Monitoring report form
(Version 05.1)

Monitoring report

Title of the project activity	Animal Manure Management System (AMMS) GHG Mitigation Project , Shandong Minhe Livestock Co. Ltd., Penglai, Shandong Province, P.R. of China
Reference number of the project activity	1891
Version number of the monitoring report	01
Completion date of the monitoring report	12/06/2015
Monitoring period number and duration of this monitoring period	Monitoring period number : 5thmonitoring period Duration of this monitoring period: 01/01/2014 - 31/12/2014
Project participant(s)	1. China: Shandong Minhe Livestock Co. Ltd. 2. Netherlands: Netherlands’ Ministry of Infrastructure and the Environment (IenM) 3. Belgium: Kingdom of Belgium - Walloon Region Ministry of the Environment; Bruxelles Environnement - IBGE 4. Denmark: Aalborg Portland A/S; Danish Ministry of Climate, Energy and Building/Danish Energy Agency; Dong Naturgas A/S; Maersk Olie og Gas A/S; Nordjysk Elhandel A/S 5. Luxembourg: Government of Luxembourg - Ministry of the Environment 6. Spain: Endesa Generacion S.A.; Hidroelectrica del Cantabrico, S.A.; Gas Natural SDG, S.A.; Kingdom of Spain - Ministry of Agriculture, Food and Environment and Ministry of Economy and Competitiveness; EDP-Energias de Portugal, S.A. 7. Italy: Italy - Ministry for the Environment, Land and Sea 8. Japan: Daiwa Securities Co., Ltd.; FUJIFILM Corporation;

	Idemitsu Kosan Co., Ltd.; JX Nippon Oil & Energy Corporation; The Okinawa Electric Power Corporation, Incorporated 9. Germany: BASF SE; KfW 10. Sweden: Göteborg Energi AB 11. Finland: Ruukki Metals Oy 12. Norway: Statkraft Carbon Invest AS; Statoil ASA 13. Austria: Kommunalkredit Public Consulting GmbH 14. Switzerland: Schweizerische Rückversicherungsgesellschafts AG (Swiss RE) Community Development Carbon Fund (CDCF): International Bank for Reconstruction and Development (IBRD) as Trustee of the Community Development Carbon Fund (CDCF)
Host Party(ies)	China
Sectoral scope(s)	Sectoral scopes: 13- Waste handling and disposal; 15- Agriculture
Selected methodology(ies)	ACM0010-Version 02: Consolidated baseline methodology for GHG emission reductions from manure management systems
Selected standardized baseline(s)	NA
Estimated amount of GHG emission reductions or net GHG removals by sinks for this monitoring period in the registered PDD	72,371 tCO_2e

Total amount of GHG emission reductions or net GHG removals by sinks achieved in this monitoring period	GHG emission reductions or net GHG removals by sinks reported up to 31 December 2012	GHG emission reductions or net GHG removals by sinks reported from 1 January 2013 onwards
	NA	93,603 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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1. Purpose of the project activity and the measures taken to reduce greenhouse gas emissions

Animal Manure Management System (AMMS) GHG Mitigation Project is located in Penglai city. The purpose of this project is to mitigate greenhouse gas (GHG) emissions from chicken manure by improving AMMS at chicken farms and utilizing a biogas co- generation system to supply electricity and displace electricity from a grid-based conventional energy source.

2. Brief description of the installed technology and equipment

The technology employed by the project activity includes installation of new mesophilic temperature anaerobic digesters with biogas capture and power generation. The total volume of the anaerobic digesters is of 26,400 m^3 and three sets of 1063 KW co-generators were installed; the annual electricity generation capacity from biogas is 22.96 million kWh. The Total mixed reactor (CSTR) anaerobic reactors have sufficient capacity and hydraulic retention time to eliminate the volatile solids loading in the effluent. Processed effluent was applied to the land with aerobic condition. The electricity that was produced based on captured biogas, was supplied to the China North Grid.

3. Relevant dates for the project activity (e.g. construction, commissioning, continued operation periods, etc.).

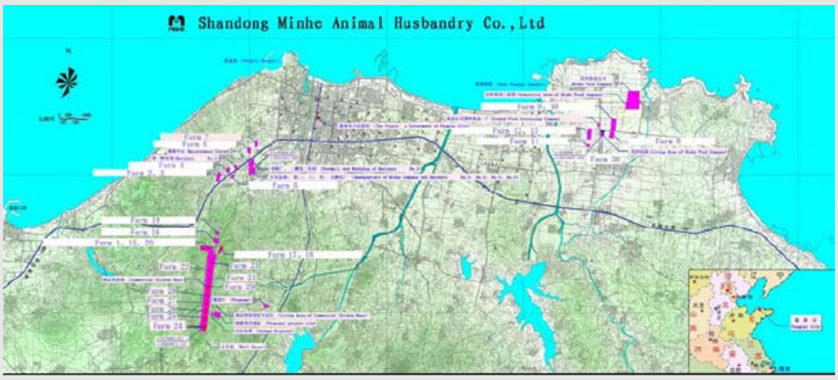
The construction of all biogas digesters was completed in October 2008. The test run period of biogas power plant was from November 2008 to February 2009. On 15/02/2009, the generated power was sent to the grid. Thus the starting date of operation and monitoring of the project activity was defined as 15/02/2009.

4. Total emission reductions achieved in this monitoring period.

This monitoring report is for the 5th monitoring period, which is from 01/01/2014 to 31/12/2014. Total emission reductions achieved in this monitoring period are 93,603 tCO_2e.

A.2. Location of project activity

>>All the project activities are located in the area of Minhe, Penglai, Shandong Province, People's Republic of China , which is located within [37.416667N, 120.583333E]; [37.83333N, 120.583333E]; [37.416667N, 121.133333E]; and [37.833333N, 120.583333E]. The 16 farms are located at [37.746173N 120.709423E]. There are 2,950,950 broilers and 648,326 layers included in farms numbered No. 1 and No.15 to No.29. The biogas digesters and power station are located within the farms.



A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
China (host)	Shandong Minhe Livestock Co. Ltd.	No
Netherlands	Netherlands' Ministry of Infrastructure and the Environment (IenM)	Yes
Belgium	Kingdom of Belgium - Walloon Region Ministry of the Environment; Bruxelles Environnement - IBGE	Yes
Denmark	Aalborg Portland A/S; Danish Ministry of Climate, Energy, and Building/Danish Energy Agency; Dong Naturgas A/S ; Maersk Olie og Gas A/S ; Nordjysk Elhandel A/S	Yes
Luxembourg	Government of Luxembourg - Ministry of the Environment	Yes
Spain	Endesa Generacion S.A.; Hidroelectrica del Cantabrico, S.A.; Gas Natural SDG, S.A.; Kingdom of Spain - Ministry of Agriculture, Food and Environment and Ministry of Economy and Competitiveness; EDP - Energias de Portugal, S.A.	Yes
Italy	Italy - Ministry for the Environment, Land and Sea	Yes

Japan	Daiwa Securities Co., Ltd.; FUJIFILM Corporation; Idemitsu Kosan Co., Ltd.; JX Nippon Oil & Energy Corporation; The Okinawa Electric Power Corporation, Incorporated	No
Germany	BASF SE; KfW	No
Sweden	Göteborg Energi AB	No
Finland	Ruukki Metals Oy	No
Norway	Stratkraft Carbon Invest AS; Statoil ASA	No
Austria	Kommunalkredit Public Consulting GmbH	No
Switzerland	Schweizerische Rückversicherungsgesellschafts AG (Swiss RE)	No

A.4. Reference of applied methodology and standardized baseline

>> This project activity utilizes the Executive Board of Clean Development Mechanism (CDM) approved consolidated baseline methodology ACM0010-Version 02 titled "Consolidated baseline methodology for GHG emission reductions from manure management systems". This baseline methodology can be downloaded from the Executive Board (EB) website:
http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

The methodology also refers to the latest version of the "Tool to determine project emissions from flaring gases containing Methane1".As well as version 02 of " Tool for demonstration assessment and of additionally".

A.5. Crediting period of project activity

>> A fixed 10 years crediting period was chosen for the project activity. The start date of the crediting period was 27/04/2009, which is the same date shown in the registered PDD.

A.6. Contact information of responsible persons/ entities

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Li Yue, Institute of Environment and Sustainable Development in Agriculture, Chinese Academy of Agricultural Sciences. 12, Zhongguancun South Street, Beijing, 100081, China. Tel: 0086-010-82105615. E-mail: Yueli@ami.ac.cn, liyue@caas.cn.

Dong Hongmin, Institute of Environment and Sustainable Development in Agriculture, Chinese Academy of Agricultural Sciences. 12, Zhongguancun South Street, Beijing, 100081, China. Tel: 0086-010-82109979. E-mail: donghongmin@caas.cn.

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

>> The construction of all biogas digesters was completed in October 2008. The test run period of biogas power plant was from November 2008 to February 2009. On 15/02/2009, the generated power was sent to the grid. Thus the starting date of operation and monitoring of the project activity was defined as 15/02/2009.

During this monitoring period, there was no special event occurred, such as overhaul and downtimes of biogas digesters and power generators, that might affect the applicability of the methodology. All the equipment operates well and no equipment was under maintenance during this monitoring period.

B.2. Post registration changes

B.2.1. Temporary deviations from registered monitoring plan, applied methodology or applied standardized baseline

>> **NA.**

B.2.2. Corrections

>> NA.

B.2.3. Changes to start date of crediting period

>> NA.

B.2.4. Inclusion of a monitoring plan to the registered PDD that was not included at registration

>> NA.

B.2.5. Permanent changes from registered monitoring plan or applied methodology or applied standardized baseline

>> NA .

B.2.6. Changes to project design of registered project activity

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During project implementation, three sets of 1,063 KW co-generators were installed at the project site, with total installed capacity being changed to 3,189 KW compared to 3,000 KW estimated in the PDD. The estimation of annual electricity generated by the project activity is updated as 22.96 million KWh, against the amount of 16.88 million KWh in the registered PDD. A reassessment was then performed as per paragraph 10(b) of EB 48 Annex 66.

It has been validated by the DOE that the change of co-generators installed has no impact on the additionality and operation of the project activity. The request for notification of changes with was submitted to the secretariat on 28/09/2010 and the change was accepted by EB on 27/02/2011， the approval change was included in registered PDD version 09 which completed on 12/07/2010.

The scale of the CDM project activity remains the same.

B.2.7. Types of changes specific to afforestation or reforestation project activity

>> NA.

SECTION C. Description of monitoring system

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1. Data collection procedure

In accordance with the Monitoring Methodology ACM0010 version 02, the location and ID numbers of the monitoring equipment for key parameters that must be monitored ex-post are described in Figure C1 and Table C1.

Table C1: ID number of monitoring equipment for key parameters

	Name of equipment	ID number
1	Electricity meter 1	370110010273792
2	Electricity meter 2	370010202422979
3	Electricity meter 3	370110010274151
4	Biogas flow meter 1	8060604
5	Biogas flow meter 2	8060602
6	Biogas flow meter 3	8060601

