MONITORING REPORT I

For the verification of Biogas Program for Animal Husbandry Sector of Vietnam

Monitoring period I (28/06/2010 – 31/12/2011)

Version 2.3
21 Feb 2013

Prepared by
Nexus – Carbon for Development

The Gold Standard®
Premium quality carbon credits

MONITORING REPORT I

For the verification of Biogas Program for Animal Husbandry Sector of Vietnam

Monitoring period I

Main contact person
Mrs. Nguyen Thi Minh Nguyet
Title: Program Coordinator
Email: nguyetntm@biogas.org.vn
Phone: +84 4 3726 1771 ext.18
Mob: +84 904 265 668
Website: www.biogas.org.vn

Contact details of Project Participants are listed in Annex I

Author of study
Eric Buysman
Consultant to Nexus – Carbon for Development
+84 (0) 1692696835
Email: ericishier@gmail.com
Skype: ericishier

Acronyms

AWMS	Animal Waste Management System
BE	Baseline emission
BUS	Biogas User Survey
CDM	Clean Development Mechanism
CH_4	Methane Gas
CO_2	Carbon Dioxide
CO_2eq	Relative potency of non-CO_2 gases compared to CO_2
EF	Emission factor
ER	Emission reduction
GBM	Gold Standard Biodigester Methodology
GHG	Greenhouse Gas
GS	Gold Standard
GSPR	Gold Standard Passport Report
GWP	Global Warming Potential
hh	household
IPCC	Intergovernmental Panel on Climate Change
LPG	Liquefied Petroleum Gas
LSC	Local Stakeholder Consultation Report
MCF	Methane conversion factor
MS	Manure system (equivalent to AWMS)
MPI	Monitoring Period x (I or II)
MRII	Monitoring Report (I or II)
N_2O	Nitrous oxide
NRB	Non-Renewable Biomass
PDD	Project Description Document
PE	Project Emission
SNV	Netherlands Development Organization
UNFCCC	United Nation Framework Convention on Climate Change
VER	Voluntary emission reduction
VGS	Voluntary Gold Standard

Table of Contents

1. INTRODUCTION

The Biogas Program for the Animal Husbandry Sector in Vietnam (BP) is implemented by Livestock Production Department the Biogas Project Division (BPD) (under the Ministry of Agriculture and Rural Development (MARD)) in partnership with the Netherlands Development Organization (SNV). Overall objectives of BP are (i) effectively exploiting biogas technology and developing a commercial viable biogas sector in Vietnam; and (ii) contributing to rural development and environmental protection via provision of clean and affordable energy to rural households, improvement of community's sanitation and rural people's health, creation of jobs for rural labor and reduction of greenhouse gas emissions (GHG).

This report presents the results of the monitoring activities of monitoring period I (MPI), 28-06-2010 to 31-12-2011. The BP VGS project in this document will be referred to as 'the VGS project'. The next table shows the key VGS development stages.

Table 1: Status of Gold Standard accreditation of the VGS project

Milestone	Date
Validation	02 May 2012
Registration	28 June 2012
DOE on site verification visit	25 – 28 June 2012

1.1 VGS PROJECT CHARACTERISTICS

The table hereunder details the characteristics of the VGS project.

Table 2: BP VGS project characteristics

Item	Data
Host country	Viet Nam
Project title	Biogas Program of the Animal Husbandry Sector of Viet Nam
Project size	Large scale
Gold standard project animal icon	Pelican
GS project ID	GS1083
Project scope according to UNFCCC categories	Renewable energy delivery to the user and methane avoidance
Applied methodology	Technologies and practices to displace decentralized thermal energy consumption[1]
Crediting period	7 years (renewable)
Project start date	13/06/2006
Start date of crediting period I	28/06/2010

[1] http://www.cdmgoldstandard.org/wp-content/uploads/2011/10/GS_110411_TPDDTEC_Methodology.pdf

The methodology 'Technologies and practices to displace decentralized thermal energy consumption', will be referred to as the 'methodology' in this document.

1.2 TECHNICAL PROJECT DESCRIPTION

The purpose of the project activity is to (further) develop the commercial and structural deployment of domestic biogas[2] in Vietnam. To that extent, the project will:

- Promote the long-term utilization of renewable energy produced in an environmentally compatible and economically viable way;
- Increase the awareness of prospective livestock smallholder households and extension workers on the full extent of the potential costs and benefits of domestic biogas installations;
- Strengthen the supporting capacity of involved Biogas Construction Teams (BCTs) and (non-) Government officials regarding all aspects of marketing, construction, after sales service and quality management of domestic biogas installations;
- Support the development of a commercially viable, market oriented domestic biogas sector in Vietnam;
- Strengthen the institutional infrastructure for coordination and implementation of sustained dissemination of domestic biogas at national, provincial and district level.

The project will build on the achievements of the "Support Project to the Biogas Programme for the Animal Husbandry Sector in some Provinces of Vietnam" (BP I) and aims to build 107,078 units in the period 2017-2016 in phase II 2007- 2014 and the follow up phase until 2016. With implementation of this Project, greenhouse gas (GHGs) emissions will be reduced, both from the displacement of non-renewable biomass (NRB) and fossil fuels currently used in stoves with clean and efficient biogas technology, but also by improving animal waste management systems (AWMS).

Contribution to Sustainable Development

The Project will contribute to sustainable development (SD) of Vietnam in several areas:

(1) Contribution to environmental development

- Substitution of conventional household fossil fuels by biogas and efficient biogas stoves, resulting in cleaner indoor air;
- Substitution of biomass fuel that is unsustainably harvested, helping to alleviate deforestation;
- Mitigation of the GHGs emissions by switching a high GHG emissions AWMS practice to a lower GHG emission AWMS practice;
- Substitution of synthetic fertilizer with the organic residue from the digestion process – bio-slurry;

[2] *Domestic biogas is defined as any biogas plant with a volume between 4 to 50 m^3, the minimum daily feedstock requirement of the smallest size is manure from 2 pigs or two bovines (20 kg/day) and the largest digester can treat around 300 kg/manure/day.*

- Improvement of sanitary conditions on the farms through connection of latrines to sewers or biogas digester and regular collection and treatment of animal manure from stables;
- Reduction in environmental load on surface waters as a result of averted discharge of untreated manure; and
- Improvement of indoor (kitchen) air quality by substituting less efficient cooking fuels by biogas.

(2) Contribution to economic development

- Reduction in the expenses for domestic thermal energy;
- Reduction in expenses for synthetic fertilizer by applying bio-slurry;
- Increase in agricultural production yields by applying nutrient rich bio-slurry; and
- Creation of employment opportunities for the construction and maintenance of biogas digester systems in rural areas.

(3) Contribution to social development

- Reduction in domestic workload of women and children by
  - the reduced demand for wood (less time is spent on fuel wood gathering)
  - Provision of a convenient cooking fuel that burns faster and cleaner then solid fuels (time is saved on cooking activities and cleaning the pots)and
- Prevention of respiratory illnesses resulting from indoor air pollution and gastro-enteric diseases attributed to poor sanitary conditions.

(4) Conformation to the governmental policy and strategy of Vietnam

- The Project contributes to the Government's National Strategy for Environmental Protection with the major objectives:-
  - *"To halt pollution acceleration, remedy degraded areas and improve the environment quality and ensure sustainable development of the country is achieved"*;
  - *"To guarantee that all people are entitled to live in an environment with good quality of air, land and water measuring up to standards stipulated by the State"*; and
  - *"To increase the rate of clean energy use to 5% of the total annual energy consumption"*.
- The Project is also consistent with Vietnam's Global Environment Facility Strategy and Renewable Energy Action Plan which promotes the efficient use of energy sources.

BP has received international acclaim by winning the prestigious Energy Globe Award in 2006 and the Ashden Award in 2010. Both awards recognize the tremendous contribution that the programme has achieved in sustainable development, tackling energy poverty and the treat of climate change.

1.3 APPLIED TECHNOLOGY

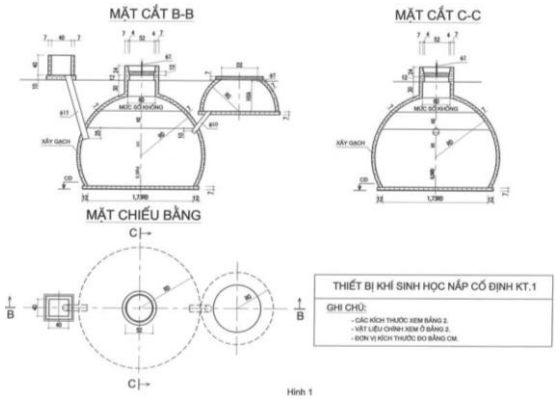
The project involves the installation and implementation of model types KT.1 and KT.2 (model A and B) domestic biogas plan or equivalent[3]. In case other domestic biogas technologies are included; a detailed description of the equivalent technology will be included in the monitoring report. Each installation will be installed according to the MARD national standard[4], and in that case the expected lifetime is in the order of 25 years. The KT.1, KT.2 and other models of biogas plants have been developed after 1990s in Vietnam. Development is done by the Institute of Energy as well as others based on earlier Chinese and German design. Design, construction and fitting has been standardized in MARD's "standards for small size biogas plants # 10 TCN 497 – 2005 –- Part 6".

The hemi-spherical fixed dome plants are made on-site, entirely out of brick work. The materials required for construction, including bricks, cement, iron bars, fitting materials etc. are all locally manufactured. Basic appliances, which are also widely available, consist of gas pipe, main valves, stoves and gas lamps. Biogas plants will be installed in the range of 4 m^3 to 50 m^3 with a current average size of 8m^3 to 15m^3 (11.35 m^3 on average of units built between 1-1-2007 and 31-08-2011),

Both designs need a fair amount of construction skills, but have otherwise proven to be robust and virtually maintenance-free. With feeding of on-farm produced manure of pigs, cattle or buffalo to the digester, biogas will be produced to meet the energy demand of the household. The residue of the digestion process can be used as organic fertilizer.

The KT.1 model is a further development of the model NL.5 of the Institute of Energy and has been accepted widely in the programme.

KT.1 Domestic biogas design

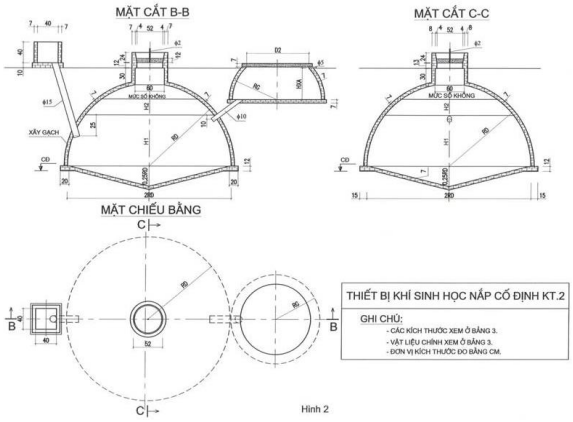


[3] Biogas plants that are recognized in the MARD biogas standard for small scale biogas

[4] MARD national standard: 10 TCN 97 ÷102 – 2006. Issued by decision N^0 4006/QĐ-BNN-KHCN of Ministry of Agriculture and Rural development on 26th December 2006.

The KT2 model follows the TG-BP design as applied in the Mekong Delta by the Can Tho University. Similar to KT.1, the revised design for KT.2 accommodates digester volumes of 4 to 50 m^3. There are two models of KT2 built, KT2A and KT2B. KT2B is a modified version of KT2A, and currently the only model promoted by the programme[5]

KT.2 Domestic biogas design



Although the KT.1 model optimizes material economy best, it needs deeper excavation. For areas with a high water table or rocky ground, the KT.2 is then better suited.

For both models, design variations allow for the type of manure (pig and cattle/buffalo), the dilution ratios of water and manure (1/1, 2/1 and 3/1) and the specific climatic conditions (the North with a cold winter and the South with a warm winter).The programme uses an elaborate design manual, combining over 100 design variations.

1.4 UNITS DISSEMINATED AND PROJECT AREA

The PDD lists where the project is active. At the end of MPI, the VGS project includes 47 provinces at the end of monitoring period I (MPI), of which 18 in climate zone warm and 29 in climate zone temperate, the next table displays the number of units built in the warm zone at the end of MPI.

Table 3: Units installed by climate zone and province

#	Province zone Warm	Number of units installed
1	An Giang	369
2	Bà Rịa-Vũng Tàu	899
3	Bạc Liêu	9
4	Bến Tre	1475
5	Bình Định	4791
6	Cần Thơ	68
7	Đồng Nai	1564

[5] Denoted as KT2 model in the database

8	Hậu Giang	101
9	Khánh Hòa	465
10	Kiên Giang	526
11	Long An	266
12	Quảng Nam	828
13	Quảng Ngãi	2323
14	Sóc Trăng	16
15	Tây Ninh	17
16	Tiền Giang	3150
17	Trà Vinh	1278
18	Vĩnh Long	291
	Grand Total zone warm	**18436**

In total 18,436 units were built in the climate zone warm, around 70,740 units were built in the temperature zone at the end of MPI:

Table 4: Number of units installed in the temperate zone by province

#	Provinces zone Temperate	Number of units installed
1	Bắc Giang	4776
2	Bắc Ninh	4520
3	Đắc Lắc	2363
4	Điện Biên	8
5	Gia Lai	612
6	Hà Nam	2821
7	Hà Nội	6243
8	Hà Tây	3228
9	Hà Tĩnh	740
10	Hải Dương	3892
11	Hải Phòng	1939
12	Hoà Bình	1471
13	Hưng Yên	2491
14	Lâm Đồng	58
15	Lạng Sơn	661
16	Lào Cai	205
17	Nam Định	1770
18	Nghệ An	4814
19	Ninh Bình	3448
20	Phú Thọ	2622
21	Quảng Ninh	1962
22	Sơn La	1054
23	Thái Bình	1817
24	Thái Nguyên	3957
25	Thanh Hoá	7063
26	Thừa Thiên Huế	1438
27	Tuyên Quang	138
28	Vĩnh Phúc	2894
29	Yên Bái	1735
	Grand Total zone Temperate	**70740**

The next figure shows the distribution of provinces by climate zone in Vietnam.

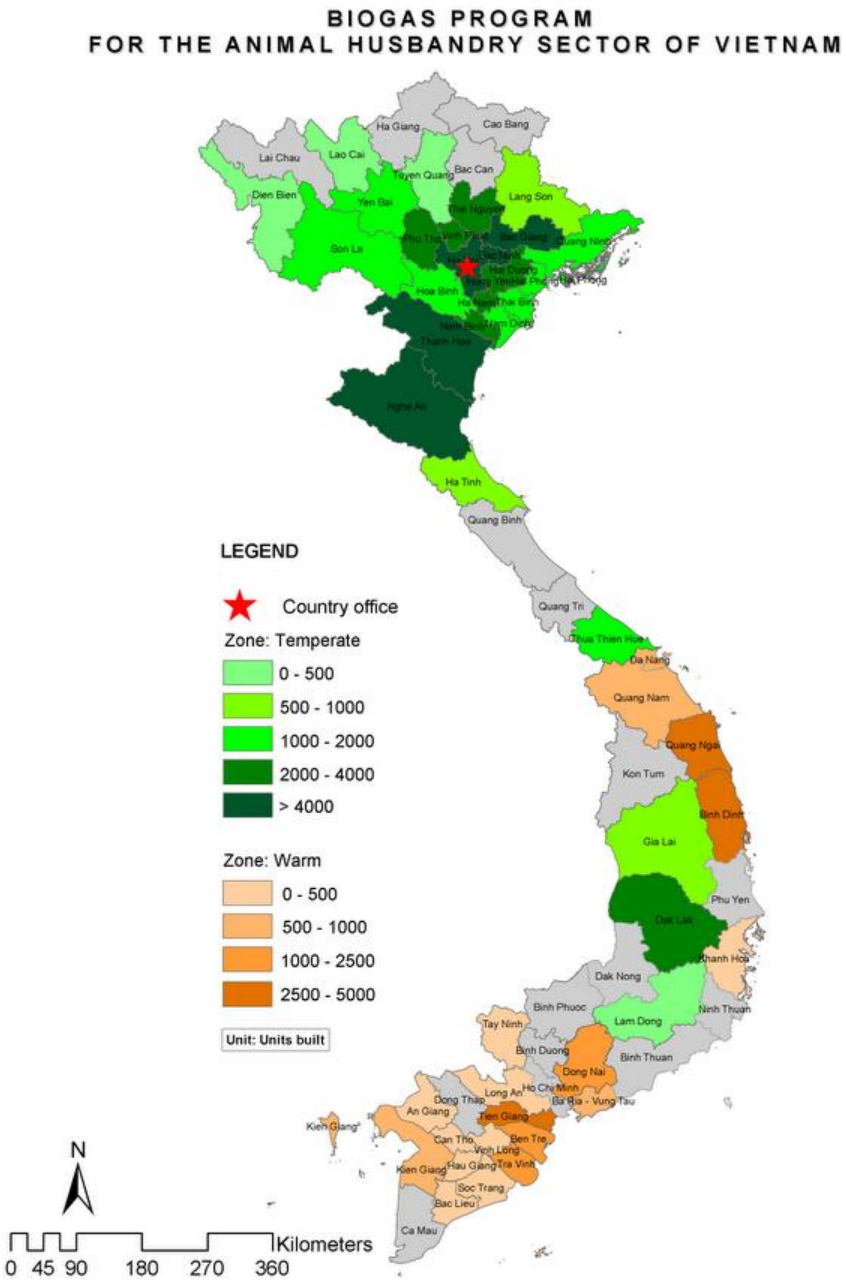


Figure 1: The provinces included in MPI by climate zone

The next table shows the number of units commissioned between 1/1/2007 to 31/12/2011 by year.

