by the project activity, and not equipped with biogas recovery, in year *y* (tCO_{2e}).
$PE_{ww,discharge,y}$	Methane emissions from degradable organic carbon in treated wastewater in year *y* (tCO_{2e}).
$PE_{s,final,y}$	Methane emissions from anaerobic decay of the final sludge produced in year *y* (tCO_{2e}).
$PE_{fugitive,y}$	Methane emissions from biogas release in capture systems in year *y*
$PE_{biomass,y}$	Methane emissions from biomass stored under anaerobic conditions which would not have occurred in the baseline situation.
$PE_{flaring,y}$	Methane emissions due to incomplete flaring in year *y*
$PE_{process,y}$	Project emission related to the upgrading and compression of the biogas in year y (tCO_2e)

As the Project doesn't cause change of the wastewater treatment system, $PE_{ww,treatment,y}$, $PE_{ww,discharge,y}$ and $PE_{biomass,y}$ can be neglected.

The sludge treatment will not be affected by the project activity, and is excluded in the project boundary. So the $PE_{s,treatment,y}$ and $PE_{s,final,y}$ will not to be considered as well.
As the Project doesn't involve flaring, $PE_{flaring,y}$ can be neglected.
Therefore, in this project, the formula (8) for project emission can be simplified into formula (9)

$$PE_y = PE_{power,y} + PE_{fugitive,y} + PE_{process,y} \quad (9)$$

Determination of $PE_{power,y}$

$$PE_{power,y} = PE_{power,elec,y} + PE_{power,\ fuel,y} \quad (10)$$

Where:

$PE_{power,elec,y}$ Emissions from electricity consumption in the year *y* (tCO_2e).

$PE_{power,\ fuel,y}$ Emissions from fuel consumption in the year y (tCO_2e).

The emission is from coal consumption in order to produce steam. Only a small amount steam produced by the starch plant is used in this project, and the fuel to produce steam is coal. Although, the exactly amount of coal consumed for this project can not monitored directly, the quantity, temperature and pressure of steam are available, so the emission from coal consumption due to the Project can be calculated as per formula (12) and (13).

According to the methodology, emissions from electricity consumption are determined as per the procedures described in "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (ver.1).
According to above tool,

$$PE_{power,ele,y} = EC_{y,consumed} * EF_y * (1 + TDL_y) \quad (11)$$

Where:

$EC_{y,consumed}$ Quantity of electricity consumed by the Project in year y (MWh/yr)
EF_y Emission factor for electricity generation in year y (tCO_2/MWh)
TDL_y Average technical transmission and distribution losses for providing electricity to the project in year y

As the electricity consumed is from grid (North China Grid), the "Tool to calculate the emission factor for an electricity system" is used to determine EF_y. The notification of the emission factor issued by the NDRC on Jul.2nd, 2009 is calculated according to the method to the procedures prescribed in the "Tool to calculate the Emission Factor for an electricity system". *(ver.02.1.0)* The detailed procedures and the calculation process please refer to Annex III.
According the notification of NDRC[34], the OM and BM of the North China Grid are listed as follows:

OM	1.0069tCO_2/MWh
BM	0.7802 tCO_2/MWh

The Project will consume steam to heat the process in winter, and the steam is generated from the coal-fired boiler. Therefore, according to "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion",

$$PE_{power,\ fuel,y} = FC_{coal,y} * NCV_y * EF_{CO2,coal,y} \quad (12)$$

$$= (H_{steam,y} - H_{water,y}) * Q_{steam,y} * EF_{CO2,coal,y} / \eta_{boiler} \quad (13)$$

[34] http://cdm.ccchina.gov.cn/, on Jul.2nd, 2009.

Where:

$FC_{coal,y}$: Quantity of Coal combusted in process during the year y(t)

NCV_y: The weighted average net calorific value of coal (GJ/t)

$H_{steam,y}$ Enthalpy of steam consumed in year *y*(MJ/t)

$H_{water,y}$ Enthalpy of water input to the boiler in year *y* (MJ/t)

$Q_{steam,y}$ Quantity of steam consumed in year *y (t)*

η_{boiler} The efficiency of boiler (%)

$EF_{CO2,coal,y}$ CO_2 emission factor of coal in year *y* (tCO_2/MJ)

Determination of $PE_{fugitive,y}$

$$PE_{fugitive,y} = PE_{fugitive,ww,y} + PE_{fugitive,s,y} \quad (14)$$

Where:

$PE_{fugitive,ww,y}$ Fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment systems in the year *y* (tCO2e)
This parameter is calculated as per formula (15)

$PE_{fugitive,s,y}$ Fugitive emissions through capture inefficiencies in the anaerobic sludge treatment systems in the year *y* (tCO2e)
Not applicable in the Project.

$$PE_{fugitive,ww,y} = (1 - CFE_{ww}) * MEP_{ww,treatment\,y} * GWP_{CH4} \quad (15)$$

Where:

CFE_{ww} Capture efficiency of the biogas recovery equipment in the wastewater treatment systems (a default value of 0.9 shall be used)

$MEP_{ww,treatment,y}$ Methane emission potential of wastewater treatment systems equipped with biogas recovery system in year *y* (tonnes)

$$MEP_{ww,treatment,y} = Q_{ww,y} * B_{o,ww} * UF_{PL} * \sum k COD_{removed,PJ,k,y} * MCF_{ww,treatment,PJ,k} \quad (16)$$

Where:

$COD_{removed,PJ,k,y}$ The chemical oxygen demand removed by the treatment system *k* of the project activity equipped with biogas recovery in the year *y* (tonnes/m3)

$MCF_{ww,treatment,PJ,k}$ Methane correction factor for the project wastewater treatment system *k* equipped with biogas recovery equipment (Because the project activity doesn’t affect the wastewater treatment system, that is, an anaerobic reactor, the biogas amount won’t be affected by the project and it is just recovered by the Project. Hence, MCF values under project scenario should be as same as the baseline scenario.)

UF_{PL} Model correction factor to account for model uncertainties (1.12)

Determination of $PE_{process,y}$

$$PE_{process,y} = PE_{ww,upgrade,y} + PE_{CH4,equip,y} + PE_{ventgas,y} \quad (17)$$

$PE_{process,y}$: Project emissions related to the upgrading and compression of the biogas in year y(tCO_2)

$PE_{ww,upgrade,y}$: Emission from methane contained in waste water discharge of upgrading installation in year y (tCO_2).
$PE_{CH4,equip,y}$: Emission from compressor leaks in year y (tCO_2)
$PE_{ventgas,y}$: Emission from venting gases retained in upgrading equipment in year y (tCO_2).
According to paragraph 9 in the annex I of AMS.III H, if project activity emissions from venting gases retained in upgrading equipment do not have to be considered if vent are channeled to storage bags. In the project, as the gases retained in the PSA system will not vented or flared[35]. Therefore, this part of project emission is unnecessary to calculate.

$$PE_{ww,upgrade,y}=Q_{ww,upgrade,y}*[CH_4]_{ww,upgrade,y}*GWP_{CH4} \quad (18)$$

Where:
$Q_{ww,upgrade,y}$ Volume of wastewater discharge from upgrading installation in year y
$[CH_4]_{ww,upgrade,y}$ Dissolved methane contained in the wastewater discharge in year y

$$PE_{CH4,equip,y}=GWP_{CH4}*(1/1000)*\sum_{equipment} w_{CH4,stream,y}*EF_{equipment}*T_{equipment,y} \quad (19)$$

Where:
$w_{CH4,stream,y}$: Average methane weight fraction of the gas (kg-CH_4/kg) in year “y”
$T_{equipment,y}$: Operation time of the equipment in hours in year “y” (in absence of detailed information, it can be assumed that the equipment is used continuously, as a conservative approach)
$EF_{equipment}$: Leakage rate for fugitive emissions from the compression technology as per specification from the compressor manufacturer in kg/hour/compressor. If no default value from the technology provider is available, the default value in the methodology shall be used.
For the project case, during the upgraded process, besides the compressor, the PSA system also produces fugitive emission, so this part of emission is also calculated and included in. The compressor provider and the PSA provider provide the leakage rate, that is, 0.35Nm^3/h for natural gas compressor and 0.36Nm^3/h (0.04%*15/min*60h) for biogas compressor, and 0.5% (m^3/m^3) for PSA[36]. Therefore, equation (19) reformates to,

$$PE_{CH4,equip,y}=GWP_{CH4}*\sum_{equipment} w_{CH4}*\rho*EF_{equipment}*T_{equipment,y} \quad (20)$$

Where,
w_{CH4}: Average methane volume fraction of the gas (m^3-CH_4/m^3) in year “y”
ρ: Concentration of the methane(t/m^3)
$EF_{equipment}$: Leakage rate for fugitive emissions from the compression technology as per specification from the compressor manufacturer in m^3/hour/equipment.

Leakage

According to Annex 1 in the AMS-III.H, as the users of the bottles filled with upgraded biogas are not included in the project boundary, the following leakage emissions are included and calculated as follows:

$$LE_{bottling,y}=LE_{leakage,bb,y}+LE_{trans,y} \quad (21)$$

Where:
$LE_{bottling,y}$: Leakage emissions project activities involving bottling of biogas in year y (tCO_2)
$LE_{leakage,bb,y}$: Emissions due to physical leakage from biogas bottles in year y (tCO_2)
$LE_{trans,y}$: Emissions due to fossil fuel use for transportation of bottles; biogas filled bottles due to the end users and the return of empty bottles to the filling site in year y (tCO_2)

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[35] Please refer the explanation of the retained gas in the PSA system.
[36] Please refer to the technical agreement of the biogas compressor and the methane compressor, as well as the statement about efficiency of PSA given by PSA provider.

$LE_{leakage,bb,y}=Q_{methane,bb,y}*LR_{bb}*GWP_{CH4}$ (22)

Where:

$Q_{methane,bb,y}$: total quantity of methane bottled in year y (m^3)

LR_{bb}: Physical leakage rate from biogas bottles (if no project-specific values can be identified a default value of 1.25% shall be applied)

$LE_{trans,y}=(Q_{bb,y}/CT_{bb,y})*DAF_{bb}*EF_{CO2}$ (23)

$Q_{bb,y}$: Total freight volume of upgraded biogas in bottles transported in year y (m^3)

$CT_{bb,y}$: Average truck freight volume capacity for the transportation of bottles with upgraded biogas (m^3/truck)

DAF_{bb}: Aggregated average distance for bottle transportation; biogas filled bottles to the end users and the return of empty bottles to the filling site (km/truck)

EF_{CO2}: CO_2 emission factor from fuel use due to transportation (tCO_2/km)

Emission Reduction

According to AMS-III.H, emission reductions are estimated ex ante in the PDD as follows:

$ER_{y,ex,ante}= BE_{y,ex,ante} -(PE_{y,ex,ante} +LE_{y,ex,ante})$ (24)

Where:

$ER_{y,ex,ante}$	*Ex ante* emission reduction in year *y* (tCO_2e)
$BE_{y,ex,ante}$	*Ex ante* baseline emissions in year *y* (tCO_2e)
$PE_{y,ex,ante}$	*Ex ante* project emissions in year *y* (tCO_2e)
$LE_{y,ex,ante}$	*Ex ante* leakage emissions in year *y* (tCO_2e)

Ex post emission reductions shall be achieved in any year is the lowest value of the following:

$ER_{y,ex,post}= min((BE_{y,ex,post} -PE_{y,ex,post} -LE_{y,ex,post}), (MD_y-PE_{power,y}-PE_{biomass,y}-LE_{y,ex,post}))$ (25)

Where:

$ER_{y,ex,post}$	Emission reductions achieved by the project activity based on monitored values for year y (tCO_2e)
$BE_{y,ex,ante}$	Baseline emissions calculated as per formula(2) using ex post monitored values (tCO_2e)
$PE_{y,ex,ante}$	Project emissions calculated as per formula(10) using ex post monitored values (tCO_2e)
MD_y	Methane captured and destroyed/gainfully used by the project activity in the year y (tCO_2e)

And for this project:

$ER_{y,ex\ post}=min ((BE_{y,ex\ post}-PE_{y,ex\ post}-LE_{y,ex\ post}), (MD_y-PE_{power,y}-LE_{y,ex\ post}))$ (26)

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	$MCF_{ww,treatment,BLi}$
Data unit:	—
Description:	Methane correction factor for baseline wastewater treatment systems *i* (MCF values as per table B.6.)
Source of data used:	Approved baseline methodology AMS-III.H.