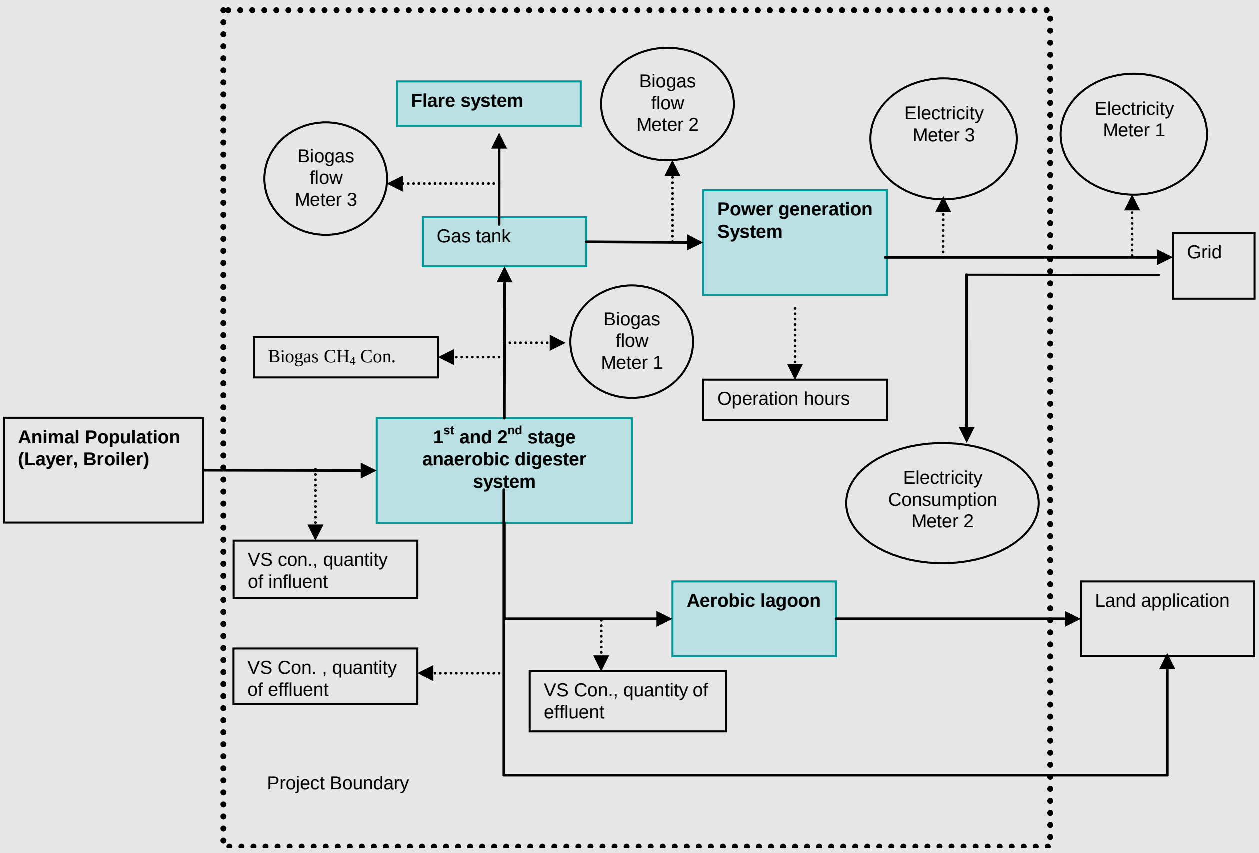

Figure C1 Location of Monitoring Equipment

1) Electricity exported to grid: $EG_{d,y}$

The electricity exported to grid is measured through an electric meter (electricity meter 1) installed by the grid company at the transformer. The grid company records the readouts of electricity meter 1 on a given date every month. Minhe installs another electricity meter (electricity meter 3) at the outlet of biogas power generator and records the readout of electricity meter 3 every month. Electricity meter 3 serves as backup meter of electricity meter 1.

The readout records of electricity meter 1 have been recorded monthly. It is cross-checked by the utility invoices produced by the utility company that specifically is based on the readout of the electricity meter 1. The electricity meter was calibrated periodically by an officially accredited entity. Collected data is archived in both electronic and printed copies. The level of accuracy was deducted from annual electricity supply while calculating the emission reduction.

2) The electricity used in project AMMSs: $EL_{Pr,y,}$

Minhe responsible staff reads the electricity meter 2 installed in project site, once every month. The local grid company confirms the readings and issues the sale invoices based on the readings of electricity meter 2. The electricity consumption of the biogas plant for the monitoring period is the sum of the monthly consumption. The electricity meter used was calibrated periodically by an officially accredited entity; the original collected data is archived in both electronic and printed copies. The level of accuracy was added to the annual electricity used while calculating the emission reduction.

3) Biogas flow: V_f

The Minhe responsible staff reads the biogas flow meters (biogas flow meter 1 installed at the outlet of the anaerobic digesters, biogas flow meter 3 installed at the inlet of the flare, biogas flow meter 2 installed at the inlet of the power generator) every day and copies picture of the screen of monitoring computer. The daily biogas production or biogas flow to the flare was determined by taking the reading minus the outputs of the previous reading. The weekly biogas production or biogas flow to the flare is the sum of the daily output, same principle was applied to calculate the monthly/annual biogas production or biogas flow to the flare. The biogas flow meters used were calibrated periodically by an officially accredited entity. In addition, the biogas flow meter automatically measured temperature and pressure and automatically displayed biogas volumes in normalized cubic meters, it is not necessary to separately measure the biogas temperature and pressure according to the monitoring plan of the registered PDD which was updated as version 09 and was approval on 27/02/2011. Original collected data is archived in both electronic and printed copies.

4) Methane fraction of biogas: $\mathbf{C_{CH4}}$

CH_4 fraction of biogas was measured continuously through onsite gas analyzer installed at the outlet of the anaerobic digesters. The Minhe staffs download hourly recordings of gas analyzer once per day. Monthly CH_4 concentration was calculated based on the daily average CH_4 concentration. Gas analysis meter was calibrated periodically by an officially accredited entity. Original collected data is archived in both electronic and printed copies. The level of accuracy was deducted from average concentration values while calculating the emission reduction.

5) Influent flow rate measurement

The Minhe staff read cumulative operational hours of influent pumps installed at the inlet of biogas digesters every day. The daily operational time of influent pumps is calculated by the hour reading as of the day minus the hours on the previous reading. The daily influent amount was calculated based on the operation hours of pump and flow rate of pumps. The weekly influent is the sum of the daily influent, same principle was applied to calculate the monthly/annual influent. Original collected data is archived in both

electronic and printed copies.

6) Effluent flow rate measurement

The Minhe staff read cumulative of effluent flow rate installed at the outlet of biogas digesters (same to inlet of aerobic lagoon) every day. The daily effluent quantity was the reading to date minus reading of previous day. The weekly influent is the sum of the daily effluent, same principle was applied to calculate the monthly/annual effluent. Original collected data is archived in both electronic and printed copies.

7) VS concentration measurement

Samples were taken from sample points located before the inlet of biogas digesters and inlet of aerobic lagoon for 5 consecutive days quarterly. VS concentration of collected samples was analysed in Penglai inspection testing center, the average of VS concentration for 5 consecutive days was applied to calculate the fraction of Volatile solids directed to the stages of anaerobic digesters and aerobic treatment respectively. Original collected data is archived in both electronic and printed copies.

8) Average chicken population used in both baseline and project case emission estimation: N_{LT}

The populations of the chicken are recorded daily by the technicians in farms. The data on the start date and hand-in chicken numbers, end date and hand-out chicken number of each flock were also recorded. The relevant monthly/flock data of chicken is checked by the operators in the farm and delivered to the CDM monitor division, a report for every flock of chicken is generated by the CDM monitor staff in the form of Excel tables, and the original collected data is archived in both electronic and printed copies.

9) Weight of chicken: W_{site}

0.2% of broiler and layers for each flock was sampled and weighted weekly by the technicians in each farm, Site weight of each flock was estimated based on average weight of sampled chicken in each flock. After every month or when every flock of broiler is finished, the weighing result is checked by the CDM broiler farm operators and delivered to the CDM monitor division. A report on chicken weight for every month or every flock of broiler is generated by the CDM monitor staff in the form of Excel tables, and the original collected data is archived in both electronic and printed copies.

2. Organizational structure

Figure C2 outlines the Project’s operational and management structure. General Manager of Biogas power generation plant is responsible for implementation and supervision of the CDM monitoring activity and is the liaison of the CDM project. Since March 2009, Ms. DONG Tai-li has been serving as General Manager. Digester division is responsible for daily operation of the digesters, power generation division (here refers to CHP) is responsible for the daily operation of the power generators; maintenance division is responsible for daily check and maintenance of the CDM project activity, above three division ensure the sustainable operating of project system.

Monitoring division is responsible for monitoring the CDM data: the data collection personnel are responsible for collecting, processing and submitting data. Internal verification personnel are responsible for meter calibration and data review and archiving in order to ensure data accuracy and completeness. Monitored data was reviewed and approved by General Manager before it is accepted and stored.

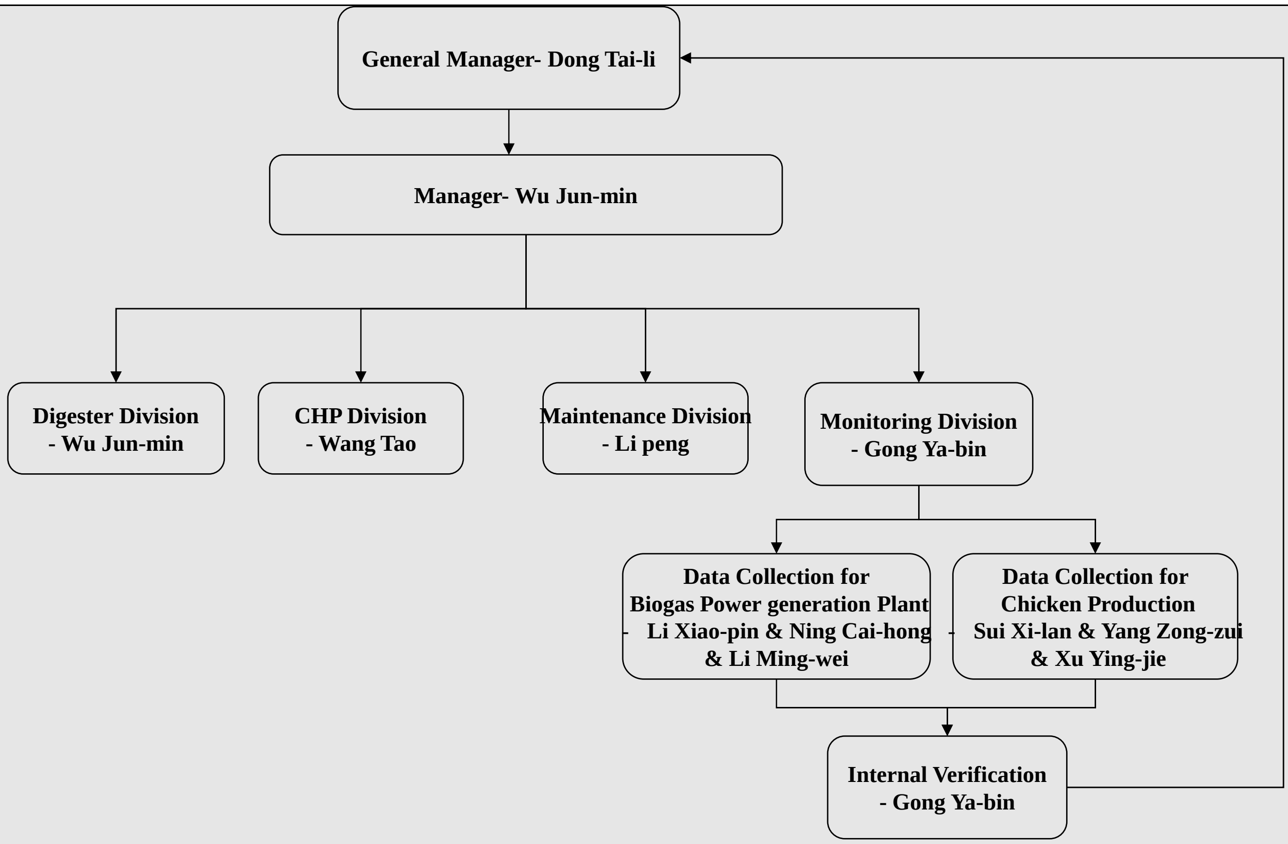

Figure C2: Project's operational and management structure

3. Emergency procedure:

If abnormal operation occurs, the responsible staff should immediately report to Project General Manager. When erroneous measurement is detected by operators involved in implementation of the monitoring plan, the erroneous measurement should be reported to the Project General Manager instantly. The Project Manager takes the responsibility to handle the erroneous measurement as follows: If the reason for erroneous measurement is the malfunction of the meter(s), recalibrate or replace the meter as appropriate. At the same time, training courses will be re-arranged for relevant employees to ensure the correct implementation of the monitoring plan, so as to prevent error.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

ID Number:	1
Data / Parameter:	$RV_{S,n}$
Data unit:	Fraction
Description:	VS degradation factor
Source of data used:	Annex 3 of ACM0010-version 2
Value(s) applied	Uncovered anaerobic lagoon: 71%
Choice of data or measurement methods and procedures	Estimated from Table provided in Annex 1 of ACM0010.