Table 5: Total Number of units in commissioned by year

year	Installation/year	Cumulative installations
2007	14,453	14,453
2008	15,843	30,296
2009	22,239	52,535
2010	23,220	75,755
2011	13,421	89,176

In total 89,176 biodigesters were taken into operation as of 31 December 2011 in the VGS project area. The next figure shows the cumulative number of installed biodigesters.

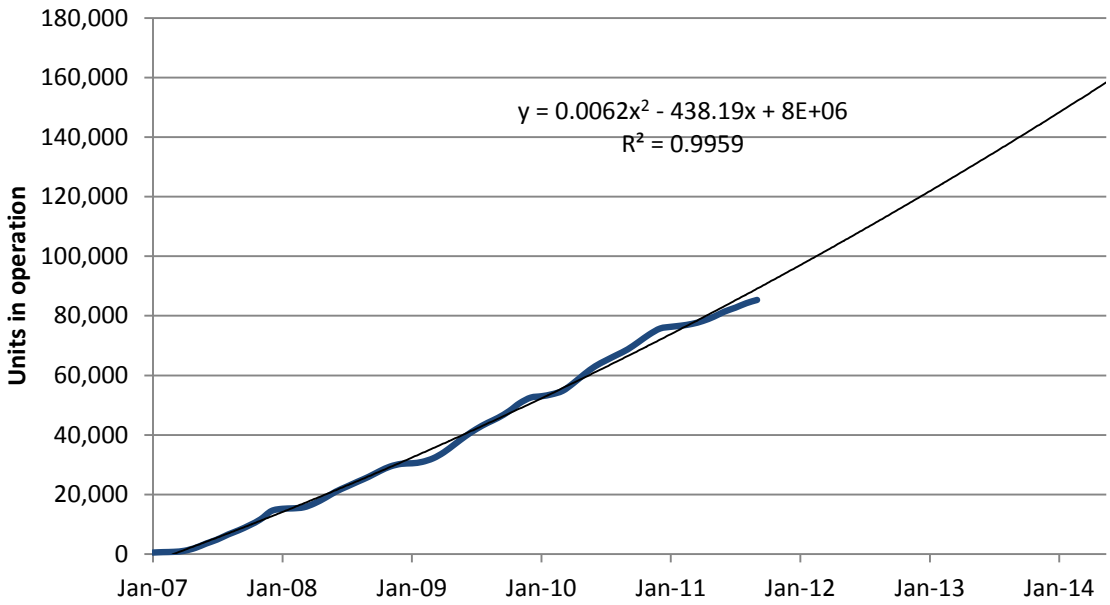


Figure 2: Number of units installed under the VGS project

Figure 2 shows that the number of units installed is steadily increasing and slowly accelerating. This indicates that the programme is gradually becoming more popular. The trend line plotted in the figure forecasts, based on the best fit (r^2 of 0.99) with the existing progress, a population of 160,000 in 2014. The next figure shows the number of units installed by month:

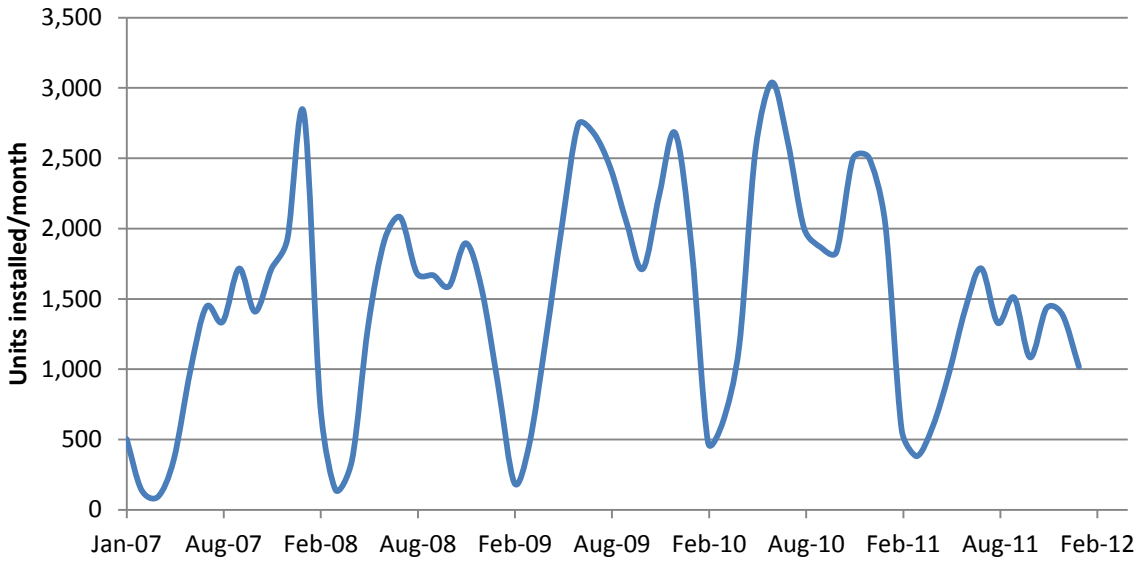


Figure 3: Number of units installed by month

The figure also shows that there are seasonal effects affecting the number of units installed, the most predominant effect that impacts the production figures is Vietnamese New Year (Tet). BP installs digester in many different sizes according to manure availability and climate zone; the next figure shows the popularity of each digester by size range expressed in fraction of total number of digesters built:

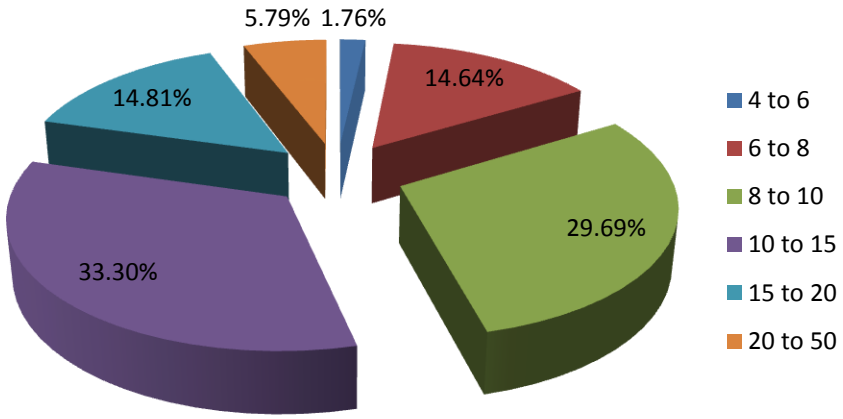


Figure 4: Share of digester volume ranges (m3) in total digester population

The average digester has a volume of 11.3 m^3. The VGS project has a cumulative digester volume of 1,007,349 m^3.

1.5 SUMMARY OF EMISSION REDUCTIONS

The next table shows the total number of emissions reduced by month and the cumulative for MPI. The start of the MP differs from the PDD (may 2010) due to delays with the validation of the PDD.

Table 6: Summary of the Emission Reductions by month

Month of program	Period		Units installed	Cumulative number of units	ER/month (tCO_2e)	Cumulative ER (tCO_2e)
43	28-Jun-10	31-Jul-10	2326	65,010	23,193	23,193
44	1-Aug10	31-Aug-10	1846	66,856	24,057	47,250
45	1-Sep-10	30-Sep-10	1866	68,722	24,748	71,998
46	1-Oct-10	31-Oct-10	2496	71,218	25,427	97,425
47	1-Nov-10	30-Nov-10	2505	73,723	26,350	123,775
48	**1-Dec-10**	**31-Dec-10**	**2032**	**75,755**	**27,277**	151,052
49	1-Jan-11	31-Jan-11	567	76,322	28,029	179,080
50	1-Feb-11	28-Feb-11	381	76,703	28,238	207,319
51	1-Mar-11	31-Mar-11	598	77,301	28,379	235,698
52	1-Apr-11	30-Apr-11	969	78,270	28,601	264,299
53	1-May-11	31-May-11	1428	79,698	28,959	293,258
54	1-Jun-11	30-Jun-11	1717	81,415	29,488	322,746
55	1-Jul-11	31-Jul-11	1329	82,744	30,123	352,869
56	1-Aug-11	31-Aug-11	1509	84,253	30,615	383,483
57	1-Sep-11	30-Sep-11	1084	85,337	31,173	414,656
58	1-Oct-11	31-Oct-11	1434	86,771	31,574	446,230
59	1-Nov-11	30-Nov-11	1387	88,158	32,105	478,335
60	**1-Dec-11**	**31-Dec-11**	**1018**	**89,176**	**32,618**	510,952

The vintages for 28 June to 31 December 2010 are: 151,051 VERs[6]
The vintages for 1 January to 31 December 2011 are: 359,901 VERs[6].

[6] Rounded down from 151,052.6 to 151,051 and rounded up from 359,900.8 to 359.901. Rounding up and down was necessary to match the total number of ERs of 510,952.

2. METHODOLOGY

The USAGE survey design and the Carbon Monitoring Survey is described in chapter 2.1 and chapter 2.2 respectively. Both surveys are executed in compliance with the monitoring plan in the PDD and the GSPR, any deviations, if occurred, are described in the respective chapters.

2.1 USAGE SURVEY DESIGN

The usage survey provides a single usage parameter that is weighted based on drop off rates that are representative of the age distribution for project technologies in the database. A usage parameter must be established to account for drop off rates as project technologies age and are replaced. Prior to a verification, a usage parameter is required that is weighted to be representative of the quantity of project technologies of each age being credited in a given project scenario.

For example, if only technologies in the first year of use (age 0-1) are being credited, a usage parameter must be established through a usage survey for technologies age 0-1. If an unequal number of technologies in the first year of use (age 0-1) and second year of use (age 1-2) are credited, a usage parameter is required that is weighted to be equally representative of drop off rates for technologies age 0-1 and age 1-2 . The minimum total sample size is 100, with at least 30 samples for project technologies of each age being credited

To ensure conservativeness, participants in a usage survey with technologies in the first year of use (age 0) must have technologies that have been in use on average longer than 0.5 years. For technologies in the second year of use (age 1-2), the usage survey must be conducted with technologies that have been in use on average at least 1.5 years, and so on.

The usage survey is designed based on the following guidelines as per PDD:

- Each year BPD will monitor the usage of the biogas units by selecting randomly at least 30 samples (biogas households)[7] from each year credited, the total sample will be over 100 units each time;
- To ensure conservativeness, only technologies will be selected that are in use for at least 0.5 year, for year 1-2 only technologies that are in use for at least 1.5 years etc. for the other years.

After random selection of the households by age group, the obtained drop-off rate of each year will be weighted according to the numbers of units built in that period. The drop-off rate will be applied when calculating the quantity of fuel consumed, where it is assumed that any drop off rate is replaced by fuel consumption of the applicable baseline scenario.

Usage survey design (US)

The US monitoring procedure applied will consist of the following steps:

[7] See page 24 of the methodology

I. Details of the biogas households of each age group are gathered;
II. Simple random selection of at least 30 households from each age group (35 were selected by applying oversampling). The sampling is executed using a web based random number generator[8]. Screenshots were made of the generated numbers and available at request.
III. The generated numbers were linked to the households, i.e. randomly generated number 97 was linked with number 97 of the age group, number 97 was then included in the list of samples.
IV. BP personal surveyed the sampled households, and the gathered data was entered into a database at the head office after inspection of the quality.
V. The obtained drop-off rate will be used to discount emission reductions

The next table shows the number of households selected by age group and the population of units that belongs to that age group:

Table 7: Usage survey selection by age group

Year	Age group	Units included that are at least in use for (years)	Period		Units built in that period (age group population)	Sample drawn from units built (at random)
2007	0-1	4.5	1-Jan-07	30-Jun-07	3529	35
2008	1-2	3.5	1-Jul-07	30-Jun-08	17464	35
2009	2-3	2.5	1-Jul-08	30-Jun-09	18587	35
2010	3-4	1.5	1-Jul-09	30-Jun-10	23440	35
2011	4-5	0.5	1-Jul-10	30-Jun-11	26156	35
					Total	**175**

Of each age group 35 units were selected randomly, for example, in age group 0-1 out of the 3529 35 units were selected. The list with randomly selected households is attached in Annex II. The next table shows the sampling plan of the of the US.

[8] http://www.graphpad.com/quickcalcs/index.cfm

Table 8: US Sample plan and objective

Sampling plan	Sampling MPI
Sampling objective:	The objective of the sampling effort is to obtain reliable data for the US survey;
Field Measurement Objectives and Data to be collected:	The survey will consist of household visit in random selected end-users to collect usage data;
Target Population and Sampling Frame:	The sampling frame will be drawn from the database of each age group;
Sampling method (approach):	Simple random sampling, each observation is chosen randomly and entirely by chance, such that each observation has the same probability of being chosen.
Implementation:	The US was executed in January 2012 and will be executed annually from the date of registration
Desired Precision/Expected Variance and Sample Size.	The minimum total sample size is 100, with at least 30 samples for project technologies of each age being credited. The applied methodology does not prescribe a desired precision. By surveying 175 households, BP ensured that the minimum requirements were easily met.
Procedures for Administering Data Collection and Minimizing Non-Sampling Errors:	Data was checked by the BP staff at the head office

2.2 CARBON MONITORING SURVEY DESIGN

A carbon monitoring survey (CMS) was executed from the 19th of April to the 07th of May 2012 amongst a representative sample of biogas user in each climate zone[9] with the objective to obtain reliable and unbiased data on the impact of the program on sustainable development and on GHG emission modalities, such as fossil and fuel wood consumption and manure management practices. Data obtained from each zone will be used to calculate the emission reductions and weighted by the proportion of households that are situated in each zone. The CMS can combine up to 6 project studies according to the PDD, but not all studies are necessary for each MP. The next tables shows the CMS studies and the studies included in MPI.

Table 9: Carbon Monitoring Survey (CMS) studies

#	Name of study	Monitoring interval	MPI
1	Project non-renewable biomass (NRB) assessment;	Once for the first crediting period	fNRB is established once for the first crediting period. The figure from the PDD is adopted for MPI.
2	Project studies (PS) of target	Annual	Included in CMS MPI

[9] *The IPCC provides values for 3 climate zones (cool <15°C, temperate ≥15,< 26°C and warm ≥ 26°C), see Chapter 10: Emissions from Livestock and Manure Management, Volume 4 - AGRICULTURE, FORESTRY AND OTHER LAND USE, 2006 IPCC Guidelines for National Greenhouse Gas Inventories.*

	population characteristics;		
3	Baseline Fuel Test and Project Performance Field Test (PFT) of fuel consumption;	Biennial for PFT and once for BFT in this crediting period	Not included in this MR. A BFT and PFT will be executed for the next verification[10].
4	Monitoring of the SD parameters.	Annual	Included in CMS MPI
5	Leakage emission assessment	Every two year after first verification	Not included
6	Maintenance of total sale record and project database	continuous	continuous activity

1. NRB Assessment

Over the course of a project activity the project proponent may at any time choose to re-examine renewability by conducting a new NRB assessment. In case of a renewal of the crediting period and as per Gold Standard rules, the NRB fraction must be reassessed as any other baseline parameters and updated in line with most recent data available. According to Annex 5 of the applied methodology the NRB assessment shall be updated as proposed by the project proponent (PP). The PP chooses to update the $f_{NRB.}$ for each crediting period, which is justified in PDD annex 3.

2. Project survey (PS) of the target population characteristic

In addition to the parameters monitored as per PDD and GSPR, the CMS survey includes a set of target population parameters, such as household size, digester size, ID code.

3. Baseline Fuel Test (BFT) and the Project Performance Field (BFT)

The baseline performance field tests (BFT and project performance field test (PFT) measure real, observed technology performance in the field.

BFT: Baseline data is collected from each household participating in the VGS project before installation of the biogas plant. The BFT is therefore fixed for each household. The aggregate of the baseline emissions of the participating households however, will be different for each monitoring period because continuously new household will install a biogas plant. The BFT therefore does not have to be updated at household level.

I. During the selection of new programme participants the data about the fossil fuel consumption in the baseline will be collected of each household;
II. When the biogas plant has been constructed it has to be accepted by the District Biogas Technician (DBT). Only after the acceptance by the district technician, provincial technician and BPD the subsidy is sent to the programme participant. At this point the plant is registered with a unique number in the database;

[10] This is an approved deviation from the applied methodology. Results from the KPT (BFT and PFT) of the next verification will be applied retroactively to this MP.

PFT: The PFT will measure the performance of the biogas plant, which is defined as degree that biogas displaces baseline fuels. The degree is measured in kg/year of baseline fuel and performance ratio (number of biogas plants in use).

4. Sustainability assessment

The CMS survey includes the monitoring of the SD parameters where it applies to biogas households. Chapter 3.3, details the results of the SD monitoring and the sources of data used.

5. Leakage emission assessment

A leakage investigation will be conducted every 2 years as per page 47 of the applied methodology. Physical leakage assessment however is part of the PFT and included in the calculations.

6. Maintenance of total sale record and project database

All data sale records are collected and stored in a central database and continuously updated. Excerpts of this database will be made available in the excel workbook belonging to this report.

CMS survey design

The CMS was executed in April/May 2012 by an independent selected consultant, AMDI, after an extensive tendering process. Annex 3 contains a description of the surveyor training records. The CMS survey design was developed by Nexus – Carbon for Development.