Value applied:	0.8
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is the default value for anaerobic reactor without methane recovery
Any comment:	-

Data / Parameter:	$MCF_{ww,treatment,PLi}$
Data unit:	—
Description:	Methane correction factor for project wastewater treatment systems *i* (MCF values as per table B.6.)
Source of data used:	Approved baseline methodology AMS-III.H.
Value applied:	0.8
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is the default value for anaerobic reactor without methane recovery
Any comment:	-

Data / Parameter:	$B_{o,ww}$
Data unit:	kg CH_4/kg COD
Description:	Methane producing capacity of the wastewater
Source of data used:	IPCC default value
Value applied:	0.25
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC lower value for domestic wastewater
Any comment:	-

Data / Parameter:	UF_{BL}
Data unit:	-
Description:	Model correction factor to account for model uncertainties
Source of data used:	Approved baseline methodology AMS-III.H.
Value applied:	0.89
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value in AMS-III.H
Any comment:	-

Data / Parameter:	GWP_{CH4}
Data unit:	-
Description:	Global Warming Potential for methane
Source of data used:	IPCC 2006
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default value
Any comment:	-

Data / Parameter:	CEF_{NG}
Data unit:	tCO_2e/TJ
Description:	Carbon emission factor of natural gas
Source of data used:	IPCC 2006
Value applied:	56.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to AMS-III.H, accurate and reliable local or national data may be used where available, otherwise appropriate IPCC default values shall be used. For the local and national data is not available in China, appropriate IPCC default value is applicable.
Any comment:	

Data / Parameter:	$EF_{grid,CM,y}$
Data unit:	tCO_2e/MWh
Description:	Emission factor of the grid (combined margin emission factor of the North China Power Grid) in the year y
Source of data used:	Chinese DNA: 2009 Baseline Emission Factor for Regional Grids in China (2 ,July, 2009)
Value applied:	0.89355
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to the 2009 Baseline Emission Factor for Regional Grids in China which issued by the NDRC, the OM is 1.0069 and BM is 0.7802. After calculation, CM is 0.89355.
Any comment:	Calculated based on $EF_{grid,OM}$ *and* $EF_{grid,BM,y}$ recommended by China DNA and fixed ex-ante

Data / Parameter:	CFE_{ww}
Data unit:	-
Description:	Capture efficiency of the biogas recovery equipment in the wastewater treatment systems
Source of data used:	Approved baseline methodology AMS-III.H.
Value applied:	0.9

Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value in AMS-III.H
Any comment:	-

Data / Parameter:	UF_{PJ}
Data unit:	-
Description:	Model correction factor to account for model uncertainties
Source of data used:	Approved baseline methodology AMS-III.H.
Value applied:	1.12
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value in AMS-III.H
Any comment:	-

Data / Parameter:	$EF_{equipment,y}$ (biogas compressor)
Data unit:	Nm^3/h/compressor
Description:	Leakage rate for fugitive emissions from the compression technology as per specification from the compressor manufacturer
Source of data used:	Technical agreement of biogas contract
Value applied:	0.36
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to AMS-IIIH, the default value from the technology provider is preferred. The leakage rate given by the technology provider is 0.04%, and the Design gas quantity is15m^3/min, the leakage rate can rewritten to 0.04%*15*60=0.36
Any comment:	-

Data / Parameter:	$EF_{equipment,y}$ (alternative biogas compressor)
Data unit:	ml/s/compressor
Description:	Leakage rate for fugitive emissions from the compression technology as per specification from the compressor manufacturer
Source of data used:	Technical agreement of biogas contract
Value applied:	500
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to AMS-IIIH, the default value from the technology provider is preferred.
Any comment:	-

Data / Parameter:	$EF_{equipment,y}$ (natural gas compressor)
Data unit:	m^3/hour/compressor
Description:	Leakage rate for fugitive emissions from the compression technology as per specification from the compressor manufacturer
Source of data used:	Technical agreement of biogas contract
Value applied:	0.35
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to AMS-IIIH, the default value from the technology provider is preferred.
Any comment:	-

Data / Parameter:	$EF_{equipment,y}$ (PSA)
Data unit:	m^3/hour/compressor
Description:	Leakage rate for fugitive emissions from the PSA system as per specification from the PSA manufacturer
Source of data used:	Statement made by the PSA manufacture
Value applied:	3.0
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to AMS-IIIH (ver.15), the default value from the technology provider is preferred. The leakage rate given by the technology provider is 0.5%, and the Design gas quantity is 600m^3/h, the leakage rate can rewritten to 0.5%*600 m^3/h =3.0 m^3/h
Any comment:	-

Data / Parameter:	$H_{steam,y}$
Data unit:	MJ/t
Description:	The enthalpy of the steam consumed in the Project in year *y*
Source of data used:	Enthalpy Table of Steam according to the design temperature and pressure of the coal-fired boiler
Value applied:	3393.7
Justification of the choice of data or description of measurement methods and procedures actually applied :	The actual temperature and pressure of the steam consumed are much lower than the design values, but the design values are applied to determine the enthalpy of the steam for simplification, which is conservative.
Any comment:	-

Data / Parameter:	$H_{water,y}$
Data unit:	MJ/t
Description:	The enthalpy of the water input into the boiler in year *y*
Source of data used:	Enthalpy Table of Steam
Value applied:	0

Justification of the choice of data or description of measurement methods and procedures actually applied :	Due to the parameters of water input is not available, so the conservative value 0 which is under 0 ℃ is applied
Any comment:	-

Data / Parameter:	$Q_{steam,y}$
Data unit:	t
Description:	Quantity of steam consumed by the project activity in year *y*
Source of data used:	Estimated by the project owner
Value applied:	150
Justification of the choice of data or description of measurement methods and procedures actually applied :	Only for ex-ante calculation
Any comment:	-

Data / Parameter:	η_{boiler}
Data unit:	%
Description:	The efficiency of boiler
Source of data used:	China: Efficient industrial boilers, GEF Focal area: Climate Change, (reference to Annex 1 of Methodology AM0072)
Value applied:	60
Justification of the choice of data or description of measurement methods and procedures actually applied :	The lower value of typical efficiency levels for Chinese coal-fired industrial boilers.
Any comment:	-

Data / Parameter:	LR_{bb}
Data unit:	-
Description:	Physical leakage rate from biogas bottles
Source of data used:	Value suggested by AMS-III.H
Value applied:	1.25%
Justification of the choice of data or description of measurement methods and	According to AMS-III.H, if no project-specific values can be identified, a default value of 1.25% shall be applied

procedures actually applied :	
Any comment:	-

Data / Parameter:	EF_{CO2}[37]
Data unit:	tCO_2/km
Description:	CO_2 emission factor from fuel use due to transportation
Source of data used:	The default value of CO_2 emissions from transport or mobile sources from the web of <the GHG protocol initiative>
Value applied:	0.00087
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	-

B.6.3 Ex-ante calculation of emission reductions:

After the gas pipeline from the natural gas distribution grid to the project site put into operation

I. **Baseline emission:**

As mentioned in B6.1, the baseline emission includes two aspects:

(1) $BE_{avoidance,y}$;

(2) $BE_{injectction,y;}$

Calculation of $BE_{avoidance,y}$**:**

In order to determine $COD_{removed}$ *and* Q_{ww}, the ten-day measurement campaign was carried out and the results are shown as following table:

Table B.7 Ten-day measurement campaign table

date	Q_{ww}(m^3/d)	COD of untreated water(mg/l)	COD of treated water(mg/l)
2010.1.13	5,028	13,992.3	1,048.9
2010.1.14	4,986	14,056.6	1,023.6
2010.1.15	4,926	14,180.7	1,044.8
2010.1.16	5,098	14,098.4	1,036.6
2010.1.17	5,028	14,067.7	1,056.3
2010.1.18	4,968	14,062.6	1,105.6
2010.1.19	5,096	14,192.7	1,045.1
2010.1.20	5,038	14,048.7	1,073.6

[37] http://www.ghgprotocol.org/calculation-tools/all-tools. The download document <Calculating CO_2 Emission from Mobile Sources> is provided. According to Table 4 in the document, for diesel heavy truck, the CO2 emission factor is 870gram CO2/km.

2010.1.21	5,024	14,068	1,032.1
2010.1.22	5,102	14,156.3	1,061.2
average data	5,029.4	14,092.4	1,052.8
Data*0.89[38]	4,476.2	12,542.2	937.0
COD removed (mg/l)	11,605.3		
removed rate	92.5%		

The parameters used to calculate $BE_{avoidance,y}$ are listed as following table:

Table B.8 Input Values and Data Sources for the Calculation of $BE_{ww,treatment,y}$

Parameter	Data	Unit	Source
Q_{ww}	1,477,135	m^3/y	Base on a 10-days measurement campaign
$COD_{removed}$	11,605	g/m^3	Base on a 10-days measurement campaign
$MCF_{ww,treatment,BL}$	0.8	—	Table III.H.1 in AMS-III.H
$B_{o,ww}$	0.25	kg CH_4/kg COD	Default value in AMS-III.H
UF_{BL}	0.89	—	Default value in AMS-III.H
GWP_{CH4}	21	—	Default value in AMS-III.H

$BE_{avoidance,y} = BE_{ww,treatment,y}$

$= \sum_i Q_{ww,i,y} * COD_{removed,i,y} * MCF_{ww,treatment,BL,i} * B_{o,ww} * UF_{BL} * GWP_{CH4}$

$=1,477,135*11,605.3*0.8*0.25*0.89*21/1,000,000=64,079tCO_2$

Calculation of $BE_{injection,y}$**:**

The parameters used to calculate $BE_{injection,y}$ are listed as following table:

Table B.9 Input Values and Data Sources for the Calculation of $BE_{injection,y}$

Parameter	Data	Unit	Source
The amount of upgraded biogas in the FSR	4,633,200	m^3/year	Page 2 in FSR
The amount of upgraded biogas calculated	4,394,922	m^3/year	Calculated according to the ten-day measurement[39]
$Q_{ug,generate,y}$	4,394,922	m^3/year	The minimum value between data in FSR and data calculated according to the ten-day measurement
The concentration of methane of upgraded biogas	90%		Page 3 in FSR

[38]According to AMS-IIIH (ver.15), in order to determine $COD_{removed}$ *and* Q_{ww}, average values from the measurement campaign shall be used and the result shall be multiplied by 0.89 to account for the uncertainty range (30% to 50%) associated with this approach as compared to one-year historical data.

[39] Please refer to ER spreadsheet, "baseline emission" cell C17

Percentage of upgraded biogas injected into natural gas grid	60%	--	Annex table in FSR
The amount of biogas captured in FSR	7,128,000	m^3/year	Page 14 in FSR(21,600 m^3/day*330=7,128,000m^3)
The amount of biogas captured by calculation	6,124,865	m^3/year	Calculated according to the ten-day measurement[40]
$Q_{cap,biogas,y}$	6,124,865	m^3/year	the minimum value between data in FSR and data calculated according to the ten-day measurement
$NCV_{ug,y}$	35.9	MJ/m^3	Public information[41]
$w_{CH4,ww}$	65%	m^3 CH_4/m^3 biogas	Page 14 in FSR
CEF_{NG}	56.1	tCO_2/TJ	IPCC 2006

$$Q_{cap,CH4,y}=w_{CH4,ww}*Q_{cap,biogas,y} = 65\%*6,124,865*60\%=2,388,697\ m^3/year$$
$$Q_{ug,in,y}= w_{in,ww}* Q_{ug,generat,y} =4,394,922*60\%*90\%=2,373,258\ m^3/year$$
$$Q_{ug,y}=min(Q_{ug,in,y},Q_{cap,CH4,y}) = 2,373,258\ m^3/year$$
$$BE_{injection,y}{}^{42}=E_{ug,y}*CEF_{NG} = Q_{ug,y}*NCV_{ug,y}* CEF_{NG}=2,373,258*35.9*56.1/1,000,000=4,780\ tCO_2$$

Calculation of $BE_{y,ex\text{-}ante}$:

$$BE_{y,ex,ante}= BE_{avoidance,y}+ BE_{injectction,y}=64,079+4,780= 68,859CO_2$$

II. **Project emission:**

As mentioned in B6.1, the project emission is calculated as follows:

$$PE_y= PE_{power,y}+ PE_{fugitive,y} + PE_{process,y}$$

Calculation of $PE_{power,y}$:

The parameters used to calculate $PE_{power,y}$ are listed as following table:

Table B.10 Input Values and Data Sources for the Calculation of $PE_{power,y}$

Parameter	Data	Unit	Source
$EC_{y,consumed}$	2,233	MWh	Page 8 in FSR
EF_y	0.89355	tCO_2/MWh	Notification issued by NDRC

[40] Please refer to ER spreadsheet, “baseline emission” cell C23

[41] http://www.lzny.com/Article/news_view.asp?newsid=1371

[42] The calculation of $BE_{injection,y}$ is only for ex-ante calculation, because 60% upgraded biogas would be injected into local natural gas distribution grid is based on the expectation in FSR, the gas distribution grid still has not been constructed yet, and all the upgraded gas will be bottled for sale before the gas distribution grid put into operation.