Purpose of data calculations)	Data on uncovered anaerobic lagoon of 71% are used for baseline emission calculations when the temperature is 13.5°C.
Additional comment:	N/A

ID Number:	2
Data/Parameter	$EF_{N2O, D,j}$, $EF_{N2O,ID,j}$
Unit	kg N_2O-N/ kg N and kg N_2O-N/ kg NH_3-N and NO_X-N
Description	N_2O emission factors (direct and indirect emissions)
Source of data	IPCC 2006 Guidelines
Value(s) applied	$EF_{N2O, D}$=0 for anaerobic lagoon and digester; $EF_{N2O, D}$=0.01 for aerobic lagoon; $EF_{N2O,ID,j}$=0.01 for indirect N_2O emission
Choice of data or measurement methods and procedures	Default values in IPCC 2006 Guidelines were used because country specific or region specific data are not available.
Purpose of data	Data on $EF_{N2O, D}$=0 for anaerobic lagoon and $EF_{N2O,ID,j}$=0.01 are used for baseline emission Data on $F_{N2O, D}$=0 for a digester, $EF_{N2O, D}$=0.01 for aerobic lagoon, *as well as* $EF_{N2O,ID,j}$=0.01 are used for project emission
Additional comment	-

ID Number:	3
Data/Parameter	F_{gasm}
Unit	Fraction
Description	Fraction of N lost due to volatilization
Source of data	IPCC 2006 Guidelines
Value(s) applied	40% for lagoon, 20% for land application
Choice of data or measurement methods and procedures	Default values in IPCC 2006 Guidelines were used because country specific or region specific data are not available.
Purpose of data	Data on 40% for lagoon and 20% for land application are used for Baseline, Project and Leakage emission calculations.
Additional comment	-

ID Number:	4
Data/Parameter	EF_1, EF_4, EF_5
Unit	kg N_2O-N/ kg N for EF_1, EF_5 and kg N_2O-N/ kg NH_3-N and NO_X-N for EF_4
Description	EF_1 is emission factor for direct N_2O from soils; EF_4 is emission factor for direct N_2O emissions from atmospheric deposition of N on soils and water surfaces; EF_5 is emission factor for indirect N_2O emission of from runoff.
Source of data	IPCC 2006 Guidelines
Value(s) applied	EF_1=0.01, EF_4=0.01, EF_5=0.0075

Choice of data or measurement methods and procedures	Default values in IPCC 2006 Guidelines may be used because country specific or region specific data are not available.
Purpose of data	Data on EF_1=0.01, EF_4=0.01, EF_5=0.0075 were used for baseline, project and leakage emission calculations.
Additional comment	-

ID Number:	5
Data/Parameter	F_{leach}
Unit	Fraction
Description	Fraction of N leached
Source of data	IPCC 2006 Guidelines
Value(s) applied	0
Choice of data or measurement methods and procedures	Default values in IPCC 2006 Guidelines were used because country specific or region specific data are not available.
Purpose of data	Data were used for leakage emission calculations.
Additional comment	

ID Number:	6
Data/Parameter	$EG_{Bl,y}$
Unit	MWh
Description	Electricity consumption by baseline AMMS
Source of data	Project proponents
Value(s) applied	182
Choice of data or measurement methods and procedures	Recorded under baseline
Purpose of data	data are used for baseline emission calculations
Additional comment	-

ID Number:	7
Data/Parameter	N_{dy}
Unit	Number
Description	Number of days treatment plant was operational.
Source of data	Project proponents
Value(s) applied	365
Choice of data or measurement methods and procedures	365 days in 2014
Purpose of data	Data are used for baseline, project and leakage emission calculations.
Additional comment	N/A

ID Number:	8

Data/Parameter	$MS\%_{Bl,j}$
Unit	Fraction
Description	Fraction of manure handled in open lagoon system in the baseline
Source of data	Project proponents
Value(s) applied	100%
Choice of data or measurement methods and procedures	Recorded under baseline
Purpose of data	Data are used for baseline emission calculations
Additional comment	N/A

ID Number:	9
Data/Parameter	GWP_{CH4}
Unit	tCO_2 e/tCH_4
Description	Global warming potential for CH_4
Source of data	IPCC, Climate Change 2007. The Physical Science Basis. The Working Group I contribution to the IPCC Fourth Assessment Report.
Value(s) applied	25
Choice of data or measurement methods and procedures	GWP_{CH4} of 25 was applied for the second commitment period according to the Annex 3 of EB 69.
Purpose of data	Data are used for baseline, project and leakage emission calculations.
Additional comment	-

ID Number:	10
Data/Parameter	GWP_{N2O}
Unit	tCO_2e/tN_2O
Description	Global warming potential for N_2O
Source of data	IPCC, Climate Change 2007. The Physical Science Basis. The Working Group I contribution to the IPCC Fourth Assessment Report.
Value(s) applied	298
Choice of data or measurement methods and procedures	GWP_{N2O} of 298 for the second commitment period according to the Annex 3 of EB 69.
Purpose of data	Data are used for baseline, project and leakage emission calculations.
Additional comment	-

ID Number:	11
Data/Parameter	D_{CH4}
Unit	t/m^3
Description	Density of methane

Source of data	ACM0010
Value(s) applied	0.00067
Choice of data or measurement methods and procedures	0.00067 t/m^3 is density of methane at room temperature 20℃ and 1 atm pressure
Purpose of data	Data are used for baseline, project and leakage emission calculations.
Additional comment	-

ID Number:	12
Data/Parameter	MCF_d
Unit	t/m^3
Description	Methane conversion factor for leakage calculation.
Source of data	ACM0010
Value(s) applied	1
Choice of data or measurement methods and procedures	Default values in ACM0010
Purpose of data	Data are used for leakage emission calculations.
Additional comment	N/A

ID Number:	13
Data/Parameter	$CF_{N2O-N,N}$
Unit	
Description	Conversion factor N to N_2O
Source of data	ACM0010
Value(s) applied	44/28
Choice of data or measurement methods and procedures	-
Purpose of data	Data are used for baseline, project and leakage emission calculations.
Additional comment	-

ID Number:	14
Data/Parameter	$EF_{OM, y}$
Unit	tCO_2/MWh
Description	Operating Margin Emission Factor
Source of data	The Affiche about determining the emission factors of China regional power grid, released by Office of National Coordination Committee on Climate Change, National Development and Reform Committee, December 15, 2006 (http://cdm.ccchina.gov.cn/Detail.aspx?newsId=3524&TId=3)
Value(s) applied	1.0585

Choice of data or measurement methods and procedures	According to the calculations of NDRC of China. (http://cdm.ccchina.gov.cn/Detail.aspx?newsId=3524&TId=3)
Purpose of data	Data are used for baseline and project emission calculations.
Additional comment	-

ID Number:	15
Data/Parameter	$EF_{BM,\ y}$
Unit	tCO_2/MWh
Description	Build Margin Emission Factor
Source of data	The affiche about determining the emission factor of China Regional Power Grid, released by Office of National Coordination Committee on Climate Change, National Development and Reform Committee, December 15, 2006 (http://cdm.ccchina.gov.cn/Detail.aspx?newsId=3524&TId=3)
Value(s) applied	0.9066
Choice of data or measurement methods and procedures	According to the calculations of NDRC of China. (http://cdm.ccchina.gov.cn/Detail.aspx?newsId=3524&TId=3)
Purpose of data	Data are used for baseline and project emission calculations.
Additional comment	N/A

ID Number:	16
Data/Parameter	$\eta_{flare,h}$
Unit	percent
Description	Flare efficiency in hour h
Source of data	Tool to determine project emissions from flaring gases containing methane
Value(s) applied	0 %
Choice of data or measurement methods and procedures	It is conservative to set flare efficiency as zero.
Purpose of data	Data are used for project emission calculations.
Additional comment	

ID Number:	17
Data/Parameter	NCV_{CH4}
Unit	GJ/t
Description	Net calorific value of methane
Source of data	Rose and Cooper, 7th edition 1977 "Technical Data on Fuel" WEC British National Committee, Edinburgh
Value(s) applied	50.04
Choice of data or measurement methods and procedures	-

Purpose of data	Data are used for project emission calculations.
Additional comment	N/A

D.2. Data and parameters monitored

ID Number:	1
Data/Parameter	MCF
Unit	Fraction
Description	Methane conversion factor
Measured/Calculated /Default	Default
Source of data	IPCC 2006 Guidelines
Value(s) of monitored parameter	71%
Monitoring equipment	NA
Measuring/Reading/ Recording frequency	Annually
Calculation method (if applicable)	Annual average temperature during the monitoring period was 13.5℃ according to the record Penglai Meteorological Station. According to IPCC 2006 Guideline, when annul average temperature=13.5 ℃, the MCF for lagoon is 71%
QA/QC procedures	IPCC default factor was applied resulting in no error due to measurement.
Purpose of data	The data was used for baseline emission calculations
Additional comment	N/A

ID Number:	2
Data/Parameter	$B_{O,LT}$
Unit	m^3CH_4/kg-VS
Description	Maximum methane production
Measured/Calculated /Default	Default
Source of data	IPCC 2006 Guidelines
Value(s) of monitored parameter	0.36 for broiler; 0.39 for layer
Monitoring equipment	NA
Measuring/Reading/ Recording frequency	Annually
Calculation method (if applicable)	NA

QA/QC procedures	Developed country values were applied because following conditions are satisfied: 1) Genetic source -Arbor Acres(AA) of the production operations livestock originate from US which is Annex I Party; 2) Formulated feed rations (FFR) used by farms are optimized for various chicken, stage and productivities. 3) Farms keep the recording of FFR use which have been used at the project site 4) The project animal weight is similar to developed country IPCC default values.
Purpose of data	The data was used for baseline, project, and leakage emission calculations
Additional comment	N/A

ID Number:	3
Data/Parameter	$VS_{LT,y}$
Unit	kg dry matter/animal/year
Description	Volatile solid excretion per animal per year
Measured/Calculated /Default	Calculated
Source of data	IPCC 2006 Guidelines
Value(s) of monitored parameter	5.406 for broiler 12.771 for layer
Monitoring equipment	NA
Measuring/Reading/ Recording frequency	Annually, estimated or based on published information such as IPCC
Calculation method (if applicable)	According to equation (4) in ACM0010, site-specific average VS was calculated based on default VS value provided by IPCC 2006, default weight, and measured site average weight of chicken. Please refer to the calculation in section E. $VS_{LT,y} = \left[\frac{W_{site,LT}}{W_{default}}\right] \times VS_{default} \times nd_y$
QA/QC procedures	Values for developed countries were applied because genetic source of the production operations livestock originate from an Annex I Party; formulated feed rations (FFR) have been used at the project site.
Purpose of data	The data was used for baseline, project, and leakage emission calculations
Additional comment	N/A

ID Number:	4
Data/Parameter	$CEF_{Bl,elec,y}$
Unit	tCO_2/MWh
Description	Emission factor of baseline electricity use

Measured/Calculated /Default	Default
Source of data	ACM0010 version 02.
Value(s) of monitored parameter	0.8
Monitoring equipment	NA
Measuring/Reading/ Recording frequency	At start of project
Calculation method (if applicable)	
QA/QC procedures	In cases where electricity would, in the absence of the project activity, be purchased from the grid, and project electricity consumption of 182MWh is less than small scale threshold (15 GWh/yr), according to ACM0010 version 2. Default emission factor of 0.8 tCO_2/MWh was applied.
Purpose of data	The data was used for baseline emission calculations
Additional comment	N/A

ID Number:	5
Data/Parameter	CEF_{grid}
Unit	tCO_2/MWh
Description	Emission factor of exported electricity
Measured/Calculated /Default	Default
Source of data	The affiche about determining the emission factor of China Regional Power Grid, released by Office of National Coordination Committee on Climate Change, National Development and Reform Committee For 2014, data issued by China NDRC on 11/05/2015 (http://cdm.ccchina.gov.cn/zyDetail.aspx?newsId=52505&TId=161) .
Value(s) of monitored parameter	0.7995 as per the data issued by China NDRC on 11/05/2015, which is conservative
Monitoring equipment	NA
Measuring/Reading/ Recording frequency	Annually
Calculation method (if applicable)	According to NDRC publication of Emission factors for grids
QA/QC procedures	
Purpose of data	The data was used for baseline emission calculations
Additional comment	N/A

ID Number:	6
Data/Parameter	CEF_d

Unit	tCO_2/MWh
Description	Emissions factor for project activity consumption electricity
Measured/Calculated /Default	Default
Source of data	The affiche about determining the emission factor of China Regional Power Grid, released by Office of National Coordination Committee on Climate Change, National Development and Reform Committee错误！超链接引用无效。 For 2014, data issued by China NDRC on 11/05/2015 (http://www.ccchina.gov.cn/archiver/cdmcn/UpFile/Files/Default/20130917081426863466.pdf.)
Value(s) of monitored parameter	0.7995 as per the data issued by China NDRC on 11/05/2015, which is conservative
Monitoring equipment	NA
Measuring/Reading/ Recording frequency	Annually
Calculation method (if applicable)	According to NDRC publication of Emission factors for grids
QA/QC procedures	
Purpose of data	The data was used for project emission calculations
Additional comment	N/A

ID Number:	7
Data/Parameter	LF_{AD}
Unit	Fraction
Description	Fraction of methane leakage from anaerobic digester
Measured/Calculated /Default	Calculated
Source of data	IPCC 2006 Guidelines
Value(s) of monitored parameter	0.15*64.26%=0.096
Monitoring equipment	NA
Measuring/Reading/ Recording frequency	Annually
Calculation method (if applicable)	0.15*64.26%=0.096 which was calculated according to ACM0010 version 02
QA/QC procedures	IPCC default factor is applied resulting in no error due to measurement
Purpose of data	The data was used for project emission calculations
Additional comment	N/A