The CMS sampling plan

The CMS sampling plan is developed using guidance of the applied GS methodology and the UNFCCC standard on sampling (EB 65 annex 3: Standard for Sampling and Survey for CDM Project Activities and Programme of Activities)[11]

Sampling plan	Sampling MPI
Sampling objective:	The objective of the sampling effort is to obtain reliable data for the CMS survey;
Field Measurement Objectives and Data to be collected:	The survey will consist of household visit in random selected end-users to collect data described in PDD section B.7.1. Data will be collected using interview methods, the interviewee will be either the head of the household or the wife of the head of household;
Target Population and Sampling Frame:	As Vietnam consists of two climate zones, temperate and warm; the CMS will study each zone separately[12]. The ERs are calculated based on the information gathered from both zones, and in case one zone contains more households than the other, a proportional weight is applied to the larger zone to adjust for the size difference. The sampling frame for each climate zone will be drawn from the database; all households in the sampling frame represent the target population. Target

[11] http://cdm.unfccc.int/filestorage/T/P/X/TPXDOG9Q5HE7Z18CFBM3VSKIWU4YJ2/eb65_repan02.pdf?t=Qkl8bTBuaXRlfDBBzCTHDwxtF4VIkxoXVrTj

[12] *The IPCC distinguishes 3 climate zones: cool <15°C, temperate ≥15,≤ 25°C and warm > 25°C, see Chapter 10: Emissions from Livestock and Manure Management, Volume 4 - AGRICULTURE, FORESTRY AND OTHER LAND USE, 2006 IPCC Guidelines for National Greenhouse Gas Inventories.*

	population membership is recorded in the database and uniquely identifiable based on the ID code of the biogas plant.
Sampling method (approach):	As per approved PDD: Clustered random sampling in each climate zone, in each climate zone 10 clusters will be selected randomly for each monitoring interval. One cluster is one district. The two zones are based on IPCC climatic classification: temperate and warm. Data obtained from both zones will be aggregated proportionally (a weight will be applied to the data of each zone based on the total number of biogas households in each zone i.e. if zone A is has only 25% of the households in zone B, the weight of zone B is 4 and zone A 1).
Implementation:	The CMS was executed by a selected independent consultant AMDI in April and May 2012
Desired Precision/Expected Variance and Sample Size.	The VGS methodology prescribes confidence precision level of 90/10.
Procedures for Administering Data Collection and Minimizing Non-Sampling Errors:	The standard procedure for conducting the data collection is the following steps (1) Development of questionnaire; (2) Training and selection of surveyors; (3) Pilot testing of the questionnaire to ascertain that the questionnaire is appropriate and yields the required information. In addition, data was checked by the AMDI staff and 10% of the household was called by AMDI to check the data collected by the surveyor. The carbon consultant hired by Nexus checked the data as well before using it.

Sample size: The surveys are conducted on a sample size estimated by using the "General Guidelines for Sampling and Surveys for Small-scale CDM Project Activities" (CDM EB 65 Annex 2) which prescribes a 90% confidence interval with a 10 % error margin. The VGS methodology applied specifies that if the sample size is large enough to satisfy the 90/10 rule, the overall emission reductions per unit can be calculated per unit or MEAN fuel annual savings per unit. The sample size is calculated using the next equation[13].

$$n = \frac{Nx}{1 + Nx(e)^2}$$

Where:

n = minimal sample size
e = level of precision (10%)
Nx = the BP biogas population in $zone_x$
x = Temperature zone (warm or temperature)

Table 10: Minimum sample size per zone

Zone	Classification	Nx	Calculated n
A	Temperate	70,740	100
B	Warm	18,436	99

Survey design and cluster sample size

[13] http://edis.ifas.ufl.edu/pd006 *and Yamane, Taro. 1967. Statistics, An Introductory Analysis, 2nd Ed., New York: Harper and Row.*

Once overall sample size requirements have been determined, the final step in developing the sample design is to determine how many clusters and how many households per cluster should be chosen. Before that is possible, the magnitude of the cluster sampling design effect has to be taken into consideration. The design effect[14] is caused by the loss of efficiency as there is a risk that the sample is not as varied as it would be with simple random sampling. The loss of effectiveness by the use of cluster sampling, instead of simple random sampling, is the design effect. The design effect is basically the ratio of the actual variance, under the sampling method actually used, to the variance computed under the assumption of simple random sampling. A D of 1.5 was deemed appropriate for the monitoring, see the PDD.

Table 11: Minimum cluster sample size with D of 1.5

Zone	Classification	n	n with D 1.5	Number of clusters	Sample size/cluster
A	Temperate	100	150	10	15
B	Warm	99	150	10	15

It is good practice to employ oversampling not only to compensate for any attrition, outliers or non-response associated with the sample but also for the reason that in the event the required reliability is not achieved additional sampling efforts would be required to determine the parameter value (CDM EB 65 Annex 2). Oversampling is employed by increasing the sample size by 10%. The cluster sample size is therefore 17 households (15*110%), making the total sample size per zone 17*10 = 170 and for both zones combined 340.

Sampling procedure – cluster selection

The sampling procedure of the district selection consisted of the following steps:

- Drafting a list of districts by zone;
- Random selection of 10 districts in each zone using a random number generator;
- In case a district does not contain enough samples, the neighboring district was also included in the cluster. This can happen as continuously new districts are included in the program. Initial installation rates are very low in the newest districts.

14 Robert Magnani, 1997. Sampling guide. Food and Nutrition Technical Assistance project (FANTA). Academy for Educational Development

The following districts were selected by zone

Table 12: Selected districts in zone A: Temperate

Zone A: Temperate			
#	Cluster	Neighboring district that was included	Province
1	Huyện Yên Lập		Phú Thọ
2	Huyện Đăk Pơ		Gia Lai
3	Huyện Lộc Bình		Lạng Sơn
4	Huyện Tiên Yên	Đầm Hà	Quảng Ninh
5	Huyện Vụ Bản		Nam Định
6	Thành phố Thái Nguyên		Thái Nguyên
7	Huyện Phù Cử		Hưng Yên
8	Huyện Bình Lục		Hà Nam
9	Huyện Đức Cơ		Gia Lai
10	Thị xã Hưng Yên		Hưng Yên

Table 13: Randomly selected clusters in zone B: Warm

Zone B: Warm			
#	Cluster	Neighbouring district that was included	Province
1	Huyện Phước Long	Thành phố Bạc Liêu	Bạc Liêu
2	Huyện Long Thành		Đồng Nai
3	Huyện Tam Bình		Vĩnh Long
4	Huyện Thốt Nốt	Bình Thủy	Cần Thơ
5	Huyện An Phú		An Giang
6	Huyện Mỏ Cày		Bến Tre
7	Huyện Tiểu Cần		Trà Vinh
8	Huyện Bình Sơn		Quảng Ngãi
9	Huyện Tịnh Biên		An Giang
10	Thị xã Ngã Bảy	Long Mỹ	Hậu Giang

The selected district in Quảng Ngãi, Huyện Ba Tơ was replaced with Huyện Bình Sơn despite that Ba Tơ had enough samples . The reason was that Huyện Ba Tơ is the epicenter of the outbreak of a potentially fatal skin disease, which killed 19 people (21 April 2012[15]). To avoid any risk, another district was randomly selected in Quảng Ngãi. Of the 9 districts in that province, only 5 were considered safe and used for the random selection. The next figure shows the selected districts in Vietnam. Evidences of the random selection and screenshots are available at request for inspection.

[15] http://health.newsplurk.com/2012/04/vietnam-hit-by-mystery-skin-disease.html

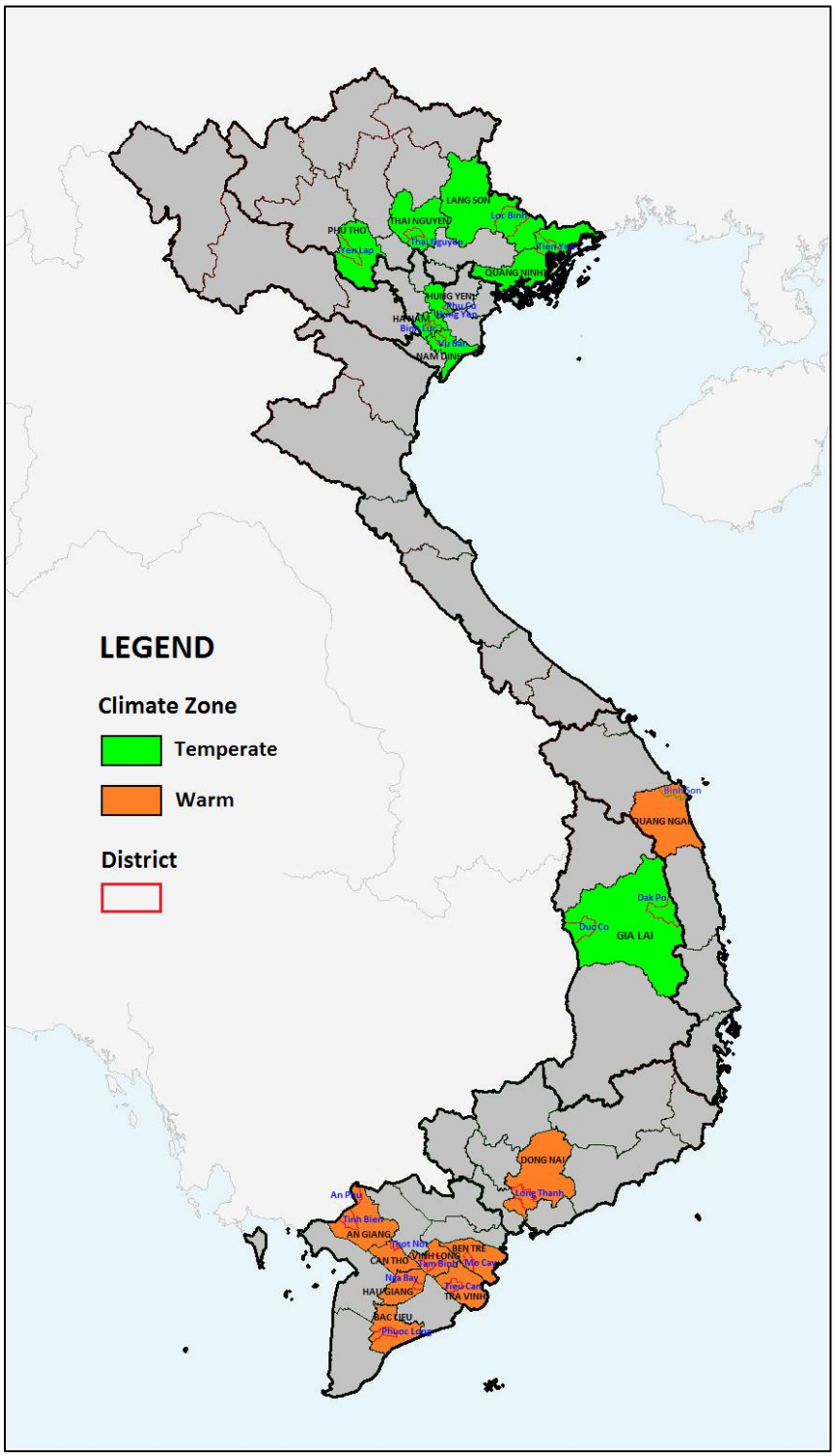


Figure 5: Selected clusters by climate zone

Sampling procedure – household selection

The households are selected according to the following procedure:

- Gathering of all biogas user data of the selected clusters by zone;
- Random selection of 17 households in each cluster using a random number generator;
- Gathering the selected households in a list for survey execution.

Since the list is very large, 340 households, the list is not attached as Annex. The list of the randomly selected households are available at request for inspection.

Procedures for Administering Data Collection and Minimizing Non-Sampling Errors

- **QA/QC:** The contracted party can only proceed with each step if the step is completed upon satisfaction and when the results are inspected by BP. The survey team will interview a random selection of biogas households, in case of non-response the surveyor will proceed to the next household in the list of random selected households. The surveyor will document the out-of population cases, refusals and other sources of non-response. Also, the surveyor will only interview informed interviewees, i.e. interviewees with knowledge on cooking and manure practices. See also chapter 4.
- **QA/QC procedures**: The contracted party will develop an inception report, draft report and final report which are all inspected by BP before the party can continue with the next stages. The final stage is the workshop, where the results are discussed with BP and invited independent experts. The final CMS report is subsequently inspected by a contracted DOE. See also chapter 4.
- **Data storage arrangement:** All data obtained from the CMS will be stored in a database, which will contain the data of the sampled households for each monitoring interval:
    1. Location of each biogas plant surveyed;
    2. Name of the each biogas plant owner;
    3. Unique code of each surveyed biogas plant;
    4. Size of the each surveyed biogas plant;
    5. Type of biogas plant;
    6. Name and ID of mason that built the biogas plant;
    7. Number of animals (Pig, buffalo, cattle and dairy cow);
    8. Fuel consumption (kg/year) of surveyed households;
    9. Date of commissioning for each plant;

2.3 NON RESPONSIVENESS

As households for the survey were ex-ante identified, it may occur that the biodigester owner is not available, no qualified respondent is available or the respondent does not want to be interviewed. In those cases the surveyors were instructed to proceed to the next households on the list of ex-ante identified households during sampling. In total, this happened 17 times, the reasons were, in all cases, no qualified respondent was available. The total sample size is therefore 323.

3. RESULTS

3.1 USAGE SURVEY RESULTS

The outcome of the usage survey is depicted in the following table:

Table 14: Usage Survey results

Year	Age group	Period of inclusion		Percentage in operation (A)	Units built in that period (B)	Number of biogas plants in operation (A*B)
2007	0-1	1-Jan-07	30-Jun-07	80%	3529	2823
2008	1-2	1-Jul-07	30-Jun-08	100%	17464	17464
2009	2-3	1-Jul-08	30-Jun-09	91%	18587	16994
2010	3-4	1-Jul-09	30-Jun-10	97%	23440	22684
2011	4-5	1-Jul-10	30-Jun-11	100%	26156	26156
				Sum	86121[16]	86121

The weighted average of units in operation is then simply calculated by dividing the units in operating with the total population, totaling 96.574%

3.2 CMS RESULTS

The emission reductions are calculated based on the data collected during the CMS survey, the project database containing baseline data and the results from the US.

Table 15: Sources of emissions

#	Emission source/item	Data source	Chapter
1	Baseline emission from thermal energy demand	VGS database	3.21
2	Baseline emission from AWMS	CMS survey	3.21
3	Physical Leakage emissions from AMWS	CMS, VGS database	3.22
4	Project emissions from thermal energy use	CMS	3.22
5	Emission reductions	Step 1 to 4	3.23

[16] *the population differs from the total number of units included in MPI, that is because according to the methodology applied, units need to be in operation for at least half a year for the US, hence, the last 6 months of 2011 are not included in the US.*

3.21: EX-POST BASELINE EMISSIONS

1. Ex-post Baseline emission from thermal energy demand

The total amount of fuel used for thermal energy demand of the biogas users (BU) with the technical potential is listed in the following two tables:

Table 16: Thermal energy demand of BU in climate zone A: Temperate

Fuel *i*	Average per household (kg/year)	NCV_i (TJ/Gg)	Thermal energy demand (TJ/year)
LPG	14.0	47.3	0.0006643
Charcoal	83.8	29.5	0.0024712
Coal	444.7	25.8	0.0114741
Firewood	1840.4	15.6	0.0287105
Agriculture residues	653.8	11.6	0.0075843
Kerosene	0.8	43.8	0.0000363

And the climate zone B: Temperate

Table 17: Thermal energy demand of BU in climate zone A: Warm

Fuel *i*	Average per household (kg/year)	NCV_i (TJ/Gg)	Thermal energy demand (TJ/year)
LPG	36.1	47.3	0.0017075
Charcoal	101.3	29.5	0.0029874
Coal	29.3	25.8	0.0007548
Firewood	1798.3	15.6	0.0280536
Agriculture residues	156.9	11.6	0.0018205
Kerosene	0.8	43.8	0.0000335

In absence of national relevant emission factors the default emission factors from the IPCC 2006 Guidelines for National Greenhouse Gas Inventories, volume 2: Energy, Chapter 1 are used, see the next table.

Table 18: CO_2, CH_4 and N_2O emission factors

Fuel *i*	$EF_{CO2,}$ (kg/TJ)	$EF_{CH4,}$ (kg/TJ)	$EF_{N20,}$ (kg/TJ)
LPG	63100	11.95	2.1
Charcoal	112000	330.5	5.45
Coal	94600	1458.5	NA
Firewood	112000	1224	11.25
Agriculture residues	100000	2210	9.7
Kerosene	71900	12.6	1.55
Charcoal production	1285 gCO_2 /kg charcoal[17]	1000	NA

** Other bituminous coal ** woody waste*

The $f_{NRB.}$ is estimated to be 67%, the NRB assessment can be found in Annex 3 of the PDD. The $f_{NRB.}$ value is applicable to CO_2 emissions from firewood, agricultural residues and charcoal consumption and production. Methane and nitrous oxide emission is 100% non-renewable by definition. The baseline emission is the baseline thermal energy consumption multiplied by emission factors and the global warming potential of each GWP. The GWP applied are taken form the Second Assessment Report of the IPCC, 21 and 310 for CH_4 and N_20 respectively. The calculated ex-post baseline emissions by zone are shown in the next 2 tables:

Table 19: Ex-post baseline emission of each fuel and total from thermal energy use in zone A: Temperate

Fuel *i*	Baseline emissions from CO_2 (tCO_2e/yr)	Baseline emission from CH_4 (tCO_2e/yr)	Baseline emission from N_20 (tCO_2e/yr)	Total (tCO_2e/yr)
LPG	0.042	0.00	0.000	0.043
Charcoal	0.185	0.02	0.004	0.207
Coal	1.085	0.35	0.000	1.437
Firewood	2.154	0.74	0.100	2.993
Agriculture residues**	0.000	0.35	0.023	0.375
Kerosene	0.003	0.00	0.000	0.003
Charcoal production	0.072	0.05	0.000	0.124

[17] Averaged CO_2 emissions from Kirk R. Smith, David M. Pennise (1999) Charcoal-Making Kilns in Thailand. Smith et al reported the CO2 emission as being between 970-1600 gCO_2/kg charcoal produced, 1285 is the average of that figure. Charcoal kilns are assumed to be similar or better in Thailand compared to Vietnam.