TDL_y	20%	-	Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion
T_{steam}	485	℃	The rate temperature of steam in the nameplate
P_{steam}	5.29	MPa	The rate press of steam in the nameplates
$H_{steam,y}$	3,393.7	MJ/t	Enthalpy Table of Steam[43]
$H_{water,y}$	0	MJ/t	Conservative assumption
$Q_{steam,y}$	150	t	Provided by the design institute[44]
$EF_{CO2,coal,y}$	$10.1*10^{-5}$	tCO_2/MJ	Upper value of CO2 emission factor of Anthracite type of coal in Table 2-3 of chapter 2 in volume 2 of IPCC 2006
η_{boiler}	60%	-	Default value in Annex 1 of Methodology AM0072

$PE_{power,ele,y}=EC_{y,consumed}*EF_y=2,233*0.89355*(1+20\%)=2,394tCO_2$

$PE_{power,fuel,y}= (H_{steam,y}-H_{water,y}) *Q_{steam,,y} *EF_{CO2,coal,1,y} /\eta_{boiler}$

$= (3,393.7-0)*150*10.1*10^{-5}/60\%=86\ tCO_2e$

$PE_{power,\ y=}\ PE_{power,ele,y} + PE_{power,fuel,y} =2,480tCO_2e$

Calculation of $PE_{fugitive,ww,y}$:

The parameters used to calculate $PE_{fugitive,ww,y}$ are listed as following table:

Table B.11 Input Values and Data Sources for the Calculation of $PE_{fugitive,ww,y}$

Parameter	Data	Unit	Source
$COD_{removed,PJ,k,y}$	11,605	g/m^3	Base on a 10-days measurement campaign
$Q_{ww,y}$	1,477,135	m^3	Base on a 10-days measurement campaign
$MCF_{ww,treatment,PJ,k}$	0.8	--	Table III.H.1 in AMS-III.H
UF_{PL}	1.12	--	Default value in AMS-III.H
CFE_{ww}	0.9	--	Default value in AMS-III.H

$MEP_{ww,treatment,y} =Q_{ww,y}* B_{o,ww}* UF_{PL}*\sum kCOD_{removed,PJ,k,y}*MCF_{ww,treatment,PJ,k}$

[43] The enthalpy of the steam is determined by the rate temperature and the press of the steam. From the heat enthalpy value table, under the condition of 485℃ and 5.29 Mpa, the enthalpy of the steam is determined to be 3393.7MJ/t. This data can be cross-checked on the web of http://wenku.baidu.com/view/3580400bf78a6529647d537e.html.

[44] According to the explanation provided by the design institute, the amount of steam consumed is estimated as 1 t per day in cold days (from Nov. to Mar.), that is five months totally. Therefore the amount of steam consumed per year is estimated as 1*30*5=150t/y.

$PE_{fugitive,ww,y} = (1- CFE_{ww}) * MEP_{ww,treatment\,y} * GWP_{CH4} = (1- CFE_{ww})\, Q_{ww,y} * B_{o,ww} *$

$UF_{PL} * \sum kCOD_{removed,PJ,k,y} * MCF_{ww,treatment,PJ,k}\ GWP_{CH4} = (1-0.9) * 1,477,135 * 0.25 * 1.12 * 0.8 * 11,605 * 21 = 8,064 tCO_2$

Calculation of $PE_{process}$:

According to B6.1, $\boldsymbol{PE}_{process,y} = PE_{ww,upgrade,y} + PE_{CH4,equip,y}$

The parameters used to calculate $PE_{ww,upgrade,y}$ *and* $PE_{CH4,equip,y}$ are listed as following table:

Table B.12 Input Values and Data Sources for the Calculation of $PE_{CH4,equip,y}$

Parameter	Data	Unit	Source
$Q_{ww,upgrade,y}$	8.25	m^3/year	Pre-monitoring data
$[CH_4]_{ww,upgrade,y}$ [45]	41	mg/L	Public information[46]
$w_{CH4,n,y}$	0.90	m^3-CH_4/m^3	The standard in the PSA technical agreement
$w_{CH4,b,y}$	0.65	m^3-CH_4/m^3	FSR
$T_{equipment,y}$	7,920	h	The operation day per year is 330 which stated in Page 8 in FSR
$EF_{equipment,b}$	0.36	ml/s/compressor	The technical agreement of biogas compressor
$EF_{equipment,n}$	0.35	m^3/h/compressor	The technical agreement of natural gas compressor
$EF_{equipment,psa}$	3.0	m^3/h/PSA	The technical agreement of PSA

$PE_{ww,upgrade,y} = Q_{ww,upgrade,y} * [CH_4]_{ww,upgrade,y} * GWP_{CH4} = 8.25*21*41/1000000 = 0.007t$

$PE_{CH4,equip,y} = GWP_{CH4} * (1/1000) * \sum w_{CH4,y} * EF_{equipment} * T_{equipment,y}$
$= 21 \times 0.00067 * (0.36*0.65 + 0.35*0.90 + 3.0*0.90) * 7,920 = 362 tCO_2e$

$\boldsymbol{PE}_{process,y} = PE_{ww,upgrade,y} + PE_{CH4,equip,y} = 362 tCO_2e$

Calculation of $PE_{y,ex\text{-}ante}$:

$PE_{y,ex\text{-}ante} = PE_{power,y} + PE_{fugitive,y} + PE_{process,y}$ =2,480+8,064+362=10,906 tCO_2

III. **Leakage:**

As mentioned in B6.1, the leakage emission is calculated as follows:

$LE_{bottling,y} = LE_{leakage,bb,y} + LE_{trans,y}$

Calculation of $LE_{leakage,bb,y}$

[45] For $PE_{ww,upgrade,y}$, as the project uses PSA system to upgrade biogas, and the wastewater generated from PSA is just steam water from the biogas, therefore the dissolved methane contained in the steam water is very little

[46] http://www.methane-stripping.com/html/solubility_curve.html. According to the Methane Solubility Curve in Distilled Water at 1 Atmosphere, the solubility of methane will decrease with temperature drop, and so the solubility under 0℃ is adopted for conservative consideration.

The parameters used to calculate $LE_{leakage,bb,y}$ are listed as following table:

Table B.13 Input Values and Data Sources for the Calculation of $LE_{leakage,bb,y}$

Parameter	Data	Unit	Source
$Q_{methane,bb,y}$:	4,633,200*40%*0.90	m^3	Page 2 in FSR and Annex table in FSR
LR_{bb}	1.25%		Default value in AMS-III.H
GWP_{CH4}	21	--	

$LE_{leakage,bb,y}=Q_{methane,bb,y}*LR_{bb}*GWP_{CH4}=4,633,200*0.4*0.90*0.00067*21=293tCO_2$

Calculation of $LE_{trans,y}$

The parameters used to calculate $LE_{trans,y}$ are listed as following table:

Table B.14 Input Values and Data Sources for the Calculation of $LE_{trans,y}$

Parameter	Data	Unit	Source
$Q_{bb,y}$	4,633,200*40%	m^3	Page 2 in FSR and Annex table in FSR
$CT_{bb,y}$	2,304	m^3/truck	According to the nameplate of product attached on the truck[47]
DAF_{bb}	600*2	km/truck	Page15 in FSR
EF_{CO2}	0.00087	tCO_2/km	Default value

$LE_{trans,y}=(Q_{bb,y}/CT_{bb,y})*DAF_{bb}*EF_{CO2}=4,633,200*0.4/2,304*600*2*0.00087=840\ tCO_2$

Calculation of $LE_{bottling,y}$

$LE_{bottling,y}=LE_{leakage,bb,y}+LE_{trans,y}=293+840=1,133tCO_2$

IV. **Reduction emission:**

According to AMS-III.H, emission reductions are estimated ex ante in the PDD as follows:

$ER_{y,ex,ante}= BE_{y,ex,ante} –(PE_{y,ex,ante} +LE_{y,ex,ante})=68,859-10,906-1,133=56,819tCO_2$

Before the gas pipeline from the natural gas distribution grid to the project site put into operation

Because the construction of gas pipeline from the natural gas distribution grid to the project site will be completed in the second half of year 2014, and 100% upgraded biogas will be bottled until then, therefore, the emission reductions are estimated as follows:

$ER_{y,ex,ante}= BE_{y,ex,ante} –(PE_{y,ex,ante} +LE_{y,ex,ante})=64,079-10,906-2,833=50,340tCO_2$

In which, the emission reduction due to fossil fuel displacement in natural gas grid is not counted in and deemed as 0, and all the upgraded biogas is applied to calculate leakage. Please refer to the ER sheet (ER_boxing_20111222).

B.6.4 Summary of the ex-ante estimation of emission reductions:

Year	Estimation of project activity emission	Estimation of baseline emissions (tCO_2e)	Estimation of leakage(tCO_2e)	Estimation of overall emission reduction (tCO_2e)

[47] Based on the nameplate, the capacity per truck is 11.52m^3 under 20MPa, which equals 2304 (11.52*200) m^3 under standard pressure (0.1Mpa).Therefore, the capacity per truck is 2304m^3 under standard pressure.

	(tCO_2e)			
01/10/2011-30/09/2012	10,906	64,079	2,833	50,340
01/10/2012-30/09/2013	10,906	64,079	2,833	50,340
01/10/2013-30/09/2014	10,906	64,079	2,833	50,340
01/10/2014-30/09/2015	10,906	68,859	1,133	56,819
01/10/2015-30/09/2016	10,906	68,859	1,133	56,819
01/10/2016-30/09/2017	10,906	68,859	1,133	56,819
01/10/2017-30/09/2018	10,906	68,859	1,133	56,819
01/10/2018-30/09/2019	10,906	68,859	1,133	56,819
01/10/2019-30/09/2020	10,906	68,859	1,133	56,819
01/10/2020-30/09/2021	10,906	68,859	1,133	56,819
Total (tCO_2e)	109,060	674,246	16,430	548,753

B.7 Application of a monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	**$Q_{ww,i,y}$**
Data unit:	m^3/a
Description:	Volume of wastewater treated in the year "y"
Source of data to be used:	Data from a 10-days measurement record is used in the PDD for ex-ante calculation. Monitored data from on-site measurement ex-post will be used during implementation of the Project.
Value of data	1,477,135=5,029*330*0.89
Description of measurement methods and procedures to be applied:	Monitored continuously with flow meters installed in-line of the influent pipe to the four UASB units (one meter per UASB) and recorded on a weekly basis The meter accuracy is 0.5 grade
QA/QC procedures to be applied:	The data will be recorded by starch plant and kept by the project owner up to two years after the end of the crediting period. The flow meter will undergo maintenance / calibration in accordance with specification provided by the manufacturer.
Any comment:	

Data / Parameter:	**$COD_{ww,untreated,y}$**
Data unit:	$tonnes/m^3$
Description:	Chemical oxygen demand of the wastewater entering the anaerobic treatment reactor in the year "y"
Source of data to be used:	Data from a 10-days measurement record is used in the PDD for ex-ante calculation. Monitored data from on-site measurement ex-post will be used during implementation of the Project.
Value of data	$12542*10^{-6}=14092*10^{-6}*0.89$
Description of measurement methods and procedures to be applied:	Weekly sampling of the influent into the UASB and analysis in the lab will be conducted ex-post. The accuracy of the measurement is ±8.5% according to *GB11914-89*.

QA/QC procedures to be applied:	Sampling and analysis will be carried out according to *Water quality Determination of the chemical oxygen demand Dichromate method (GB 11914-89)* by starch plant, and the data will be kept by the project owner up to two years after the end of the crediting period.
Any comment:	This data is used to calculate parameter $COD_{ww,removed,y}$, that is ,$COD_{ww,removed,y}$= $COD_{ww,untreated,y}$- $COD_{ww,treated,,y}$

Data / Parameter:	**$COD_{ww,treated,y}$**
Data unit:	tonnes/m^3
Description:	Chemical oxygen demand of the wastewater out of the anaerobic treatment reactor in the year "y"
Source of data to be used:	Data from a 10-days measurement record is used in the PDD for ex-ante calculation. Monitored data from on-site measurement ex-post will be used during implementation of the Project.
Value of data	$937*10^{-6}=1052.78*10^{-6}*0.89$
Description of measurement methods and procedures to be applied:	Weekly sampling of the influent from the UASB and analysis in the lab will be conducted ex-post. The accuracy of the measurement is ±8.5% according to *GB11914-89*.
QA/QC procedures to be applied:	Sampling and analysis will be carried out according to *Water quality Determination of the chemical oxygen demand Dichromate method (GB 11914-89)* by starch plant, and the data will be kept by the project owner up to two years after the end of the crediting period.
Any comment:	This data is used to calculate parameter $COD_{ww,removed,y}$, that is ,$COD_{ww,removed,y}$= $COD_{ww,untreated,y}$- $COD_{ww,treated,,y}$

Data / Parameter:	**$COD_{ww,removed,PJ,k,y}$**
Data unit:	tonnes/m^3
Description:	The chemical oxygen demand of the treatment system k of the project activity equipped with biogas recovery in the year "y"
Source of data to be used:	This data is calculated as $COD_{ww,untreated,y}$ minus $COD_{ww,treated,y.}$
Value of data	$11605*10^{-6}$
Description of measurement methods and procedures to be applied:	Because the project scenario is as the same as the baseline treatment system, the value of $COD_{ww,removed,PJ,1,y}$ equals to $COD_{ww,removed,1y}$,which is calculated as $COD_{ww,untreated,y}$ minus $COD_{ww,treated,y}$. The monitoring methods of $COD_{ww,untreated,y}$ and $COD_{ww,treated,y}$. Please refer to the table above.
QA/QC procedures to be applied:	The procedures please refer to the table above.
Any comment:	

Data / Parameter:	**$Q_{cap,biogas,y}$**
Data unit:	m^3/y
Description:	Quantity of biogas captured at the wastewater treatment in year y
Source of data to be used:	The data from Feasibility study report (FSR) will be used for ex-ante calculation. For the ex-post calculation, the measured data will be used.
Value of data	6,124,865

Description of measurement methods and procedures to be applied:	The biogas captured will be monitored by a continuous gas flow meter installed before desulfurization system and recorded on a weekly basis. Meter accuracy is 1.0 grade. The flow meter could measure flow, pressure and temperature and displays normalised flow of biogas.
QA/QC procedures to be applied:	The monitoring staff will be trained and the data will be kept up to two years after the end of the crediting period. The meter should consist with relevant national procedures.
Any comment:	According to the paragraph 36 of Methodology AMS-III.H, if the biogas flow meter employed measures flow, pressure and temperature and displays/outputs normalized flow of biogas, there is no need for separate monitoring of pressure and temperature of the biogas.