ID Number:	8
Data/Parameter	$R_{N,n}$
Unit	fraction
Description	Nitrogen degradation factor
Measured/Calculated /Default	Default
Source of data	Refer to IPCC default value
Value(s) of monitored parameter	0.0 for heated digesters 0.4 for aerobic treatment
Monitoring equipment	NA
Measuring/Reading/ Recording frequency	Annually
Calculation method (if applicable)	According to IPCC default value
QA/QC procedures	According to IPCC default value
Purpose of data	The data was used for leakage emission calculations
Additional comment	N/A

ID Number:	9
Data/Parameter	Type
Unit	Type of barn and AMMS
Description	Project proponents
Measured/Calculated /Default	Default
Source of data	Barn and AMMS layout and configuration
Value(s) of monitored parameter	keep same with the baseline
Monitoring equipment	NA
Measuring/Reading/ Recording frequency	NA
Calculation method (if applicable)	Barn and AMMS layout and configuration
QA/QC procedures	N/A
Purpose of data	NA
Additional comment	N/A

ID Number:	10
Data/Parameter	T
Unit	℃
Description	Annual average ambient temperature at weather station nearby project site

Measured/Calculated /Default	Measured
Source of data	Penglai Meteorological Station
Value(s) of monitored parameter	13.5
Monitoring equipment	The data source is from meteorological station directly, no equipment is required on the project site.
Measuring/Reading/ Recording frequency	Monthly
Calculation method (if applicable)	Average of monthly temperature
QA/QC procedures	NA
Purpose of data	The data was used for baseline emission calculations
Additional comment	N/A

ID Number:	11
Data/Parameter	Rainfall
Unit	mm
Description	Annual average rainfall at weather station nearby project site
Measured/Calculated /Default	Measured
Source of data	Penglai Meteorological Station
Value(s) of monitored parameter	31.4
Monitoring equipment	The data source is from meteorological station directly, no equipment is required on the project site.
Measuring/Reading/ Recording frequency	Monthly
Calculation method (if applicable)	Average of monthly rainfall
QA/QC procedures	NA
Purpose of data	The data was used for both baseline and leakage emission calculations
Additional comment	N/A

ID Number:	12
Data/Parameter	Evaporation
Unit	mm
Description	Annual average evaporation at weather station nearby project site
Measured/Calculated /Default	Measured
Source of data	Penglai Meteorological Station

Value(s) of monitored parameter	156.8
Monitoring equipment	The data source is from meteorological station directly, no equipment is required on the project site.
Measuring/Reading/ Recording frequency	Monthly
Calculation method (if applicable)	Average of monthly evaporation
QA/QC procedures	NA
Purpose of data	The data was used for baseline and leakage emission calculations
Additional comment	N/A

ID Number:	13
Data/Parameter	$EG_{d,y}$
Unit	MWh
Description	Electricity exported to grid
Measured/Calculate d /Default	Measured
Source of data	Project proponents
Value(s) of monitored parameter	22,264 for electricity meter 1
Monitoring equipment	Name : Electricity meter 1 Type: DSZ188 Accuracy class: 0.5S Series number: 370110010273792 Calibration frequency: every 5 years Date of calibration: 15/04/2013 Validity: 14/04/2018 Calibration standard: JJG596-1999 Calibration agency: Metrological Center of Yantai Electricity Company Name : Electricity meter 3 Type: DSZ188 Accuracy class: 0.5S Series number: 370110010274151 Calibration frequency: every 5 years Date of calibration: 06/05/2013 Validity: 05/05/2018 Calibration standard: JJG596-1999 Calibration agency: Metrological Center of Yantai Electricity Company Other: This is backup meter installed in the project site.
Measuring/Reading/ Recording frequency	Monthly

Calculation method (if applicable)	N/A
QA/QC procedures	Electricity meters undergo maintenance/calibration subject to appropriate industry standards (JJG596-1999). The accuracy of the meter readings was verified by receipts issued by the purchasing power company. Uncertainty (0.5%) of the meters obtained from the manufacturers and verified by Calibration agency. This uncertainty was included in a conservative manner while calculating CERs
Purpose of data	The data was used for baseline emission calculations
Additional comment	N/A

ID Number:	14
Data/Parameter	N_{LT}
Unit	Number
Description	Average chicken population used in both baseline and project case emissions estimations.
Measured/Calculated /Default	Measured and calculated
Source of data	Project proponents
Value(s) of monitored parameter	Broiler: 2,950,950 Layers: 648,326
Monitoring equipment	NA
Measuring/Reading/ Recording frequency	Each flock, broiler lived around 42-43 days. For conservative, the number of hand-out broilers was applied. The layer lived more than 365 days, layers number in stock was monitored every day. For conservative, died layers were not considered.
Calculation method (if applicable)	Average broiler population is calculated based on the numbers of broiler grown annual and chicken growing days for each flock and growing cycles. Average layers population is calculated based on the daily numbers of layers (not including died layers).
QA/QC procedures	Feed purchase is recorded to verify the chicken population
Purpose of data	The data was used for baseline, project and leakage emission calculations
Additional comment	N/A

ID Number:	15
Data/Parameter	W_{site}
Unit	kg
Description	Weight of chicken
Measured/Calculated /Default	measured and calculated
Source of data	Project proponents

Value(s) of monitored parameter	Broiler: 1.333 Layers: 3.149
Monitoring equipment	Name: Scale Type: ACS-30 Accuracy class: III Series number: 08105295, 08106701, 08074223, 08071582, 08090309, 08061195, 08091093, 08021852. Calibration frequency: once a year Date of calibration: 25/01/2013, 21/01/2014 Validity: 24/01/2014, 20/01/2015 Calibration standard: JJG539-97 Calibration agency: Metrological Center of Penglai City
Measuring/Reading/ Recording frequency	Weekly
Calculation method (if applicable)	0.2% of broiler and layers are weighed weekly to obtain average site weight.
QA/QC procedures	-
Purpose of data	The data was used for baseline, project, and leakage emission calculations
Additional comment	N/A

ID Number:	16
Data/Parameter	F_{AD}
Unit	Fraction
Description	Fraction of volatile solids directed to anaerobic digesters
Measured/Calculated /Default	Measured and calculated
Source of data	Project proponents
Value(s) of monitored parameter	100%
Monitoring equipment	Name: Nemo Pump Type: NM090SY01L06V Accuracy class: NA Series number: 19456 and 19457 (one main and one backup) Calibration frequency: no such national standard addressing the calibration requirement; to make sure the accuracy of data, once per one or two years as per manufacturer's recommendation adopted Date of calibration: 24/04/2013, 22/04/2014 Validity: 22/04/2014, 20/04/2015 Calibration standard: NS0003 company standard of NETZSCH (Lanzhou) Pumps Co. Ltd Calibration agency: NETZSCH (Lanzhou) Pumps Co. Ltd.
Measuring/Reading/ Recording frequency	Four times a year in different seasons.

Calculation method (if applicable)	Fraction of volatile solids directed to anaerobic digesters was calculated based on the VS concentration and quantity of influent of biogas digesters with the same location of point 1 in monitored parameters No volatile solids were sent to the land. VS concentration was measured by taking sample of influent. Quantity of influent was measured by the operation hours of pumps.
QA/QC procedures	Pumps was in compliance with relevant standards in China, there is no national or local standard on test NETZSCH pump, the pumps were tested according to company standard by NETZSCH (Lanzhou) Pumps Co. Ltd.. VS concentration of collected samples was sent for analysis Metrological Center of Penglai City which is qualified testing Centers at the city level.
Purpose of data	The data was used for project emission calculations
Additional comment	N/A

ID Number:	17
Data/Parameter	F_{Aer}
Unit	Fraction
Description	Fraction of volatile solids directed to aerobic treatment
Measured/Calculated /Default	Calculated
Source of data	Project proponents
Value(s) of monitored parameter	16.3%
Monitoring equipment	Name: Flow meter installed in front of aerobic lagoon Type: XSJ/A-H2IB1AV0 Accuracy class: 1.0 Series number: H0809010801-W1 Calibration frequency: once a year Date of calibration: 28/02/2013, 21/02/2014 Validity: 27/02/2014, 20/02/2015Calibration standard: JJG771-1990 Calibration agency: Metrological Institute of Yantai City Name: Nemo Pump Type: NM090SY01L06V Accuracy class: NA Series number: 19456 and 19457 (one main and one backup) Calibration frequency: no such national standard addressing the calibration requirement; to make sure the accuracy of data, once per one or two years as per manufacturer’s recommendation is adopted Date of calibration: 24/04/2013, 22/04/2014 Validity: 22/04/2014, 20/04/2015 Calibration standard: NS0003 company standard of NETZSCH (Lanzhou) Pumps Co. Ltd Calibration agency: NETZSCH (Lanzhou) Pumps Co. Ltd. VS concentration of collected samples was sent for analysis at

	Metrological center of Penglai City which is qualified testing centers at the city level.
Measuring/Reading/ Recording frequency	VS concentration was measured by taking sample of influent four times a year in each season. Quantity of influent was continuously measured by flow meter.
Calculation method (if applicable)	Fraction of volatile solids directed to aerobic lagoons was calculated based on the VS concentration and quantity of influent of biogas digesters. VS concentration was measured by taking sample of influent. Samples were taken from three points four times a year. Point 1 is at the inlet of biogas digester, Point 2 is before transportation to land and Point 3 is at the inlet of aerobic lagoon. To calculate the F_{Aer}, only data for point 1 and point 3 were applied, because F_{Aer} is the fraction into aerobic lagoon while data for point 2 is the concentration directed to land, and effluent for direct land application did not happen during this monitoring period. The influent of biogas digesters was monitored by pumps working hours. Quantity of volatile solids directly to aerobic treatment was measured by flow meter.
QA/QC procedures	Flow meter was in compliance with relevant standards in China, calibration of flow meter occurred according to technical specification (JJG771-1990) by an officially accredited entity. The pumps were tested according to their company standard by NETZSCH (Lanzhou) Pumps Co. Ltd since there is no national or local standard on pump test. Samples were taken for 5 consecutive days quarterly, and VS concentration of collected samples was sent for analysis Metrological Center of Penglai City which is qualified testing Centers at the city level.
Purpose of data	The data was used for project emission calculations
Additional comment	N/A

ID Number:	18
Data/Parameter	$EL_{Pr,y}$
Unit	MWh
Description	Electricity used in project AMMSs
Measured/Calculate d /Default	Measured
Source of data	Project proponents
Value(s) of monitored parameter	1,638

Monitoring equipment	Name : Electricity meter 2 Type: DTZY188 Accuracy class: 1.0 Series number: 370010202422979 Calibration frequency: 5 years Date of last calibration: 29/12/2012 Validity: 28/12/2017 Calibration standard: JJG596-1999 Calibration agency: Metrological Center of Penglai Electricity Company
Measuring/Reading/ Recording frequency	Monthly
Calculation method (if applicable)	Accumulative electricity consumption
QA/QC procedures	Electricity meter undergoes maintenance/calibration subject to appropriate industry standards. The accuracy of the meter readings is verified by receipts issued by the purchasing power company. Uncertainty of the meter of 623154 (2.0%) and meter of 370010202422979 (1.0%) was obtained from the manufacturers. Uncertainty of 2.0% was included in a conservative manner while calculating CERs
Purpose of data	The data was used for project emission calculations
Additional comment	N/A

ID Number:	19
Data/Parameter	V_f
Unit	m^3
Description	Biogas flow
Measured/Calculated /Default	Measured
Source of data	Project proponents
Value(s) of monitored parameter	11,464,979 m^3 for biogas flow meter 1; 11,380,794 m^3 for biogas flow meter 2 ; 56,121 m^3 for biogas flow meter 3
Monitoring equipment	Name: biogas flow meter 1 Type: KVS08IIKF23FSN Accuracy class: 0.5 Series number: 8060604 Calibration frequency: no lower than once every two years Calibration date: 13/06/2013, 11/06/2014 Validity: 12/06/2014, 10/06/2015 Calibration standard: JJG640-1994 Calibration agency: National Steam Flow Rate Measurement Station it is same calibration entity which was reported as Metrological Institute in 3rd monitoring period. Other: biogas meter 1 installed in outlet of digesters