Total	**3.542**	**1.511**	**0.128**	**5.180**

And the climate zone B: Warm:

Table 20: Ex-post baseline emission of each fuel and total from thermal energy use in zone B: Warm

Fuel *i*	**Baseline emissions from CO_2 (tCO_2e/yr)**	**Baseline emission from CH_4 (tCO_2e/yr)**	**Baseline emission from N_20 (tCO_2e/yr)**	**Total (tCO_2e/yr)**
LPG	0.108	0.00	0.001	0.109
Charcoal	0.224	0.02	0.005	0.250
Coal	0.071	0.02	0.000	0.095
Firewood	2.105	0.72	0.098	2.924
Agriculture residues**	0.000	0.08	0.005	0.090
Kerosene	0.002	0.00	0.000	0.002
Charcoal production	0.087	0.06	0.000	0.150
Total	**2.598**	**0.913**	**0.109**	**3.620**

The average ex-post emissions from thermal energy demand are calculated by combining the BE from both zones proportionally. Consequently, as zone A contains 70,740 units and zone B only 18,534, the calculated BE of zone A has a weight of (70,740/18,534) compared to 1 of Zone B.

Table 21: Proportionally averaged per unit ER in the VGS project

Zone	**Classification**	**ER/unit**	**Units**	**Total ER**
A	Temperate	5.180	18,534	366445
B	Warm	3.620	70,740	66741
		Sum	(a) 89,176	(b) 433186
		Weighted average (b/a)	tCO_2e/unit	**4.8576**

2. Ex-post Estimation of baseline emissions from AWMS

The following equation is applied to estimate the baseline emissions from animal waste management systems

$$BE_{awms,h} = GWP_{CH4} * \sum_{T} \left(EF_{awms(T)} * N_{(T),h} \right)$$

Equation 1: Equation to estimate baseline emissions from AWMS

Where:

$BE_{awms,h}$	The baseline emissions from handling of animal waste in premise h (tCO_2e/year)
GWP_{CH4}	Global warming potential of methane (tCO_2e per tCH4): 21 for the first commitment period. It shall be updated to any future COP/MOP decisions
$N_{(T),h}$	The number of animals of livestock species per category T[18]
$EF_{awms(T)}$	Emission factor for the defined livestock population category T, (ton CH4 per head per yr). The relevant Default methane emission factor for livestock for default animal waste methane emission factors by temperature and region can be found in tables 10.14, 10.15 & 10.16 in Chapter 10: Emissions from Livestock and Manure Management, Volume 4 - AGRICULTURE, FORESTRY AND OTHER LAND USE, 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

The IPCC lists for each regions default values for methane emissions from AWMS at various average temperatures in chapter 10 volume 4 of the IPCC 2006 guidelines. As Vietnam has more than 1 climate zones, a determination of the IPCC default value for each climate zone is required. Climate date for each province has been collected and for each province a separate IPCC default factor is obtained. This approach is allows for maximum precision. Once the average annual temperature was determined for each province and the respective IPCC default value was obtained; the average weighted emission factor could be determined in Vietnam.

Table 22: Methane emission factors by climate zone

Animal	Zone A: Temperate	Zone B: Warm
Pig	5	6
Buffalo	2.00	2.00
Dairy cow	21	28
Cattle	1.00	1.00

The table shows that the EF for pig and dairy cows are temperature dependent, the EF of the other animals are the same for the temperature ranges observed in Vietnam. The next table shows the calculated BE from AWMS and the animal population obtained from the CMS.

[18] Excluding households which treat the waste of more than 5 pigs/m^3 digester volume. These households are not included in the calculation of baseline emissions as per registered PDD.

Table 23: Ex-post BE AWMS emission in the climate zone A: Temperate

Animal	N(T),h	EF(T)	GWPCH4	Beawms,h
T	#	kgCH4/head/year	tCO2/tCH4	tCO2e/hh/year
Pig	14.03	5.00	21	1.473
Buffalo	0.17	2.00	21	0.007
Dairy cow	0.00	21.00	21	0.000
Cattle	0.15	1.00	21	0.003
			Total	**1.48**

And the climate zone warm:

Table 24: Ex-post BE AWMS emission in the climate zone A: Warm

Animal	N(T),h	EF(T)	GWPCH4	Beawms,h
T	#	kgCH4/head/year	tCO2/tCH4	tCO2e/hh/year
Pig	15.9475	6.00	21	2.009
Buffalo	0.01	2.00	21	0.000
Dairy cow	0.40	28.00	21	0.238
Cattle	0.69	1.00	21	0.014
			Total	**2.26**

The average weighted annual emissions from AWMS are 1.644 tCO_2 per household.

3.22: EX-POST ASSESSMENT OF PROJECT AND LEAKAGE EMISSIONS

3.221. Ex-post Leakage emission assessment

The project proponent should investigate the following potential sources of leakage:

Table 25: Leakage emission assessment

#	*Leakage source*	Applicability
a	The displaced baseline technologies are reused outside the project boundary in place of lower emitting technology or in a manner suggesting more usage than would have occurred in the absence of the project.	The baseline technologies are not reused outside the project boundary. Furthermore, the baseline technologies outside the project boundary are the same with the same efficiencies
b	The non-renewable biomass or fossil fuels saved under the project activity are used by non-project users who previously used lower emitting energy sources.	Most household rely on wood in Vietnam. The small share of household that use a lower emitting energy source, such as LPG, will not switch back to NRB or coal due to the project activity.
c	The project significantly impacts the NRB fraction within an area where other CDM or VER project activities account for NRB fraction in their baseline scenario.	There are no other CDM or VER activities that account for NRB in their baseline in Vietnam registered.
d	The project population compensates for loss of the space heating effect of inefficient technology by adopting some other form of heating or by retaining some use of inefficient technology	Space heating in an infrequent occurrence in Vietnam and confined to the mountainous areas with limited biogas potential. There is only 1 province out of 49 with an average annual temperature lower than 20oC: Lâm Đồng (18.2), only 206 digesters are built in that provinces
e	By virtue of promotion and marketing of a new technology with high efficiency, the project stimulates substitution within households who commonly used a technology with relatively lower emissions, in cases where such a trend is not eligible as an evolving baseline.	The baseline is not fixed in this project, and the combustion of biogas always leads to lower emissions compared to all baseline fuels as it is 100% renewable.

Space heating may be the only source of leakage emissions, this source however is negligible and not reported. Also, some households install biogas heaters and biogas lamps that warm the house and thereby reducing the need for space heating completely.

3.222: PROJECT EMISSIONS FROM THERMAL ENERGY DEMAND

Not all fuels will be replaced by biogas. The fuels that people continue to use in the project scenario will be obtained from the monitoring surveys. The next table shows the estimated remaining fuel consumptions sourced from CMS MPI.

Table 26: Estimated thermal energy use for the zone A: Warm

Fuel	Average per household (kg/year)	NCV_i (TJ/Gg)	Thermal energy demand (TJ)
LPG	8.7	47.3	0.000413
Charcoal	10.0	29.5	0.000295
Coal	56.5	25.8	0.001458
Firewood	971.7	15.6	0.015159
Agriculture residues	33.1	11.6	0.000384
Kerosene	0.0	43.8	0.000000

And for the zone warm:

Table 27: Estimated thermal energy use for the zone B: Warm

Fuel	Average per household (kg/year)	NCV_i (TJ/Gg)	Thermal energy demand (TJ)
LPG	4.1	47.3	0.000194
Charcoal	3.4	29.5	0.000101
Coal	1.0	25.8	0.000026
Firewood	527.6	15.6	0.008230
Agriculture residues	109.7	11.6	0.001273
Kerosene	0.0	43.8	0.000001

The ex-post estimated project emissions are shown in the next table by fuel and GHG.

Table 28: Estimated ex-post project emission from thermal energy use for Zone A: Temperate

Fuel	Project emissions from CO_2 (tCO_2e/yr)	Project emission from CH_4 (tCO_2e/yr)	Project emission from N_2O (tCO_2e/yr)	Total (tCO_2e/yr)
LPG	0.026	0.00	0.000	0.026
Charcoal	0.033	0.00	0.000	0.036
Coal	0.138	0.04	0.000	0.183
Firewood	1.138	0.39	0.053	1.580
Agriculture residues**	0.038	0.02	0.001	0.057
Kerosene	0.000	0.00	0.000	0.000
Charcoal production	0.009	0.01	0.000	0.015
Total	**1.382**	**0.460**	**0.055**	**1.897**

And zone temperate

Table 29: Estimated ex-post project emission from thermal energy use for Zone B: Warm

Fuel	Project emissions from CO_2 (tCO_2e/yr)	Project emission from CH_4 (tCO_2e/yr)	Project emission from N_2O (tCO_2e/yr)	Total (tCO_2e/yr)
LPG	0.012	0.00	0.000	0.012
Charcoal	0.011	0.00	0.000	0.012
Coal	0.002	0.00	0.000	0.003
Firewood	0.618	0.21	0.029	0.858
Agriculture residues**	0.127	0.06	0.004	0.190
Kerosene	0.000	0.00	0.000	0.000
Charcoal production	0.003	0.00	0.000	0.005
Total	**0.774**	**0.272**	**0.033**	**1.079**

The total annual proportional weighted ex-post project emissions of both zones are 1.7277 tCO_2 per household

3.223 EX-POST PHYSICAL LEAKAGE EMISSIONS

The project emissions involve emissions from the bio-digester, which include physical leakage and incomplete combustion of biogas, as well as emissions from the animal waste not treated in the bio-digester and emissions from bio-slurry storage.

The EF_{AWMS} in the project scenario has been calculated using the IPCC Tier 2 approach using default values for the maximum methane potential (Bo), volatile solids excretion (VS) and methane density and the manure management category biodigester. The manure management categories (MS) for each climate zone and applicable MCF are shown in the next two tables, where $MS_{(P,S,k)}$ is the fraction of manure not fed into the biogas plants, which are the sum of manure management systems which are not biogas plant and $MS_{(T,S,k)}$ is the MS system biogas plant. The MS is simply calculated by dividing the amount of manure fed in a system by the total amount of manure, i.e. if 2 kilo is put in a slurry system out of the 100 kilo available daily, then the MS slurry is 2% (2/100). Another example, MS pasture is the fraction of time that the animals are in the field, i.e. if this is 6 hours/day, then it is assumed that 25% (6/24) of manure is left in the field. Thus, in this case, if the amount of manure *measured* is 100 kilo/day, then this amount measured comprises 75% (or 18 hours) of the total as 25% (6 hours) cannot be measured as it is excreted in the field. The total amount of manure is in that case: 1+(25%/75%)*100 = 133 kilo/day.

Table 30: Share of manure management systems in the project scenario in climate zone: Temperate

Manure management system	Pig	Buffalo	Dairy cow	Cattle	MCF factor by system
Biogas plant	93%	36%	.N/A	26%	10.0%
Pasture	0%	18%	N/A	29%	1.5%
Daily spread	1%	29%	N/A	24%	0.5%
Solid storage	4%	16%	N/A	22%	4.0%
Slurry	1%	0%	N/A	0%	50.0%
Lagoon	0%	0%	N/A	0%	78.0%
Other	1%	1%	N/A	0%	1.0%

Table 31: Share of manure management systems in the project scenario in climate zone: Warm

Manure management system	Pig	Buffalo	Dairy cow	Cattle	MCF factor by system
Biogas plant	92%	34%	28%	29%	10.0%
Pasture	0%	35%	0%	26%	2.0%
Daily spread	1%	0%	0%	18%	1.0%

Solid storage	0%	31%	72%	27%	5.0%
Slurry	2%	0%	0%	0%	71.0%
Lagoon	0%	0%	0%	0%	79.0%
Other	5%	0%	0%	0%	1.0%

The calculated MCF by taking into account the share in each MS is shown in the next table by climate zone:

Table 32: Calculated average MCF by climate zone and animal

Animal	Temperate zone MCF.MS	Warm zone MCF.MS
Pig	10.07%	10.62%
Buffalo	4.66%	5.15%
Dairy cow	N/A	5.69%
Cattle	4.00%	4.42%

The next two tables depict the calculated emission factor by type of animal.

Table 33: Calculated emission factor by animal in zone: Temperate

Animal	Volatile Solids (VS) (kg/day)	Maximum Methane potential (Bo_T)	MCF x MS	Density methane (kg/m^3)	$EF_{AWMS\ (P)}$ ($kgCH_4$/year)
Pig	0.3	0.29	10.07%	0.67	2.142
Buffalo	3.9	0.1	4.66%	0.67	4.445
Cattle	2.3	0.1	4.00%	0.67	2.251

- *Dairy cows are excluded as the population is zero in zone temperate*

Table 34: Calculated emission factor by animal in zone: Warm

Animal	Volatile Solids (VS) (kg/day)	Maximum Methane potential (Bo_T)	MCF x MS	Density methane (kg/m^3)	$EF_{AWMS\ (P)}$ ($kgCH_4$/year)
Pig	0.3	0.29	10.62%	0.67	2.259
Buffalo	3.9	0.1	5.15%	0.67	4.907
Dairy cow	2.8	0.13	5.69%	0.67	5.065
Cattle	2.3	0.1	4.42%	0.67	2.489

In the next table the physical leakage emissions from the biogas plant are shown which are calculated by multiplying the EF per head with the average number of head for each climate zone.

Table 35: Physical leakage emission from biodigester

	Zone Temperate		Zone Warm	
Animal	**$PL_{\_biodiester}$ ($kgCH_4$/year)**	**PL_{stove} ($kgCH_4$/year)**	**$PL_{\_biodigester}$ ($kgCH_4$/year)**	**PL_{stove} ($kgCH_4$/year)**
Pig	3.004	0.006	3.602	0.007
Buffalo	0.076	0.000	0.003	0.000
Dairy cow	0.000	0.000	0.205	0.000
Cattle	0.034	0.000	0.171	0.000
Total	**3.114**	**0.006**	**3.981**	**0.008**

The emissions from physical leakage are:

Zone	Classification	LE/unit	Units	Total LE (tCO_2e)
A	Temperate	0.066	18,534	4635
B	Warm	0.084	70,740	1544
		Sum	(a) 89,176	(b) 6179
		Weighted average (b/a)	tCO_2e/unit	**0.0693**

The average annual emissions from physical leakage are 0.0693 tCO_2 per household.

3.224 EMISSIONS FROM DIGESTATE

The following leakage emission source is accounted for in this section: CH_4 emissions from the anaerobic decay of the residual organic content of digestate subjected to anaerobic storage.

Digestate typically has low biodegradability because easily biodegradable organic matter has been converted in the anaerobic digester and therefore the biodegradability of digestate is much lower than manure[19].

This emission source is determined through the following steps:

1. Estimation of the total amount of VS entering the biodigester
2. Assessment of remaining VS content of digestate
3. Assessment of methane potential of bio-slurry
4. MCF of the digestate management systems (DMS)
5. Calculation of PE_{dig} using the information obtained in the previous steps

[19] http://cdm.unfccc.int/Panels/meth/meeting/11/051/mp51_an13.pdf

1. Estimation of the total amount of VS entering the biodigester

The total amount of VS entering the biogas plant depends on the type of animal and the share of manure that is fed into the biogas plant. The share of manure fed into the biogas plant can be found in table 30 and 31, and is calculated as:

$$MS_{fed\ in\ digester,T} = 1 - MS_{not\ fed,T}$$

Where, $MS_{fed\ in\ digester}$ is the share of manure fed into the digester and $MS_{no\ fed}$ the share not fed into the digester of animal category T. The emission from the share not fed are calculated in section 3.223

The next tables depict the total amount of VS that enters the average biodigester which is calculated by multiplying the amount of VS excreted by the average number of animals and the $MS_{fed\ in\ digester}$ into the biodigester by climate zone.

Table 36: Daily VS production of the average biodigester in climate zone temperate

Animal T	**VS excretion kgVS/hd/day**	**Head/average biodigester**	**Total amount of VS excreted kgVS.day^{-1}**	**$MS_{fed\ in\ digester}$ Share fed into biodigester**	**Total VS entering the biodigester kgVS.day^{-1}**
	A	**B**	AxB =C	D	CxD
Pig	0.30	14.03	4.21	92.5%	3.89
Buffalo	3.90	0.17	0.67	36.0%	0.24
Cattle	2.30	0.15	0.35	25.8%	0.09
				Sum	**4.22**

Table 37: Daily VS production of the average biodigester in climate zone

Animal T	**VS excretion**	**Head/average biodigester**	**Total amount of VS excreted**	**Share fed into biodigester**	**Total VS entering the biodigester kgVS.day^{-1}**
Pig	0.30	15.95	4.78	92%	**4.41**
Buffalo	3.90	0.01	0.03	34%	**0.01**
Dairy cow	2.80	0.40	1.13	28%	**0.32**
Cattle	2.30	0.69	1.58	29%	**0.45**
				Sum	**5.19**

2. Assessment of remaining VS content of digestate

During anaerobic digestion VS is converted into biogas. The efficiency of that process determines how much VS remains in bio-slurry. The efficiency depends on may factors and are difficult to estimate, such as retention time, dilution ratio, temperature C/N ratio etc.

According to the Biogas Handbook (2008) of Big East, the digestion efficiency of agricultural biogas plants is typically in the range 50-60%[20]. This means that digestate contains 40-50% of the initial organic dry matter, primarily as fibers.

With other words, it can be assumed that around 55% of the initial concentration of VS is converted into biogas and that around 45% remains in digestate. Or with other words, the $MS_{digester}$ is 55% and the $MS_{digestate}$ is 45% of total VS entering the biogas plant.