Data / Parameter:	$\mathbf{w_{CH4,ww}}$
Data unit:	$m^3 CH_4/m^3$ biogas
Description:	Methane fraction of biogas captured at the outlet of the wastewater treatment source facility
Source of data to be used:	The data from Feasibility study report (FSR) will be used for ex-ante calculation. For the ex-post calculation, the measured data will be used.
Value of data	65%
Description of measurement methods and procedures to be applied:	Measurement will be monitored with a methane analyzer continuously and data recorded on a weekly basis. The analyzer will be able to measure methane directly (instead of indirect measurement of other constituents) and installed before desulfurization system, close to the location where the biogas flow meter installed. Meter accuracy is ±3% of reading.
QA/QC procedures to be applied:	The monitoring staff will be trained and the data will be kept up to two years after the end of the crediting period. The meter and analysis should consist with relevant national procedures.
Any comment:	

Data / Parameter:	$\mathbf{Q_{ug,in,y}}$
Data unit:	m^3/year
Description:	Quantity of upgraded biogas injected into the natural gas distribution grid in year y
Source of data to be used:	The data from Feasibility study report (FSR) will be used for ex-ante calculation. For the ex-post calculation, the measured data will be used.
Value of data	2,296,701
Description of measurement methods and procedures to be applied:	Monitored continuously with a gas flow meter installed at the point before the gas grid connecting point and the data will be recorded on a weekly basis after the gas pipeline from the natural gas distribution grid to the project site put into operation. Meter accuracy is 1.5 grade.
QA/QC procedures to be applied:	The monitoring instruments should be calibrated as per state and/or sector standards and rules and calibrated according to the relevant standards. Biogas injected with inferior methane content (i.e., not meeting the applicable methane content standard) will be excluded from the emission reduction calculations. The monitoring staff will be trained and the data will be kept up to two years after the end of the crediting period. The meter should consist with specification

	provided by the manufacturer.
Any comment:	

Data / Parameter:	$\mathbf{w_{CH4,grid,y}}$
Data unit:	m^3CH_4/m^3 biogas
Description:	Concentration of methane in the upgraded biogas injected into natural gas grid in year y
Source of data to be used:	The data from technical agreement will be used for ex-ante calculation. For the ex-post calculation, the measured data will be used.
Value of data	90%
Description of measurement methods and procedures to be applied:	The biogas analyze device is installed at the point before the gas grid connecting point. Measurement will be conducted continuously and data record on a weekly basis after the gas pipeline from the natural gas distribution grid to the project site put into operation. Meter accuracy is ±3% of reading.
QA/QC procedures to be applied:	The monitoring staff will be trained and the data will be kept up to two years after the end of the crediting period. The meter and analysis should consist with relevant national procedures.
Any comment:	

Data / Parameter:	$\mathbf{T_{ng}}$
Data unit:	℃
Description:	The temperature of the biogas injected into a natural grid.
Source of data to be used:	Measured
Value of data	--
Description of measurement methods and procedures to be applied:	The temperature of the injected biogas will be displayed in gas flow meter installed before the gas grid connecting point continuously and recorded on a weekly basis after the gas pipeline from the natural gas distribution grid to the project site put into operation. The accuracy of the data is 1.5 grade.
QA/QC procedures to be applied:	The monitoring staff will be trained and the data will be kept up to two years after the end of the crediting period. Sampling and analysis will be carried out adhering to relevant national procedures.
Any comment:	

Data / Parameter:	$\mathbf{P_{ng}}$
Data unit:	Pa
Description:	Pressure of biogas injected to the natural gas grid
Source of data to be used:	Measured
Value of data	--
Description of measurement methods and procedures to be applied:	The pressure of the biogas injected into the grid will be regulated and monitored using a regularly calibrated pressure gauge before the gas grid connecting point continuously and recorded on a weekly basis after the gas pipeline from the natural gas distribution grid to the project site put into operation. The accuracy of the data is 1.5 grade at least.
QA/QC procedures to	The monitoring staff will be trained and the data will be kept up to two years

be applied:	after the end of the crediting period. Sampling and analysis will be carried out adhering to relevant national procedures.
Any comment:	

Data / Parameter:	$\mathbf{Q_{bb,\ y}}$
Data unit:	m^3/year
Description:	Total quantity of upgraded biogas bottled in year y.
Source of data to be used:	The data from FSR will be used for ex-ante calculation. For the ex-post calculation, the record data will be used.
Value of data	1,853,280
Description of measurement methods and procedures to be applied:	The amount of upgraded biogas bottled will be monitored continuously by flow meter installed on the pipe before natural gas compression for bottling and recorded weekly. The percentage of upgraded biogas bottle is 40%. $Q_{bb,\ y}$ =4633200*0.4 Meter accuracy is 0.5 grade.
QA/QC procedures to be applied:	The monitoring staff will be trained and the data will be kept up to two years after the end of the crediting period.
Any comment:	

Data / Parameter:	$\mathbf{w_{CH4,bb,y}}$
Data unit:	m^3CH_4/m^3 biogas
Description:	Concentration of methane in the upgraded biogas bottled in year y
Source of data to be used:	The data from technical agreement will be used for ex-ante calculation. For the ex-post calculation, the measured data will be used.
Value of data	90%
Description of measurement methods and procedures to be applied:	The biogas analyze device is installed on the pipe before natural gas compression for bottling. Measurement will be conducted continuously and data record on a weekly basis. Meter accuracy is ±3% of reading.
QA/QC procedures to be applied:	The monitoring staff will be trained and the data will be kept up to two years after the end of the crediting period. The meter and analysis should consist with relevant national procedures.
Any comment:	

Data / Parameter:	$\mathbf{T_{bb}}$
Data unit:	℃
Description:	The temperature of the biogas bottled
Source of data to be used:	Measured
Value of data	--
Description of measurement methods and procedures to be applied:	The temperature of the biogas bottled will be measured continuously by the temperature transmitter displayed on the injection column before bottling and recorded on a weekly basis. The accuracy of the data is 1.5 grade.
QA/QC procedures to be applied:	The monitoring staff will be trained and the data will be kept up to two years after the end of the crediting period. Sampling and analysis will be carried out adhering to relevant national procedures.
Any comment:	

Data / Parameter:	P_{bb}
Data unit:	Pa
Description:	The pressure of the biogas bottled
Source of data to be used:	Measured
Value of data	--
Description of measurement methods and procedures to be applied:	The pressure of the biogas injected into the grid will be regulated and monitored using a regularly calibrated pressure gauge installed on the pipe before bottling continuously and recorded on a weekly basis. The accuracy of the data is 1.5 grade at least.
QA/QC procedures to be applied:	The monitoring staff will be trained and the data will be kept up to two years after the end of the crediting period. Sampling and analysis will be carried out adhering to relevant national procedures.
Any comment:	

Data / Parameter:	$NCV_{ug,y}$
Data unit:	MJ/m^3
Description:	Net calorific value of the upgraded biogas in year y
Source of data to be used:	The NCV of methane is used for ex-ante calculation, since $Q_{ug,y}$ is considered as the amount of the pure methane in the biogas. For the ex-post calculation, the NCV shall be calculated based on the measured methane content ($w_{CH4,y}$) multiply the NCV of methane.
Value of data	35.9for ex-ante $w_{CH4,1,y}$*35.9for ex-post
Description of measurement methods and procedures to be applied:	According to AMS-III.H (ver.15), NCV of the biogas shall be measured directly from the gas stream using an online heating value meter or calculated based on the measured methane content ($w_{CH4,y}$) using the NCV of methane. The measurement methods of $w_{CH4,y}$ please refer to above table.
QA/QC procedures to be applied:	The QA/AC procedures please refer to the $w_{CH4,y}$ monitoring table.
Any comment:	-

Data / Parameter:	$EG_{y,consumed}$
Data unit:	MWh/year
Description:	Amount of electricity consumed by all of the equipments in the Project in year *y*
Source of data to be used:	Data from FRS is for ex-ante calculation Data from on-site measurement by an electricity meter for ex-post calculation
Value of data	2233
Description of measurement methods and procedures to be applied:	Monitored continuously through electricity meters, and record monthly. The accuracy of the meter is 2 grade.
QA/QC procedures to be applied:	The monitoring staff will be trained and the data will be kept up to two years after the end of the crediting period. The electricity meter will undergo maintenance / calibration in accordance with appropriate industry standards.
Any comment:	

Data / Parameter:	$T_{equipment,y}$
Data unit:	hours
Description:	Operation time of the equipment in hours in year y
Source of data to be used:	The data from Feasibility study report (FSR) are used for ex-ante calculation. Ex-post record will be used for ex-post calculation.
Value of data	7920
Description of measurement methods and procedures to be applied:	The compressor and PSA operation start & stop times will be recorded and the operating hours will be accumulated on a monthly basis. The accuracy of the data is 1′.
QA/QC procedures to be applied:	The shut-down period will be recorded clearly. The monitoring staff will be trained and the data will be kept up to two years after the end of the crediting period.
Any comment:	

Data / Parameter:	$CT_{bb,y}$
Data unit:	m^3/truck
Description:	Average truck freight volume capacity for the transportation of bottles with upgraded biogas
Source of data to be used:	The data from the nameplate attached on the truck is used for ex-ante calculation. For ex-post calculation, the record data will be used.
Value of data	2304 (Based on the nameplate, the capacity per truck is 11.52m^3 under 20MPa, which equals 2304(11.52*200) m^3 under standard pressure (0.1Mpa).Therefore, the capacity per truck is 2304m^3 under standard pressure.)
Description of measurement methods and procedures to be applied:	The freight volume capacity of truck will be recorded through upgraded gas injection column.
QA/QC procedures to be applied:	Any change of the truck type will be recorded. The monitoring staff will be trained and the data will be kept up to two years after the end of the crediting period.
Any comment:	

Data / Parameter:	DAF_{bb}
Data unit:	Km/truck
Description:	The average aggregated distance for transporting the bottled biogas
Source of data to be used:	The data from Feasibility study report (FSR) will be used for ex-ante calculation. For the ex-post calculation, the record data will be used.
Value of data	1200 (2*600)
Description of measurement methods and procedures to be applied:	The distance for transporting the bottled biogas will be recorded.
QA/QC procedures to be applied:	If there is any change of the transportation destination, the distance will be re-measured. The monitoring staff will be trained and the data will be kept up to two years after the end of the crediting period.

Any comment:	

Data / Parameter:	$FC_{coal,PJ,y}$
Data unit:	t
Description:	Quantity of coal combusted to generate the steam consumed by the project activity during the year y
Source of data to be used:	Ex-ante calculation does not adopt this parameter. Ex-post measure will be used for ex-post calculation.
Value of data	Calculated as $FC_{coal,total,y}$ *$Q_{steam,PJ,y}$/ $Q_{steam,total,y}$
Description of measurement methods and procedures to be applied:	The steam used in this project activity is only a small part of the total amount of steam generated by a steam boiler. Two steam flow meters will be installed separately to monitor the total amount of steam generated ($Q_{steam,total,y}$) and the amount of steam used by this project activity ($Q_{steam,PJ,y}$) continuously. And the total quantity of the coal combusted in the steam boiler ($FC_{coal,total,y}$) will be measured continuously by a weighbridge and recorded on a monthly basis. Then $FC_{coal,PJ,y}$ will be calculated as $FC_{coal,total,y}$ * $Q_{steam,PJ,y}$/ $Q_{steam,total,y}$
QA/QC procedures to be applied:	The monitoring staff will be trained and the data will be kept up to two years after the end of the crediting period. The flow meter will undergo maintenance / calibration in accordance with specification provided by the manufacturer.
Any comment:	Formula (13) is used for ex-ante calculation, and the formula (12) will be used for ex-post calculation according to "*Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion*"

Data / Parameter:	$EF_{CO2,coal,y}$
Data unit:	tCO_2/MJ
Description:	Upper value of CO_2 emission factor of Anthracite type of coal in year *y*
Source of data to be used:	*IPCC 2006 Revised Guidelines Vol.2 Tab2.2*
Value of data	$10.1*10^{-5}$
Description of measurement methods and procedures to be applied:	Review the appropriateness of the data annually based on the actual type of coal combusted
QA/QC procedures to be applied:	-
Any comment:	Any future revision of the IPCC Guidelines should be taken into account

Data / Parameter:	$Q_{ww,PSA,y}$
Data unit:	m^3/year
Description:	Volume of wastewater discharge from upgrading installation(PSA) in year y
Source of data to be used:	The data from project owner are used for ex-ante calculation. Ex-post measure will be used for ex-post calculation.
Value of data	8.25
Description of measurement methods and procedures to be applied:	As the project uses PSA system to upgrade biogas, and the wastewater generated from PSA is just steam water from the biogas which the volume is very little, therefore the volume of the wastewater can be monitored continuously by the measuring vessel and data recorded on a weekly basis.
QA/QC procedures to	The measuring vessel should be purchased with the production certificate.

be applied:	
Any comment:	

Data / Parameter:	**$[CH_4]_{ww,PSA,y}$**
Data unit:	mg/L
Description:	Dissolved methane contained in the wastewater discharged from PSA in year y
Source of data to be used:	Default value of dissolved methane contained in water for ex-ante calculation. Monitored data will be used for ex-post calculation.
Value of data	41 mg/L under 0℃ and 1 atmosphere[48]
Description of measurement methods and procedures to be applied:	Samples are taken at least every six months during normal operation of the facility
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	Parameters for the emergency flare
Data unit:	1. hour 2. m^3 3. ℃
Description:	1. operation time of the emergency flare. 2. the quantity of biogas sent to the flare 3. temperature in the exhaust gas of the flare
Source of data to be used:	Project participant
Value of data	-
Description of measurement methods and procedures to be applied:	1. The time of the upgrading facility shut down and emergency flare operation & stop should be recorded manually. 2. A continuous gas flow meter is installed before the flare and data recorded on a monthly basis. 3. the exhaust gas stream in the flare by a thermocouple continuously and recorded on an hourly basis. The flare is installed before the flow meter which is used for monitoring the captured biogas. The emission reduction during the period that flare operates is deemed as 0 for conservative consideration
QA/QC procedures to be applied:	-
Any comment:	The methodology require the project participants to ensure that the captured biogas is flared at the site of its capture using an (emergency) flare during the periods when the biogas upgrading facility is closed due to scheduled maintenance or repair of equipment or during exigencies.