	Name: biogas flow meter 2 Type: KVS08IIKF23FSN Accuracy class: 0.5 Series number: 8060602 Calibration frequency: no lower than once every two years Calibration date: 13/03/2013, 6/03/2014 Validity: 12/03/2014, 5/03/2015 Calibration standard: JJG640-1994 Calibration agency: National Steam Flow Rate Measurement Station, it is same calibration entity which was reported as Metrological Institute in 3rd monitoring period. Other: biogas meter 2 installed in inlet of power generator Name: biogas flow meter 3 Type: KVS04IIKC23FSN Accuracy class: 0.5 Series number: 8060601 Calibration frequency: no lower than once every two years Calibration date: 13/03/2013, 6/03/2014 Validity: 12/03/2014, 5/03/2015 Calibration standard: JJG640-1994 Calibration agency: National Steam Flow Rate Measurement Station, it is same calibration entity which was reported as Metrological Institute in 3rd monitoring period. Other: biogas meter 3 installed in inlet of flare
Measuring/Reading/ Recording frequency	Continuously measured by flow meters and report the accumulative data on weekly basis
Calculation method (if applicable)	Accumulative total biogas production
QA/QC procedures	Biogas flow meters undergo maintenance/calibration subject to appropriate national standards or manufacture's recommendations. The reading is expressed as biogas volumes in normalized cubic meters with temperature of 20°C and pressure of 101.325KPa. No separate biogas temperature and pressure monitoring is required.
Purpose of data	The data was used for project emission calculations
Additional comment	N/A

ID Number:	20
Data/Parameter	C_{CH4}
Unit	Fraction
Description	Methane fraction of biogas
Measured/Calculated /Default	Measured
Source of data	Project proponents
Value(s) of monitored parameter	64.26%

Monitoring equipment	Name : Methane concentration meter Type: 97460 Accuracy class: <±2% Series number: 27112 Calibration frequency: once a year Date of last calibration: 06/03/2013, 28/02/2014 Validity: 05/03/2014, 27/02/2015 Calibration standard: JJG693-2011 Calibration agency: National Institute of Metrology, China. Other: Installed at the outlet of the anaerobic digesters
Measuring/Reading/ Recording frequency	Continuous measurement and monthly recorded
Calculation method (if applicable)	Monthly average
QA/QC procedures	The measuring instrument has been calibrated in accordance to appropriate national/international standards The level of accuracy was deducted from average concentration measurement.
Purpose of data	The data was used for project emission calculations
Additional comment	N/A

ID Number:	21
Data/Parameter	$PE_{flare,y}$
Unit	tCO_2e
Description	Project emission from flaring of the residual gas stream in year y
Measured/Calculated /Default	Measured
Source of data	Project participant
Value(s) of monitored parameter	605
Monitoring equipment	Name : biogas flow meter 3 Type: KVS04IIKC23FSN Accuracy class: 0.5S Series number: 8060601 Calibration frequency: no lower than once every two years Calibration date: 13/03/2013, 6/03/2014 Validity: 12/03/2014, 5/03/2015 Calibration standard: JJG640-1994 Calibration agency: National Steam Flow Rate Measurement Station, it is same calibration entity which was reported as Metrological Institute in 3rd monitoring period. Other: biogas flow meter 3 installed at the inlet of flare.
Measuring/Reading/ Recording frequency	Continuously by flow meter and reported cumulatively on weekly basis
Calculation method (if applicable)	Accumulative total biogas flared

QA/QC procedures	Biogas flow meter has been undergone maintenance/calibration subject to appropriate national standards or manufacture's recommendations.
Purpose of data	The data was used for project emission calculations
Additional comment	N/A

ID Number:	22
Data/Parameter	$MS\%_j$
Unit	Fraction
Description	Fraction of manure handled in anaerobic digesters under project activity
Measured/Calculated /Default	Measured
Source of data	Project proponents
Value(s) of monitored parameter	100%
Monitoring equipment	NA
Measuring/Reading/ Recording frequency	Annually
Calculation method (if applicable)	The manure flew into digesters by pipes. Fraction of manure handled in anaerobic digesters under project activity was 100%. Percentage of manure which did not flow into system is recorded as zero.
QA/QC procedures	The manure flew into digesters by pipes.
Purpose of data	The data was used for project emission calculations
Additional comment	N/A

ID Number:	23
Data/Parameter	$NEX_{LT,y}$
Unit	kg N/animal/year
Description	Annual average nitrogen excretion per chicken, in kg N/animal/year estimated as described in Annex 2 of ACM0010
Measured/Calculated /Default	Default
Source of data	2006 IPCC Guideline, Project proponents
Value(s) of monitored parameter	0.535 for broiler, 0.954 for layer
Monitoring equipment	NA
Measuring/Reading/ Recording frequency	Annually
Calculation method (if applicable)	N/A

QA/QC procedures	NA
Purpose of data	The data was used for baseline, project, and leakage emission calculations
Additional comment	N/A

ID Number:	24
Data/Parameter	Genetic source
Unit	
Description	Genetic source of broilers and layers
Measured/Calculated /Default	Default
Source of data	Project proponent, recorded certificate of genetic source
Value(s) of monitored parameter	Arbor Acres (AA)
Monitoring equipment	NA
Measuring/Reading/ Recording frequency	Annually
Calculation method (if applicable)	NA
QA/QC procedures	Genetic source of the livestock production operations was confirmed to originate from an Annex I Party.
Purpose of data	The data was used for baseline, project, and leakage emission calculations
Additional comment	N/A

ID Number:	25
Data/Parameter	FFR
Unit	
Description	Formulated feed ratio
Measured/Calculated /Default	NA
Source of data	Project proponent, recorded amounts of FFR for farm and the ingredient of FFR
Value(s) of monitored parameter	100%
Monitoring equipment	NA
Measuring/Reading/ Recording frequency	Annually
Calculation method (if applicable)	NA

QA/QC procedures	NA
Purpose of data	The data was used for baseline, project, and leakage emission calculations
Additional comment	N/A

ID Number:	26
Data/Parameter	MCF_{sl}
Unit	Fraction
Description	Methane conversion factor
Measured/Calculated /Default	Default
Source of data	IPCC 2006 Guidelines
Value(s) of monitored parameter	0.1%
Monitoring equipment	NA
Measuring/Reading/ Recording frequency	Annually
Calculation method (if applicable)	NA
QA/QC procedures	IPCC default value is applied.
Purpose of data	The data was used for project emission calculations
Additional comment	N/A

ID Number:	27
Data/Parameter	Regulations
Unit	--
Description	Existence and enforcement of relevant regulations
Measured/Calculated /Default	NA
Source of data	Project proponents, check the website of China ministry of environmental protection (www.sepa.gov.cn)
Value(s) of monitored parameter	No regulation.
Monitoring equipment	NA
Measuring/Reading/ Recording frequency	Monthly
Calculation method (if applicable)	NA
QA/QC procedures	Quality control for the existence and enforcement of relevant regulations and incentives is beyond the bounds of the project activity. Instead, the DOE will verify the evidence collected.

Purpose of data	The data was used for baseline, project, and leakage emission calculations
Additional comment	N/A

D.3. Implementation of sampling plan

>> NA.

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

>>The calculation of baseline emission is included in excel file named as ERs calculation spreadsheet-Minhe fourth monitoring period.

Baseline emissions are estimated as follows:

$$BE_y = BE_{CH4,y} + BE_{N2O,y} + BE_{elec/heat,y} \qquad (1)$$

where:

BE_y	Baseline emissions in year y, in tCO_2e/year.
$BE_{CH4,y}$	Baseline methane emissions in year y, in tCO_2e/year.
$BE_{N2O,y}$	Baseline N_2O emissions in year y, in tCO_2e/year.
$BE_{elec/heat,y}$	Baseline CO_2 emissions from electricity and/or heat used in the baseline in year y, in tCO_2e/year.

(i) Methane emissions

$$BE_{CH4,y} = GWP_{CH4} * D_{CH4} * \sum_{j,LT}(MCF_j * B_{O,LT} * N_{LT} * VS_{LT,y} * MS\%_{Bl,j}) \qquad (2)$$

where:

$BE_{CH4,y}$	The annual baseline methane emissions in t CO_2 e/y
GWP_{CH4}	Global Warming Potential (GWP) of CH_4. 25 was applied according to the Annex 3 of EB 69.
D_{CH4}	CH_4 density (0.00067 t/m^3 at room temperature (20ºC) and 1 atm pressure).
MCF_j	Annual methane conversion factor (MCF) for the baseline $AMMS_j$ (anaerobic lagoon) from IPCC 2006 Guidelines Table 10.17, chapter 10, volume 4. MCF_j =0.71 was applied. A conservativeness factor was applied by multiplying MCF values with a value of 0.94, to account for the 20% uncertainty in the MCF values as reported by IPCC 2006.
$B_{O,LT}$	Maximum methane producing potential of the volatile solid generated, in m^3CH_4/kg dm, by broiler and layer chicken. $B_{O,LT}$ =0.36 for broiler and 0.39 for layers respectively
N_{LT}	Number of broiler and layer for the year y, expressed in numbers. N_{LT} = 2,950,950 for broiler and 648,326 for layers respectively.
$VS_{LT,y}$	Annual volatile solid for broiler and layer chickens on a dry matter weight basis (kg dm/year).
$MS\%_{Bl,j}$	Fraction of manure handled in system j, here, In this proposed project, the baseline manure management system is an anaerobic lagoon only. The amount of manure handled by the anaerobic lagoon is 100%.

Baseline CH_4 emission and values of related parameters were listed in table E1.

Table E1: Estimated baseline methane emissions

Parameters	Unit	Broiler	Layers
GWP_{CH4}	tCO_2 e/tCH_4	25	25
D_{CH4}	t/m_3	0.00067	0.00067
MCF_j	fraction	0.71	0.71
Conservativeness factor of MCF	Fraction	0.94	0.94
$B_{O,LT}$	m^3CH_4/kg dm	0.36	0.39
N_{LT}	head	2,950,950	648,326
$VS_{LT,y}$ *	kg dm/year	5.406	12.771
$MS\%_{Bl,j}$	%	100	100
$BE_{CH4,y}$ for different chicken	t CO_2 e	64,201	36,097
$BE_{CH4,y}$	t CO_2 e/y	100,298	

*: Calculated using equation (3), the results were listed in table E2.

Estimation of various variables and parameters for above equations:

(A) Determination of volatile solids ($VS_{LT,y}$)

ACM0010-Version 2 provides four options for the determination of volatile solids (VS) excretion rate: (1) Using published country specific data; (2) Estimation of VS based on dietary intake of livestock; (3) Scaling default IPCC values to adjust for a site-specific average animal weight; (4) Utilizing published IPCC defaults.

According to scientific publication database (www.cnki.net), there are no published country-specific data on VS, there are no energy intake of chicken available. Scaling default IPCC values $VS_{default}$ to adjust for a site-specific average animal weight as shown in equation (3):

$$VS_{LT,y} = \left[\frac{W_{site,LT}}{W_{default}}\right] \times VS_{default} \times nd_y \quad (3)$$

Where

$W_{site,LT}$	Average animal weight of a defined livestock population at the project site for LT type of chicken.
$W_{default}$	IPCC Default weight, 2006 IPCC Guidelines (kg) for developed countries.
$VS_{default}$	The IPCC default $VS_{LT,y}$ values, The IPCC default $VS_{LT,y}$ values for broilers (0.01 kg dm/day) and for layers (0.02 kg dm/day) are selected for the project activity sites. Because the genetic source of chicken is from the developed country, the FFR was used as chicken feed, and animal weight are similar to developed country IPCC default value.

ndy	Number of days in year "y" where the treatment plant was operational. *Ndy =365 days*

Estimation of annual volatile solid for broiler and layer chickens was listed in table E2.

Table E2: Annual volatile solid for broiler and layer chickens

Parameters	$VS_{default}$ (kg dm/day/head)	$W_{default}$ (kg)	$W_{site,LT}$ (kg)	nd_y (day)	$VS_{LT,y}$ (kg dm/year/head)
Broiler	0.01	0.9	1.333	365	5.406
Layer	0.02	1.8	3.149	365	12.771

(B) ***Maximum Methane Production Potential (*** $B_{O,LT}$ ***):***

According to the scientific publication database (www.cnki.net), there are no published country specific data on Bo. Developed countries $B_{O,LT}$ values are used. Because the genetic source of chicken is from the developed country, the FFR was used as chicken feed, and animal weight are similar to developed country IPCC default value.

(C) Methane conversion factor (MCF_j ***):***

IPCC 2006 Guidelines MCF values given in table 10.17 (chapter 10, volume 4) is used. MCF values depend on the annual average temperature where the anaerobic manure treatment facility in the baseline existed. For this project, the annual average temperature is 13.5℃ and the value of 71% is applied. A conservative factor is applied by multiplying MCF values with a value of 0.94, to account for the 20% uncertainty in the MCF values as recommended by ACM0010.