The remaining VS however has a different composition than VS in manure, it is more fibrous and therefore it will more slowly degrade under continued anaerobic conditions. Some compounds, could even be recalcitrant to further anaerobic biodegradation. The next table shows the calculated amount of VS that leaves the average biodigester per day:

Table 38: Average amount of VS in digester effluent by zone

Zone	(A) Total VS entering the biodigester kgVS.day^{-1}	Digester efficiency	(B) Total VS destroyed in the biodigester kgVS.day^{-1}	A-B Total VS in bio-slurry kgVS.day^{-1}
Temperate	4.22	55%	2.32	1.90
Warm	5.19	55%	2.85	2.33

3. Assessment of the methane potential of digestate

As the nature of VS has changed during anaerobic conversion, the default methane potential (B_0) value is no longer applicable to VS in digestate. According to EB65 Annex 32 the remaining fraction of the original methane potential is 20% for the liquid digestate of conventional digesters. The effluent from biodigesters in Vietnam is liquid and therefore this fraction was applied. The B_0 of digestate is calculated with the following equation:

$$B_{o,dig,T} = F_{ww,CH4,default} \times B_{0,T}$$

Where:

$B_{o,dig,T}$ = Methane potential of digestate from animal type T manure

[20] P55 http://www.lemvigbiogas.com/BiogasHandbook.pdf

$F_{ww,CH4,}$ = Default factor representing the remaining CH4 production capacity of liquid digestate

$B_{0,T}$ = Methane potential of manure from animal type T

With this equation it is possible to calculate for each animal the remaining methane potential.

Table 39: Calculated methane potential of digestate from manure by animal type

Animal T	$F_{ww,CH4,}$	Bo(T) (m^3CH4/kgVS)*	$B_{o,dig}$ (m^3CH4/kgVS)
Pig	20%	0.290	0.058
Buffalo	20%	0.100	0.02
Dairy cow	20%	0.130	0.026
Cattle	20%	0.100	0.02

** see table 33*

However, since farmers often have a mix of animals it is necessary to calculate the average methane potential of digestate from mixed sources and that average has to be weighted as the population of pigs is, for example, much larger than the other animals, relevant calculations can be found in the monitoring database. The following table shows the weighted averaged methane potential for digestate by climate zone

Table 40: Weighed average methane potential of digestate by zone

Zone	Weighed $B_{0,dig}$ (m^3CH4/kgVS)
Temperate	0.057
Warm	0.056

All calculations can be found in the excel workbook.

4. MCF of the digestate management systems (DMS)

The monitoring survey investigated the storage systems of slurry by the households. The results are shown in the table below:

Table 41: Digestate management systems by type and zone

DMS	Temperate (%)	Warm (%)
Flow to farm year	39%	30.4%
Flow into sufficient size storage area	29%	17.7%
Stored dry with hut	0%	0.7%

flow into large pond	5%	17.7%
Flow into river, channel	23%	27.3%
Stored under dry conditions with other organic matter	1%	0.1%
Other	3%	6.2%
Sum	**100%**	**100.0%**

Each DMS has a different methane conversion factor (MFC). MFCs are sourced from the IPCC 2006 guidelines, volume 4 chapter 10, for each AWMS that is similar to the DMS.

Table 42: Applicable MCF values to the DMS

DMS	Applicable IPCC MS category	Applicable MCF zone temperate (22.9◦C)	Applicable MCF zone warm (26.8◦C)
Flow to farm year	daily spread	0.5%	1.0%
Flow into sufficient size storage area	slurry	50.0%	71.0%
Stored dry with hut	solid storage	4.0%	5.0%
flow into large pond	other	1.0%	1.0%
Flow into river, channel	other`	1.0%	1.0%
Stored under dry conditions with other organic matter	solid storage	4.0%	5.0%
Other	solid storage	1.0%	1.0%

The sum of the MCF times the %DMS is the average MCF. The summations are presented in the next table:

Table 43: Average MCF by zone

Zone	∑DMSxMCF
Temperate	15.27%
Warm	13.42%

5. Calculation of PE_{dig} using the information obtained in the previous steps

F_{ww} and $Bo_{,dig}$ is a default factor and applicable to the remaining VS in the digestate, see equation 6 of EB 66 Annex 32. However, as it is now known what the COD concentration of liquid digestate is, the proxy VS remaining in bio-slurry is used, which is calculated in table 38. The next table shows the calculated emissions from digestate by each zone using the IPCC tier 2 approach. The emissions are calculated using **equation 16** of the applied GS methodology **as per registered PDD**.

Table 44: Calculated emissions from digestate by zone

Zone	Total VS in bio-slurry kgVS.day^{-1}	$B_{0,dig}$ (m^3CH4/kgVS)	∑DMSx MCF	D_{CH4} (kg/m^3CH_4)	Digester emissions (tCO_2/year/hh)
Temperate	1.90	0.057	0.153	0.67	0.085
Warm	2.34	0.056	0.134	0.670	0.090

The weighted emissions from digestate are, taking into account the proportion of units built in each zone, shown in the next table:

Table 45: Weighted average emissions from digestate

Zone	Classification	ER/unit	Units	Total ER
A	Temperate	0.085	70740	6024
B	Warm	0.090	18436	1652
		Sum	(a) 89,176	(b) 7677
		Weighted average (b/a)	tCO_2e/unit	**0.0861**

3.23: EX-POST ESTIMATE OF THE EMISSION REDUCTIONS

The next table shows the ex-ante estimate of the emission reductions for each biogas unit:

Table 46: Average annual emission reductions

Emission source	BE (tCO_{2e}/h/year)	PE (tCO_{2e}/h/year)	ER (tCO_{2e}/h/year)
Fuel use	4.86	1.73	3.13
AWMS	1.64	0.07	1.57
Digestate	0.00	0.09	-0.09
Sum	**6.50**	**1.88**	**4.62**

The ex-post estimated averaged emission reductions weighted by climate zone are 4.62 tCO_2 per household per year. The cumulative ex-post emission reductions are calculated with the following calculation:

$$ER_{y,h} = U_{y,h} \times \left(BE_{y,h} - PE_{y,h}\right) \times N_{p,y}$$

Where:

$ER_{y,h}$	=	Annual average emission reductions in year y
$U_{Fy,h}$	=	Effective cumulative usage rate for technologies in project scenario p in year y, based on cumulative adoption rate and drop off rate revealed by usage surveys (fraction)
$BE_{y,h}$	=	Annual average baseline emissions per household in year y
$PE_{y,h}$	=	Annual average project activity emissions per household in year y
$N_{p,y}$	=	Total number of biogas units commissioned as of year y

The effective usage rate is calculated as follows:

$$U_{Fy,h} = U_{y,h} \times Up_{y,h}$$

Where:

$U_{Fy,h}$	=	Effective cumulative usage rate for technologies in project scenario p in year y, based on cumulative adoption rate and drop off rate revealed by usage surveys (fraction)
$U_{y,h}$	=	cumulative usage rate for technologies in project scenario p in year y, based on cumulative adoption rate and drop off rate revealed by usage surveys (fraction)
$Up_{y,h}$	=	Uptime (share of the year that the digester is in operation[21])

The calculated usage rate, $U_{y,h}$ is 96.574%. Some of the biodigester units in usage may undergo periodically emptying and are therefore not in use for a number of days. Typically this happens on a 3 to 5 year interval. In this MR the periodic cleaning is assumed to be annual due to lack of more detailed date from the usage survey. Other causes of temporarily non-use of the digester are repairs. In this MP the USAGE survey did not reveal any repairs that impact digester performance. A few households reported broken stoves (but they were still using because they had another stove) while others reported broken slabs of the outlet tanks. A broken slab will not impact digester performance and all these households continued to use biogas.

The calculated weighted averaged uptime ratio is 99.54%. This factor has been multiplied with the usage rate resulting in an *effective* usage rate of 96.13%. The effective usage rate is used to discount the ERs. The next table shows the ER by month.

[21] Not in operation refers to the time that the unit is emptied, cleaned or repaired

Table 47: Emission reductions realized by the VGS project of NBP

Month of program	Period		Units installed	Cumulative number of units	ER/month (tCO_2e)	Cumulative ER (tCO_2e)
43	28-Jun-10	31-Jul-10	2326	65,010	23,193	23,193
44	1-Aug10	31-Aug-10	1846	66,856	24,057	47,250
45	1-Sep-10	30-Sep-10	1866	68,722	24,748	71,998
46	1-Oct-10	31-Oct-10	2496	71,218	25,427	97,425
47	1-Nov-10	30-Nov-10	2505	73,723	26,350	123,775
48	**1-Dec-10**	**31-Dec-10**	**2032**	**75,755**	**27,277**	151,052
49	1-Jan-11	31-Jan-11	567	76,322	28,029	179,080
50	1-Feb-11	28-Feb-11	381	76,703	28,238	207,319
51	1-Mar-11	31-Mar-11	598	77,301	28,379	235,698
52	1-Apr-11	30-Apr-11	969	78,270	28,601	264,299
53	1-May-11	31-May-11	1428	79,698	28,959	293,258
54	1-Jun-11	30-Jun-11	1717	81,415	29,488	322,746
55	1-Jul-11	31-Jul-11	1329	82,744	30,123	352,869
56	1-Aug-11	31-Aug-11	1509	84,253	30,615	383,483
57	1-Sep-11	30-Sep-11	1084	85,337	31,173	414,656
58	1-Oct-11	31-Oct-11	1434	86,771	31,574	446,230
59	1-Nov-11	30-Nov-11	1387	88,158	32,105	478,335
60	**1-Dec-11**	**31-Dec-11**	**1018**	**89,176**	**32,618**	510,952

The table shows that the total number of ERs realized is **510,952** tCO_2 for the monitoring period I.

3.3 SUSTAINABLE DEVELOPMENT MONITORING RESULTS

3.31 SAFEGUARD PRINCIPLES

The next table summarizes the outcome of the 'Do no Harm' Assessment in the GSPR, and list the safeguard principles for which an mitigation principles has been identified.

Safeguarding principles	**Application of mitigation measure**
1.The project respects internationally proclaimed human rights including dignity, cultural property and uniqueness of indigenous people. The project is not complicit in Human Rights abuses.	Not required
2. The project does not involve and is not complicit in involuntary resettlement.	Not required
3. The project does not involve and is not complicit in the alteration, damage or removal of any critical cultural heritage	Not required
4. The project respects the employees' freedom of association and their right to collective bargaining and is not complicit in restrictions of these freedoms and rights	Not required
5. The project does not involve and is not complicit in any form of forced or compulsory labour	Not required
6. The project does not employ and is not complicit in any form of child labour	Not required
7. The project does not involve and is not complicit in any form of discrimination based on gender, race, religion, sexual orientation or any other basis.	Not required
8. The project provides workers with a safe and healthy work environment and is not complicit in exposing workers to unsafe or unhealthy work environments.	Not required
9. The project takes a precautionary approach in regard to environmental challenges and is not complicit in practices contrary to the precautionary principle.	Not required
10. The project does not involve and is not complicit in significant conversion or degradation of critical natural habitats, including those that are (a) legally protected, (b) officially proposed for protection, (c) identified by authoritative sources for their high conservation value, or (d) recognized as protected by traditional local communities.	Not required
11. The project does not involve and is not complicit in corruption.	Not required
Additional relevant critical issues for my project type	
Environmental protection	Not required

The safeguard principles identified by the Gold Standard are relevant for all projects, however for this project no mitigation measures are to be monitored according to the GSPR.

3.32 SUSTAINABILITY MONITORING PLAN

This section assesses the performance of the VGS project on the sustainability indicators by indicator (ID) identified according to the monitoring plan described in the GSPR using survey methods where applicable. Chapter 2 describes the monitoring methodology..

ID 1: Air quality

The chosen parameter for ID 1 is:

Reduction in fuel (wood, agricultural residues, kerosene and coal) consumption (kg of fuel reduced/year)

Table 48: Amount of fuel reduced due to the project activity (source: CMS survey)

Fuel	Baseline (kg/year/hh)	MPI (kg/year/hh)	Reduction (kg/year/hh)
Charcoal	73.9	8.6	65.3
Coal	112.9	45.0	67.9
Firewood	1846.5	879.9	966.6
Agricultural Residues	371.8	49.0	322.8
Kerosene	32.4	0.0	32.4

The BP project results in a significant reduction of traditional fuel use and this will improve the indoor air quality.

ID 2: Soil condition

The chosen parameter for ID 2 is:

Usage of bio-slurry

The next table shows the usage of bio-slurry by zone:

Table 49: Usage of bio-slurry (source CMS survey)

Zone	Fertilizer	Don't use	Fish feed	Other
Temperate	75.2%	19.2%	5.6%	0.0%
Warm	54.5%	19.0%	24.8%	1.7%

Bio-slurry is used by around 80.8% and 81.0% of the households in the zone temperate and warm. A minor proportion is not used, of around 19.2% and 19% in the zone temperate and warm respectively.

ID 3: Biodiversity

The chosen parameter for ID 3 is:

Cumulative savings of wood

Table 50: GHG emission reductions (source: chapter 3.23)

Zone	Baseline (kg/hh/yr)	Current (kg/hh/yr)	wood reductions (kg/hh/yr)	Total project (ton wood/year)
Temperate	1840.4	971.7	868.7	61451
Warm	1798.3	527.6	1270.8	23428
Cumulative savings in the project area				**84879**

Due to the BP project activities a significant amount of wood is saved per household. The reduction in wood use will help to keep habitat intact which will have a positive effect on biodiversity.

ID 4: Quality of Employment

The chosen parameter for ID 4 is:

Number of masons and technicians participating in the trainings

Table 51: Cumulative number of masons and technicians trained by BP (source: training reports)

Date	Cumulative number of masons	Cumulative number of technicians
28 June 2010-31 December 2010	160	77
2011	96	89
total MPI	**256**	**166**

In total 245 masons and 166 technicians were trained in this monitoring period.

ID 5: Livelihood of the poor

The chosen parameter for ID 5 is:

Number of people having access to an improved waste management system

Due to the project activity, 89,176 biogas plants are built. The average household size is 4.9 persons according to the last BUS, therefore, in total 436,962 people benefit from having access to an improved waste management system.

ID 6: Access to affordable and clean energy services

The chosen parameter for ID 6 is:

Total amount of energy replaced by biogas

Table 52: Total amount of energy displaced by biogas and fuel per hh (source: CMS survey)

Fuel	Baseline (MJ/year/hh)	MPI (MJ/year/hh)	Energy displaced by biogas (MJ/year/hh)
LPG	664	413	251
Charcoal	2471	295	2176
Coal	11474	1458	10016
Firewood	28711	15159	13552
Agriculture residues	7584	384	7200
Kerosene	36	0	36
Total	**50941**	**17709**	**33232**

Around 33232 MJ is displaced per year per average households due to the installation of a biodigester.

ID 7: Technology transfer and technological self-reliance

The chosen parameter for ID 7 is:

Number of masons trained in the construction of KT1 or KT2 bio-digesters

In total 245 masons are trained in the construction of KT1 and K2 the end of this monitoring period on top of the 922 trained before this MP (see passport), see also table 51.

4. DATA QUALITY CONTROL AND ASSURANCE

BP implements an elaborate QC/QA mechanism on the construction of the biodigester. This process is described into detail in PDD section B.7.2. In addition to this, the emission reductions and the impact on sustainable development are monitored at least biennially using survey methods. The DOE plays an important role to verify the quality of these monitoring activities as a third party independent verifier.

- **Quality Assurance of Questionnaire distribution and collection**

The emission reduction is based on field questionnaires administered to a sample of users, the quality assurance lies in the design of the questionnaires, their reliable administration and calculations based on the data analysis. It is therefore of high importance that the questionnaires are administered by specially trained personnel with extensive experience. Quality Assurance of this process is carried out by BP, SNV and Nexus.

- **Quality assurance of questionnaire design**

The main tool to capture information required for this report is the household survey questionnaire. The household questionnaire is drafted by the selected consultant based on the requirements that BP put down in the Terms of Reference (ToR). This draft was subsequently discussed and reviewed by BP staff, their technical advisor of SNV and Nexus- carbon for Development.

The questionnaire is based on the one used by a sister programme, NBP Cambodia. Using a tested questionnaire assures quality as the survey has proven to yield reliable and unbiased information during MPI. The MPI survey form was developed according to the next steps:

1. Modification of the questionnaire to the Vietnamese context
2. Field testing with surveyors (27 March) , see annex 3
3. Improvement of the survey based on field testing and feedback from BP, SNV and Nexus;
4. Implementation of the survey for MPI;

- **Quality assurance on data collection activities**

The surveyors are employees of the selected independent consultant company: AMDI. AMDI is involved in many major survey and census activities; therefore, the selected surveyors have experience in surveying. To ascertain that the surveyors have sufficient understanding of biogas and BP, a three trainings were provided:

- First training: 26 March, 2012 (from 1h30 PM to 5h00 PM)
- Tool test: 26 March, 2012 (full day)
- Refreshment training: 30 March, 2012 (from 8h30 AM to 12h30 AM)

AMDI is end-responsible for the survey data collection and operates as independent party in this VGS process. A training report is included in Annex III.

The survey forms were checked before the data entry started. Some important data was double checked, such as the amount of firewood still used, number of livestock and working biogas lamps. The data was entered by an experienced person who was also involved in the data entry during MRI. Data was entered into SPSS and exported to excel.

- **QC/QA on monitoring report**

The monitoring report is developed by an independent consultant hired by Nexus with relevant experience of CDM and carbon monitoring of domestic biogas projects. The monitoring report is checked before release by BP staff and their SNV advisor. Comments on the report were received on the 4th of June 2012, and based on the comments improved. Final guarantee about compliance with the used Methodology and PDD is provided by the DOE and the GS.