Data / Parameter:	Contracts between the project participant and each end-user
Data unit:	-
Description:	The clause of *"No emission reductions may be claimed from the displacement of*

[48] http://www.methane-stripping.com/html/solubility_curve.html

	fuels from the end use of bottled biogas" should be specified in the contracts.
Source of data to be used:	Project participant
Value of data	The contract between the project participant and Shandong Dongxu Heat Energy Science & Technology Development Co., Ltd. The contract between Shandong Dongxu Heat Energy Science & Technology Development Co., Ltd. and Shandong Jiacheng Steel Co., Ltd., the only end-user.
Description of measurement methods and procedures to be applied:	Relevant contracts should be provided for verification annually
QA/QC procedures to be applied:	-
Any comment:	-

B.7.2 Description of the monitoring plan:

>>

This monitoring plan for the project activity will be implemented in order to monitor the parameters used to calculated emission reductions generated by the project activity. The detailed aspect is described as follow:

1. Management structure

A CDM manager who is also as the project general manager is nominated to take the overall responsibility for the monitoring activity on this project. The management structure and position duties are specified in Figure B.3

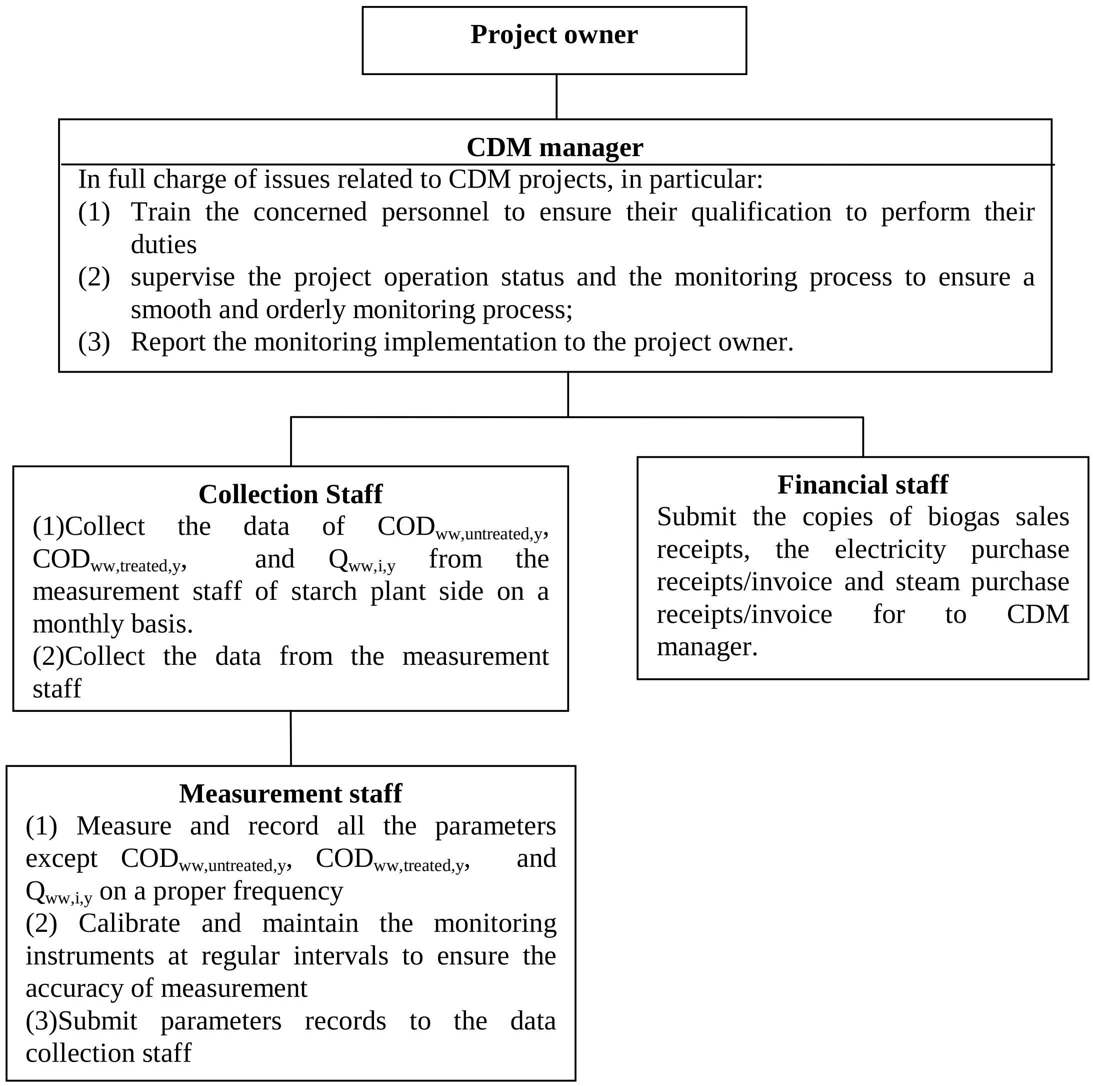

Figure B.3 Management Structure of the Monitoring Plan

2. Equipment and Installation of Monitoring

The monitoring system is shown in the following graph:

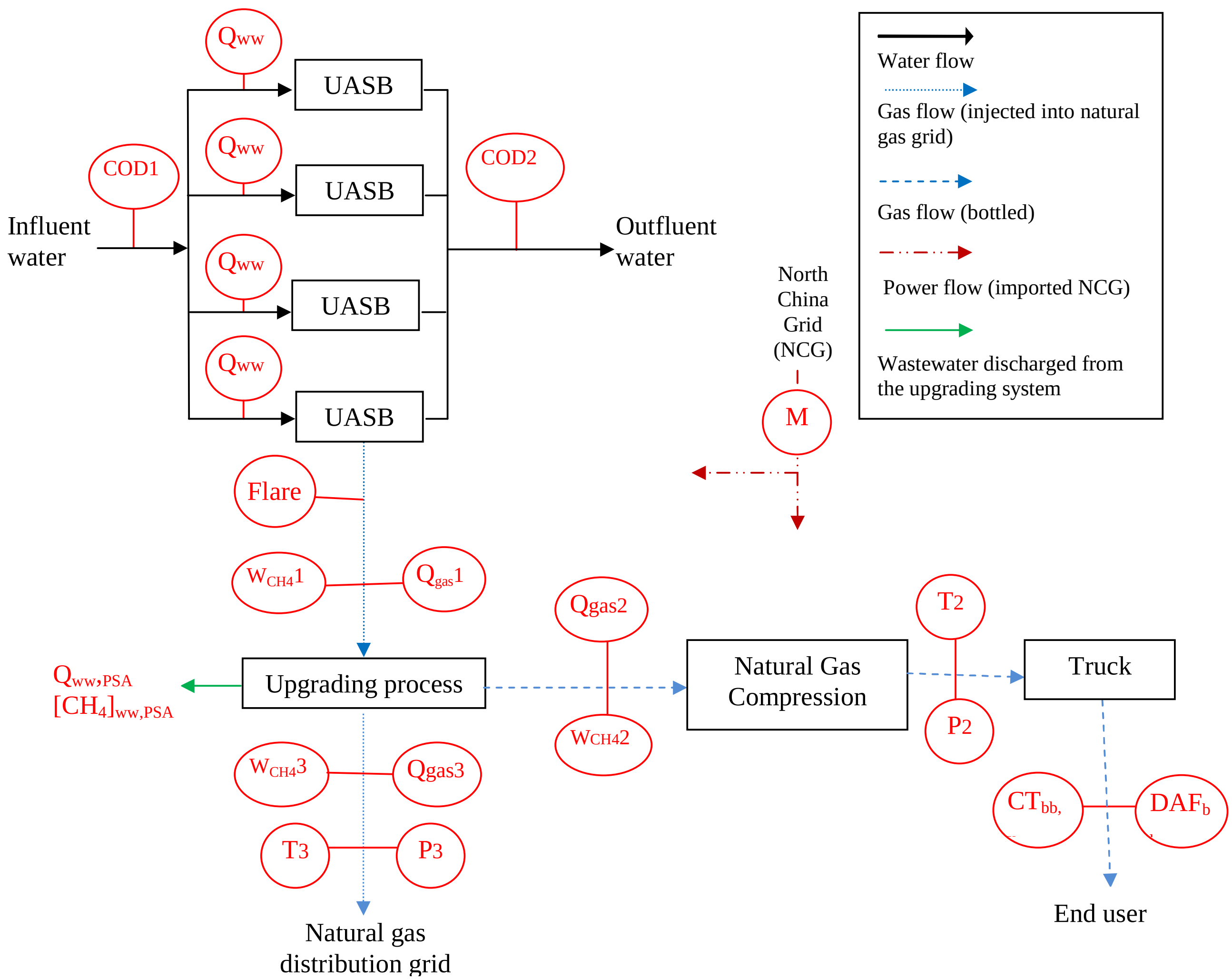

Fig.B.4 monitoring graph

Table B.15. Monitoring parameters

Symbol	Data monitoring	Monitoring device and accuracy	Installation position	Measurement frequency
COD	**$COD_{ww,untreated,y}$, $COD_{ww,treated,y}$**: Chemical oxygen demand of the wastewater entering and out of the anaerobic treatment reactor	Sampled and analyzed in the lab with accuracy of ±8.5%	Inlet of the UASB ($COD_{ww,untreated,y}$) and Outlet of the UASB ($COD_{ww,treated,y}$)	The sample will be measured weekly and recorded weekly
Qww	**$Q_{ww,i,y}$**: Volume of wastewater treated	Water flow meter with accuracy of 0.5 grade	In-line of the influent pipe to the four UASB units (one meter per UASB)	Measured continuously and recorded weekly

Qgas1	$\mathbf{Q_{cap,biogas,y}}$ The quantity of biogas (captured)	Biogas flow meter with accuracy of 1.0 grade	Before desulfurization system.	Measured continuously and recorded weekly
Qgas2	$\mathbf{Q_{bb,\ y}}$ The quantity of biogas (bottled)	Monitored by a continuous gas flow meter with accuracy of at least of 0.5 grade.	Before natural gas compressor.	Measured continuously and recorded weekly
Qgas3	$\mathbf{Q_{ug,in,y}}$ The quantity of biogas (injected into grid)	Biogas flow meter with accuracy of 1.5 grade	Before the gas grid connecting point.	Measured continuously and recorded weekly
$W_{CH4}1$	$\mathbf{w_{CH4,ww}}$ The fraction of methane in the gas captured	Biogas analyzer device with accuracy of ±3% of reading (on-line)	Before desulfurization system.	Measured continuously and recorded weekly
$W_{CH4}2$	$\mathbf{w_{CH4,bb,y}}$ The fraction of methane in the gas bottled	Biogas analyzer device with accuracy of ±3% of reading (on-line)	Before natural gas compressor.	Measured continuously and recorded weekly
$W_{CH4}3$	$\mathbf{w_{CH4,grid,y}}$ The fraction of methane in the gas injected into the grid	Biogas analyzer device with accuracy of ±3% of reading (on-line)	Before the gas grid connecting point.	Measured continuously and recorded weekly
T3	$\mathbf{T_{ng}}$:Temperature of biogas injected into grid	The data is displayed on the biogas flow meter with accuracy of 1.5 grade.	Before the gas grid connecting point.	Measured continuously and recorded weekly
P3	$\mathbf{P_{ng}}$:Pressure of biogas injected into grid	Pressure gauge with accuracy of 1.5 grade.	Before the gas grid connecting point.	Measured continuously and recorded weekly
T2	$\mathbf{T_{bb}}$:Temperature of biogas bottled	Temperature sense device with accuracy of 1.5 grade.	Displayed on the injection column installed before bottling	Measured continuously and recorded weekly
P2	$\mathbf{P_{bb}}$:Pressure of biogas bottled	Pressure gauge with accuracy of 1.5 grade.	After natural gas compressor and on the pipe before bottling.	Measured continuously and recorded weekly
M	$\mathbf{EG_{y,consumed}}$:Amount of electricity consumed by all of the equipments in the	Electric meter with accuracy of 2 grade	The location of electricity imported to the Project.	Measured continuously and recorded monthly