（ii）***N_2O emissions from manure management***

Equation 4 will be applied to calculate N_2O emissions from the baseline according to ACM0010.

$$BE_{N2O,y} = GWP_{N2O} * CF_{N2O-N,N} * \frac{1}{1000} * (E_{N2O,D,y} + E_{N2O,ID,y}) \quad (4)$$

where:

GWP_{N2O}	Global Warming Potential for N_2O. 298 was applied according to the Annex 3 of EB 69.
$CF_{N2O-N,N}$	Conversion factor N_2O-N to N_2O (44/28).
$E_{N2O,D,y}$	Direct N_2O emission in kg N_2O-N/year.
$E_{N2O,ID,y}$	Indirect N_2O emission in kg N_2O-N/year.

Direct N_2O emission estimated according to equation 5.

$$E_{N2O,D,y} = \sum_{j,LT} (EF_{N2O,D,j} * NEX_{LT,y} * N_{LT} * MS\%_{BL,j}) \quad (5)$$

where:

$EF_{N2O,D,j}$	The direct N_2O emission factor for the treatment system j of the manure management system in kg N_2O-N/kg N. According to scientific the publication database (www.cnki.net)), there are no published country specific data on EF_{N2O}. Default EF_3 from table 10.21, chapter 10, volume 4, in the IPCC 2006 Guidelines was applied.

$NEX_{LT,y}$	The annual average nitrogen excretion per head of a defined livestock population in kg N/animal/year. Even there are data on crude per cent of protein, there are no gross energy intake data available, because lack of daily weight gain data which is important to calculate the gross energy intake. So, there is no data on protein intake. According to scientific publication database (www.cnki.net), there are also no published country-specific data on NEX data available. According to the Annex 2 of ACM0010 version 2, scaling default IPCC values NEX to adjust for a site-specific average animal weight as shown in equation (6).
$MS\%_{BL,j}$	Fraction of manure handled in system j, in %. In this proposed project, j = anaerobic lagoon. $MS\%_{BL,j}$ =100%.
N_{LT}	Number of broilers and layers for the year y, expressed in numbers. N_{LT} = 2,950,950 for broiler and 648,326 for layers respectively.

(1) Calculation of $NEX_{LT,y}$

$$NEX_{LT,y} = \left[\frac{W_{site,LT}}{W_{default}}\right] \times NEX_{IPCC,default} \quad (6)$$

Where

$NEX_{IPCC,default}$	2006 IPCC Guidelines default NEX. The default value (1.1 kg /1000 kg animal mass/day for broilers, 0.83 kg /1000 kg animal mass/day for layers) in volume 4, chapter 10, table 10.19 in IPCC 2006 Guidelines for developed countries was applied. Because the genetic source of chicken is from the developed country, the FFR was used as chicken feed, and animal weight are similar to developed country IPCC default value.

Estimation of nitrogen excretion per head of chicken was listed in table E3.

Table E3: Annual nitrogen excretion per head of chicken (kgN/head/year)

Parameters	$NEX_{IPCC,default}$ (kgN/1000kganimal mass/day)	$W_{site,LT}$ (kg)	$W_{default}$ (kg)	nd_y (day)	$NEX_{LT,y}$ (kg N/head/year)
Broiler	1.1	1.333	0.9	365	0.535
Layer	0.83	3.149	1.8	365	0.954

Because the N2O emission factor for anaerobic lagoon is 0, therefore, the annual direct baseline N2O emission is zero.

The indirect N2O emissions estimated according to equation 7.

$$E_{N2O,ID,y} = \sum_{j,LT}(EF_{N2O,ID,j} * F_{gasm} * NEX_{LT,y} * N_{LT} * MS\%_{Bl,j}) \quad (7)$$

Where:

$EF_{N2O,ID,j}$	The indirect N_2O emission factor for N_2O emissions from atmospheric deposition of nitrogen on soils and water surfaces, kg N_2O-N/kg NH_3-N and NOx-N emitted. According to scientific publication database (www.cnki.net), there are no published country specific data on $EF_{N2O,ID,j}$. Default values for EF_4 from table 11.3, chapter 11, volume 4 of IPCC 2006 Guidelines was applied.
F_{gasm}	Percent of managed manure nitrogen for livestock category that volatilizes as NH_3 and NOx in the manure management system. According to scientific publication database (www.cnki.net), there are no published country specific data on F_{gasm}. Default value (Table 10.22, Volume 4 of IPCC 2006 Guidelines.

Indirect baseline N_2O emission was estimated and listed in table E4.

Table E4: Estimated indirect baseline N_2O emission

	$EF_{N2O,ID,j}$ (fraction)	F_{gasm} (fraction)	$NEX_{LT,y}$ (kg N/animal/year)	N_{LT} (head)	$MS\%_{Bl,j}$ (fraction)	$E_{N2O,ID,y}$ kg N_2O-N
Broiler	0.01	0.4	0.535	2,950,950	100	6,317
Layer	0.01	0.4	0.954	648,326	100	2,473
Total	-	-	-	-	-	8,790

N_2O emissions from manure management under baseline is listed in table E5.

Table E5: N_2O emission under baseline

Parameters	Unit	Value
GWP_{N2O}	tCO_2e/tN_2O	298
$CF_{N2O-N,N}$	-	44/28
$E_{N2O,D,y}$	kg N2O-N	0
$E_{N2O,ID,y}$	kg N2O-N	8,790
$E_{N2O,y}$ during the monitoring period	t CO_2e	4,116

(iii) CO_2 emission from electricity and heat within the project boundary

$$BE_{elec/heat,y} = EG_{Bl,y} * CEF_{Bl,elec,,y} + EG_{d,y} * CEF_{grid} + HG_{BL,y} * CEF_{Bl,\ therm,y} \quad (8)$$

where:

$EG_{Bl,y}$	The amount of electricity in the year y that would be consumed at the project site in the absence of the project activity (MWh) for operating AMMS.
$CEF_{Bl,\ elec,y}$	The carbon emissions factor for electricity consumed at the project site in the absence of the project activity (tCO_2/MWh).
$EG_{d,y}$	The amount of electricity generated utilizing the biogas collected under project activity and exported to the grid during the year y (MWh).
CEF_{grid}	The carbon emissions factor for the grid in the project scenario (tCO_2/MWh)
$HG_{BL,y}$	The quantity of thermal energy that would be consumed in year y at the project site in the absence of the project activity (MJ) using fossil fuel for operating AMMS, there is no thermal energy consumption in the baseline.
$CEF_{Bl,\ therm}$	The CO_2 emissions intensity for thermal energy generation (tCO_2e/MJ), it is not related.

Baseline CO_2 emissions were estimated and listed in table E6.

Table E6: Estimated baseline CO_2 emission

Parameters	$EG_{Bl,y}$ (MWh)	$CEF_{Bl,\ elec,y}$ (tCO_2/MWh)	$EG_{d,y}$ (MWh)	CEF_{grid}* (tCO_2/MWh)	$HG_{BL,y}$ (MJ)	$CEF_{Bl,\ therm}$ (tCO_2 e/MJ)	$BE_{elec/heat,y}$ (t CO_2 **e**)
Value	182	0.8	22,246	0.7995	0	-	17,945

*:calculated using equation (9) and listed in table E10.

The carbon emission factor for the grid CEF_{grid} is calculated as the weighted average of the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin emission factor ($EF_{BM,y}$):

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

where the weights ω_{OM} and ω_{BM} are 50% and 50% respectively by default.

Where the default weights are adopted for the proposed project, the baseline emission factor is:

$$CEF_{grid} = 0.50 \times EF_{OM,y} + 0.50 \times EF_{BM,y} \quad (10)$$

The carbon emissions factor for the grid was calculated using equation (9) and listed in table E7.

Table E7: Carbon emissions factor for the grid

Parameters	ω_{OM}	$EF_{OM,y}$ (tCO_2/MWh)	ω_{BM}	$EF_{BM,y}$ (tCO_2/MWh)	CEF_{grid} (tCO_2/MWh)
CEF_{grid} in 2014	0.5	1.058	0.5	0.541	0.7995

Table E8 is the summary of the baseline emissions during the monitoring period:

Table E8: Summary of the baseline emissions during the monitoring period (t CO_2 e)

$BE_{CH4,y}$	100,298
$BE_{N2O,y}$	4,116
$BE_{elec,y}$	17,945
BE_y	122,359

E.2. Calculation of project emissions or actual net GHG removals by sinks

>>The calculation of project emissions is included in excel file named as ERs calculation spreadsheet-Minhe fourth monitoring period.

Project emissions are calculated as follows:

$$PE_y = PE_{AD,y} + PE_{Aer,y} + PE_{N2O,y} + PE_{PL,y} + PE_{flared,y} + PE_{elec/heat} \quad (11)$$

$PE_{AD,y}$	Leakage from AMMS systems that capture methane in tCO_2e/yr
$PE_{Aer,y}$	Methane emissions from AMMS that aerobically treats the manure in tCO_2e/y
$PE_{N2O,y}$	Nitrous oxide emission from project manure waste management system in tCO_2e/yr
$PE_{PL,y}$	Physical leakage of emissions from biogas network to flare the captured methane or supply to the facility where it is used for heat and/or electricity generation in tCO_2e/yr
$PE_{flared,y}$	Project emissions from flaring of the residual gas stream in tCO_2e/yr
$PE_{elec/heat,y}$	Project emissions from use of heat and/or electricity in the project case in tCO_2e/yr

(i) Methane emissions from anaerobic digester where gas is captured ($PE_{AD,y}$):

ACM0010 specifies physical leakage from anaerobic digesters as being 15% of total biogas production. Because two stage manure management is involved in the manure treatment for the project activity, the equation 12 is applied to the estimate methane emissions from the project activity.

$$PE_{AD,y} = GWP_{CH4} * D_{CH4} * LF_{AD} * F_{AD} * \left[\prod_{n=1}^{N}\left(1-R_{VS,n}\right)\right] * \sum_{j,LT}(B_{O,LT} * N_{LT} * VS_{LT,y} * MS\%_j) \quad (12)$$

D_{CH4}	CH_4 density (0.00067 t/m^3 at room temperature (20 ºC) and 1 atm pressure).
LF_{AD}	Methane leakage from Anaerobic digesters, default of 0.15 multiplied by methane content of biogas. LF_{AD} =0.15*64.26%=0.096
F_{AD}	Fraction of volatile solid treated in anaerobic digester, 100% was applied, because all the manure was feed into anaerobic digester.
$R_{VS,n}$	Fraction of volatile solid degraded in AMMS stage n. $R_{VS,n}$ = 83.7%
LT	Index for livestock type
$B_{O,LT}$	CH_4 production capacity from manure for chickens, in m^3 CH_4/kg-VS. $B_{O,LT}$=0.36 for broiler and 0.39 for layers respectively
$VS_{LT,y}$	Annual volatile solid excretion of chickens on a dry matter basis in kg/animal/year. $VS_{LT,y}$ =5.406 for broiler and 12.771 for layers respectively
N_{LT}	Population of livestock type LT for the year y, expressed in numbers. N_{LT}= 2,950,950 for broiler and 648,326 for layers respectively.
MS%j	Fraction of manure handled in system j. MS%j=100%

Annual project CH_4 emissions from anaerobic digester and values of related parameters were listed in table E9.

Table E9: Estimated annual project CH_4 emissions from anaerobic digester where gas is captured

Parameters	Unit	Broiler	Layers
GWP_{CH4}	tCO_2 e/tCH_4	25	25
D_{CH4}	t/m^3	0.00067	0.00067
LF_{AD}	fraction	0.096	0.096
F_{AD}	%	100	100
$R_{VS,n}$	%	83.7	83.7
$B_{O,LT}$	m^3CH_4/kg_dm	0.36	0.39
N_{LT}	head	2,950,950	648,326
$VS_{LT,y}$ *	kg dm/year	5.406	12.771
$MS\%_{Bl,j}$	%	100	100
$PE_{AD,y}$ for different chicken	t CO_2 e	7,760	4,363
Total	t CO_2 e	12,123	

(ii) Methane emissions from aerobic AMMS treatment ($PE_{Aer,y}$):

IPCC 2006 Guidelines specify emissions from aerobic lagoons as 0.1% of total methane generating potential of the waste processed, which can be used as a default for all types of aerobic AMMS treatment.

$$PE_{Aer,y} = GWP_{CH4} \cdot D_{CH4} * 0.001 * F_{Aer} * \left[\prod_{n=1}^{N} (1 - R_{VS,n}) \right] * \sum_{j,LT} (B_{O,LT} * N_{LT} * VS_{LT,y} * MS\%_{j}) + PE_{Sl,y} \quad (13)$$

F_{Aer}	The fraction of volatile solid directed to aerobic system. F_{Aer} =16.3%
$PE_{Sl,y}$	CH_4 emissions from sludge disposed in storage pit prior to disposal during the year in tCO_2e/yr.

The equation used to estimate methane emissions from sludge is in equation 14.

$$PE_{SL,y} = GWP_{CH4} * D_{CH4} * MCF_{sl} * F_{Aer} * \left[\prod_{n=1}^{N} (1 - R_{VS,n}) \right] * \sum_{j,LT} (B_{O,LT} * N_{LT} * VS_{LT,y} * MS\%_{j}) \quad (14)$$

MCF_{sl}	Methane conversion factor (MCF) for the sludge stored in sludge pits estimated as in the baseline emissions section. MCF_{sl} =0.1%

The slurry storage ponds are not within the project boundary. The CH_4, direct N_2O and indirect N_2O emissions from methane emissions from sludge are considered as leakage of the project activity.

Total project CH_4 emissions from aerobic lagoon during the monitoring period were listed in table E10.

Table E10. Estimated annual CH_4 emissions from aerobic lagoon under project activity

Parameters	Unit	Broiler	Layers
GWP_{CH4}	tCO_2e/tCH_4	25	25
D_{CH4}	t/m^3	0.00067	0.00067
F_{Aer} to aerobic lagoon	%	16.3	16.3
MCF_{sl}	fraction	0.1%	0.1%
$R_{VS,n}$	%	83.7	83.7
$B_{O,LT}$	m^3CH_4/kg_dm	0.36	0.39
N_{LT}	head	2,950,950	648,326
$VS_{LT,y}$ *	kg dm/year	5.406	12.771
$MS\%_{Bl,j}$	%	100	100
$PE_{Aer,y}$	t CO_2 e	3	2
Total	t CO_2 e	5	

(iii) N_2O emissions from manure management

$$PE_{N2O,y} = GWP_{N2O} \cdot CF_{N2O-N,N} \cdot \frac{1}{1000} * (E_{N2O,D,Y} + E_{N2O,ID,y}) \quad (15)$$

where:

$PE_{N2O,y}$	Annual project N_2O emissions in t CO_2e / yr
GWP_{N2O}	Global Warming Potential (GWP) for N_2O. 298 was applied f according to the Annex 3 of EB 69.
$CF_{N2O-N,N}$	Conversion factor N_2O-N to N_2O (44/28).
$E_{N2O,D,y}$	Direct N_2O emission in kg N_2O-N/year.
$E_{N2O,ID,y}$	Indirect N_2O emission in kg N_2O-N/year.

The same method applied in estimating N_2O emissions in the baseline is used to estimate the project emissions of nitrous oxide.

$$E_{N2O,D,y} = \sum_{j,LT} (EF_{N2O,D,j} * NEX_{LT,y} * N_{LT} * MS\%_j) \quad (16)$$

where:

$EF_{N2O,D,j}$ The direct N_2O emission factor for the treatment system j of the manure management system in kg N_2O-N/kg N. According to scientific publication database (www.cnki.net), there are no published country specific data on $EF_{N2O,D,j}$. Default EF3 in volume 4, chapter 10, table 10.21 in IPCC 2006 Guidelines was applied. $EF_{N2O,\ D}$=0.01 for aerobic lagoon.

$NEX_{LT,y}$ The annual average nitrogen excretion per head of a defined livestock population in kg N/animal/year. IPCC default value with site weight adjustment was applied.

Direct N_2O emission from aerobic lagoon under project activity was estimated and listed in table E11.

Table E11: Estimated direct N_2O emission from aerobic lagoon under project activity

	$EF_{N2O,D,j}$ (fraction)	$NEX_{LT,y}$ * (kg N/animal/year)	$MS\%_{BL,j}$ (%)	N_{LT} (head)	$E_{N2O,D,y}$ kg N_2O-N
Broiler	0.01	0.535	100	2,950,950	15,794
Layer	0.01	0.954	100	648,326	6,185
Total	-	-	-	-	21,979

*: calculated using equation (6), results listed in table E3.

$$E_{N2O,ID,y} = \sum_{j,LT} EF_{N2O,ID,j} * F_{gasm} * NEX_{LT,y} * N_{LT} * MS\%_j \quad (17)$$

where:

$EF_{N2O,ID,j}$	The indirect N_2O emission factor for N_2O emissions from atmospheric deposition of nitrogen on soils and water surfaces, kg N_2O -N/kg NH_3-N and NOx-N emitted, estimated with site-specific, regional or national data if such data is available. Otherwise, default values for EF_4 from table 11.3, chapter 11, volume 4 of IPCC 2006 Guidelines can be used. $EF_{N2O,ID,j}$=0.01 for indirect N_2O emission
F_{gasm}	Percent of managed manure nitrogen for livestock category that volatilizes as NH_3 and NOx in the manure management system. F_{gasm} =40% were applied.

Indirect N2O emission under project activity was estimated and listed in table E12.

Table E12: Indirect N2O emission from project activity

	$EF_{N2O,ID,j}$ (fraction)	$NEX_{LT,y}$ (kg N/animal/year)	$MS\%_{BL,j}$ (%)	N_{LT} (head)	F_{gasm} (%)	$E_{N2O,ID,y}$ kg N_2O-N
Broiler	0.01	0.535	100	2,950,950	40	6,318
Layer	0.01	0.954	100	648,326	40	2,474
Total						8,792

Total N_2O emissions from manure management under project activity are listed in table E13.

Table E13: N_2O emission under project activity

Parameters	Unit	Value
GWP_{N2O}	tCO_2e/tN_2O	298
$CF_{N2O-N,N}$	-	44/28
$E_{N2O,D,y}$	kg N2O-N	21,979
$E_{N2O,ID,y}$	kg N2O-N	8,792
P $E_{N2O,y}$	t CO_2e	14,410

(iv) Physical leakage from distribution network of the captured methane ($PE_{PL,Y}$)

This refers to leaks in the biogas system from the biogas pipeline delivery system. In this monitoring period, the pipeline leakage of biogas was 28,065 m^3. The $PE_{PL,Y}$ is calculated using equation (18):

$$PE_{PL,y} = V_L * C_{CH_4} * \text{GWP}_{\text{CH}_4} * D_{CH_4} \quad (18)$$

where:

V_L	Pipeline leakage of biogas, m^3
C_{CH_4}	Methane concentration in the biogas, %
GWP_{CH4}	Global Warming Potential (GWP) of CH_4. 25 was applied according to the Annex 3 of EB 69.
D_{CH4}	CH_4 density (0.00067 t/m^3 at room temperature (20ºC) and 1 atm pressure).

Annual project CH_4 emissions from physical leakage and related parameters were listed in table E14.

Table E14. Estimated CH_4 emissions from physical leakage

Parameters	Unit	Value
V_L	m^3	28,065
C_{CH_4}	%	64.26
GWP_{CH4}	tCO_2e/tCH_4	25
D_{CH4}	t/m^3	0.00067

Table E15: Total project CH_4 emissions from physical leakage during the monitoring period

Parameters	Unit	total
Monitoring period	day	365
Project CH_4 emissions from pipeline leakage during the monitoring period	t CO_2 e	303

(v) Project emissions from flaring of the residual gas stream ($PE_{flare,y}$):

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} \times (1 - \eta_{flare,h}) \times \frac{GWP_{CH4}}{1000} \quad (19)$$

where

$PE_{flare,y}$	Project emissions from flaring of the residual gas stream in year y, tCO_2e
$TM_{RG,h}$	Mass flow rate of methane in the residual gas in the hour h
$\eta_{flare,h}$	Flare efficiency in hour h. According to registered PDD, in this project, fixed value of 0% for the flare efficiency was applied, and this is for conservative.

Total project CO_2 emissions from flare during the monitoring period were estimated and listed in table E15.

Table E15: Project CO_2 emissions from flare during the monitoring period

Parameters	$\sum_{h=1}^{8856} TM_{RG,h}$ (kg)	$\eta_{flare,h}$ (%)	$PE_{flare,y}$ (t CO_2 **e**))
Value	24,163	0	605

(vi) Project emissions from heat and electricity use ($PE_{elec/heat}$):

$$PE_{elec/heat} = EL_{Pr,y} * CEF_d + HG_{Pr,y} * CEF_{Pr,therm,y} \quad (20)$$

where:

$EL_{Pr,y}$	The amount of electricity in the year y that is consumed at the project site for the project activity (MWh).
CEF_d	The carbon emissions factor for electricity consumed at the project site during the project activity (tCO_2/MWh).
$HG_{Pr,y}$	The quantity of thermal energy consumed in year y at the project site due to the project activity (MJ). there is no thermal energy consumption in the project activity
$CEF_{Pr,therm,y}$	The CO_2 emissions intensity for thermal energy generation (tCO_2e/MJ). The factor is zero if biogas is used for generating thermal energy. It is not related

In this project, there is no thermal energy consumed, Determination of CEF_d: the determination of CEF_d is the same as the method of $CEF_{grid.}$

Total project CO_2 emissions from heat and electricity use during the monitoring period were estimated and listed in table E16.

Table E16: Project CO_2 emissions from heat and electricity use during the monitoring period

Parameters	$EL_{Pr,y}$ (MWh)	CEF_d (tCO_2/MWh)	$HG_{Pr, y}$ (MJ)	$CEF_{Pr, therm,y}$ (tCO_2e/MJ)	$PE_{elec/heat,y}$ (t CO_2 **e)**)
Value	1,638	0.7995	0	-	1,310

CEF_d is calculated as the weighted average of the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin emission factor ($EF_{BM,y}$):

$$CEF_d = \omega_{OM} \times EF_{OM,y} + \omega_{BM} \times EF_{BM,y} \quad (21)$$

where the weights ω_{OM} and ω_{BM} are 50% and 50% respectively by default.

Where the default weights are adopted for the proposed project, the baseline emission factor is:

$$CEF_d = 0.50 \times EF_{OM,y} + 0.50 \times EF_{BM,y} \quad (22)$$

The carbon emissions factor for the grid was calculated using equation (21) and listed in table E17.

Table E17: Carbon emissions factor for the grid CEF_d

Parameters	ω_{OM}	$EF_{OM,y}$ (tCO_2/MWh)	ω_{BM}	$EF_{BM,y}$ (tCO_2/MWh)	CEF_{grid} (tCO_2/MWh)
CEF_d in 2014	0.5	1.058	0.5	0.541	0.7995

Therefore for this monitoring period the following is the summary of the Project Emissions:

Summary of Project Emissions for this monitored Period (tCO_2e)	
$PE_{AD, y}$	12,123
$PE_{Aer,y}$	5
$PE_{N2O, y}$	14,410
$PE_{PL,y}$	303
PEflare,y	605
$PE_{elec/heat}$	1,310
PE_y	28,756

E.3. Calculation of leakage

>>The calculation of leakage is included in excel file named as ERs calculation spreadsheet-Minhe fourth monitoring period.

Leakage emissions are calculated as follows:

$$LE_y = (LE_{P,N2O} - LE_{B,N2O}) + (LE_{P,CH4} - LE_{B,CH4}) \quad (23)$$

Where,

$LE_{P,N2O}$	The N_2O emissions released during the project activity from land application

	of the treated manure, in tCO_2e/year.
$LE_{B,N2O}$	The N_2O emissions released during the baseline scenario from land application of the treated manure, in tCO_2e/year.
$LE_{P,CH4}$	The CH_4 emissions released during the project activity from land application of the treated manure, in tCO_2e/year.
$LE_{B,CH4}$	The CH_4 emissions released during the baseline scenario from land application of the treated manure, in tCO_2e/year.

(i) Estimation of N_2O emissions outside the project boundary in baseline:

$$LE_{B,N2O} = GWP_{N2O} * CF_{N2O-N,N} * \frac{1}{1000} * (LE_{N2O,land} + LE_{N2O,runoff} + LE_{N2O,vol}) \tag{24}$$

$$LE_{N2O,land} = EF_1 * \prod_{n=1}^{N} (1 - R_{N,n}) * \sum_{LT} NEX_{LT,y} * N_{LT} \tag{25}$$

$$LE_{N2O,runoff} = EF_5 * F_{Leach} * \prod_{n=1}^{N} (1 - R_{N,n}) * \sum_{LT} NEX_{LT,y} * N_{LT} \tag{26}$$

$$LE_{N2O,vol} = EF_4 * F_{gasm} * \prod_{n=1}^{N} (1 - R_{N,n}) * \sum_{LT} NEX_{LT,y} * N_{LT} \tag{27}$$

where:

$LE_{N2O,land}$	Direct nitrous oxide emission from application of manure waste, in Kg N_2O-N/year.
$LE_{N2O,runoff}$	Nitrous oxide emission due to leaching and run-off, in Kg N_2O-N/year.
F_{gasm}	Fraction of animal manure N that volatizes as NH_3 and NO_X in kg NH_3-N and NOx-N per kg of N. There is no site-specific, regional, or national data available. According to ACM0010, default values from table 11.3, chapter 11, volume 4 of IPCC 2006 Guidelines was used. F_{gasm} = 20% for land application were applied
EF_1	Emission factor for direct emission of N_2O from soils in Kg N_2O-N/kg N. There is no site-specific, regional, or national data available. According to ACM0010, default values from table 11.1, chapter 11, volume 4 of IPCC 2006 Guidelines was used. $EF_1=0.01$
EF_4	Emission factor for N_2O emissions from atmospheric deposition of N on soils and water surfaces, in kg N- N_2O / (kg NH_3-N + NOx-N volatilized. There is no site-specific, regional, or national data available. According to ACM0010, default values from table 11.3, chapter 11, volume 4 of IPCC 2006 Guidelines was used. $EF_4=0.01$
EF_5	Emission factor for indirect emission of N_2O from runoff in Kg N_2O-N/kg N. There is no site-specific, regional, or national data available. According to ACM0010, default values from table 11.3, chapter 11, volume 4 of IPCC 2006 Guidelines was used. $EF_5=0.0075$
F_{leach}	Fraction of *all* N added to mineralized in managed soils in regions where leaching/runoff occurs that is lost through leaching and runoff. There is no site-specific, regional, or national data available. According to ACM0010, default values from table 11.3, chapter 11, volume 4 of IPCC 2006 Guidelines was used. $F_{leach}=0$
$R_{N,n}$	Fraction of NEX in manure waste that is reduced in the Baseline AMMS. The relative reduction of nitrogen depends on the treatment technology and should be estimated in a conservative manner. Default values for different treatment

	technologies can be found in Annex 1 of methodology ACM 0010.However, there is no value for aerobic lagoon in ACM0010 Annex I or national date , so the default value of 2006 IPCC guideline was applied.

Baseline N_2O leakage emission for land application was estimated as table E18.

Table E18: Estimated baseline N_2O leakage emission from land application

	EF_1 (fraction)	$NEX_{LT,y}$ * (kg N/head/year)	$R_{N,n}$ (fraction)	N_{LT} (head)	F_{gasm} (%)	$LE_{N2O,land}$ (kg N_2O-N)
Broiler	0.01	0.535	0.4	2,950,950	20	7,580
Layer	0.01	0.954	0.4	648,326	20	2,968
Total	-	-	-	-	-	10,548

Because the precipitation is less than the expiration, according to version 02 of ACM0010, the $LE_{N2O,runoff}$ is zero.

Baseline N_2O leakage emission from atmospheric deposition of N on soils and water surfaces was estimated as table E19.

Table E19：Estimated baseline N_2O leakage emission from atmospheric deposition of N on soils and water surfaces

	EF_1 (fraction)	$NEX_{LT,y}$ * (kg N/head/year)	$R_{N,n}$ (fraction)	N_{LT} (head)	$F_{gasm'}$ (%)	$LE_{N2O,vol}$ (kg N_2O-N)
Broiler	0.01	0.535	0.4	2,950,950	20	1,895
Layer	0.01	0.954	0.4	648,326	20	742
Total						2,637

Total baseline leakage N_2O emissions from land application is listed in table E20.

Table E20: N_2O emission under baseline activity

Parameters	Unit	Value
GWP_{N2O}	tCO_2e/tN_2O	298
$CF_{N2O-N,N}$	-	44/28
$LE_{N2O,land}$	kg N_2O-N	10,548
$LE_{N2O,runoff}$	kg N_2O-N	0
$LE_{N2O,vol}$	kg N_2O-N	2,637
$LE_{B,N2O}$	t CO_2e	6,174

(ii) N_2O emissions out the project boundary in project case

$$LE_{P,N2O} = GWP_{N2O} * CF_{N2O-N,N} * \frac{1}{1000} * (LE_{N2O,land} + LE_{N2O,runoff} + LE_{N2O,vol}) \quad (28)$$

$$LE_{N2O,land} = EF_1 * \prod_{n=1}^{N} (1-R_{N,n}) * \sum_{LT} NEX_{LT,y} * N_{LT} \quad (29)$$

$$LE_{N2O,runoff} = EF_5 * F_{Leach} * \prod_{n=1}^{N} (1-R_{N,n}) * \sum_{LT} NEX_{LT,y} * N_{LT} \quad (30)$$

$$LE_{N2O,vol} = EF_4 * F_{gasm} * \prod_{n=1}^{N} (1-R_{N,n}) * \sum_{LT} NEX_{LT,y} * N_{LT} \quad (31)$$

Total N_2O leakage emission from land application under project activity during the monitoring period was estimated as table E21.

Table E21: Estimated N_2O leakage emission from land application under project activity

	EF_1 (fraction)	$NEX_{LT,y}$ * (kg N/head/year)	% of NEX in Aerobic Lagoon for land application	N_{LT} (head)	F_{gasm} (%)for aerobic lagoon	F_{gasm} (%)for land application	$LE_{N2O,land}$ (kg N_2O-N)
Broiler	0.01	0.535	99	2,950,950	40	20	7,506
Layer	0.01	0.954	99	648,326	40	20	2,940
Total	-	-	-	-	-	-	10,446

Because the precipitation is less than the expiration, according to ACM0010, version 02, the $LE_{N2O,runoff}$ is zero.

Annual N_2O leakage emission from atmospheric deposition of N on soils and water surfaces under project activity was estimated as table E22.

Table E22: Estimated annual N_2O leakage emission from atmospheric deposition of N on soils and water surfaces under project activity

	EF_1 (fraction)	$NEX_{LT,y}$ * (kg N/head/year)	% of NEX in Aerobic Lagoon for land application	N_{LT} (head)	F_{gasm} (%) for aerobic lagoon	F_{gasm} (%) for land application	$LE_{N2O,vol}$ (kg N_2O-N)
Broiler	0.01	0.535	99	2,950,950	40	20	1,877
Layer	0.01	0.954	99	648,326	40	20	735
Total	-	-	-	-	-	-	2,612

Total leakage N_2O emissions under project activity from land application is listed in table E23.

Table E23: Leakage N_2O emission under project activity

Parameters	Unit	Value
GWP_{N2O}	tCO_2e/tN_2O	298
$CF_{N2O-N,N}$	-	44/28
$LE_{N2O,land}$	kg N_2O-N	10,446
$LE_{N2O,runoff}$	kg N_2O-N	0

$LE_{N2O,vol}$	kg N_2O-N	2,612
$LE_{P,N2O}$	t CO_2e	6,115

(iii) Methane emissions from disposal of treated manure in baseline condition

$$LE_{B,CH4} = GWP_{CH4} \cdot D_{CH4} * MCF_d * \left[\prod_{n=1}^{N}\left(1 - R_{VS,n}\right)\right] * \sum_{j,LT}(B_{O,LT} * N_{LT} * VS_{LT,y} * MS\%_j) \quad (32)$$

Where:

$LE_{B,CH4}$ Methane leakage emissions in the baseline (tCO_2e / yr)
MCF_d Methane conversion factor (MCF) assumed to be equal to 1.

Annual CH_4 leakage emission in baseline was estimated as table E24.

Table E24： Estimated annual methane leakage emission in baseline

Parameters	Unit	Broiler	Layers
GWP_{CH4}	tCO_2e/tCH_4	25	25
D_{CH4}	t/m^3	0.00067	0.00067
MCF_d	fraction	1	1
$R_{VS,n}$	fraction	0.71	0.71
$B_{O,LT}$	m^3CH_4/kg_dm	0.36	0.39
N_{LT}	head	2,950,950	648,326
$VS_{LT,y}$ *	kg dm/year	5.406	12.771
$MS\%_{Bl,j}$	%	100	100
$LE_{B,CH4}$	t CO_2 e	27,897	15,685
Total	t CO_2 e	43,582	

(iv) Methane emissions from disposal of treated manure in project case

$$LE_{P,CH4} = GWP_{CH4} * D_{CH4} * MCF_d * \left[\prod_{n=1}^{N}\left(1 - R_{VS,n}\right)\right] * \sum_{j,LT} B_{O,LT} * N_{LT} * VS_{LT,y} * MS\%_j) \quad (33)$$

Where:

$LE_{P,CH4}$ Methane leakage emissions in the project case (tCO_2e / yr)

Annual CH_4 leakage emission under project activity includes sludge land application and of aerobic treated effulent land application. Because there is no sludge applied to soil during 1st monitoring period, the CH_4emission from sludge land application is zero. The annual CH_4 leakage emission from aerobic lagoon effluent land application under project activity is estimated as table E25.

Table E25: Estimated annual methane leakage emission from aerobic lagoon effluent land application under project activity

Parameters	Unit	Broiler	Layers
GWP_{CH4}	tCO_2e/tCH_4	25	25
D_{CH4}	t/m^3	0.00067	0.00067
MCF_d	fraction	1	1
$R_{VS,1}$	%	83.7	83.7
$R_{VS,2}$	%	0.1	0.1
$B_{O,LT}$	m^3CH_4/kg_dm	0.36	0.39
N_{LT}	head	2,950,950	648,326
$VS_{LT,y}$ *	kg dm/year	5.406	12.771
$MS\%_j$	%	100	100
$LE_{P,CH4}$	$t\ CO_2\ e$	15,686	8,820
Total	$t\ CO_2\ e$	24,506	

Therefore leakage emissions for the current monitored period are summarized as follows:

Summary of Leakage Emissions for this monitored Period		
Parameters	Unit	Value
$\mathbf{LE}_{B,CH4}$	$t\ CO_2\ e$	43,582
$\mathbf{LE}_{p,CH4}$	$t\ CO_2\ e$	24,506
$\mathbf{LE}_{B,N2O}$	$t\ CO_2\ e$	6,174
$\mathbf{LE}_{P,N2O}$	$t\ CO_2\ e$	6,115
LE_Y	$t\ CO_2\ e$	0

For further details please see ERs calculation spreadsheet-Minhe fourth monitoring period.

E.4. Summary of calculation of emission reductions or net GHG removals by sinks

Item	Baseline emissions or baseline net GHG removals by sinks ($t\ CO_2e$)	Project emissions or actual net GHG removals by sinks ($t\ CO_2e$)	Leakage ($t\ CO_2e$)	GHG emission reductions or net GHG removals by sinks ($t\ CO_2e$) achieved in the monitoring period

				Up to 31/12/2012	From 01/01/2014	Total amount
Total	122,359	28,756	0	-	93,603	93,603

The emission reduction ERy by the project activity during a given year y is the difference between the baseline emissions (BEy) and the sum of project emissions (PEy) and leakage, as follows:

$$ER_y = BE_y - PE_y - LE_y \qquad (34)$$

Further, if the actual methane captured from anaerobic digesters in project activity is lower than ($BE_{CH4,y}$ - $PE_{AD,y}$- $PE_{PL,y}$), then ($BE_{CH4,y}$ - $PE_{AD,y}$ - $PE_{PL,y}$) (which is a component of BEy -PEy) in equation 34 is replaced by actual methane captured.

Biogas captured during monitoring period was 11,4644,979 m^3, which equals to 123,407 tCO_2e. Baseline methane emission ($BE_{CH4,y}$) was 100,298 tCO_2e. Methane emissions from anaerobic digester where gas is captured ($PE_{AD,y}$) was 12,123 tCO2e. Methane emissions from Physical leakage of distribution network were 303 tCO_2e. Actual methane captured from anaerobic digesters is higher than the difference of $BE_{CH4,y}$ $PE_{AD,y}$ and $PE_{PL,y}$. Therefore, the equation 34 can be used to calculate emission reduction.

Emission reduction generated in the monitoring period (01/01/2014-31/12/2014): 93,603 tCO_2e.

E.5. Comparison of actual emission reductions or net GHG removals by sinks with estimates in registered PDD

According to the registered PDD, the expected emission reduction of the project was estimated to be 72,371 tCO_2e per year. During the monitoring period (01/01/2014-31/12/2014), the measured emission reduction was 93,603 tCO_2e which is 29.3% higher than the ex-ante calculated result of 72,371 tCO_2e.

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO_2e)	72,371	93,603

E.6. Remarks on difference from estimated value in registered PDD

>> The increase of emission reduction compared with that in PDD is due to the changes of global warming potential for CH_4 and N_2O. GWP_{CH4} of 25 and GWP_{N2O} of 298 instead of GWP_{CH4} of 21 and GWP_{N2O} of 310 were applied according to the Annex 3 of EB 69. It cause the emission reduction increased 18.1% compared with the application of GWP_{CH4} (21) and GWP_{N2O} (310). Another reason for the emission reduction increase is the increase of electricity production. It contributed to 6.2% increase of emission reduction.

Appendix 1.

Contact information of project participants and responsible persons/ entities

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Contact information of project participants and responsible persons/ entities

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Document information

Version	*Date*	*Description*
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: • Include provisions related to delayed submission of a monitoring plan; • Provisions related to the Host Party; • Remove reference to programme of activities; • Overall editorial improvement.

Version	Date	Description
04.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from *F-CDM-MR* to *CDM-MR-FORM*; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.

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