- **Quality Control by DOE**

The Quality control is to be performed by a DOE on at least a biennial basis. They will visit a select group of households which is part of the project sample group. They must at least fulfill the same knowledge requirements as the survey team. At the household they will assess the reliability of the questionnaire by checking the figures provided by the respondents. If deviations occur, the value will be adjusted accordingly.

6. EX-ANTE AND EX-POST PARAMETERS

6.1 PARAMETERS NOT MONITORED

Data / Parameter:	**$EF_{b,CO2}$**
Data unit:	$kgCO_2/TJ$ fuel
Description:	CO2 emission factor arising from use of fuels in the baseline scenario
Source of data used:	2006 IPCC Guidelines defaults, see chapter 2 Stationary Combustion: http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html
Value applied:	**Fuel *b*** / **EF_{CO2}, (kg/TJ)** LPG: 63100 Charcoal: 112000 Coal: 94 600 Firewood: 112000 Agriculture residues: 100000 Kerosene: 71900 Charcoal production: 1285 gCO_2 /kg charcoal[22]
Any comment:	The CO2 emissions from agricultural residues are considered renewable; hence the CO2 emission will be zero.

Data / Parameter:	**$EF_{i,CH4}$**
Data unit:	$kgCH_4/TJ$ fuel
Description:	CH_4 emission factor arising from use of fuels in the baseline scenario
Source of data used:	2006 IPCC Guidelines defaults see chapter 2 Stationary Combustion: http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html, table 2.9 and for Charcoal production Good Practice Guidance and Uncertainty Management in National GHG inventories: http://www.ipcc-nggip.iges.or.jp/public/gp/bgp/2_2_Non-CO2_Stationary_Combustion.pdf table 1
Value applied:	**Fuel *i*** / **EF_{CH4}, (kg/TJ)** LPG: 11.95 Charcoal: 330.5 Coal: 1458.5 Firewood: 1224 Agriculture: 2210

[22] Averaged CO_2 emissions from Kirk R. Smith, David M. Pennise (1999) Charcoal-Making Kilns in Thailand. Smith et al reported the CO2 emission as being between 970-1600 gCO_2/kg charcoal produced, 1285 is the average of that figure. Charcoal kilns are assumed to be similar or better in Thailand compared to Vietnam.

	residues Kerosene 12.6 Charcoal production 1000
Any comment:	Some of the EF values in table 2.9 are ranges; in that case the average value is taken. The wood stove value taken is the value that has reference number 7. This stove is assumed more closely resembling the stoves in Vietnam as it is a value obtained from neighboring countries.

Data / Parameter:	**$EF_{i,N2O}$**
Data unit:	kgN_2O/TJ fuel
Description:	N_2O emission factor arising from use of fuels in the baseline scenario
Source of data used:	2006 IPCC Guidelines defaults, see chapter 2 Stationary Combustion, table 2.9 http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html
Value applied:	

Fuel *i*	**$EF_{N20,}$ (kg/TJ)**
LPG	2.1
Charcoal	5.45
Coal	NA
Firewood	11.25
Agriculture residues	9.7
Kerosene	1.55
Charcoal production	NA

Any comment:	Some of the EF values in table 2.9 are ranges; in that case the average value is taken. The wood stove value taken is the value that has reference number 7. This stove is assumed more closely resembling the stoves in Vietnam as it is a value obtained from neighboring countries.

Data / Parameter:	**NCV_i**
Data unit:	TJ/Gg
Description:	Net calorific value of the fuel i used in the baseline
Source of data used:	2006 IPCC Guidelines defaults, see chapter 1 Energy table 1.2 http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html
Value applied:	

Fuel *i*	**NCV_i (TJ/Gg)**
LPG	47.3
Charcoal	29.5
Coal	25.8

	Firewood	15.6	
	Agriculture residues	11.6	
	Kerosene	43.8	
Any comment:	the category other primary solid biomass is taken for agricultural residues		

Data / Parameter:	**GWP_{CH4}**
Data unit:	tCO_2e per tCH4
Description:	Global Warming Potential (GWP) of methane
Source of data used:	SAR IPCC
Any comment:	21 for the first commitment period. Shall be updated to any future COP/MOP decisions

Data / Parameter:	**GWP_{N2O}**
Data unit:	tCO_2e per tN_2O
Description:	Global Warming Potential (GWP) of nitrous oxide
Source of data used:	SAR IPCC
Any comment:	310 for the first commitment period. Shall be updated to any future COP/MOP decisions

Data and parameters not monitored AWMS

Data / Parameter:	**$VS_{(T)}$**
Data unit:	kg dry matter per animal per day
Description:	Daily volatile solid excreted for livestock category T
Source of data used:	Volume 4 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, chapter 10 (online: http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html)
Value applied:	Animal T: VS(T) kg/day — Pig 0.3; Buffalo 3.9; Dairy cow 2.8; Cattle 2.3
Any comment:	Any comment: 365 = basis for calculating annual VS production, days per year

Data / Parameter:	**$Bo_{(T)}$**
Data unit:	m^3 CH_4 per kg of VS excreted
Description:	Maximum methane production capacity for manure produced by

	livestock category T
Source of data used:	Volume 4 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, chapter 10 (online: http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html)
Value applied:	
Any comment:	

Animal	VS(T)	Bo(T)
T	kg/day	m3CH4/kgVS
Pig	0.3	0.29
Buffalo	3.9	0.1
Dairy cow	2.8	0.13
Cattle	2.3	0.1

Data / Parameter:	**$MCF_{(k)}$**
Data unit:	[-]
Description:	Methane conversion factor for each manure management system by climate region k
Source of data used:	Volume 4 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, chapter 10 (online: http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html)
Value applied:	10% for biodigester systems
Any comment:	

Data / Parameter:	$\eta_{biogasstove}$
Data unit:	[-]%
Description:	Combustion efficiency of the biogas stove
Source of data used:	98%, the default value from the GS methodology: Indicative Programme, baseline, and monitoring methodology for Small Scale Biodigester
Value applied	98%
Any comments	

6.2 DATA AND PARAMETERS MONITORED

Data / Parameter:	**$f_{NRB,y}$**
Data unit:	Fraction of non-renewability
Description:	Non-renewability status of woody biomass fuel in scenario I during year y
Source of data to be used:	Literature review, surveys
Value of data applied for the purpose of calculating expected emission reductions	67%

QA/QC procedures to be applied:	
Any comment:	Fixed by baseline study for each crediting period

Data / Parameter:	**$P_{b,y}$**
Data unit:	Quantity of fuel that is consumed in the baseline scenario in year y
Description:	The baseline is continuously updated with new households that install a biogas plant.
Source of data to be used:	BPD database
Value of data applied for the purpose of calculating expected emission reductions	

Fuel *i*	**Average per household in zone temperate (kg/year)**	**Average per household in zone warm (kg/year)**
LPG	14.0	36.1
Charcoal	83.8	101.3
Coal	444.7	29.3
Firewood	1840.4	1798.3
Agriculture residues	653.8	156.9
Kerosene	0.8	0.8

QA/QC procedures to be applied:	Fuel data is collected by the district technician before the biogas plant is installed and inspected by the provincial biogas technician before the data is entered into the database
Any comment:	100% representativeness is achieved as fuel data is collected of each household

Data / Parameter:	**$P_{h,y}$**
Data unit:	kg/household
Description:	Quantity of fuel that is consumed in the project scenario in year y
Source of data to be used:	Monitoring survey
Value of data applied for the purpose of calculating expected emission reductions	

Fuel *i*	**Average per household in zone temperate (kg/year)**	**Average per household in zone warm (kg/year)**
LPG	8.7	4.1
Charcoal	10.0	3.4
Coal	56.5	1.0
Firewood	971.7	527.6

	Agriculture residues	33.1	109.7	
	Kerosene	0.0	0.0	
QA/QC procedures to be applied:	See chapter 4			
Any comment:				

Data / Parameter:	**$U_{p,y}$**
Data unit:	Percentage
Description:	Percentage of bio-digesters in use in monitoring period y
Source of data to be used:	Usage survey
Value of data applied for the purpose of calculating expected emission reductions	96.574%
QA/QC procedures to be applied:	Conservative sample of 35 household per year for each programme year was taken instead of 30. All data was collected by provincial or district technicians (expert persons) and checked at national level by BP before entering into the database.
Any comment:	See table 14

AWMS data and parameters monitored over the crediting period

Data / Parameter:	**$N_{p,y}$**
Data unit:	units
Description:	Number of biogas plants commissioned
Source of data to be used:	BPD database
Value of data applied for the purpose of calculating expected emission reductions	89,176
QA/QC procedures to be applied:	100% of all plants are checked after completion of the construction by the district technician on compliance with the MARD biogas standard. 5% of the plants will be visited by the provincial technician for the same check (QC on QC on random sampling basis.
Any comment:	

Data / Parameter:	**$MS_{(T,S,k)}$**
Data unit:	[-]&

Description:	Fraction of livestock category *T*'s manure fed into the biodigester *S*, in climate zone *k*
Source of data used:	CMS monitoring survey
Value of data applied for the purpose of calculating expected emission reductions	The next table shows the share of manure fed into the biodigesters. In the climate zone temperate none of the households owned dairy cows.

Climate zone	Pig	Buffalo	Dairy cow	Cattle
temperate	93%	36%	N/A	26%
warm	92%	34%	28%	29%

Value of data applied for the purpose of calculating expected emission reductions	Annual
QA/QC procedures to be applied:	See chapter 4 and 2.2
Any comment:	

Data / Parameter:	**$MS_{(P,S,k)}$**
Data unit:	[-]&
Description:	Fraction of livestock category *T*'s manure not fed into the biodigester *S*, in climate zone *k*
Source of data used:	CMS monitoring survey
Value of data applied for the purpose of calculating expected emission reductions	The next table shows the share of manure not fed into the biodigesters. In the climate zone temperate none of the households owned dairy cows.

Climate zone	Pig	Buffalo	Dairy cow	Cattle
temperate	7%	64%	N/A	74%
warm	8%	66%	72%	71%

Monitoring frequency	Annual
QA/QC procedures to be applied:	See chapter 4 and 2.2
Any comment:	

Data / Parameter:	**$N_{(T)}$**
Data unit:	[-]
Description:	Number of animals of livestock category T
Source of data used:	CMS monitoring survey
Value of data applied for the purpose of calculating expected emission reductions	

Animal	N(T),h climate zone temperate	N(T),h climate zone warm
T	#	#
Pig	14.03	15.95
Buffalo	0.17	0.01

	Dairy cow	0.00	0.40	
	Cattle	0.15	0.69	
Monitoring frequency	Annual			
QA/QC procedures to be applied:	See chapter 4 and 2.2			
Any comment:				

Data / Parameter:	**PL**
Data unit:	%
Description:	Physical leakage of the biodigester
Source of data to be used:	IPCC 2006 guidelines
Value of data applied for the purpose of calculating expected emission reductions	10%
Monitoring frequency	Updated with new IPCC guidance, the PP will check annually if there are new IPCC default values applicable
QA/QC procedures to be applied:	.
Any comment:	The physical leakage is not monitored, this is not possible.

Data / Parameter:	**$EF_{awms,T,}$**
Data unit:	$kgCH_4$ per animal per year for livestock type T in the project
Description:	Animal waste methane emission factor by average temperatures
Source of data used:	IPCC default values for the region Asia from volume 4 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, chapter 10 (online: http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html)
Value of data applied for the purpose of calculating expected emission reductions	
Any comment:	The IPCC default value depends on the average annual temperature. Therefore the value is determined for the average conditions in each provinces and the average is obtained by the weighted average based on the animal (T) population in each province.

EF AWMS by animal	Zone temperate	Zone Warm
Pig	2.142	2.259
Buffalo	4.445	4.907
Dairy cow	N/A	5.065
Cattle	2.251	2.489

Data / Parameter:	**PE_{dig}**
Data unit:	tCO_2/year from digestate storage
Description:	Methane emissions from digestate
Source of data used:	CMS monitoring survey
Value of data applied for the purpose of calculating expected emission reductions	**Average Bioslurry emissions**

	Units	CO2e/unit	CO2e
Temperate	70740	0.085	6024
Warm	18436	0.090	1652
Total	89176		7677
Average emissions	**0.0861**	tCO2e/year/hh	

Any comment:	

ANNEX 1: CONTACT DETAILS OF THE PROJECT PARTICIPANTS

Organization:	Biogas Program for the Animal Husbandry Sector of Vietnam
Street/P.O.Box:	298 Kim Ma
Building:	Room 104, Bldg 2G, Vanphuc Compound
City:	Hanoi
State/Region:	N/A
Postcode/ZIP:	1000
Country:	Vietnam
Telephone:	04.3726 1771
FAX:	04.3726 1773
E-Mail:	Giaohk.cn@mard.org.vn
URL:	www.biogas.org.vn
Represented by:	Mr. Hoang Kim Giao
Title:	Director
Salutation:	N/A
Last name:	Hoang
Middle name:	Kim
First name:	Giao
Department:	Department of Livestock Production – Ministry of Agricultural and Rural Development (DLP-MARD)
Mobile:	84. 9132 48452
Direct FAX:	04.3734 4829
Direct tel:	04.3734 4829
Personal e-mail:	N/A

Organization:	SNV Netherlands Development Agency
Street/P.O.Box:	La Thanh Hotel, 218 Doi Can
Building:	6th Floor, Building B
City:	Ba Dinh, Ha Noi
State/Region:	N/A
Postcode/ZIP:	N/A
Country:	Vietnam
Telephone:	+31 70 3440244
FAX:	+31 70 3855531
E-Mail:	N/A
URL:	www.snvworld.org
Represented by:	Tom Derksen
Title:	Director SNV Vietnam
Salutation:	Mr.
Last name:	Derksen
Middle name:	N/A
First name:	Tom
Department:	SNV Vietnam
Mobile:	+84 (0) 904292900
Direct FAX:	N/A
Direct tel:	+84 (0) 48463791
Personal e-mail:	Tderksen@snvworld.org

ANNEX II: USAGE SURVEY SAMPLE

#	Province ID (*)	Location	ID Card	Fullname (*)	PlantCode (*)	PlantType (*)	Digester volume (m3)	Code of Mason (*)	Name of Mason (*)	Completed Date of households (mm/dd/yyyy)
1	NBI	Ninh Bình	164179144	Đố Văn Quang	NBI-TD-DS-049	KT 1	10	NBI-TĐ-01	Bùi Thanh Tùng	04/01/2007
2	NBI	Ninh Bình	164336865	Dương Văn Thịnh	NBI-NQ-XT-036	KT 1	12	NBI-NB-01	Vũ Văn Ban	06/01/2007
3	HTA	Hà Tây	111524988	Lê Xuân Thắng	HTA-TO-TM-074	KT 1	9	HTA-TO-01	Hà Đức Đào	16/01/2007
4	THO	Thanh Hoá	170568721	Nguyễn Văn Kiên	THO-TX-XS-034	KT 1	18	THO-DS-01	Nguyễn Thế Trận	18/01/2007
5	SLA	Sơn La	50384897	Quàng Văn Nhung	SLA-TX-CD-002	KT 1	6	SLA-TX-06	Lê Đình Tại	20/01/2007
6	HPH	Hải Phòng	30440710	Nguyễn Văn Phi	HPH-TL-TT-008	KT 2B	6	HPH-TL-01	Đỗ Văn trụ	22/01/2007
7	SLA	Sơn La	50371987	Ngô Thị Tương	SLA-TX-QT- 036	KT 1	6	SLA-TX-01	Nguyễn Dương Thông	01/02/2007
8	SLA	Sơn La	50441702	Phùng Thị Lý	SLA-MS-CN-043	KT 1	15	SLA-MS-02	Nguyễn Quốc Xuân	11/02/2007
9	HNO	Hà Nội	12664342	Nguyễn Duy Chí	HNO-GL-ĐX-629	KT 1	6	HNO-GL-02	Vương Xuân Hùng	05/04/2007
10	THO	Thanh Hoá	172073245	Nguyễn Thị Thảo	THO-HH-HH-024	KT 2A	6	THO-HH-01	Thiều Đình Tiếp	06/04/2007
11	NBI	Ninh Bình	164046430	Trịnh Văn Linh	NBI-NQ-VP-012	KT 1	12	NBI-NB-01	Vũ Văn Ban	18/04/2007
12	HNA	Hà Nam	168162447	Nguyễn Văn Hoà	HNA-LN-HL-061	KT 1	12	HNA-LN-05	Nguyễn Văn Bình	23/04/2007
13	NAN	Nghệ An	201121078	Thái Thị Cảnh	NAN-NĐ-NB-196	KT 1	10	NAN-NN-01	Lê Văn Truyền	30/04/2007
14	YBA	Yên Bái	60827856	Phạm Thị Xuyến	YBA-YB-VK-060	KT 1	6	YBA-TY-01	Nguyễn Thế Mạnh	30/04/2007
15	TGI	Tiền Giang	310228015	Trần Thị Tảo	TGI-CB-AC-170	KT 2A	7	TGI-CB-02	Phạm Văn Hà	07/05/2007
16	BNI	Bắc Ninh	125130932	Nguyễn Sỹ Chuỷ	BNI-GB-ĐL-355	KT 1	12	BNI-GB-03	Lê Công Vũ	18/05/2007
17	TGI	Tiền Giang	311534605	Huỳnh Thanh Nhân	TGI-CL-PN-217	KT 1	11	TGI-CL-01	Phạm Minh Cảnh	21/05/2007
18	HPH	Hải Phòng	31057555	Phạm Văn Quang	HPH-CH-CT-005	KT 1	9	HPH-TN-03	Lê Văn Vịnh	25/05/2007
19	HNA	Hà Nam	161499792	Chu Văn Khải	HNA-KB-DH-056	KT 1	10	HNA-KB-01	Phạm Văn Quỳnh	27/05/2007
20	TNG	Thái Nguyên	90553912	Đoàn Quốc Toản	TNG-DY-CN-422	KT 2A	16	TNG-DY-04	Ngô Văn Sinh	05/06/2007
21	BNI	Bắc Ninh	125237229	Nguyễn Văn Sơn	BNI-TT-GĐ-357	KT 1	10	BNI-TT-01	Nguyễn Văn Hoàn	10/06/2007
22	SLA	Sơn La	50553316	Ngô Văn Can	SLA-YC-CS-026	KT 1	12	SLA-YC-01	Nguyễn Đức Hà	10/06/2007
23	HNO	Hà Nội	130267143	Nguyễn Thị Hoà	HNO-SS-TM-903	KT 1	12	HNO-SS-05	Nguyễn Xuân Hoàn	12/06/2007
24	TNG	Thái Nguyên	90426468	Đào Thị Kiều	TNG-TN-ĐP-495	KT 1	16	TNG-TN-02	Ngô Văn Lâm	12/06/2007
25	YBA	Yên Bái	60197966	Trần Kim Lĩnh	YBA-YB-PA-109	KT 1	9	YBA-TY-01	NGUYỄN THẾ MẠNH	14/06/2007
26	YBA	Yên Bái	60219581	Nguyễn Văn Thăng	YBA-YB-YB-113	KT 1	9	YBA-TY-01	NGUYỄN THẾ MẠNH	14/06/2007
27	DLA	Đắc Lắc	240143658	Nguyễn Mạnh Hùng	DLA-KB-HL-235	KT 1	10	DLA-KA-09	Trương Công Đỉnh	20/06/2007
28	HNA	Hà Nam	162121574	Lã Văn Huấn	HNA-LN-HL-164	KT 1	11	HNA-LN-05	Nguyễn Văn Bình	25/06/2007
29	NAN	Nghệ An	181943321	Hà Văn Phúc	NAN-ĐN-NK-284	KT 1	10	NAN-ND-01	Biện Văn Tân	25/06/2007
30	NAN	Nghệ An	186116711	Phan Thị Trường Thành	NAN-NĐ-KL-243	KT 1	6	NAN-ND-01	Biện Văn Tân	25/06/2007
31	TTH	Thừa Thiên Huế	190450010	Hoàng Trọng Bôn	TTH-HT-HA-428	KT 1	6	TTH-HU-04	Lê Quang Luỹ	26/06/2007
32	NAN	Nghệ An	181927618	Nguyễn Ngọc Sơn	NAN-NĐ-NG-289	KT 1	10	NAN-ND-01	Biện Văn Tân	26/06/2007
33	BDI	Bình Định	210028314	Võ Xuân Khải	BDI-AN-BD-569	KT 2B	10	BDI-AN-02	Lưu Văn Từ	26/06/2007
34	YBA	Yên Bái	60634534	Nguyễn Văn Đoàn	YBA-VY-YP-093	KT 1	9	YBA-VY-01	Trần Trung Thực	28/06/2007