	Project			
CTbby	**$CT_{bb,y}$** :Average truck freight volume capacity for the transportation of bottles with upgraded biogas	The freight volume capacity of truck will be recorded through upgraded gas injection column	--	Recorded per truck.
DAFbb	**DAFbb:** The average aggregated distance for transporting the bottle biogas	The distance for transporting the bottled biogas will be recorded per transportation.	--	Recorded per transportation.
Flare	Parameters for the flare	1. operation time of the emergency flare. 2. the quantity of biogas sent to the flare 3. temperature in the exhaust gas of the flare	Before the flow meter which is used for monitoring captured biogas(**$Q_{cap,biogas,y}$**)	Monitored continuously
----	**$Q_{ww,PSA,y}$:** Volume of wastewater discharge from upgrading installation in year y	Measuring vessel	Outlet of Gas-water separating tank	Measured continuously and recorded weekly
----	$[CH_4]_{ww,PSA,y}$: Dissolved methane contained in the wastewater discharged from PSA in year y	Sampled and analyzed in the lab	Outlet of Gas-water separating tank	Every six months
----	**$T_{equipment}$:** Operation time of the equipment in hours in year y	Recorded by measurement staff	----	Accumulated monthly
----	$FC_{coal,PJ,y}$: Quantity of coal combusted to generate the steam consumed by the project activity in year y	A weighbridge with accuracy of ± 1% at least is used to monitor the quantity of coal Two steam flow meters with accuracy of ± 1% at least are used to monitor the total amount of steam generated and the	close to the steam boiler One is installed on the steam outlet pipe of steam boiler. The other one is installed on the dedicated steam pipe connected to this	Measured continuously and recorded monthly

		amount of steam used by this project activity	project.	
----	$EF_{CO2,coal,y}$: Upper value of CO_2 emission factor of Anthracite type of coal in year y	Review the appropriateness according to IPCC 2006	----	Annually
Contracts between the project participant and each end-user				Annually

Besides the above monitored parameters, the following parameters can be calculated from other parameters and don't need to be monitored:

(1) $COD_{ww,removed,PJ,k,y}$: calculated as **$COD_{ww,untreated,y}$** minus **$COD_{ww,treated,y}$**

(2) $NCV_{ug,y}$:according to AMS-III.H (ver15), NCV of the biogas shall be calculated based on the measured methane content (**$w_{CH4,y}$**) using the NCV of methane.

$NCV_{ug,y} = w_{CH4,y} * 35.9$ MJ/m^3

3、Date collection and management

The monitoring data should be collected and recorded at a pre-fixed frequency specified in the table B.15. The monitoring parameters like **$Q_{ww,i,y}$** , **$COD_{ww,untreated,y}$, $COD_{ww,treated,y}$** of wastewater entering UASB and leaving UASB, shall be measured by measurement staff of starch plant and collected by the collection staff of the Project[49]. Other parameters shall be measured and recorded by the measurement staff of the Project.

The records should be submitted to the CDM manager at the end of each quarter, and the measurement staff keep a set of copy ones. All these records shall be verified by the CDM Manager and kept up to 2 years after the end of the crediting period.

4、Calibration

In order to ensure the reliability of the data measured, the monitoring instruments should be calibrated as per specification provided by the manufacturer.

5、QA/QC

In order to ensure monitoring plan high quality, QA/QC measures are carried out in procedures making, equipment calibrating and staff training.

The monitoring procedures, especially laboratory analysis, are identified and developed according to relevant industrial standards. All the analysis result can be tracked and re-produced.

All the monitoring equipments, especially lab instruments, are calibrated before operation by certified entities. In order to ensure accuracy of equipments, the calibration is carried out according to relevant standards, the calibration records are considered as supporting evidences for emission reduction calculation and verification.

[49] Waste water monitoring contract was signed between the Project owner and the Junhuang biochemical technology Group.

The operation and maintenance of equipments are carried out by certified person. Any equipment failed or accidental situation will be reported to CDM director and handling immediately, the replacement will be implemented soon if necessary. The specification of equipment is considered as guide for operation, maintenance and calibration.

All the staffs who included in this monitoring plan will take training before project operation, the training includes CDM knowledge and special skill for monitoring as following:

(1) Roles and responsibility of each staff

(2) Information about data to be collected

(3) Maintenance of data records in logbook and spreadsheet

(4) Procedures of monitoring instruments maintenance

etc,

6、Measures to take in case of emergency

In case of emergency, the equipments will be shut down and the proper approach will be implemented to ensure the normal operation. If this emergency is caused by the malfunction of the equipments, the repairing or replacement will be implemented soon. Such emergency will be recorded and the emission reductions will be calculated as zero during this period.

7、Verification

Verification will be carried out based on project participants' decision. The PPs are responsible for the monitoring report and Emission reduction internal audit.

B.8 Date of completion of the application of the baseline and monitoring methodology and the name of the responsible person(s)/entity(ies)

>>

The application of the baseline study and monitoring methodology of the Project was completed on 15/08/2009 by

Ms. Lu Wang
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Tel: +86(0)10 64085566

Fax: +86(0)10 64085565

Website: www.accordgetc.com

Entity: ACT Global Environment Technology Co., Ltd

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Website: www.accordgetc.com

Entity: ACT Global Environment Technology Co., Ltd

The person/entity is not project participant listed in Annex 1.

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>
31/10/2008 (the date of the construction contract)

According to the glossary of CDM terms, the earliest date of a CDM project activity is the earliest date at which either the implementation or construction or real action of a project activity begins. Therefore, based on the table above, the construction contract is the starting date of the project.

C.1.2. Expected operational lifetime of the project activity:

>>10 years

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

>>
Not applicable

C.2.1.2. Length of the first crediting period:

>>
Not applicable

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>
01/10/2011 or the registered date, whichever is later.

C.2.2.2. Length:

>>
10 years

SECTION D. Environmental impacts

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

>>
The environment impact assessment report was approved by Boxing County Environment Protect Bureau (Bohuanbiao[2008]23) on 14th,October,2008. The impact on the surrounding environment by the Project and the measure taken by the project owner to alleviate the negative impact are shown as follows:

During construction period:
Noise pollution: The noises mainly come from construction machines. For the limited construction amount and the sound proof effect of the surrounding buildings and woods, the construction will have little impact on the surrounding environment. The project owner will alleviate the impact above by reducing the construction during night, choosing low-noise construction and installing temporary sound-proof facility.

Air pollution: Fugitive dust and exhaust gas from machine and transportation vehicle will result in air pollution. For the village nearby is far from project site, the impact is not significant. The project owner will take some measures to alleviate the impact above by sparking, washing, low-speed driving and so on.

Solid waste: Solid waste is mainly from domestic waste, residue soil and stone generated from earth-rock construction. The Project will stack these solid wastes at directing site, so the impact of solid waste is insignificant.

Waste water: The waste water including domestic sewage and wastewater generated from construction. Because the quantity of waste water is small and quality of that is simple, so the impact is insignificant. The domestic sewage will be treated in the septic tank and the residue will be used as fertilizer.

During operation period:
Noise pollution: The noise generated from compressors and pumps is the main noise during operation period. Low-noise equipment will be chosen to decrease the noise pollution.
Air pollution: The Project involves biogas utilization, which CH_4 in the biogas will be used as energy and H_2S will be destroyed. The air pollution resulted from the wastewater treatment will be solved when the project put into operation.
Solid waste: Small amount of desulfurizer and decarburizer will be generated during the process of biogas desulfurization and decarburization. These desulfurizer and decarburizer will be recovered by supplier. None of them will be discharged.
Waste water: A little of wastewater will be generated during deep-dehydration of product. Because the quantity of wastewater generated is quite small, it will be treated mixed with domestic wastewater, that is, treated in the septic tank and the residue will be used as fertilizer.
In conclusion, construction and operation of the Project will not have significant impact on the environment.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>>

The project involves biogas recovery and utilization, and the impact on environment is in accordance with the relevant national regulation. Environmental impacts are considered not significant.

SECTION E. Stakeholders' comments

E.1. Brief description how comments by local stakeholders have been invited and compiled:

>>

The stakeholders identified for the Project are the residents near the Project, local government and staff of Xiangchi Group. Staff of Boxing Yuantong Bio-energy Co., Ltd. made a survey in February 5-8, 2009 on the stakeholders. The survey was conducted through distributing and collecting responses to a questionnaire. 40 questionnaires were distributed and 40 questionnaires are returned, with response rate 100%. The questionnaires mainly focus on following issues:

·Do you know this Project?

·What positive impacts will be introduced by the implementation of the Project on the livelihood of stakeholders?

·What positive impacts will be introduced by the implementation of the Project on the local sustainable development?

·What positive impacts will be introduced by the implementation of the Project on the environment?

·What negative impacts will be introduced by the implementation of the Project from the view of stakeholders?

·What measures should be applied to reduce the negative impacts from the view of stakeholders?

·What is the attitude of the stakeholders on the construction and operation of the Project?

E.2. Summary of the comments received:

>>

Based on the 40 returned questionnaires, the summary of the comments are shown as follows:

·All people surveyed (100%) support the construction of the Project.

·Possible positive impacts considered by the people surveyed to be caused by the construction of the Project include improvement of living conditions (97.5%), increase in job opportunity (40%), increase in income (12.5%)，increase in supply of natural gas in the city distribution grid (40%), utilization local biogas resources(92.5%), energy-save and emission-reduction which accords with national policy (82.5%), diversifying natural gas supply and decrease dependence on fossil fuel (67.5%), reducing emission of toxic gas (37.5%), reducing GHG emission (100%) .

·No one think the project has any negative impact.

E.3. Report on how due account was taken of any comments received:

>>

As shown in Section E.2, the Project received positive comments which led to no changes of the initial project planning.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Boxing Yuantong Bio-energy Co.,Ltd. (project owner)
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<u>Annex 2</u>

INFORMATION REGARDING PUBLIC FUNDING

The financial plans for the Project activity does not involve ODA from Annex I countries.

Annex 3

BASELINE INFORMATION

The *"Tool to calculate the emission factor for an electricity system (ver.02.1.0)"* is used to calculate the emission factor for electricity which is determined by calculating the "operating margin" (OM) and "build margin" (BM) as well as the "combined margin" (CM).

The tool provides procedures to determine the following parameters:

Parameter	***SI Unit***	***Description***
$EF_{grid,CM,y}$	tCO_2/MWh	*Combined margin CO_2 emission factor for grid connected power generation in year y*
$EF_{grid,BM,y}$	tCO_2/MWh	*Build margin CO_2 emission factor for grid connected power generation in year y*
$EF_{grid,OM,y}$	tCO_2/MWh	*Operating margin CO_2 emission factor for grid connected power generation in year y*

The following is the detailed process of calculating the baseline CO_2 emission factor of the grid which the Project connected to according to the steps provided by the *Tool to calculate the emission factor for an electricity system.*

STEP 1. Identify the relevant electricity system.

Chinese DNA has published a delineation of the project electricity system and connected electricity system. The project physically connects through transmission and distribution lines to the North China Grid. It is composed of Beijing Power Grid, Tianjing Power Grid, Hebei Power Grid, Shandong Power Grid, Inner Mongolia Autonomous Region Power Grid. Therefore, the project selects the North China Grid for the calculation of baseline emission factor.

When there exists net electricity imports from a connected electricity system within the same host country(ies)， one of the following options to determine the CO_2 emission factor(s) for net electricity imports ($EF_{grid,import,y}$) from a connected electricity system within the same host country(ies):

(a) 0 tCO_2/MWh, or

(b) The weighted average operating margin (OM) emission rate of the exporting grid, determined as described in step 4 (d) below; or

(c) The simple operating margin emission rate of the exporting grid, determined as described in step4 (a), if the conditions for this method, as described in step 3 below, apply to the exporting grid; or

(d) The simple adjusted operating margin emission rate of the exporting grid, determined as described in step 4 (b) below.

Option C will be chosen in the PDD.

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

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

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

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

For the Project, option I is chosen.

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

According to the *Tool to calculate the emission factor for an electricity system* four methods compute the Operating Margin Emission factor can be used as follows:

(a) Simple OM, or

(b) Simple adjusted OM, or

(c) Dispatch data analysis OM, or

(d) Average OM.

The simple OM method only can be used when low-cost/must run resources constitute less than 50% of total amount of grid generating output 1) in the recent five years, or 2) by taking into account long-term normal for hydroelectricity generation. If the dispatch data is available the (c) Dispatch Data Analysis OM method should be the first methodological choice, while in case of the Project, the (a) Simple OM method is adapted with two reasons as follows:

(1) In cases where China presently the power grid dispatch and load data are unavailable as business secrets, so (b) and (c) cannot apply in the Project for calculating the Operating Margin Emission Factor ($EF_{grid,OM,y}$).

(2) During the most recent 5 years, from 2003 to 2007 the hydroelectricity, nuclear-electricity and other low-cost/must run resources annual proportion in North China Grid is: 33.87% in 2003 and 40.17% in 2004, 38.28% in 2005, 36.90% in 2006, 35.79% in 2007,[50], which are much less than 50%.

For simple OM, the emission factor can be calculated using either of the two following data vintages:

- Ex ante option: A 3-year generation weighted average, based on the most recent data available at the time of submission of the CDM-PDD for validation, without requirement to monitor and recalculate the emissions factor during the crediting period, or
- Ex post option: The year in which the project activity displaces grid electricity, requiring the emission factor to be updated annually during monitoring. If the data required calculating the emission factor for year y usually only available later than six months after the end of year y.

Project participant employs “ex-ante” for its operation margin calculation with two reasons as follows:

1) the full generation-weighted average for the most recent 3 years for which data are available at the time of PDD submission; and

2) the calculation adopts *Notification on Determining Baseline Emission Factor of China’s Grid (2 July 2009)*, which is published by Chinese DNA, therefore it is considered as authoritative data. In this notification, the OM is calculated *ex-ants*.

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

From the *Tool to calculate the emission factor for an electricity system*, ($EF_{grid,simple,OM}$) may be calculated:

[50] *China Electric Power Yearbook*, 2004, 2005, 2006,2007, 2008

- Based on the net electricity generation and a CO_2 emission factor of each power unit (Option A), or
- Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system (option B)

Because the fuel consumption data is unavailable for each power unit, Operation A cannot be used. At the same time 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, at the same time the off-grid power plants are not included in the calculation so Option B was the only operation can be used.

Where Option B is used, the simple OM method formula of $EF_{Grid,OM,Simple,y}$ calculation is:

$$EF_{Grid,OM,simple,y} = \frac{\sum_i FC_{i,y} \bullet NCV_{i,y} \bullet EF_{CO2,i,y}}{\sum EG_y} \quad (1)$$

where:

$EF_{grid,OMsimply,y,}$ is simple operating margin CO_2 emission factor in year y(tCO_2/MWh);

$FC_{i,y}$ is amount of fossil fuel type i consumed in the project electricity system in year y;

$NCV_{i,y}$ is net calorific value (energy content) of fossil fuel type i in year y (GJ / mass or volume unit);

$EF_{CO2,i,y}$ is CO_2 emission factor of fossil fuel type i in year y (tCO_2/GJ) and

EG_y is net electricity generated and delivered to the grid by power plant / unit m in year y (MWh);

i is all fossil fuel types combusted in power sources in the project electricity system in year y;

y is either the three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option) or the applicable year during monitoring (ex post option), following the guidance on data vintage in step 2.

The data on electricity generation and auxiliary electricity consumption are obtained from the *China Electric Power Yearbook* from 2006 to 2008 (published annually). The data on different fuel consumptions for power generation and the net caloric values of the fuels are obtained from the *China Energy Statistical Yearbook* from 2006 to 2008 (published annually after 2003). The emission factors of the fuels adopted are obtained from *Table 1.3* and *Table 1.4* of the *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, Volume 2, Chap 1, Page 1.21-1.24.

The detailed calculation can be found in another part of Annex 3, the $EF_{grid,OM,y}$ = 1.0069tCO_2/MWh

STEP 5. Calculate the build margin emission factor.

The sample group of power units *m* used to calculate the build margin consists of either:

a) The set of five power units that have been built most recently, or

b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently[51].

Project participants should use the set of power units that comprises the larger annual generation.

In China it is very difficult to obtain the data of the five existing power plants built most recently or the power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that were built most recently. Taking notice of this situation, EB accepts[52] the following deviation in methodology application:

1) Use of capacity additions during the last 1~3 years for estimating the build margin emission factor for grid electricity, i.e. the capacity addition over 1-3years, whichever results in a capacity addition that is close to 20% of total installed capacity.

2) Use proportional weights that correlate to the distribution of installed capacity in place during the selected period above, using plant efficiencies and emission factors of commercially available best practice technology commercially available in the provincial/regional or national grid of China, as a conservative proxy.

In terms of vintage of data, project participants can choose between one of the following two options: Option 1. For the first crediting period, calculate the build margin emission factor ex-ante based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Option 2. For the first crediting period, the build margin emission factor shall be updated annually, ex-post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to 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.

The PDD choose Option 1.

According to the *Tool to calculate the emission factor for an electricity system*, the following equation is adopted to calculate $EF_{grid,BM,y}$.

$$EF_{Grid,BM,y} = \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}} \qquad (2)$$

where:

[51] If 20% falls on part capacity of a unit, that unit is fully included in the calculation.

$EF_{grid,BM,y}$ is build margin CO_2 emission factor in year y (tCO_2/MWh);

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

$EF_{EL,m,y}$ is CO_2 emission factor of power unit m in year y (tCO_2/MWh);

m is power units included in the build margin;

y is most recent historical year for which power generation data is available;

Consider of data availability, The Project adopted the following deviation method which was published by Chinese DNA and accepted by CDM EB[53]:

1) Use of capacity additions during the last 1~3 years for estimating the build margin emission factor for grid electricity.

2) Use of weights estimated using installed capacity in place of annual electricity generation.

And it is suggested to use the efficiency level of the best technology commercially available in the provincial/regional or national grid of China, as a conservative proxy.

Therefore for the Project: First, calculate the share of different power generation technology in recent capacity additions. Second, calculate the weight for capacity additions of each power generation technology. And finally calculate the emission factor use the efficiency level of the best technology commercially available in China.

Since data of installed capacities cannot be separated to coal based, oil based and gas based at present, BM is calculated with following steps and formula:

(1) Calculate the power generation emissions for solid, liquid and gas fuel and each share of total emissions based on the *Energy Balance Table* of the most recent year

$$\lambda_{Coal} = \frac{\sum_{i \in COAL, j} F_{i,j,y} \times COEF_{i,j,y}}{\sum_{i,j} F_{i,j,y} \times COEF_{i,j,y}} \quad (3)$$

$$\lambda_{Oil} = \frac{\sum_{i \in OIL, j} F_{i,j,y} \times COEF_{i,j,y}}{\sum_{i,j} F_{i,j,y} \times COEF_{i,j,y}} \quad (4)$$

52 Http://cdm.unfccc.int/Projects/Deviations

53 http://cdm.unfccc.int/Projects/Deviations ; DNV deviation request, “Request for clarification on use of approved methodology AM0005 for several projects in China”

$$\lambda_{Gas} = \frac{\sum_{i \in GAS, j} F_{i,j,y} \times COEF_{i,j,y}}{\sum_{i,j} F_{i,j,y} \times COEF_{i,j,y}} \quad (5)$$

where:

$F_{i,j,y}$ is the amount of fuel i (in a mass or volume unit) consumed by power j in year(s) y,

$COEF_{i,j,y}$ is the CO_2 emission coefficient of fuel i (tCO_2/tCe), taking into account the carbon content of the fuels (coal, oil and gas) used by power j and the percent oxidation of the fuel in year(s) y, and

COAL, OIL and GAS are footnote group for solid fuels, liquid fuels and gas fuels.

(2) Calculate emission factor for thermal power of the grid based on the result of Step a and the efficiency level of the best technology commercially available in China

$$EF_{Thermal} = \lambda_{Coal} \times EF_{Coal,Adv} + \lambda_{Oil} \times EF_{Oil,Adv} + \lambda_{Gas} \times EF_{Gas,Adv} \quad (6)$$

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

Step c. Calculate BM of the grid based on the result of Step b and the share of thermal power of recent 20% capacity additions.

$$EF_{grid,BM,y} = \frac{CAP_{Thermal}}{CAP_{Total}} \times EF_{Thermal} \quad (7)$$

Where CAP_{Total} is total capacity additions while $CAP_{Thermal}$ is capacity additions of thermal power.

The data on different fuel consumptions for power generation and the net caloric values of the fuels are obtained from the China Energy Statistical Yearbook from 2006 to 2008 (published annually after 2003). The emission factors and oxidation factors of the fuels adopted are obtained from the Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook.

With reference to the Notification on Determining Baseline Emission Factor of China's Grid, the weighted average fuel consumption for power generation of the top 30 sets of 600 MW lowest coal-consumed power generators built in 2007 (322.5 gCe/kWh) and the 200 MW oil/gas based combined cycle power generators (246 gCe/kWh) are taken as the efficiency level of the best technology commercially available in China.

The Build Margin emission factor ($EF_{BM,y}$) of the North China Grid is 0.7802tCO_2e/MWh.

STEP 6. Calculate the combined margin (CM) emissions factor.

Based on the *Tool to calculate the emission factor for an electricity system*, the baseline emission factor ($EF_{grid,CM,y}$) is calculated as the weighted average of the operating margin emission factor ($EF_{grid,OM,y}$) and the build margin emission factor ($EF_{grid,BM,y}$), as

$$EF_{grid,CM,y} = \omega_{OM} \cdot EF_{grid,OM,y} + \omega_{BM} \cdot EF_{grid,BM,y} \qquad (8)$$

According to the *Tool to calculate the emission factor for an electricity system*, both the weight w_{OM} and the weight w_{BM} take 0.5 as default. Therefore the combined baseline emission factor

$EF_{grid,CM,y}$ =0.5×1.0069+0.5×0.7802=0.89355 (tCO_2e/MWh).

The detailed calculation is shown as following:

Table 3.1 Fuel-fired power generation of the North China Grid in 2005

	Electricity generation (MWh)	Auxiliary electricity consumption (%)	Electricity delivered to the grid (MWh)
Beijing	20,880,000	7.73	19,265,976
Tianjin	36,993,000	6.63	34,540,364
Hebei	134,348,000	6.57	125,521,336
Shanxi	128,785,000	7.42	119,229,153
Inner Mongolia Autonomous Region	92,345,000	7.01	85,871,616
Shandong	189,880,000	7.14	176,322,568
Total	603,231,000		560,751,013

Data source: China Electric Power Yearbook 2006

Table 3.2 Fuel-fired power generation of the North China Grid in 2006

	Electricity generation (MWh)	Auxiliary electricity consumption (%)	Electricity delivered to the grid (MWh)
Beijing	20,705,000	7.51	19,150,055
Tianjin	35,924,000	6.86	33,459,614
Hebei	143,888,000	6.63	134,348,226
Shanxi	150,250,000	7.45	139,056,375
Inner Mongolia Autonomous Region	139,593,000	7.58	129,011,851
Shandong	230,922,000	7.12	214,480,354
Total	721,282,000		669,506,473

Data source: China Electric Power Yearbook 2007

Table 3.3 Fuel-fired power generation of the North China Grid in 2007

	Electricity generation (MWh)	Auxiliary electricity consumption (%)	Electricity delivered to the grid (MWh)
Beijing	22,300,000	7.51	20,625,270
Tianjin	39,900,000	6.53	37,294,530
Hebei	163,300,000	6.67	152,407,890
Shanxi	173,400,000	7.99	159,545,340
Inner Mongolia Autonomous Region	180,100,000	7.77	166,106,230
Shandong	259,100,000	7.23	240,367,070
Total	838,100,000		776,346,330

Data source: China Electric Power Yearbook 2008

Table 3.4 Calculation of simple OM emission factor of the North China Grid in 2005

Fuel	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Toal fuel	Default carbon content (tC/TJ)	Oxidation Rate (%)	Emission Factor ($kgCO_2$/TJ)	NCV (MJ/t or $1000m^3$)	Emission (tCO_2e)
		A	B	C	D	E	F	G=A+B+C+D+E+F	H	I	J	K	L=G*J*K/100000 (mass unit) or L=G*J*K/10000 (volume unit)
Coal	10^4t	897.75	1675.2	6726.5	6176.45	6277.23	10405.4	**32158.53**	25.8	100	87,300	20,908	586,979,486
Cleaned coal	10^4t						42.18	**42.18**	25.8	100	87,300	26,344	970,069
Other washed coal	10^4t	6.57		167.45	373.65		108.69	**656.36**	25.8	100	87,300	8,363	4,792,018
Coke	10^4t					0.21	0.11	**0.32**	29.2	100	95,700	28,435	8,708
Coke oven gas	10^8m^3	0.64	0.75	0.62	21.08	0.39		**23.48**	12.1	100	37,300	16,726	1,464,870
Other gas	10^8m^3	16.09	7.86	38.83	9.88	18.37		**91.03**	12.1	100	37,300	5,227	1,774,786
Crude oil	10^4t					0.73		**0.73**	20	100	71,100	41,816	21,704
Gasoline	10^4t			0.01				**0.01**	18.9	100	67,500	43,070	291
Diesel	10^4t	0.48		3.54		0.12		**4.14**	20.2	100	72,600	42,652	128,197
Fuel oil	10^4t	12.25		0.23		0.06		**12.54**	21.1	100	75,500	41,816	395,901
LPG	10^4t							**0**	17.2	100	61,600	50,179	0
Refinery gas	10^4t			9.02				**9.02**	15.7	100	48,200	46,055	200,231
Nature gas	10^8m^3	0.28	0.08		2.76			**3.12**	15.3	100	54,300	38,931	659,553
Other oil	10^4t							**0**	20	100	75,500	41,816	0

products													
Other coking products	10^4t							**0**	25.8	100	95,700	28,435	0
Other energy	10^4t Ce	8.58		32.35	69.31	7.27	118.9	**236.41**	0	0	0	0	0
Total emission of the North China Grid (tCO_2e) L								647649331					
Fossil power supply of the North China Grid (MWh) M								560,751,013					
Imported electricity from the Northeast China Grid (MWh) N								3,929,000					
Emission factor of Northeast China Grid(tCO_2e/MWh) O								1.16489					
Total emission (tCO_2e) P=L+O*N								601,972,682					
Total electricity delivered to the grid (MWh) Q=M+N								564,680,013					
Emission factor(tCO_2/MWh) R=P/Q								1.06604					

Data sources: China Energy Statistical Yearbook 2006

Table 3.5 Calculation of simple OM emission factor of the North China Grid in 2006

Fuel	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Toal fuel	Default carbon content (tC/TJ)	Oxidation Rate (%)	Emission Factor ($kgCO_2$/TJ)	NCV (MJ/t or $1000m^3$)	Emission (tCO_2e)
		A	B	C	D	E	F	G=A+B+C+D+E+F	H	I	J	K	L=G*J*K/100000 (mass unit) or L=G*J*K/10000 (volume unit)
Coal	10^4t	796.63	1639.2	6867.99	6968.88	8404.05	10930.66	**35607.41**	25.8	100	87,300	20,908	649,930,803
Cleaned coal	10^4t						39.77	**39.77**	25.8	100	87,300	26,344	914,643
Other washed coal	10^4t	6.36		214.13	371.14	61.77	544.6	**1198**	25.8	100	87,300	8,363	8,746,477
Coke	10^4t	7.97					27.77	**35.74**	26.6	100	87,300	20,908	652,351
Coke oven gas	10^8m^3						3.23	**3.23**	29.2	100	95,700	28,435	87,896
Other gas	10^8m^3	0.38	0.63	5.8	22.32	0.64	5.79	**35.56**	12.1	100	37,300	16,726	2,218,517
Crude oil	10^4t	20.66	6.58	69.72	13.79	22.76	7.22	**140.73**	12.1	100	37,300	5,227	2,743,772
Gasoline	10^4t					0.74		**0.74**	20	100	71,100	41,816	22,001
Diesel	10^4t			0.01				**0.01**	18.9	100	67,500	43,070	291
Fuel oil	10^4t	0.21		3.01		0.07	6.32	**9.61**	20.2	100	72,600	42,652	297,577
LPG	10^4t	6.38		0.08			4.1	**10.56**	21.1	100	75,500	41,816	333,391
Refinery gas	10^4t						0.01	**0.01**	17.2	100	61,600	50,179	309
Nature gas	10^8m^3			2.43			2.32	**4.75**	15.7	100	48,200	46,055	105,443
Other oil products	10^4t	3.41	0.73		0.53			**4.67**	15.3	100	54,300	38,931	987,216
Other coking	10^4t						0.28	**0.28**	20	100	75,500	41,816	8,840

products													
Other energy	10^4tCe							**0**	25.8	100	95,700	28,435	0
Total emission of the North China Grid (tCO_2e) L								667,049,525					
Fossil power supply of the North China Grid (MWh) M								776,346,330					
Imported electricity from the Northeast China Grid (MWh) N								2,618,060					
Emission factor of Northeast China Grid(tCO_2e/MWh) O								1.14972					
Imported electricity from the Central China Grid (MWh) P								497,060					
Emission factor of Central China Grid(tCO_2e/MWh) Q								1.12157					
Total emission (tCO_2e) R=L+O*N+P*Q								672,621,593					
Total electricity delivered to the grid (MWh) S=M+N+P								670,617,037					
Emission factor(tCO_2/MWh) T=R/S								0.99702					

Data sources: China Energy Statistical Yearbook 2007

Table 3.6 Calculation of simple OM emission factor of the North China Grid in 2007

Fuel	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Toal fuel	Default carbon content (tC/TJ)	Oxidation Rate (%)	Emission Factor ($kgCO_2$/TJ)	NCV (MJ/t or $1000m^3$)	Emission (tCO_2e)
		A	B	C	D	E	F	G=A+B+C+D+E+F	H	I	J	K	L=G*J*K/100000 (mass unit) or L=G*J*K/10000 (volume unit)
Coal	10^4t	816.17	1753.99	7716.13	7510.06	10434.25	11884.83	**40115.43**	25.8	100	87,300	20,908	732,214,267
Cleaned coal	10^4t						18.43	**18.43**	25.8	100	87,300	26,344	423,859
Other washed coal	10^4t	5.76		156.89	478.81	48.57	756.84	**1446.87**	25.8	100	87,300	8,363	10,563,452
Coke	10^4t	7.93					42.86	**50.79**	26.6	100	87,300	20,908	927,054
Coke oven gas	10^8m^3			0.02			4.09	**4.11**	29.2	100	95,700	28,435	111,843
Other gas	10^8m^3	0.07	0.72	3.13	25.46	2.58	13.61	**45.57**	12.1	100	37,300	16,726	2,843,020
Crude oil	10^4t	11.8	7.6	88.38	72.8	28.17	29.64	**238.39**	12.1	100	37,300	5,227	4,647,821
Gasoline	10^4t							**0**	20	100	71,100	41,816	0
Diesel	10^4t			0.01				**0.01**	18.9	100	67,500	43,070	291
Fuel oil	10^4t	0.33		2.35		0.62	5.08	**8.38**	20.2	100	72,600	42,652	259,490
LPG	10^4t	4.74		0.18			2.35	**7.27**	21.1	100	75,500	41,816	229,522
Refinery gas	10^4t							**0**	17.2	100	61,600	50,179	0
Nature gas	10^8m^3	0.06		2.85			1.65	**4.56**	15.7	100	48,200	46,055	101,225
Other oil products	10^4t	5.03	0.73		0.54	4.22	0.01	**10.53**	15.3	100	54,300	38,931	2,225,993

Other coking products	10^4t	1.72						**1.72**	20	100	75,500	41,816	54,302
Other energy	10^4tCe	4.74						**4.74**	25.8	100	95,700	28,435	128,986
Total emission of the North China Grid (tCO_2e) L								754,731,124					
Fossil power supply of the North China Grid (MWh) M								776,346,330					
Imported electricity from the Northeast China Grid (MWh) N								1,789,750					
Emission factor of Northeast China Grid(tCO_2e/MWh) O								1.08186					
Imported electricity from the Central China Grid (MWh) P								803000					
Emission factor of Central China Grid(tCO_2e/MWh) Q								1.10197					
Total emission (tCO_2e) R=L+O*N+P*Q								757,552,268					
Total electricity delivered to the grid (MWh) S=M+N+P								778,939,080					
Emission factor(tCO_2/MWh) T=R/S								0.97254					

Data sources: China Energy Statistical Yearbook 2008

$EF_{OM,y}=(P_{2005}+R_{2006}+R_{2007})/(Q_{2005}+S_{2006}+S_{2007})$ = 1.00689 tCO_2e/MWh

Table 3.7 Data for simple BM emission factor

Fuel	Unit	Beijing	Tianjin	Hebei	Shanxi	Shandong	Inner Mongolia	Total fuel	NCV (MJ/t or $1000m^3$)	Default carbon content (tC/TJ)	Oxidation Rate	Emission (tCO_2e)
		A	B	C	D	E	F	G=A+…+F	H	I	J	K=G×H×I×J/100,000
Coal	10^4t	816.17	1,753.99	7,716.13	7,510.06	11,884.83	10,434.3	40,115.43	20,908	87,300	1	732,214,267
Cleaned coal	10^4t	0	0	0	0	18.43	0	18.43	26,344	87,300	1	423,859
Other washed coal	10^4t	5.76	0	156.89	478.81	756.84	48.57	1,446.87	8,363	87,300	1	10,563,452
Briquette	10^4t	7.93	0	0	0	42.86	0	50.79	20,908	87,300	1	927,054
Coke	10^4t	0	0	0.02	0	4.09	0	4.11	28,435	95,700	1	111,843
Other coke products	10^4t	4.74	0	0	0	0	0	4.74	28,435	95,700	1	128,986
Total solid fuel	**744,369,461**											
Crude oil	10^4t	0	0	0	0	0	0	0	41,816	71,100	1	0
Gasoline	10^4t	0	0	0.01	0	0	0	0.01	43,070	67,500	1	291
Diesel oil	10^4t	0.33	0	2.35	0	5.08	0.62	8.38	42,652	72,600	1	259,490
Fuel oil	10^4t	4.74	0	0.18	0	2.35	0	7.27	41,816	75,500	1	229,522
Other oil products	10^4t	1.72	0	0	0	0	0	1.72	41,816	75,500	1	54,302
Total liquid fuel	**543,604**											
Nature gas	10^7m^3	50.3	7.3	0	5.4	0.1	42.2	105.3	38,931	54,300	1	2,225,993
Coke oven gas	10^7m^3	0.7	7.2	31.3	254.6	136.1	25.8	455.7	16,726	37,300	1	2,843,020
Other coal gas	10^7m^3	118	76	883.8	728	296.4	281.7	2,383.9	5,227	37,300	1	4,647,821
LPG	10^4t	0	0	0	0	0	0	0	50,179	61,600	1	0
Finery gas	10^4t	0.06	0	2.85	0	1.65	0	4.56	46,055	48,200	1	101,225
Total gas fuel	**9,818,059**											

Total	**754,731,124**

Data sources: China Energy Statistical Yearbook 2008

Table 3.8 Emission factor of best technology

	Variable	Electricity supply efficiency	Carbon content of fuel (tC/TJ)	Oxidation rate	Emission factor (tCO_2/MWh)
		A	B	C	3.6/A/1,000,000×B×C
Coal-based power plants	$EF_{coal,y}$	38.10	87,300	1	0.8249
Gas-based power plants	$EF_{gas,y}$	49.99	75,500	1	0.5437
Oil-based power plants	$EF_{oil,y}$	49.99	54,300	1	0.3910

Obtained from formula (15)-(17) in section B6.1: $\lambda_{Coal,y}$ =98.63%, $\lambda_{Oil,y}$ =0.07%, $\lambda_{Gas,y}$ =1.30%

$EF_{Thermal,y} = \lambda_{Coal,y} \times EF_{Coal,Adv} + \lambda_{Oil,y} \times EF_{Oil,Adv} + \lambda_{Gas,y} \times EF_{Gas,Adv}$ =0.8191tCO_2e/MWh

Table 3.9 Installed capacity of the China Northern Power Grid in 2007

Installed capacity	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total
Thermal power	MW	3,900	6,920	29,020	30,950	39,870	54,140	164,800
Hydro power	MW	1050	10	780	790	830	1,050	4,510
Nuclear power	MW	0	0	0	0	0	0	0
Wind power and Other	MW	2.7	0	410	0	1,096.5	210	1,719.2
Total	MW	4,952.7	6,930	30,210	31,740	41,796.5	55,400	171,029.2

Data source: China Electric Power Yearbook 2008

Table 3.10 Installed capacity of the China Northern Power Grid in 2006

Installed capacity	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total
Thermal power	MW	3,984	6,512	26,087	26,661	28,899	49,395	141,538
Hydro power	MW	1,053	5	785	790	818	553	4,004
Nuclear power	MW	0	0	0	0	0	0	0
Wind power and Other	MW	24	24	218	0	565	106	937
Total	MW	5,061	6,541	27,090	27,451	30,282	50,054	146,479

Data source: China Electric Power Yearbook 2007

Table 3.11 Installed capacity of the China Northern Power Grid in 2005

Installed capacity	Unit	Beijing	Tianjin	Hebei	Shanxi	Inner Mongolia	Shandong	Total
Thermal power	MW	3,833.5	6,149.9	22,333.2	22,246.8	19,173.3	37,332	111,068.7
Hydro power	MW	1,025	5	784.5	783	567.9	50.8	3,216.2
Nuclear power	MW	0	0	0	0	0	0	0
Wind power and Other	MW	24	24	48	0	208.9	30.6	335.5
Total	MW	4,882.5	6,178.9	23,165.7	23,029.8	19,950.2	37,413.4	114,620.4

Data source: China Electric Power Yearbook 2006

Table 3.12 Calculation of BM emission factor of the North China Grid

	Installed capacity in 2005	Installed capacity in 2006	Installed capacity in 2007	Capacity additions from 2005-2007	Share in total capacity additions
	A	B	C	D=C-A	
Thermal power (MW)	111,068.7	141,538	164,800	53,731.3	95.25%
Hydro power (MW)	0	0	0	0	0%
Nuclear power(MW)	3,216.2	4,004	4,510	1,293.8	2.29%
Wind power and other (MW)	335.5	937	1,719.2	1,383.7	2.45%
Total (MW)	**114,620.4**	**146,479**	**171,029.2**	**56,408.8**	**100.00%**
Share in 2007	67.02%	85.65%	100%		

$EF_{BM,y}$=0.8191×95.25%=0.7802 tCO_2/MWh

Annex 4

MONITORING INFORMATION

Please refer to section B.7

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