35	NAN	Nghệ An	182329445	Bùi Văn Dũng	NAN-YT-PT-479	KT 1	12	NAN-YT-03	Nguyễn Viết Hoàn	30/06/2007
36	TTH	Thừa Thiên Huế	190230243	Trần Mậu Khánh	TTH-HT-HV-493	KT 1	6	TTH-HT-01	Trần Ngừng	23/05/2008
37	HNA	Hà Nam	162125228	Vũ Văn Kha	HNA-BL-HC-300	KT 1	10.5	HNA-BL-03	Đào Ngọc Bẩy	12/05/2008
38	DLA	Đắc Lắc	241155377	Nguyễn Chính Quý	DLA-KA-EK-0462	KT 1	10	DLA-KA-09	Trương Công Đỉnh	22/10/2007
39	DNA	Đồng Nai	271342078	Nguyễn Thị Minh Hoa	DNA-LT-CD-006	KT 2B	8	DNA-LT-01	Hoàng Văn Khoa	15/08/2007
40	NAN	Nghệ An	181373639	Trần Hữu Soa	NAN-DC-DL-498	KT 1	9	NAN-DC-03	Đinh Văn Bàng	26/07/2007
41	THO	Thanh Hoá	171815086	nguyễn Văn Bình	THO-CT-CP-002	KT 1	9	THO-CT-01	Ngô Quang Tám	28/10/2007
42	HPH	Hải Phòng	30923195	Cao Thị Iu	HPH-TL-QP-047	KT 2B	12	HPH-TL-03	Ngô Văn Hải	25/12/2007
43	YBA	Yên Bái	60501170	Lê Thị Nguyên	YBA-TY-ĐT-030	KT 1	9	YBA-TY-01	NGUYỄN THẾ MẠNH	15/07/2007
44	TNG	Thái Nguyên	90650916	Mai Thanh Niên	TNG-SC-TL-156	KT 2A	8	TNG-PY-03	Nguyễn Văn Luận	30/09/2007
45	TNG	Thái Nguyên	90557768	Dương Thị Tâm	TNG-PB-BL-561	KT 1	20.3	TNG-PB-05	Nguyễn Tiến Lợi	16/05/2008
46	HNA	Hà Nam	168024248	Phạm Quang Thuỷ	HNA-TL-TH-051	KT 1	12	HNA-TL-04	Lại Mai Vinh	03/07/2007
47	VPH	Vĩnh Phúc	135230388	Tạ Văn Toản	VPH-YL-YP-116	KT 1	9	VPH-YL-07	Quách Văn Chúc	30/06/2008
48	BGI	Bắc Giang	121516782	Phạm Văn Giáp	BGI-TY-VL-013	KT 1	8	BGI-LN-09	Lương Văn Sáu	26/09/2007
49	THO	Thanh Hoá	171835262	Lê Văn Hoàn	THO-TX-XH-171	KT 1	12	THO-TX-01	Lê Văn Hùng	15/08/2007
50	HDU	Hải Dương	141564887	Trần Thị Thê	HDU-KM-DT-320	KT 1	9	HDU-KM-04	Phạm Văn Bao	13/06/2008
51	BGI	Bắc Giang	120959744	Đỗ Văn Bẩy	BGI-LG-XL-073	KT 1	9	BGI-LN-07	Hoàng Minh Dũng	10/12/2007
52	NAN	Nghệ An	181635854	Đinh Thị Sử	NAN-ND-VD-379	KT 1	10.5	NAN-ND-02	Nguyễn Văn Lâm	25/04/2008
53	BDI	Bình Định	211660274	Lê Thị Trước	BDI-HN-HT-440	KT 1	8	BDI-HN-03	Phan Thanh Sơn	23/10/2007
54	TNG	Thái Nguyên	90504514	Nguyễn Văn Hồng	TNG-DY-NH-446	KT 2A	15	TNG-DY-04	Ngô Văn Sinh	05/09/2007
55	NAN	Nghệ An	186132813	Phan Xuân Long	NAN-DC-DL-611	KT 1	9.55	NAN-DC-03	Đinh Văn Bàng	23/05/2008
56	NAN	Nghệ An	182129576	Hoàng Phi Văn	NAN-DC-DM-557	KT 1	7.15	NAN-DC-02	Ngô Xuân Túc	28/03/2008
57	HNO	Hà Nội	11412911	Hoàng Thị Gái (rin)	HNO-ĐA-DT-0587	KT 1	10	HNO-DA-01	Hoàng Hữu Chính	26/11/2007
58	BDI	Bình Định	210352052	Lê Chí Thanh	BDI-AN-NM-482	KT 1	10	BDI-AN-03	Cù Văn Vinh	10/10/2007
59	DLA	Đắc Lắc	240431838	Hà Thị Thơm	DLA-KB-BT-0294	KT 1	10	DLA-BM-02	Lê Viết Nghĩa	26/11/2007
60	HPH	Hải Phòng	31026824	Lương Văn Dành	HPH-TL-BH-083	KT 1	9	HPH-TL-03	Ngô Văn Hải	26/05/2008
61	TGI	Tiền Giang	312041439	Phan Văn Cường	TGI-CL-BP-269	KT 1	13.03	TGI-CL-02	Phạm Tấn Giàu	10/01/2008
62	DNA	Đồng Nai	121412121	Nguyễn Khắc Đinh	DNA-LT-PT-028	KT 2B	11	DNA-LT-01	Hoàng Văn Khoa	12/11/2007
63	HTA	Hà Tây	111052856	Đặng Văn Nhung	HTA-UH-PT-057	KT 1	6	HTA-UH-03	Nguyễn Viết Du	29/07/2007
64	DNA	Đồng Nai	270723271	Trần Phước Thọ	DNA-LT-BA-008	KT 2B	8	DNA-LT-01	Hoàng Văn Khoa	20/08/2007
65	HTA	Hà Tây	111111847	Lê Văn Mạnh	HTA-UH-KD-134	KT 1	6	HTA-UH-01	Nguyễn văn Thanh	17/01/2008
66	HNA	Hà Nam	161008925	Đặng Văn Thọ	HNA-LN-CL-289	KT 1	12	HNA-LN-05	Nguyễn Văn Bình	16/12/2007
67	HNA	Hà Nam	161028801	Trần Đình Nghị	HNA-BL-HC-280	KT 1	10.5	HNA-BL-03	Đào Ngọc Bẩy	28/04/2008
68	HNA	Hà Nam	162053458	Trần Công Thoại	HNA-LN-CL-332	KT 1	16.3	HNA-TL-04	Lại Mai Vinh	02/06/2008
69	HDU	Hải Dương	142051411	Dương Văn Tuỵ	HDU-KM-HS-327	KT 1	10.5	HDU-KM-04	Phạm Văn Bao	14/06/2008
70	HTA	Hà Tây	111741464	Hoàng Mạnh Châu	HTA-MD-DH-071	KT 1	9	HTA-MD-02	Trần văn Điền	12/09/2007
71	BTR	Bến Tre	320868081	Phạm Hoàng Giang	BTR-MC-PMT-39	KT 2	7.6	BTR-TX-10	Hồ Thanh Bình	20/05/2009
72	PTH	Phú Thọ	130864541	Thiều Văn Phổ	PTH-TT-XL-112	KT 1	11	PTH-TT-23	Hà Trọng Tài	20/03/2009
73	YBA	Yên Bái	60627315	Lạc Quang Lượng	YBA-YB-VK-338	KT 1	9	YBA-TY-01	NGUYỄN THẾ MẠNH	15/06/2009
74	TGI	Tiền Giang	311375564	Lê Thiện Hùng	TGI-GC-LH-188	KT 2	10.1	TGI-GC-01	Trương Văn Xuân	30/03/2009
75	HDU	Hải Dương	141910229	Lương Văn Trường	HDU-KT-TV-20	KT 1	12.1	HDU-KM-05	Phạm Văn Tấn	22/09/2008

76	BDI	Bình Định	210264176	Đỗ Quốc Khánh	BDI-PC-CH-247	KT 1	12.02	BDI-PC-02	Nguyễn Đăng Hượt	27/07/2008
77	NAN	Nghệ An	180541655	Đậu Thị Khang	NAN-DC-DT-745	KT 1	10.46	NAN-DC-03	Đinh Văn Bàng	02/11/2008
78	BNI	Bắc Ninh	120804775	Nguyễn Hữu Kim	BNI-YP-TN-407	KT 1	9.8	BNI-YP-02	Mẫn Văn Hoàn	18/07/2008
79	NAN	Nghệ An	186663048	Nguyễn Thị Thắng	NAN-YT-MT-607	KT 1	9	NAN-YT-03	nguyễn việt hoàn	20/10/2008
80	BDI	Bình Định	211190602	Dương Văn Tín	BDI-TP-PQ-537	KT 1	7.5	BDI-TP-03	Hồ Văn Tuấn	01/06/2009
81	YBA	Yên Bái	60651375	Trần Thị Thảo	YBA-YB-PA-322	KT 1	12	YBA-TY-01	NGUYỄN THẾ MẠNH	22/05/2009
82	TGI	Tiền Giang	310300055	Trương Quang Nghiêm	TGI-CB-HK-311	KT 2	9.9	TGI-CB-02	Phạm Văn Hà	24/04/2009
83	DLA	Đắc Lắc	240505697	Nguyễn Văn Thêm	DLA-KA-BT-522	KT 1	8.34	DLA-KA-09	Trương Công Đỉnh	04/09/2008
84	THO	Thanh Hoá	172294457	Lê Thị Mỹ	THO-VL-VH-005	KT 2	12.2	THO-TT-01	Trần Văn Năm	25/06/2009
85	BNI	Bắc Ninh	125334742	Nguyễn Thị Bình	BNI-TD-MĐ-447	KT 1	12	BNI-TS-02	Ngô Văn Dũng	12/10/2008
86	HNO	Hà Nội	111365487	Nguyễn Ngọc Hùng	HNO-PT-PĐ-400	KT 1	30.2	HNO-PT-04	Nguyễn công Quảng	21/06/2009
87	HTA	Hà Tây	280276552	Phan Thị Minh Hương	HNO-BV-CĐ-177	KT 1	8.1	HTA-BV-02	Nguyễn Văn Biên	27/03/2009
88	QNI	Quảng Ninh	101120019	Lê Văn Mạnh	QNI-MC-HH-002	KT 1	15	QNI-ĐT-06	Nguyễn Hồng Khanh	20/04/2009
89	TGI	Tiền Giang	310010248	Hà Thị Bạch Tuyết	TGI-MT-P9-287	KT 1	9.9	TGI-MT-04	Võ Văn Long	26/03/2009
90	THO	Thanh Hoá	171249205	Nguyễn Thị Khuyến	THO-NT-ML-026	KT 1	9	THO-NT-01	Trịnh Phú Hoàn	25/09/2008
91	QNG	Quảng Ngãi	211284043	Nguyễn Thị Ngọc	QNG-TN-NH-028	KT 2	7.6	QNG-TN-02	Võ Thành Đức	10/07/2008
92	YBA	Yên Bái	60524430	Hoàng Thị Diện	YBA-VC-NT-176	KT 1	24.1	YBA-TX-01	Lê Văn Thanh	25/03/2009
93	BGI	Bắc Giang	121104203	Nguyễn Văn Quyền	BGI-LN-CĐ-436	KT 1	12	BGI-LN-07	Hoàng Minh Dũng	12/05/2009
94	BDI	Bình Định	210490026	Trương Minh Hoàng	BDI-PM-MC-282	KT 1	7.5	BDI-PM-02	Vũ Quang Trưởng	25/09/2008
95	BGI	Bắc Giang	120286253	Nguyễn Văn Nhã	BGI-LG-XH-366	KT 1	12	BGI-LN-09	Lương Văn Sáu	10/04/2009
96	HNO	Hà Nội	11767928	Lưu Văn Gia	HNO-SS-QT-1493	KT 1	12.1	HNO-SS-05	Nguyễn Xuân Hoàn	22/10/2008
97	NDI	Nam Định	160860204	Nguyễn Chi Song	NDI-YY-YP-154	KT 1	12.1	NDI-YY-02	Tạ Văn Liêm	24/05/2009
98	NDI	Nam Định	162349074	Bùi Thị Hương	NDI-HH-HS-165	KT 1	9	NDI-HH-02	Nguyễn Văn Quang	13/11/2008
99	HTA	Hà Tây	11474410	Lê Thị Chức	HTA-CM-PC-227	KT 1	12	HTA-CM-01	Hồ Văn Hán	05/11/2008
100	DLA	Đắc Lắc	240896936	Diêm Công Thuyết	DLA-CK-EH-42	KT 1	8.34	DLA-KA-09	Trương Công Đỉnh	23/09/2008
101	HTA	Hà Tây	110432559	Nguyễn Thị Trào	HTA-PX-PT-189	KT 1	12	HTA-PX-02	Nguyễn Văn Dũng	08/12/2008
102	NBI	Ninh Bình	164308252	Vũ Thị Liễu	NBI-YK-KV-038	KT 2	6.2	NBI-YK-02	Phạm Văn Định	02/07/2008
103	VPH	Vĩnh Phúc	130932512	Nguyễn Văn Chỉnh	VPH-TD-TV-165	KT 1	15	VPH-VY-12	Nguyễn Văn Viện	25/02/2009
104	NBI	Ninh Bình	164140979	Lưu Danh Hoạt	NBI-NQ-VP-356	KT 1	12	NBI-NQ-03	Bùi Tống Tước	19/10/2008
105	PTH	Phú Thọ	130951475	Nguyễn Thị Hoà	PTH-HH-HX-230	KT 1	18.1	PTH-HH-04	Trần Văn Hải	03/06/2009
106	HYE	Hưng Yên	145080029	Ngô Văn Yến	HYE-TL-CC-210	KT 1	20.3	HYE-TL-09	Vũ Công Thoại	26/10/2009
107	TBI	Thái Bình	150099927	Nguyễn Thanh Hải	TBI - TT-TD-125	KT 1	6	TBI- TT- 05	Nguyễn Văn Uyên	29/04/2010
108	NDI	Nam Định	161738754	Phạm Văn Trình	NDI-TN-TH-146	KT 2	12.4	NDI-TN-01	Phạm Trung Thà	28/09/2009
109	HPH	Hải Phòng	31273479	Vũ Thị Thịnh	HPH-AD-QT-163	KT 2	8.2	HPH-AL-02	Dương Đức Thi	20/04/2010
110	DLA	Đắc Lắc	240287955	Ngô Văn Cầm	DLA-BM-ET-558	KT 1	10.6	DLA-KA-09	Trương Công Đỉnh	10/07/2009
111	QNI	Quảng Ninh	100565024	Hoàng Thị Bích	QNI-ĐT-TrA-460	KT 1	16.3	QNI-ĐT-02	Nguyễn Văn Thu	25/05/2010
112	BGI	Bắc Giang	120953997	Đặng Thị Thủy	BGI-LG-TT-857	KT 1	20.3	BGI-LN-05	Lê Văn Mạnh	05/05/2010
113	TGI	Tiền Giang	310100079	Phạm Văn Một	TGI-GD-TH-908	KT 2	7.6	TGI-GD-01	Trần Văn Hùng	20/05/2010
114	QNG	Quảng Ngãi	211367523	Lê Thị Hồng Hoa	QNG-NH-HTn-154	KT 1	8.7	QNG-NH-03	Nguyễn Hữu Công	25/08/2009
115	HNO	Hà Nội	112360347	Nguyễn Văn Khải	HNO-DP-TC-531	KT 1	9	HNO-DP-02	Hoàng thiên Cúc	29/06/2010
116	TGI	Tiền Giang	311737512	Đoàn Phú Thứ	TGI-CB-HT-420	KT 2	16.6	TGI-CB-01	Bùi Văn Hiệp	14/04/2010
117	NBI	Ninh Bình	164468489	Lưu Thị Thùy	NBI-KS-KC-180	KT 1	9	NBI-KS-02	Hoàng Văn Nhâm	12/11/2009

118	BDI	Bình Định	210660029	Nguyễn Văn Phương	BDI-HN-HĐ-779	KT 1	12.1	BDI-HN-01	Phan Văn Hương	30/10/2009
119	VTA	Bà Rịa-Vũng Tàu	273012491	Lê Đình Nam	VTA-CD-SN-133	KT 2	10.1	VTA TX01	Nguyễn Tiến Thành	07/06/2010
120	BDI	Bình Định	211419198	Hồ Thanh Hạnh	BDI-HA-ÂH-335	KT 1	6.5	BDI-HA-01	Nguyễn Hữu Thành	21/08/2009
121	BGI	Bắc Giang	121138844	Đặng Đình Luận	BGI-LG-TH-742	KT 1	16.3	BGI-LN-05	Lê Văn Mạnh	10/04/2010
122	TNG	Thái Nguyên	90588080	Đồng Văn Ấn	TNG-SC-BX-062	KT 1	20.3	TNG-SC-05	Cù Văn Nhân	27/11/2009
123	GLA	Gia Lai	230475702	Phạm Bá Cường	GLA-CP-IG-35	KT 2	16.6	ĐLA - CK - 02	La Duy Sự	25/09/2009
124	BGI	Bắc Giang	121416116	Phạm Văn Thuật	BGI-YD-TD-176	KT 1	15	BGI-LN-09	Lương Văn Sáu	20/09/2009
125	BDI	Bình Định	211620812	Đoàn Sĩ Chiến	BDI-AN-NK-1046	KT 2	15.1	BDI-AN-03	Cù Văn Vinh	07/06/2010
126	BGI	Bắc Giang	120838478	Nguyễn Kim Hải	BGI-YT-XL-129	KT 2	16.5	BGI-YT-14	Ngô Văn Thập	04/10/2009
127	BDI	Bình Định	210762959	Phạm Ngọc Cường	BDI-HN-TBS-753	KT 1	10.46	BDI-HN-01	Phan Văn Hương	27/10/2009
128	NBI	Ninh Bình	161403300	Lê Đức Chính	NBI-GV-GX-275	KT 1	12	NBI-NB-01	Vũ Văn Ban	05/06/2010
129	BGI	Bắc Giang	121575538	Đinh Văn Nam	BGI-YT-TCG-171	KT 1	20.3	BGI-YT-14	Ngô Văn Thập	06/09/2009
130	HNO	Hà Nội	111604135	Nguyễn Văn Canh	HNO-TT-HB-330	KT 1	9	HNO-ThT-06	Kiều Đức Sinh	20/04/2010
131	BTR	Bến Tre	320752074	Phan Thanh Minh	BTR-BT-MT-92	KT 2	5.9	BTR-BT-07	Huỳnh Văn Nên	24/09/2009
132	TNG	Thái Nguyên	90629836	Hoàng Thị Hường	TNG-PL-CL-088	KT 2	16.5	TNG-PL-03	Trần Đức Lạc	16/11/2009
133	BTR	Bến Tre	320995506	Ngô Văn Hồng	BTR-BT-BT-357	KT 2	6.6	BTR-BT-07	Huỳnh Văn Nên	20/06/2010
134	HYE	Hưng Yên	141844534	Nguyễn Văn Lực	HYE-TPHY-QC-108	KT 1	15	HYE-TL-11	Vũ Công Tỉnh	04/03/2010
135	HNO	Hà Nội	10935906	Nguyễn Thị Chài	HNO-BV-CM-233	KT 1	8.1	1	Hoàng Tuyển Thoan	24/05/2010
136	NBI	Ninh Bình	164410162	Quách Văn Nhâm	NBI-NQ-LV-458	KT 1	9	NBI-NQ-03	Bùi Tống Tước	10/10/2009
137	QNI	Quảng Ninh	100212619	Lài Cá Phoóng	QNI-BL-LH-11	KT 1	9	QNI-13	Lô Đức Diêm	08/12/2009
138	HNO	Hà Nội	12507568	Lê Văn Viện	HNO-DA-TX-875	KT 1	10.5	HNO-DA-01	Hoàng Hữu Chính	20/11/2009
139	QNG	Quảng Ngãi	211218341	Trần Ngọc Phái	QNG-NH-HTĐ-000201	KT 1	8.7	QNG-NH-03	Nguyễn Hữu Công	01/04/2010
140	BTR	Bến Tre	320858181	Nguyễn Văn Mười Một	BTR-GT-BH-63	KT 2	9.9	BTR-GT-18	Lê Văn Để	27/05/2010
141	TGI	Tiền Giang	310186392	Lê Thị Xuân Mỹ	TGI-GT-BN-1138	KT 2	10.1	TGI-GT-04	Trần Văn Thất	12/11/2010
142	KGI	Kiên Giang	370317683	VŨ HỮU CƯƠNG	KGI-TH-TĐA-101	KT 2	6.6	KGI-TH-02	Trần Thái Hòa	06/09/2010
143	QNG	Quảng Ngãi	211023686	Lê Thị Ngọc Ánh	QNG-TN-NHi-000195	KT 1	7.5	QNG-TN-02	Võ Thành Đức	24/09/2010
144	HDU	Hải Dương	142256815	Lưu Văn Thanh	HDU-BG-TD- 49	KT 1	12.1	HDU-BG-01	Nguyễn Văn Dân	17/09/2010
145	THO	Thanh Hoá	173616344	Lê Thị Hoa	THO-TX-TL-1278	KT 1	15	THO-TH-02	Lê Đình Hinh	29/11/2010
146	LAN	Long An	300626114	Nguyễn Văn Xướng	LAN-CĐ-LK-02	KT 1	7.5	TGI-CG-01	Trương Văn Xuân	17/12/2010
147	HNO	Hà Nội	111698651	Hoàng Thanh Sơn	HNO-TT-TX-379	KT 1	9	HNO-ThT-06	Kiều Đức Sinh	01/09/2010
148	QNG	Quảng Ngãi	211219917	Đinh Duy Liên	QNG-TN-NTư-000240	KT 1	7.5	QNG-ST-04	Bùi Tân	27/06/2011
149	HBI	Hoà Bình	113505704	Lại Tuấn Bình	HBI-LT-PL-024	KT 1	15	HBI-LT-01	Bùi Văn Nhạn	11/10/2010
150	YBA	Yên Bái	60743101	Hà Đức Sáu	YBA-VC-PS-254	KT 1	12	YBA-TX-02	Nguyễn Xuân Thọ	26/10/2010
151	BTR	Bến Tre	320714465	Lê Thị Yên	BTR-BT-MN-374	KT 2	8.8	BTR-BT-07	Huỳnh Văn Nên	06/07/2010
152	PTH	Phú Thọ	11309605	Nguyễn Đức Thuận	PTH-TB-LL-190	KT 1	7.9	PTH-TB-28	Bùi Văn Hà	17/07/2010
153	VPH	Vĩnh Phúc	111392852	Chu Thị Lưu	VPH-LT-BB-284	KT 1	9	VPH-LT-01	Trần Minh Huyên	26/04/2011
154	BTR	Bến Tre	320911961	Bùi Thị Phượng	BTR-BT-BT-427	KT 2	6.6	BTR-BT-07	Huỳnh Văn Nên	21/09/2010
155	BNI	Bắc Ninh	125050110	Nguyễn Thị Tươi	BNI-YP-LC-780	KT 1	19.9	BNI-YP-02	Mẫn Văn Hoàn	21/10/2010
156	SLA	Sơn La	50302349	Nguyễn Bá Lương	SLA-MS-HL-11	KT 1	15	SLA-MS-01	Phạm Văn Đạt	26/10/2010
157	NAN	Nghệ An	181198903	Chu Văn Quỵ	NAN-QL-QD-693	KT 1	6	NAN-QL-01	Hồ Tiến Lục	15/08/2010
158	BDI	Bình Định	210816965	Phan Hữu Châu	BDI-HA-AN-485	KT 2	7.6	BDI-HA-01	Nguyễn Hữu Thành	03/09/2010

159	CTH	Cần Thơ	361095730	Ngô Văn Tạm	CTH-BT-LT-023	KT 2	9.9	CTH-BT-04	Trần Văn Xuân	07/06/2011
160	NBI	Ninh Bình	161866759	Trần Xuân Thanh	NBI-KS-KT-200	KT 1	9	NBI-KS-02	Hoàng Văn Nhâm	10/11/2010
161	DLA	Đắc Lắc	240201894	Huỳnh Đức Ẩn	DLA-QĐ-805	KT 2	9.9	DLA-BM-02	Lê Viết Nghĩa	23/06/2011
162	HDU	Hải Dương	141504124	Trần Thị Bích	HDU-KM-MT-121	KT 1	12	HDU-KM-01	Tiên Văn Ương	30/12/2010
163	HTI	Hà Tĩnh	183185618	Nguyễn Thị Thúy Hằng	HTI- CX-CB-52	KT 2	8	HT-CX-01	Nguyễn Thừa Quý	02/08/2010
164	HNO	Hà Nội	13237946	Nguyễn Trọng Dục	HNO-SS-PL-2156	KT 1	12	HNO-SS-05	Nguyễn Xuân Hoàn	20/09/2010
165	AGI	An Giang	350816281	Trương Thị Văn	AGI-AP-QT-10	KT 2	6.6	AGI-AP-02	Nguyễn Văn Dương	20/05/2011
166	DNA	Đồng Nai	271129959	Đỗ Ngọc Hoàng	DNA-TN-GT-112	KT 2	10.1	DNA-TN-01	Trần Tiến Hữu	05/07/2010
167	DLA	Đắc Lắc	191263779	Trịnh Đình Lai	DLA-BD-CK-079	KT 1	8.5	DLA-KA-09	Trương Công Đỉnh	13/08/2010
168	NDI	Nam Định	162385284	Lê Thị Xuân(Duẩn)	NDI-GT-GTH-108	KT 2	9.2	NDI-GT-01	Bùi Văn NGhĩa	06/11/2010
169	DNA	Đồng Nai	270943400	Nguyễn Hải Hồ	DNA-CM-XM-160	KT 2	9.9	DNA-CM-03	Nguyễn Văn Phước	04/04/2011
170	BDI	Bình Định	211554278	Nguyễn Thị Đỉnh	BDI-HA-ÂT-589	KT 2	10.7	BDI-HA-01	Nguyễn Hữu Thành	14/12/2010
171	TBI	Thái Bình	151719884	Quách Thị Tiến	TBI- ĐH - ĐT - 245	KT 1	9	TBI- TT- 04	Phạm Viết Lưu	20/06/2011
172	HNO	Hà Nội	112155085	Đỗ Công Tuấn	HNO-BV-CM-379	KT 1	8.1	HNO-BV-01	Hoàng Tuyển Thoan	13/09/2010
173	HPH	Hải Phòng	30779126	Nguyễn Văn Luân	HPH-TN-AS-586	KT 1	6	HPH-TN-01	Phạm Văn Vạn	23/09/2010
174	HNO	Hà Nội	112541508	Đỗ Văn Tươi	HNO-CM-ĐS-582	KT 1	12	HNO-CM-02	Trần Văn Cờ	25/11/2010
175	BDI	Bình Định	211544513	Lê Thanh Tùng	BDI-TS-BT-1067	KT 1	19.9	BDI-TS-02	Nguyễn Đặng Tuấn	09/06/2011

BUS AND CARBON SURVEY

TRAINING REPORT

March 2012

Consultant team: Asian Management and Development Institute (AMDI)

Background: BUS and carbon survey is under design and preparation stage. The survey will be conducted using structured interview and observation methods (quantitative method). Survey will be conducted with biogas users and non - biogas users (control group). The questionnaires for survey were developed by the project experts and consultant team. Field survey will be carried out by data collectors who did not involve in the design stage. Therefore, training data collectors on using the questionnaires to conduct structured interview and understand the project objective is necessary.

Training purpose: the training was conducted with following purposes:

- Briefly introduce the project implementation and context of the survey
- Help the data collectors understand types of biogas plant and its components.
- Introduce objective of the survey
- Train data collectors to deeply understand each question in the three questionnaires for both biogas users and non-biogas users.
- Train data collector on survey procedure and quality assurance during the interview
- Allow data collectors to practice on the questionnaires so that they are fluent in asking each question.
- Get feedbacks from data collectors and experts on the questionnaire to improve the survey tools.

Training time:

- First training**:** 26 March, 2012 (from 1h30 PM to 5h00 PM)
- Tool test: 26 March, 2012 (full day)
- Refresh training: 30 March, 2012 (from 8h30 AM to 12h30 AM)

Participants:

- Supervisor: Le Anh Duc, Technical Expert of BPD project
- AMDI experts: Ngo Cong Chinh (Team leader), Tran Khac Tuyen (Biogas expert), Le Van Duy (Biogas Assistant) and Nguyen Hung Manh (data analyst)
- Data collectors: Dam Thanh Hang, Nguyen Khac Hieu, Nguyen Thanh Ly, Tran Huong Giang, Truong Ha Vi, Nguyen Xuan Truong, Nguyen Thi Hong Thai, Ngo Viet Hung, Nguyen Minh Tri, Luong Ngoc Tu, Pham Van Trung

Training method: the training was conducted in participatory method. In the first training, after introducing the project objectives and the biogas plant, instructor guided and explained each question in the questionnaires. All questions were gone through to have common understanding and consistency of questioning. Data collectors and expert immediately give feedback for each question to improve the way of asking question in Vietnamese without changing meaning of the question. After that, data collectors were divided in pair for practicing the questionnaire. After practicing data collectors gave feedback one more time to improve the questionnaire. All feedbacks were taken into account and revised according before the pilot.

Pilot was conducted with 8 biogas users in Thanh Da commune, Me Linh district, Hanoi. Data collectors were divided into two groups. In each group, group leader conducted the first survey as a model, all other data collectors observed and practiced with other household. After pilot,

technical experts from BPD project and the data collectors gave comments for the questionnaire. The questionnaire was revised and adjusted one more time before the refresh training.

In the refresh training, data collectors were remarked on what they should improve in term of survey technique, using scales, and quality assurance. Instructor went through the revised questions for all data collectors to have common understanding. After that, data collectors were divided in pair for practicing. Instructor observed and immediately gave feedback to each data collector.

Lesson learned from the field test

- Usually the biogas user put manure into biogas plants once or twice a day in early morning and late afternoon. Therefore, when the team came to the household, there was no manure available for measurement. AMDI will try to contact to the selected households before visiting to increase the sample of measurement using Newton scale.
- AMDI has been contacted to the scale provider but no Newton scale more than 5 kilogram available at the survey time. While 5kg scales is usually not enough for measurement of manure or wood. The acceptable solution is survey team can use the scale available in the household but the scale must be tested using the certified calibration stone before using.
- During the field test, data collectors tend not to be accurate in measuring, for example, they did not adjust the scale to zero or they round up 9.6 kg to 10 kg. This was corrected by BPD and AMDI experts during the field test and the refresh training.

Training results:

- All data collectors have basic understanding of the biogas plant structure, the project objective and implementation.
- All data collectors understand meaning of each question in the questionnaire and fluent in asking questions to have necessary data for each question.
- All data collectors had chance to practice during the training and especially during the field test thus they are confident and ready to conduct the real survey.

List of households participated in the tool test survey

No	Name	Phone number
1	Lê Thị Thủy	04.35265059
2	Nguyễn Văn Thành	01678773258
3	Nguyễn Hữu Liệu	0974291014
4	Nguyễn Thị Vĩnh	0972443694
5	Nguyễn Thị Sáu	01652762785
6	Nguyễn Hữu Huê	01683195707
7	Nguyễn Đình An	01668865699

8	Nguyễn Thị Nạp	
9	Nguyễn Văn Lập	
10	Lưu Văn Cường	

Training agenda for first training:

Time	Duration (minutes)	Activities	Facilitator
1:00 PM	10	Introduce the project	Mr. Chinh
1:10 PM	20	Introduce objectives of survey, structure of a biogas plant and its components	Mr. Duc
1:30 PM	60	Guide and explain the questionnaire, get feedback from participants	Mr. Mạnh
2:30 PM	10	Interview rule, survey procedure and quality assurance during the interview	Mr. Mạnh
2:40 PM	5	Break	Participants
2:45 PM	120	Role play, practicing the questionnaire in pair	Participants
4:45 PM	30	Get feedback from participants	Participants
5:15 PM		Close the training	

Refresh training agenda

Time	Duration (minutes)	Activities	Facilitator
8:30 AM	30	Lesson learn from the pilot, what should be improved	Mr. Manh
9:00 AM	30	Explain and guide the revised questions	Mr. Manh
9:30 AM	120	Role play, practicing the questionnaire in pair	Participants
11:30 AM	30	Get feedback from participants	Participants
12:00 AM		Close the training	

Pictures taken during training: