

Monitoring Report Period II, VPA-1

Indonesia Domestic Biogas Programme of Activities (IDBP) (ID 1172)

Climate Focus | 02/09/2015 | MR CPI MPII

`

MONITORING REPORT VPA1

(GS1174)

Indonesia Domestic Biogas Programme of Activities (IDBP)
(ID 1172)

Monitoring Period II of the First Crediting Period
(01/06/2013 – 31/12/2014, including both days)

Version 1.3

Main contact person Indonesia Domestic Biogas Programme:
Mr. Robert de Groot
Programme Manager IDBP
Email: rdegroot@hivos.or.id
Phone: +62 812 1059119
IDBP website: www.biru.or.id

Contact details of Project Participants are listed in Annex I

Author of study
Szymon Mikolajczyk
Climate Focus
Email: s.mikolajczyk@climatefocus.com

Acronyms

BE	Baseline emission
BFT	Baseline fuel test
BUS	Biogas User Survey
CDM	Clean Development Mechanism
CH_4	Methane Gas
CMS	Carbon Monitoring Survey
CO_2	Carbon Dioxide
CO_2eq	Relative potency of non-CO_2 gases compared to CO_2
EF	Emission factor
ER	Emission reduction
GHG	Greenhouse Gas
GS	Gold Standard
GWP	Global Warming Potential
hh	household
IDBP	Indonesia Domestic Biogas Programme
IPCC	Intergovernmental Panel on Climate Change
KPT	Kitchen Performance Test
LPG	Liquefied Petroleum Gas
LSC	Local Stakeholder Consultation Report
MCF	Methane conversion factor
MPII	Monitoring Period II
MRII	Monitoring Report II
MS	Manure system
NRB	Non-Renewable Biomass
PDD	Project Description Document
PE	Project Emission
PFT	Project fuel test
SD	Sustainable Development
SNV	Netherlands Development Organisation
UNFCCC	United Nation Framework Convention on Climate Change
US	User Survey
VER	Voluntary emission reduction
VGS	Voluntary Gold Standard
VS	Volatile solids

Table of Contents

Monitoring Report VPA1 1
1. Introduction 4
1.1 project characteristics 4
1.2 Technical Project Description 5
1.3 Units disseminated and summary of Emission Reductions 8
1.4 Summary of VERs claimed in CPI MPII 12
2. Monitoring activities 13
2.1 Organisational Setup of the carbon and SD monitoring 13
2.2 Description of human resources 14
2.3 Survey design 15
2.4 Biogas user survey (us + cms) 16
2.4.1 Survey implementation 19
2.5 Baseline Fuel Test (BFT) and the Project Performance Field Test (PFT) 20
2.5.1 KPT survey design 21
2.5.2 KPT implementation 23
3. Results 27
3.1 BUS survey results 27
3.1.1 Parameters monitored and not monitored 29
3.1.2 Emission reduction component 1: Accounting for emission reductions due to the displacement of fossil fuels and non-renewable biomass 34
3.1.3 Leakage emissions 41
3.1.4: Ex-post estimate of the emission reductions 46
3.1.5 Justification for ER difference with PDD 49
4. Sustainability monitoring conform monitoring plan in Passport 51
4.1 Safeguard Principles 51
4.2 Sustainability Development Assessment 53
4.2.1 SD monitoring as per GS requirements 53
5. Stakeholder feedback 60
6. Data quality control and assurance 61
7. FARs raised during MPI 63
Annex 1: Contact details of the Project Participants 66

1. INTRODUCTION

The Indonesia Domestic Biogas Programme (IDBP) is a development programme managed and implemented by Hivos (Humanist Institute for Co-operation with Developing Countries) with technical assistance from SNV (Netherlands Development Organization) and national support from the Directorate General for Electricity and Energy Utilization of the Indonesian Ministry of Energy and Mineral Resources. The overall development objective of the IDBP is to disseminate domestic biodigesters as a local, sustainable energy source through the development of a commercial, market oriented sector in selected Indonesian provinces.

This report presents the monitoring activities of VPA-1 of the IDBP Programme of Activities according to the modalities and procedures set by the Gold Standard (GS) for the monitoring period II (MPII) of the first crediting period (CPI) covering 01/06/2013 to 31/12/2014, both dates inclusive. The IDBP project in this document will be referred to as 'the PoA'.

1.1 PROJECT CHARACTERISTICS

The table hereunder details the characteristics of the IDBP project.

Table 1: IDBP project characteristics

Item	Data
Host country	Indonesia
Project title	PoA: Indonesia Domestic Biogas Programme of Activities (IDBP) (ID 1172) VPA: Indonesia Domestic Biogas Programme of Activities (IDBP) (ID 1172), VPA-1(ID 1174)
Project scale	Small scale
Gold standard project animal icon	Pelican
GS project ID	GS1172 and GS 1174
GS website link	http://mer.markit.com/br-reg/public/master-project.jsp?project_id=103000000000019
Project scope according to UNFCCC categories	Renewably energy delivery to the user and methane avoidance
Applied methodology	'Technologies and practices to displace decentralized thermal energy consumption' (11/04/2011)
Crediting period	7 years (renewable)
Start date of project	24/10/2009
Crediting period	01/06/2011 – 31/05/2018
Registration	31/05/2013
Monitoring period I (MPI)	01/06/2011 to 31/05/2013, including both days
Monitoring period II (MPII)	01/06/2013 to 31/12/2014, including both days

The VPA-1 targets nine provinces in Indonesia, as per the next table:

Table 2: Project location by provinces in Indonesia and GPS coordinates of provincial capitals**Province**	**Latitude**	**Longitude**
Lampung	S6°45' - 3°45'	E103°48' - 105°45'
West Java	S8°0' - 5°40'	E106°0' - 109°0'
Central Java & Yogyakarta	S8°30' - 5°40'	E108°30' - 111°30'
East Java	S9°0' - 4°50'	E110°30' - 116°30'
Bali	S9°0' - 7°50'	E114°0' - 116°0'
Nusa Tenggara Barat	S9°20' - 6°20'	E115°30' - 119°30'
Sumba	S11°10' - 7°30'	E118°30' - 125°20'
South Sulawesi	S8° - 0°12'	E116°48' - 112°36'

1.2 TECHNICAL PROJECT DESCRIPTION

The National Biodigester Programme

The VPA-1 started implementation of biodigesters on 24 October 2009, following an agreement reached between the Royal Netherlands Embassy to support the Indonesian Ministry of Energy and Mineral Resources. The overall development objective of the VPA-1, and the IDBP programme which manages it, is to disseminate domestic biodigesters as a local, sustainable energy source through the development of a commercial, market oriented sector in selected Indonesian provinces.

Figure 1: The boundary of the VPA-1 is the national boundaries of the Republic of Indonesia (host party).



The scenario existing prior to the project activity

Before the onset of the project activities, most households with the technical potential for a biodigester relied primarily on firewood, kerosene and LPG to meet their thermal energy demand for cooking. The reliance on these fuels causes substantial indoor air pollution which can lead to respiratory and eye ailments, especially women and children are mostly at risk here. Furthermore, the collection of wood contributes to deforestation which is rampant in Indonesia with a fNRB value of 64.8%. A substantial part of the firewood is collected, which is physically draining and costs a lot of time, especially for women. Purchased firewood on the other hand is a burden on the limited household's revenues. In addition, unhygienic animal waste management practices and the lack of access to basic sanitation result in pollution of farmyards and surface water, foul odour, methane emissions and a relatively high prevalence of hygiene related diseases, such as diarrhoea.

Technology and emission reductions

The technology implemented under the VPA-1 covers biodigesters fed with a mixture of water and animal manure that is anaerobically digested. The generated biogas is intended for use as fuel for cooking. The biodigester type implemented under the VPA-1 consists of the fixed-dome type. This model is constructed with bricks and stone masonry. The fixed-dome technology has a proven durability, and can be installed underground, saving space and protecting the installation. Materials for its construction can be sourced locally.

The use of the biodigester models is simple:

I. Collect manure and mix with water according to the type of manure used and biodigester model;
II. Feed this mix into the biodigester;
III. Both biogas and sludge are produced.

The biogas is used as cooking fuel. The build-up of gas will push out slurry through the exit pipe of the biogas system, and is a fertiliser that can either be applied directly to crops or composted with other organic material.

Maintenance needs are limited since the biodigesters have no moving parts. Over time, some indigestible material can build up in the digester, limiting the reactor volume. This issue is solved simply by scooping the indigestible material out and re-filling the biodigester with manure.

GHG emission reductions:

The baseline scenario is composed of three components. All three components are covered by the methodology 'Technologies and practices to displace decentralized thermal energy consumption' (11/04/2011), and include the following:

i. Consumption of non-renewable biomass for cooking.

Dependency on firewood and charcoal as a source of thermal energy for cooking purposes is high in Indonesia[1]. The usage of NRB (including charcoal) contributes to deforestation and forest degradation and results in emission of GHGs. The applicable methodology states that the baseline scenario is, in the absence of the project activity, the use of NRB meeting similar thermal energy demands.

ii. Consumption of fossil fuel for cooking.

Dependency on fossil fuels as a source of thermal energy for cooking purposes, especially kerosene and LPG, is also significant in Indonesia. The combustion of fossil fuels for cooking results in emission of GHGs. The applicable methodology states that the baseline scenario is, in the absence of the project activity, the use of fossil fuels meeting similar thermal energy demands.

iii. Methane emissions from manure handling.

The baseline scenario is the situation where, in the absence of the project activity, organic matter is left to decay anaerobically within the project boundary and methane is emitted to the atmosphere. The amount of methane that is emitted under this scenario is contingent upon the baseline manure management practice, which can include storing manure in anaerobic lagoons, deep pits, liquid storage, deep bedding, or other practices outlined in the '2006 IPCC Guidelines for National Greenhouse Gas Inventories'[2]. The applicable methodology establishes that baseline emissions are calculated by using the amount of the waste that would decay anaerobically in the absence of the project activity, with the most recent IPCC Tier 1 or 2 approaches[3].

Contribution to sustainable development

This VPA-1 contributes to sustainable development in a number of ways:

(i) Environmental

- Reduced GHG emissions;
- Reduced deforestation and forest degradation in areas where NRB is used as a source of fuel. This contributes to the overall stability of forest ecosystems, which support biodiversity and watersheds;
- Improved soil conditions where digester slurry is applied to agricultural land[4].

(ii) Social

- Reduced combustion of firewood and fossil fuels reduces indoor air pollution, thereby increasing respiratory health of users, particularly women and children who spend a large portion of their time indoors[5].

[1] Laboratory of Energy and Agricultural Electrification (2002) 'Biomass energy potentials and utilisation in Indonesia'

[2] See chapter 'Emissions from Livestock and Manure Management' under the volume 'Agriculture, Forestry and other Land use' of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

[3] See chapter 'Emissions from Livestock and Manure Management' under the volume 'Agriculture, Forestry and other Land use' of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

[4] Lukehurst, C.T., Frost, P. and Al Seadi, T (2010) 'Utilisation of digestate from biogas plants as biofertiliser'. IEA Bioenergy.

(iii) Economic

- Reduced end-user expenses due to reduced expenses on the purchase of biomass and fossil fuels, as well as healthcare related expenses;
- The use of the slurry as an organic fertiliser on agricultural soils can significantly improve soil quality and offset costs that would otherwise be incurred in the purchase of chemical fertilisers. The nutrient value of the slurry produced has also been shown to be higher than raw manure[6].

1.3 UNITS DISSEMINATED AND SUMMARY OF EMISSION REDUCTIONS

The next table shows the units built and commissioned in the period from 3-1-2009 to 31-12-2014 in the VPA-1.

Table 3: Total Number of units installed by year and cumulative, VPA-1[7]

Period	Number of biodigesters in VPA-1	Cumulative number of biodigesters in VPA-1
3 November 2009 – 31 December 2009	62	62
1 January 2010 – 31 December 2010	1,586	1,648
1 January 2011 – 31 December 2011	2,995	4,643
1 January 2012 –31 December 2012	3,339	7,982
1 January 2013 –31 December 2013	3,267	11,249
1 January 2013 –31 December 2014	2,890	14,139
		Total: 14,139

In total 14,139 biodigesters were constructed as of 31-12-2014 in the VPA-1 project boundary. The figure below shows the cumulative number of installed biodigesters as well as the number of units that are installed each month.

Table 4 shows the distribution of the 14,139 biodigesters across the nine targeted provinces.

Table 4: Distribution of biodigesters per province, until 31-12-2014

Province	Number of biodigesters
Lampung	130
West Java	1,289
Central Java & Yogyakarta	1,596
East Java	6,906
Bali	806
Nusa Tenggara Barat	2,919
Sumba	201
South Sulawesi	292

[5] World Health Organization (2007) 'Indoor Air Pollution - National burden of Disease Estimates'. Geneva.

[6] Lukehurst, C.T., Frost, P. and Al Seadi, T (2010) 'Utilisation of digestate from biogas plants as biofertiliser'. IEA Bioenergy.

[7] Presented cumulative figures exclude the drop-off rate, as further explored in Section 2.4

Total:	**14,139**

Figure 2: Cumulative and monthly number of units installed until 31-12-2014

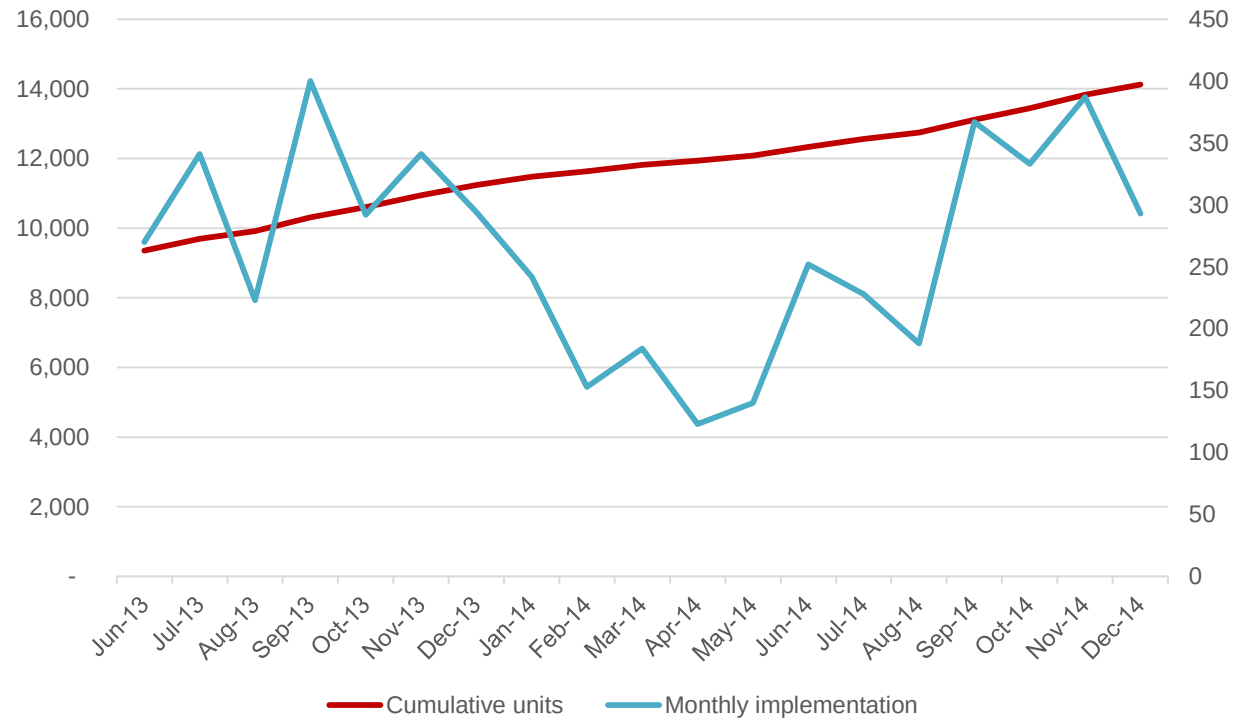
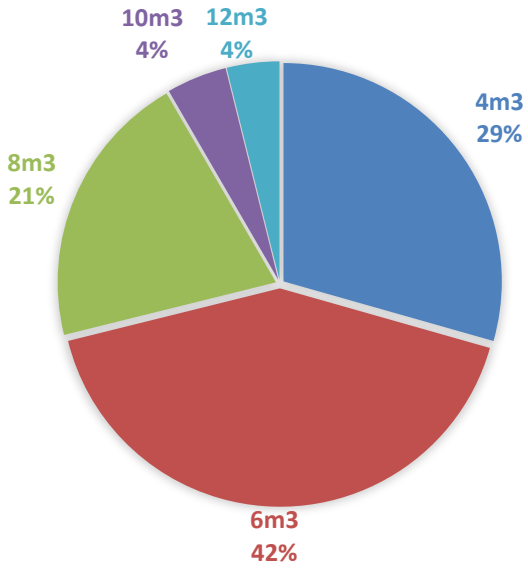


Figure 2 shows that the number of units installed is steadily increasing. The figure also shows that there are seasonal effects affecting the number of units installed.

The VPA-1 installs five different biodigester sizes; the figure below shows the proportions of each biodigester size expressed in fraction of total number of digesters built during the assessed period:

Figure 3: Biodigester capacities implemented in VPA 1 (as per 31-12-2014)[8]

[8] Figures may not add up due to rounding



The most proliferated digester has a volume of 6 m^3, followed by the 4 m^3; according to the IDBP database. Other digester sizes are built to a much smaller extent, with the 10 m^3 and 12 m^3 joining totalling around 8% of all the digesters built. The average digester size built has a volume of 6.23 m^3. The VPA-1 has a cumulative digester volume of 88,085 m^3.

The VPA-1 meets the small-scale VPAs thresholds set forth by the CDM i.e., 15 MW (45 MW_{th}) for the renewable energy component and an emissions cap of 60,000 tCO_{2e} for the methane avoidance component. As indicated above, the average biodigester size implemented in this VPA-1 is 6.23 m^3. As per the calculation presented in footnote 9 below, this biodigester size requires daily feeding of (6.23 m^3 * 7.5 kg =) 46.73 kg of manure, equivalent to 1.87 m^3 of biogas per day. As per the Table below, this amounts to a maximum output of 1.76 kW_{th}, which is below the established threshold of 150 kW_{th} per unit. Also, given 14,139 units implemented to date under the VPA-1, this cumulates to 35.840 MW_{th}.

The calculation is presented below:

$\mathbf{Th_{cap}} = \frac{\mathbf{E}}{\mathbf{t}}$ $\quad where \quad \mathbf{E} = \eta * H_b * V_b$		
Where:	Value:	Comments:
t = hours/day usage	2.15	Emission Reduction Calculation sheet 'Cumulative VER', cell F18[9]
η = efficiency of stove	50%	Indonesian Government standard on stove efficiency
H_b = heat of combustion per	21.0 MJ/m^3 [10]	Derived from IPCC defaults

[9] Average cooking hours data for the years 2009 – 2013 are derived from the BUS 2013. Data for 2014 is derived from the BUS 2015

unit volume of biogas		
V_b = volume of biogas	1.87 m^3/day[11]	Data provided by Hivos
E = Energy available from the biogas system	19.63 MJ/day[12]	Calculated
E_{th} =	5.45 kWh/day	1 MJ = 0.2778 kWh
Th_{cap} =	2,53 kW_{th}	Given a 2.15 hour/day usage
Total capacity	35,777 kW_{th}[13]	Given 14,139 units installed

As each biodigester produces a maximum emission reduction of 1.838 tCO_2e from methane avoidance (assuming GWP of 25 for methane), given 14,139 biodigesters installed, the cumulative amount of emission reductions from the methane avoidance component is 25,990 tCO_2e. This is below the methodological threshold of 60,000 tCO_2e.

[10] Methane has an energy value of 37.78 MJ/m^3; thus, biogas at 55% CH_4 has an energy value of 21 MJ/m^3

[11] Cow dung produces approximately 40 litres biogas per kg. Each m^3 capacity of the biodigester needs 7.5 kg dung per day. Given a 100 m^3 biodigester, 750 kg of cow dung per day is required. This translates into 30 m^3 of gas produced per day. See Document P_Biogas_as_renewable_energy _2005.pdf, pages 79 and 140.

[12] Calculated as: 50% efficiency * 21 MJ/m^3 * 1.87 m^3/day

[13] Figures may not add up due to rounding – see emission reduction calculation

1.4 SUMMARY OF VERS CLAIMED IN CPI MPII

The next table summarizes the total number of VERs claimed for this MPII:

Table 5: Estimated emission reductions of MPII CPI, VPA-1

Month of program	Period, begin and end date inclusive		Cumulative number of units	Monthly ER (tCO_2e)	Cumulative ER (tCO_2e)
25	1/6/2013	30/06/2013	9,358	2,251	2,251
26	1/7/2013	31/07/2013	9,699	2,317	4,568
27	1/8/2013	31/08/2013	9,922	2,402	6,970
28	1/9/2013	30/09/2013	10,322	2,457	9,427
29	1/10/2013	31/10/2013	10,614	2,556	11,983
30	1/11/2013	30/11/2013	10,955	2,628	14,611
31	1/12/2013	31/12/2013	11,249	2,713	17,324
32	1/1/2014	31/01/2014	11,491	2,786	20,110
33	1/2/2014	29/02/2014	11,644	2,846	22,955
34	1/3/2014	31/03/2014	11,828	2,883	25,839
35	1/4/2014	30/04/2014	11,951	2,929	28,768
36	1/5/2014	31/05/2014	12,091	2,960	31,727
37	1/6/2014	30/06/2014	12,343	2,994	34,722
38	1/7/2014	31/07/2014	12,571	3,057	37,778
39	1/8/2014	31/08/2014	12,759	3,113	40,891
40	1/9/2014	30/09/2014	13,126	3,160	44,051
41	1/10/2014	31/10/2014	13,459	3,250	47,301
42	1/11/2014	30/11/2014	13,846	3,333	50,634
43	1/12/2014	31/12/2014	14,139	3,429	54,063
				Total	**54,063**

The table shows that the total number of ERs realized is **54,063** tCO_2 for the monitoring period II.

2. MONITORING ACTIVITIES

2.1 ORGANISATIONAL SETUP OF THE CARBON AND SD MONITORING

All monitoring was coordinated by the CME, Hivos. The objective of the monitoring effort conducted under this VPA-1 was to meet the monitoring requirements set forth in the methodology 'Technologies and practices to displace decentralized thermal energy consumption' (11/04/2011).

Hivos appointed Ms. Rita Maria from JRI Indonesia to conduct the Biogas User Survey, which serves as the monitoring survey under the VPA-1 (BUS 2015). The survey was designed and implemented in accordance with the requirements set forth in the methodology, whereby the selected sample size follows the 90% confidence interval and a 10% margin of error (90/10) requirements. Mr. Szymon Mikolajczyk from Climate Focus was placed in charge of advising JRI Indonesia on the VPA specific monitoring procedures. JRI recruited 13 surveyors and 3 supervisors for the enumeration. Besides, Hivos recruited 5 surveyors for data collections. All these surveyors received training on survey and data collection techniques and they were supervised by Supervisors and the Provincial Coordinator of each province during implementation. Survey implementation was jointly conducted by JRI and Hivos staff, while data tabulation, analysis and reporting was prepared by JRI Indonesia.

Hivos internally designed and implemented the KPT, which was supervised by Mr. Sundar Bajgain and supported by Mr. Szymon Mikolajczyk. Twelve experienced surveyors were selected for the KPT survey, 9 of whom are Quality Inspectors working under the IDBP provincial offices and 3 of whom are other experienced staff working under IDBP. Tabulation and analysis of results was conducted by Mr. Szymon Mikolajczyk.

As per registered VPA-DD and GS PoA Passport a number of monitoring activities were undertaken for this monitoring period. The monitoring surveys that were executed and the entities involved are shown in the next figure:

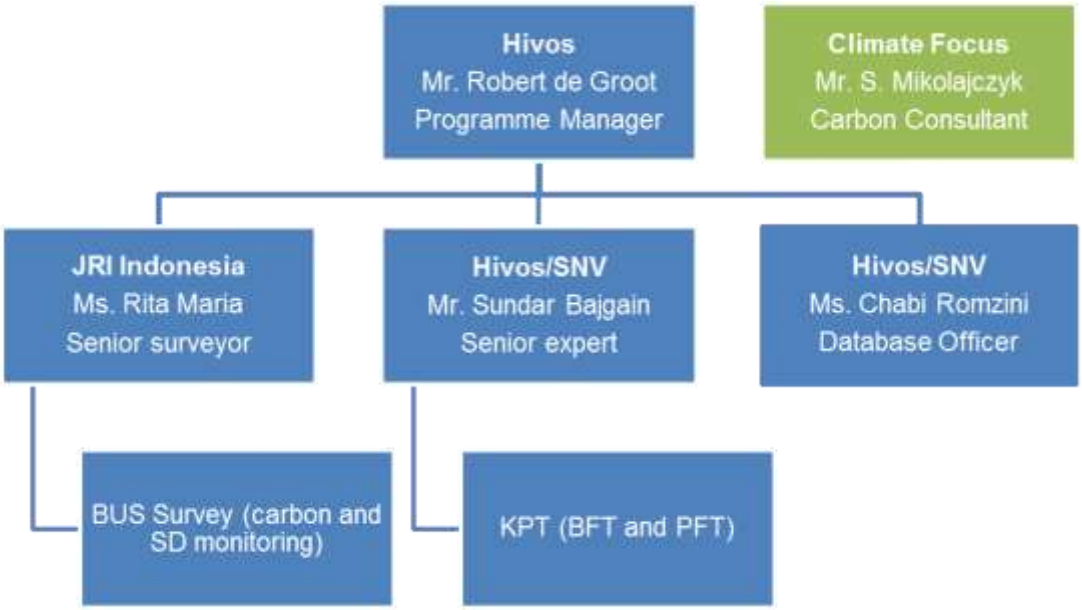


Figure 4: Surveys executed and entities involved

In terms of data monitoring, IDBP has one dedicated staff to input all the data into the IDBP Database that comes into the National Office. This is the Database Officer. In one of the Provincial Offices (East Java) a Database Assistant is responsible to perform the data entry into the IDBP Database directly. The reason for this is because East Java is the area where a large part of the biodigesters was initially implemented. All inputs are coordinated at the Central Office in Jakarta.

Hivos, based on the hard copies of the Household Agreement and the Completion Report from the biodigester constructor, is responsible for entering data into the centralised record-keeping database. It is Hivos's responsibility to ensure that data is entered correctly and to follow-up with the supplier where errors or missing data appeared.

Only the National Office can carry out payments to the CPOs. All sales records are sent to the National Office in the form of electronic files while the hard copies are stored in the provincial offices.

2.2 DESCRIPTION OF HUMAN RESOURCES

Robert de Groot: Robert de Groot is the Programme Manager of IDBP, supported by Agi Safitri, Deputy Programme Manager including the VPA-1. Robert is in charge of overall project management and acts as the key contact person between Hivos and the Indonesian Government. Robert approves any financial payments that are made to participating partners and monitors the partners' progress on a monthly basis. The Provincial Coordinators coordinate with Robert directly on a daily basis to provide updates about any occurring issues, implementation progress and working relations with partners.

Rita Maria: Rita Maria is in charge of running operations at JRI Research, a surveyor company operating in Indonesia. JRI Research employs researchers, surveyors and statisticians and has been associated with the IBDP programme since 2009. JRI has been in charge of implementing and analysis the BUS 2015, as well as previous versions of this survey (including BUS 2012 applied for the first retroactive crediting process).

Sundar Bajgain: Sundar was responsible for the preparation of the KPT (BFT and PFT) that was implemented in September 2013. He works in SNV as the senior biogas expert coordinating in the IDBP programme in Indonesia. He has previous monitoring experience by working for the Nepal Biogas Programme, which is registered under the CDM.

Chabi Romzini: Chabi is responsible for overseeing all data entry processes into the IDBP Database. This includes updating implementation figures on a monthly basis, tracking the operational rate of installed biodigesters, and tracking CPO and user trainings, amongst others. Chabi is responsible for centralising all the data that is sent in from the provincial offices.

In data entry proses, Chabi is assisted by Kristian Chandra as a data entry staff in East Java and Baiq Herni as a data entry staff in NTB. Both of them are responsible for data entry proses and send the data to Jakarta (NBPSO) every week for synchronization. For subsidy payment proses, Chabi should verify the data first before send it to finance officer.

Szymon Mikolajczyk: The key responsible person for the preparation of this Monitoring Report. Szymon was selected consultant based on a tendering process conducted by Hivos. He has been involved with the IDBP since 2010 and assisted the IDBP through the Gold Standard validation, registration and first verification process.

2.3 SURVEY DESIGN

The next table summarizes the design of the surveys:

Table 6: Survey designs summary

Item	BUS 2015 (US + CMS)	KPT 2013 (PFT)	KPT 2013 (BFT)
Target group	Households with a biodigester that has been in use for at least 6 months before the end of MPII of CPI	Users with a biodigester	Households without a biodigester
Main topics	Drop-off rate, user characteristics, fuel usage and SD survey	Project fuel use	Baseline fuel use
Sampling method	Cluster sampling based on usage age	Simple random sampling	Simple random sampling using PFT sampling

			frame
Cluster	Age group	N/A	N/A
Cluster size	Up to 43 household (oversampling applied)	N/A	N/A
Number of clusters	24	N/A	N/A
Total sample size	199	49	49

2.4 BIOGAS USER SURVEY (US + CMS)

The Biogas User Survey (BUS) is the survey implemented under the VPA-1 annually that includes both the a) User Survey (US) and b) the Carbon Monitoring Survey (CMS). The survey was executed from December 12th 2014 to January 28th 2015 (BUS 2015) amongst a representative sample of biodigester households with the objective to obtain reliable and unbiased data on the user characteristics, impact of the programme on sustainable development (SD), on GHG emission modalities such as fossil and fuel wood consumption, cattle types and amounts. Furthermore, the usage parameter (in some programmes assessed in a separate user survey) has also been included in the BUS 2015. This parameter must be established to account for drop off rates as project technologies age and are replaced. Prior to the 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.

The next table shows the studies included in the BUS 2015.

Table 7: BUS studies

#	Name of study	Monitoring interval	Conversion in MPI CPI
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 VPA-DD is adopted for MPI.
2	Project studies (PS) of target population characteristics;	Annual	Included in BUS 2015
3	Monitoring of the SD parameters.	Annual	Included in BUS 2015
4	Leakage emission assessment	Every two year after first verification	Investigated
5	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. Since this represents the first MP, the PP refers to the fNRB of 64.8% as per the PDD.

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

In addition to the parameters monitored as per VPA-DD and Gold Standard Passport, the BUS survey includes a set of target population parameters, such as household size, digester size, ID code.

3. Sustainability assessment

The BUS survey includes the monitoring of the SD parameters where it applies to biogas households. Chapter 4 details the results of the SD monitoring and the sources of data used.

4. Leakage emission assessment

A leakage investigation has been conducted (once every two years) and is presented in Section 3.25 of this MR. Physical leakage is also included in the calculations.

5. Maintenance of total sale record and project database

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

BUS survey design

In the period December 12th 2014 to January 28th 2015 the survey was executed by a team of surveyors from IDBP. The BUS monitoring procedure applied consisted of the following steps:
Details of the biogas households of each age group were gathered;

I. Random selection of at least 35 households from each age group, proportional to the overall population size of the province (multi-stage sampling). Oversampling of at least 5 households per age group was applied – in total 49 households were oversampled. This is in excess of the minimum sampling requirements of 30 households per age group. The sampling was executed using a web based random number generator[14]. The sample size for each province was determined based on the biodigester user populations derived from the IDBP database to ensure representativeness.
II. IDBP staff surveyed the sampled households, and the gathered data was entered into a database at the head office after inspection of the quality.

To establish the sample size and the sample distribution, guidance from the applied Gold Standard methodology was applied. As per the guidance, to ensure conservativeness, participants in a user survey with technologies in the first year of use (age 0 to 1) must have

[14] See http://www.randomnumbergenerator.com/

technologies that have been in use on average longer than 0.5 years. For technologies in the second year of use (age 1 to 2), the user survey must be conducted with technologies that have been in use on average at least 1.5 years, and so on. A minimum sample size of 30 for each age bracket needs to be adhered to.

For the BUS 2015, biogas users classified as the first year of use are those who have been using an IDBP biodigester from December 2013 until May 2014. Biogas users classified as the second year of use are those who have been using an IDBP biodigester from December 2012 until May 2013. And so on.

The BUS 2015 covered all nine provinces that have become intervention areas of the VPA-1. Total sample of respondents per province determined proportionally to the total population of the respected province. The distribution of respondent sample for each province, and each year of use, is described in Table 8. For all three age brackets, in excess of the 30 biodigester users were sampled to ensure representativeness.

Table 8: BUS 2015 random sample size selection and geographical distribution

	Province	Year 1	Year 2	Year 3	Year 4	Year 5	Total
1	Bali	2	1	3	2		8
2	DI Yogyakarta	1	1				2
3	West Java	3	4	5	3	2	17
4	Central Java	3	3	2	2	8	18
5	East Java	11	17	26	33	33	120
6	Lampung	1	1				2
7	West Nusa Tenggara	12	10	2	1		25
8	East Nusa Tenggara	1	1	2			4
9	South Sulawesi	1	1	1			3
	Total	**35**	**39**	**41**	**41**	**43**	**199**

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. The described BUS sampling plan is developed using guidance of the applied GS methodology and the UNFCCC standard on sampling (EB 69 annex 5: Standard for Sampling and Survey for CDM Project Activities and Programme of Activities)[15], see the next table:

[15] http://cdm.unfccc.int/UserManagement/FileStorage/S9J6CIEN84WGU1KQBA2MRFH0ZO5LX3

Table 9: BUS survey design

#	Item	Description
1	Objectives and Reliability Requirements	The objective is to obtain unbiased and reliable estimates of the monitoring parameters at a confidence / precision level of 90/10.
2	Target population	Households that have installed an IDBP certified biodigester.
3	Sampling method and sampling frame	Simple random sampling within similar cluster (on the age of usage), with Probability-Proportional-to-size (PPS) of users when determining distribution number of respondents for each province (within similar cluster.
3.1	Number of clusters	Number of cluster was determined based on the objective of the study; i.e.: to understand the impact of the biogas plants installed among different age of usage – based on the Gold Standard's definition (i.e.: Year 1 through Year 5 [16])
4	Sampling frame	The sampling frame is a random selection of households that belong to the target population in the selected cluster

2.4.1 SURVEY IMPLEMENTATION

Surveyors

Cooperation with JRI Research, an Indonesian surveyor company that has an established working relationship with Hivos, was established to execute the survey. JRI recruited 13 surveyors and 3 supervisors for the enumeration. Besides, Hivos recruited 5 surveyors for data collections. All these surveyors received training on survey and data collection techniques and they were supervised by Supervisors and the Provincial Coordinator of each province during implementation. Survey implementation was jointly conducted by JRI and Hivos staff, while data tabulation, analysis and reporting was prepared by JRI Indonesia.

Data collection tools

The questionnaire was developed jointly by the carbon consultant and JRI Research, in consultation with Hivos. The questionnaire was pilot tested during the field visit organised as part of the surveyor training. Feedback from the field was used to finalise the questionnaire. Subsequently the questionnaire has been translated into Bahasa (Indonesian).

Quality control

Questionnaires for this survey were drafted by JRI Research with reference to the objectives of the study and in consultation with Hivos. Pre-testing of the questionnaire was conducted by the IDBP team. Based on the results of this field test, questionnaire were finalised and sent to Hivos for approval.

[16] *The first year of use (age 0-1) 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 technologies have been in use on average at least 1.5 years, and so on.*

The fieldwork process was carried out by IDBP staff through house-to-house personal interviews using the structured questionnaire. To ensure good data quality, oversight of the fieldwork process was conducted by Senior Staff of the IDBP, through the following ways:

- Team members internally discussed the findings with the senior staff to ensure reliability;
- Solving any new problem that might arise in the field;

Quality control process was also conducted by JRI Research, through the following ways:

- Conduct control toward the filled questionnaires, for checking reliability of data on the questionnaires as well as their completeness;
- Follow up with phone calls to the interviewed household to verify that the surveys took place.

Execution

In the period December 12th 2014 to January 28th 2015 the survey was executed by a team of surveyors from IDBP. To establish the sample size and the sample distribution, guidance from the applied Gold Standard methodology was applied. As per the guidance, to ensure conservativeness, participants in a user survey with technologies in the first year of use (age 0 to 1) 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 to 2), the user survey must be conducted with technologies that have been in use on average at least 1.5 years, and so on. A minimum sample size of 35 for each age bracket needs to be adhered to.

2.5 BASELINE FUEL TEST (BFT) AND THE PROJECT PERFORMANCE FIELD TEST (PFT)

The baseline performance field tests (BFT) and project performance field test (PFT) measure real, observed technology performance in the field. Consumption is measured with a representative sample of end users under each defined baseline scenario (in the absence of the project technology) and project scenario. The first KPT was conducted in September 2013 for the first retroactive monitoring period. As the KPT results are valid for a period of two years, these are re-applied in this second monitoring period.

The KPT in 2013 was executed according to this protocol:

- Test period shall be 1 days[17] = the measurement campaign (MC).
- The selected test day will span fuel measurement consumption for human food cooking and boiling water totaling 24 hours.
- Cooking practices shall be during 'normal days'. Normal days are defined as periods without extra eaters. Depending on the family, this excludes days like festivals or holidays or weekend days. The MC can take place in the weekend if it can be proven that fuel use is not higher during these days (i.e. the same number of people eat meals as during the week).

[17] *A MC of 1 days (24 hour) is allowed by the GS*

- Households are instructed that they cook normally during the test. The aim is to capture their usual behavior in the kitchen, as if no tests were happening, to feed the usual variation of people with the usual variation of food types.
- To conduct the tests, ensured is that the cook uses fuel only from a designated stock which is pre-weighed.
- During the tests, also was find out how many people have eaten and how many meals each, so that you can enter into the data sheet the number of "person-meals" (individual meals as opposed to meals shared) cooked with the weighed fuel each day. Note that this count can include meals sold commercially as well as meals consumed in the domestic environment. The number of people eating meals shall be recorded using the following categories: Child 0-14 years, Female over 14 years, male 15-59 and male over 59 years old.
- It is important that the fuel is typical of the fuel normally used through the year, particularly in terms of moisture content. It is also important that the subjects are paying for fuel, or have an incentive to conserve it, otherwise they may use excessive amounts due to the free hand-out. Subjects can be told they will be rewarded for their effort and time at the end of the test, once it is successfully completed.

2.5.1 KPT SURVEY DESIGN

The KPT targets two groups. Oversampling was conducted to minimise the necessity to redo the KPT in cases of wrongly filled out questionnaires or unreliable results:

Table 10: KPT target groups

Group	Description of target group	Sample size
PFT household	Randomly selected household from the project database with a biodigester	49
BFT household	Nearest equivalent households[18] to the randomly selected project household without a biodigester	49
	Total sample	**98**

Only after data collection it can be know if the data meets the required precision, this is per Annex 4 of the applied methodology.

[18] Equivalent households is defined as a household with comparable characteristics as the selected project households in terms of the number of animals owned and socio-economic characteristics (type of house). The selected baseline household may be slightly poorer as once they adopt a biodigester they often improve their livelihood.

Table 11: KPT survey design

Item	Conversion in KPT
Sampling objective:	The objective of the sampling effort is to obtain reliable fuel use data of project and equivalent baseline households
Field Measurement Objectives and Data to be collected:	The survey will consist of a 24 hour measurement campaign amongst PFT and BFT households
Target Population and Sampling Frame:	The sampling frame will be drawn from the project database
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. The BFT household is a neighboring equivalent household to the selected PFT
Implementation:	The KPT was executed between 30th of September to 4th of October 2013. Survey results are valid for two years and are therefore applicable to MPII
Desired Precision/Expected Variance and Sample Size.	90/30 rule of the applied methodology
Procedures for Administering Data Collection and Minimizing Non-Sampling Errors:	The survey data was entered by JRI's data processing staff and served as an independent check on the data collected by the IDBP

Representativeness of the KPT

The KPT is executed for one day instead of the recommend 3 day minimum testing period by the Gold Standard. The GS confirmed that a one day testing period is possible as long as it is representative. The next table shows how representativeness is safeguarded.

Table 12: KPT representativeness issues and conversion

#	Issue	Conversion
1	Questionnaire design	The questionnaire includes a question on if this is a normal day without extra eaters. If there are extra eaters, an appointment would be made with the household for a day with normal cooking conditions. To maintain conservativeness, weekends have also been regarded as non-normal days and have been excluded in the assessment.
2	Seasonality	The KPT was implemented in the last week of September 2013, which is during the dry season[19]. As during the dry season less wood is needed for cooking purposes as the wood fuel, the primary fuel for cooking purposes of most households, contains less moisture. Seasonality does not impact usage rate of other fuels such as LPG and kerosene. Measurements conducted during the dry season can therefore be assumed to be conservative.
3	Applicability	The KPT is basically a test designed for improved cook stoves. As these stoves

[19] WWF. Climate Change in Indonesia - Implications for Humans and Nature

<table>
<tr><td></td><td></td><td>typically only reduce 20% of fuel a longer test period is necessary. Biogas project on the other hand replace typically 90 to 100% of the baseline fuel and it is therefore much easier to measure savings in a shorter period.</td></tr>
<tr><td>4</td><td>Representativeness</td><td>The KPT was implemented in a way to ensure that the households selected in the baseline KPT are representative of the households participating in the VPA. The surveyors ensured that the baseline KPT respondents have similar socio-economic conditions in terms of a similar household size, housing type, number and type of animals. Also, the sample was spread out geographically across a number of provinces to support representativeness.</td></tr>
<tr><td>5</td><td>Biodigester size distribution</td><td>Random sampling can results in a different size distribution than in the project database. Therefore the sampling is done a couple of times to ensure a good match with the size distribution of the project database. As the table hereunder demonstrates, the selected sample matches very well with the database.
<table>
<tr><th>Size (m^3)</th><th>n</th><th>% in Sample</th><th>% in Project database</th></tr>
<tr><td>4</td><td>11</td><td>22%</td><td>21%</td></tr>
<tr><td>6</td><td>25</td><td>51%</td><td>46%</td></tr>
<tr><td>8</td><td>8</td><td>16%</td><td>25%</td></tr>
<tr><td>10</td><td>2</td><td>4%</td><td>4%</td></tr>
<tr><td>12</td><td>3</td><td>6%</td><td>3%</td></tr>
</table></td></tr>
</table>

2.5.2 KPT IMPLEMENTATION

KPT Implementation

Twelve experienced surveyors were selected for the KPT survey, 9 of whom are Quality Inspectors working under the IDBP provincial offices and 3 of whom are other experienced staff working under IDBP. Also a surveyor supervisor was selected.

Questionnaire development and training

The survey supervisor and the lead consultant developed a questionnaire based on the Berkeley Air Kitchen Performance test questionnaire. This document is also referenced in the applied TPDDTEC methodology. The questionnaire was pilot tested on the 25th of September in Malang City, East Java. The questionnaire was subsequently translated into Bahasa. The first day is discussing about the contents of the questionnaire, and on the second day, the whole surveyors dropped directly into the field to do the KPT survey.

The 12 selected surveyors received a 1 day training was provided at the IDBP premises and in the field. This took place one day before the pilot test on the 24th of September. The lead trainers were Mr Sundar Bajgain (survey coordinator).

Data Collection Tools

As discussed above, the questionnaire was based on Berkeley Air KPT questionnaire[20]. Calibration was done with the comparison of traditional weighing scale. The scales were also compared to each other and all weighing scales were found accurate. The calibration procedure was as follows:

Figure 5: Weighting scales used



1. Calibrated and certified weight stones were manufactured by Wei Hang, Portable Electronic Scale company;
2. The newton scales were checked with the weight stones to ensure that the scales were reliable before the start of the survey;
3. The scales were also compared to each other and all weighing scales were found accurate.
4. The survey team was instructed to check each morning if the scale was still providing reliable and unbiased weights using the calibrated weight;
5. In total, 12 weights were used.

KPT execution

The KPT was executed in the period 30th of September to 4th of October 2013. In total 100 PFT households were selected randomly from the project database. The first households would be surveyed and the remaining households would only be selected in case of non-responsiveness or when the household is considered too remote. Out of the 49, all of the households could be visited. Another 49 samples of non-biogas households that resided close to the biogas household surveyed under the project KPT also chosen as comparison sample used for the baseline KPT. Care was taken that these households were similar in nature (household size, number of cattle, similar socio-economic conditions) as their neighbours with the biodigester.

The KPT was executed across nine provinces, covering Lampung, West Java, Central Java, Yogyakarta, East Java, Bali, NTT, NTB, South Sulawesi. All surveyed data was subsequently reported to the head office in Jakarta (NBPSO). It was then checked and tabulated by the survey coordinator.

KPT data tabulation

To translate the collected primary data into results that feed into the monitoring data as per the PDD requirements, the following steps were followed. First, the primary data was screened for

[20] University of California, Berkeley. Available on: http://ehs.sph.berkeley.edu/hem/content/KPT_Version_3.0_Jan2007a.pdf

consistency and reliability by the surveyor supervisor. Oversampling was conducted to minimise the necessity to redo the KPT in cases of wrongly filled out questionnaires or unreliable results. Outliers were excluded using the Grubb's test. A significance of 0.01, two-sided has been applied.[21] All data has been deemed consistent and passes the Grubb's test assessment.

Table 13 describes the approach applied in converting the obtained results to monitoring parameters as per PDD requirements.

Table 13: Converting KPT results into monitoring parameters

Parameter	Description	Approach
$BB_{b,bio}$	Amount of woody biomass used in the baseline scenario b	The amount of biomass consumed in the baseline and project scenarios was weighted and average usage for one day was established. This amount was multiplied by 365 to generate the tonnes/year.
$BB_{p,bio}$	Quantity of biomass consumed in project scenario p during year y	
$BB_{b,fuel}$	Amount of fossil fuels used in the baseline scenario b	The amount of LPG consumed in the baseline and project scenarios was measured in time and average usage for one day was established. This amount was multiplied by 365 to generate the tonnes/year.
$BB_{p,fuel}$	Quantity of fossil fuel consumed in project scenario p	

During the KPT, LPG was initially measured by calibrated weights. However, due to the fact that the LPG tank is connected to the cooking stove in the kitchen through a hose, the surveyors encountered difficulty to precisely measure the weight of the content per tank as the tank could not freely hand on the weighting scales. Due to this, the surveyors were instead instructed to measure the amount of time that the LPG gas has been burned. To do this, households were instructed to monitor the usage of the LPG through a stopwatch during each cooking event.

All households reported the usage of a 3kg LPG tank. This was confirmed by the surveyors and is in line with the 3 kg cylinders handed out under Indonesia's kerosene to LPG conversion programme. Upon establishing the amount of time during which the households used the LPG tank in the 24 hour measurement campaign, the surveyor supervisor converted the usage in minutes into usage in kg. Surveyed households were asked to report the exact amount of minutes that the LPG tank was in use during the 24 hour measurement campaign. Assuming an average non-biodigester household uses a 3kg LPG tanks in 10.6 days[22], the conversion is as follows:

[21] For more on the Grubbs' test, please refer to http://www.itl.nist.gov/div898/handbook/eda/section3/eda35h1.htm.
For a cross-check of the significance of the results, please refer to an online tool available on:
http://www.graphpad.com/quickcalcs/Grubbs1.cfm.

[22] According to D.Pranadji et al:. *Behaviour Analysis of Using the Household Fuel in Bogor*. 2010, an average households consumes a 3kg LPG tank in 7 to 14 days. 10.6 days from the Pertamina and World LPG Association: Kerosene to LPG conversion Programme in Indonesia report is referred to for conservativeness

(amount of time reported / average usage time) tank size * 365 = annual LPG consumption*

Where:

Table 14: LPG usage parameters

Parameter	Description	Value	Source
Amount of time reported	Daily usage time in minutes from the KPT	Variable	KPT
Average usage time	Average usage time of a 3 kg LPG tank by a non-biogas user	10.6 days 2.15 hours / day	Pertamina Report[23] BUS 2013 / 2015[24]
Tank size	Applicable tank size	3 kg	KPT

[23] Pertamina and World LPG Association: Kerosene to LPG conversion Programme in Indonesia

[24] Average cooking hours data for the years 2009 – 2013 are derived from the BUS 2013 (1.92 hours per day). Data for 2014 is derived from the BUS 2015 (3.10 hours per day)

3. RESULTS

3.1 BUS SURVEY RESULTS

The emission reductions are calculated based on the data collected during the BUS 2015, which includes both the US and CMS surveys.

Household size

The average household size in user households is 4.2 (see Table 15).

Table 15: Household size compared to capacity of biodigester

	TOTAL	Capacity of biogas plant			
		4 m3	6 m3	8 m3	10 m3
# of persons:					
2	7%	5%	5%	12%	
3	27%	23%	27%	27%	43%
4	32%	28%	35%	29%	43%
5	20%	23%	19%	19%	14%
6	9%	14%	8%	8%	
7 - 9	6%	7%	6%	6%	
–10 +	7%	5%	5%	12%	
Average	**4.2**	**4.4**	**4.2**	**4**	**3.7**

Usage rate

User survey results indicate that the IDBP is successful and maintaining installed biodigesters operational. The drop-off rate of biodigesters installed in year 1 (digesters constructed between December 2013 and May 2014) is 3%, followed by year 2 drop-off of 3%, year 3 drop-off of 12%, year 4 drop-off of 10%, and year 5 drop-off of 16%.

The drop-off rate per age group is not described in detail in the BUS 2015 as this document only assesses the data received from the 199 households that were successfully reached and completed the BUS questionnaire. When approaching 199 household addresses, 18 households reported the malfunctioning of their biodigester. Of the 35 units in year 1, 1 was not operational (1/35 = 2.86%); of the 39 units in year 2, 1 was not operational (1/39 = 2.56%); of the 41 units in year 3, 5 were not operational (5/41 = 12.20%); of the 41 units in year 4, 4 were not operational (4/41 = 9.76%); and of the 43 units in year 5, 7 were not operational (7/43 = 16.28%). The following table indicates the original results and the derived drop-off rate.

Table 16: BUS 2015 drop-off calculation

	Year 1	Year 2	Year 3	Year 4	Year 5	Total Sample
	Dec 2013 - May 2014	Dec 2012 - May 2013	Dec 2011 - May 2012	Dec 2010 - May 2011	Dec 2009 - May 2010	

Total surveyed households	35	39	41	41	43	199
Total reported dropped-off	1	1	5	4	7	18
Drop-off rate	2.86%	2.56%	12.20%	9.76%	16.28%	9.05%

The drop-off usage is explained by the fact that households have either moved out or because they no longer had livestock as livestock had been sold for paying cost for hospital or medicine.

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

Table 17: User Survey results[25]

Age group	Period, inclusive of all dates		Percentage in operation (A)[26]	Units built in that period (B)	Number of biogas plants in operation (A*B)
-1 to 0	01/06/14	31/12/14	97.14%	2,048	1,989
0 to 1	01/06/13	31/05/14	97.14%	3,003	2,917
1 to 2	01/06/12	31/05/13	97.44%	3,709	3,614
2 to 3	01/06/11	31/05/12	87.80%	2,128	1,868
3 to 4	01/06/10	31/05/11	90.24%	2,982	2,691
4 to 5	31/12/09	31/05/10	83.72%	269	225
			Sum	**14,139**	**13,305**

The weighted average of units in operation is then simply calculated by dividing the units in operating with the total population, which is 94.10%[27].

Operational rate

The operational rate is determined to adjust the calculated emission reductions for the emission reductions that are avoided due to non-operational days of the biodigesters implemented under the VPA. As per IDBP programme requirements, any issues relating to malfunctioning biodigester shall be reported and fixed by the regional constructing companies within two weeks at most. In most cases, problems reported by households are fixed within the first week due to masons being locally available. For conservativeness, however, this MR assumes a full two-week malfunctioning period for the determination of the final emission reductions.

The IDBP database reveals that throughout MRII, a total of 337 households reporting non-functioning of their biodigester.[28] Assuming a total of 15 non-operational days for each

[25] Figures may not add up due to rounding – see emission reduction calculation

[26] Calculated as 100% - drop-off percentage for a given age group

[27] Calculated as: (0.9714*(2,048/14,139) + (0.9714*(3,003/14,139) + (0.9744*(3,709/14,139) + (0.8780*(2,128 /14,139) + (0.9024*(2,982/14,139) + (0.8372*(269/14,139)

household[29] for the purpose of calculating the missed emission reductions, this amounts to a total of 5,055 non-operational days, or 13.85 non-operational years. Given an emission reduction potential of 3.16 per biodigester per year[30], the total emission reductions avoided due to non-operation amounts to 43.76 tonnes of CO_2e[31]. This amount shall be subtracted from the total emission reduction figure reported in Section 1.4.

3.1.1 PARAMETERS MONITORED AND NOT MONITORED

Table 18: Parameters monitored as per VPA-DD section B 6.1

Parameter	Data unit	Description	Applied value	Source
$U_{p1,y}$	fraction	Cumulative usage rate for technologies in project scenario p1 in year y, based on cumulative adoption rate and drop off rate (fraction)	**94.10%**	Supplement 1_Total respondents drop off rates
$N_{p1,y}$	number	Cumulative project operational rate included in the project database for project scenario p1 against baseline scenario b1 in year y	**14,125**[32]	IDBP database, dated 24 March 2015
$No_{p1,y}$	number	Cumulative number of project technologies included in the project database for project scenario p1 in year y	**14,139**	IDBP database, dated 24 March 2015
$O_{p1,y}$	number	The average technology-days during which the biodigesters are operational for project scenario p1 against baseline scenario b1 in year y	**364.64**[33]	IDBP database, dated 24 March 2015
$LE_{p1,y}$	tCO_2e/year	Leakage in project scenario p1 during	0%	See Chapter 3.25 of this MR

[28] See IDBP Database dated 24 March 2015, sheet 'NON FUNCTIONAL DIGESTERS'
[29] See instruction memo sent out to CPOs, dated 1 May 2013
[30] See ER1_Emission reduction calculation VPA 1 MRII 9June2015
[31] Calculated as 3.16 * 13.85 = 43.76
[32] Calculated as $No_{p1,y}$ * ($O_{p1,y}$/365), therefore 14,139 * (364.64/365) = 14,125
[33] Calculated as 365 - (malfunctioning digesters * maximum amount of days of malfunctioning)/ $No_{p1,y}$, therefore = 365 – ((337*15)/14,139) = 364.64

		year y			
$N_{T,h}$	number	Number of animals of livestock category T in premise h	Dairy cow	**5.21**	Primary data BUS 2015, 'Raw Data' sheet (Column MF)
			Market swine	**0.28**	Primary data BUS 2015, 'Raw Data' sheet (Column LB)
PL	%	Physical leakage of the biodigester	**10%**		VPA-DD section B.6.1
$BB_{b1,bio}$	tonnes/ year	The quantity of biomass consumed in the baseline scenario 1, in tonnes/year	**1.127**		KPT data and analysis, dated 25 June 2014
$BB_{p1,bio}$	tonnes/ year	The quantity of biomass consumed in the project scenario 1, in tonnes/year	**0.116**		KPT data and analysis, dated 25 June 2014
$BB_{b1,fuel}$	tonnes/ year	Amount of fossil fuels used in the baseline scenario 1: households	LPG	**0.078**	KPT data and analysis, dated 25 June 2014
$BB_{p1,fuel}$	tonnes /year	Quantity of fossil fuel consumed in project scenario 1 during year y, in tonnes	LPG	**0.00335**	KPT data and analysis, dated 25 June 2014
$MS_{P,S,K}$	%	Fraction of livestock category T's manure not treated in bio-digester, in climate region k	Dairy cow	**30.05%**	Primary data BUS 2015, 'Raw Data' sheet (Cells OF193 and NH193)
			Market swine	**0%**	
$MS_{T,S,k}$	%	Fraction of livestock category T's manure fed into the bio-digester, S in climate region k	Dairy cow	**69.94%**	Primary data BUS 2015, 'Raw Data' sheet (Cells OE193 and NG193)
			Market swine	**100%**	
GWP_{CH4}		Global Warming Potential of methane	**25**		IPCC[34]
Bio		Use of bio-slurry	**75%**		Primary data BUS 2015, 'Raw Data' sheet (see cell OO211)

[34] Available on: http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html

Gold Standard SD Parameters				
Parameter	Data unit	Description	Applied value	Source
GS-03 Soil condition	number	Soil condition refers to changes compared to the baseline in organic matter content.	**10,604** As per the VPA-DD, this parameter is monitored through the parameter 'Bio' reported above.	See cell OO211 of the 'I_Primary Data BUS 2015' document, 'Raw Data' sheet. 75.
GS-06 Quality of employment	number	Quality of employment refers to changes compared to the baseline in the qualitative value of employment	**1,239** vocational trainings As per the VPA-DD, this parameter is monitored through the number of employees attending vocational training programs as well as Health and Safety courses, as proven through issuance of a certificate to all constructors.	See the 'L_IDBP Database 24Mar2015' document, sheet 'OPERATION&MAINT_TRAINING' total inputs.
GS-07 Livelihood of the poor	%	Livelihood of the poor refers to changes compared to the baseline in living conditions, access to healthcare services including affordability and poverty alleviation.	'Improved': **9,897** (equivalent to 70% of total) 'The same': **4,100** (equivalent to 29% of total) 'Worsened: **141** (equivalent to 1% of total) As per the PDD, this parameter is monitored through the following question included in the BUS: "Do you feel that your living conditions have a) improved, b) stayed the same, c) worsened; since the installation of the biogas digester?"	BUS 2015 Report, page 6
GS-08 Access to affordable and clean energy services	number	Access to energy services refer to changes in unsustainable energy use.	**14,139** As per the VPA-DD, access to energy services refers to changes in unsustainable energy use. This parameter is monitored through the number of biogas units commissioned, and is therefore same as parameter '$N_{p1,y}$'.	See the 'L_IDBP Database 24Mar2015' document, sheet 'tblPCRmaster' total inputs.

GS-09 Human and institutional capacity	number	Changes compared to the baseline in education and skills, gender equality and empowerment.	**3247** women attending Operation and Maintenance training As per the VPA-DD, the number of women attending the Operation and Maintenance training as well as the bio-slurry utilization training are monitored to indicate changes in gender equality.	IDBP database, dated 24 March 2015, sheet 'OPERATION&MAINT_TRAINING'
GS-10 Quantitative employment and income generation	number	The number of jobs generated by within the IDBP as well as the number of constructors employed	**1,258** number of direct full-time jobs created by the VPA **99** number of constructors employed under the VPA **424** of the households sell the bio-slurry on the market. As per the VPA-DD, the number of jobs generated by the VPA as well as the number of constructors employed is monitored. To evidence income generation, the amount of users selling biodigester slurry on the market is also monitored.	See the 'L_IDBP Database 24Mar2015' document, cumulative of sheet 'CPO', 'Mason', 'Supervisor' total inputs. See the 'L_IDBP Database 24Mar2015' document, sheet 'CPO' total inputs. See page 93 of the BUS 2015 Report.
GS-12 Technology transfer and technological self-reliance	number	Refers to changes compared to the baseline in activities that build usable and sustainable know-how in a region/country for a technology, where know-how was previously lacking.	**10,294** Operation and Maintenance trainings As per the VPA-DD, the number of constructors trained and users attending the Operation and Maintenance training are monitored. Also, the entities outside of the programme in general and technical training about the functioning of the biodigester technology to promote knowledge dissemination and strengthen the domestic	See the 'L_IDBP Database 24Mar2015' document, sheet 'OPERATION&MAINT_TRAINING' total inputs.

			biogas market are monitored.	

Table 19: Parameters not monitored

Data/ parameter		Description	Applied Value		Source
$f_{NRB,y}$	%	Fraction of biomass used in the absence of the project activity in year y	**64.8**		VPA DD section B.5.1
NRB	m^3	Non-renewable woody biomass	**55,984,649**		VPA DD section B.5.1
DRB	m^3	Demonstrably renewable woody biomass	**30,411,351**		VPA DD section B.5.1
$EF_{b1, bio}$ $EF_{p1, bio}$	tCO_2/TJ	Emission factor of the woody biomass used in the baseline/project scenario	**112**		2006 IPCC Guidelines for National Greenhouse Gas Inventories
NCV_{bio}	TJ/tonne	Net calorific value of the non-renewable biomass used in the baseline scenario	**0.015**		2006 IPCC Guidelines for National Greenhouse Gas Inventories
$EF_{b1, fuel}$ $EF_{p1, fuel}$	tCO_2/TJ	Emission factor of fossil fuels used in the baseline/project scenario	Kerosene	**71.9**	2006 IPCC Guidelines for National Greenhouse Gas Inventories
			LPG	**63.1**	
NCV_{fuel}	TJ/tonne	Net calorific value of fossil fuels used in the baseline scenario	Kerosene	**0.0438**	2006 IPCC Guidelines for National Greenhouse Gas Inventories
			LPG	**0.0473**	
$\eta_{biogas\ stove}$	%	Combustion efficiency of the biogas stove introduced by the VPA	**50**		LIPI Stove Report, 2010; Indonesian Government standard on stove efficiency
$EF_{awms,T}$	kg CH_4	Emission factor for the defined livestock population category T by average temperature (27.1°C)	Dairy cow	**31**	2006 IPCC Guidelines for National Greenhouse Gas Inventories; Indonesian Meteorological Climatological and Geophysical Agency
			Market swine	**7**	
			Buffalo	**2**	
			Other cattle	**1**	
			Goats	**0.22**	
			Sheep	**0.20**	
			Poultry	**0.02**	

3.1.2 EMISSION REDUCTION COMPONENT 1: ACCOUNTING FOR EMISSION REDUCTIONS DUE TO THE DISPLACEMENT OF FOSSIL FUELS AND NON-RENEWABLE BIOMASS

Emission reductions are credited by comparing fuel consumption in a project scenario to the baseline scenario of VPA-1. As the baseline fuel and the project fuel and the corresponding emission factors are different, the overall GHG reductions achieved by VPA-1 in year *y* are calculated as follows:

$$\mathbf{ER_{CO2,y}} = \sum_{b1,p1} N_{p1,y} * U_{p1,y} * \left(f_{NRB} * \ ER_{b1,p1,y,CO2} + ER_{b1,p1,y,non-CO2}\right) - \sum LE_{p1,y} \quad \textbf{(1)}$$

Where:

$ER_{CO2,y}$ Cumulative CO_2 emission reductions from the substitution of non-renewable biomass and fossil fuels

$\sum_{b1,p1}$ Sum over all relevant (baseline b1/project p1) couples

$N_{p1,y}$ Cumulative project operational rate included in the project database for project scenario p1 against baseline scenario b1 in year y

$U_{p1,y}$ Cumulative usage rate for technologies in project scenario p1 in year y, based on cumulative adoption rate and drop off rate (fraction)

$ER_{b1,p1,y,CO2}$ Specific CO_2 emission savings for an individual technology of project p1 against an individual technology of baseline b1 in year y, in tCO_2/year, and as derived from the statistical analysis of the data collected from the field tests

$ER_{b1,p1,y,non\text{-}CO2}$ Specific non-CO_2 emission savings for an individual technology of project p1 against an individual technology of baseline b1 in year y, converted in tCO_2/year, and as derived from the statistical analysis of the data collected from the field tests

f_{NRB} Fraction of biomass used that can be established as non-renewable biomass

$LE_{p1,y}$ Leakage for project scenario p1 in year y (tCO_2e/yr)

As there is one common baseline scenario and one type of technology applied, and specific non-CO_2 emission savings are treated in a separate equation (equation **7** onwards), the VPA-1 can apply the following formula for calculating emission reductions:

$$\sum ER_{CO2,y} = \left(\sum BE_{b1,CO2,y} - \sum PE_{p1,CO2,y} - \sum LE_{p1,CO2,y}\right) * N_{p1,y} * \ U_{p1,y} \quad \textbf{(2)}$$

Where:

$\sum ER_{CO2,y}$ Cumulative CO_2 emission reductions from the substitution of non-renewable biomass and fossil fuels

$\sum BE_{b1,CO2,y}$ Cumulative baseline emissions as calculated below under formula (**3**) of the VPA PDD

$\sum PE_{p1,CO2,y}$ Cumulative project emissions as calculated below under formula (**4**) of VPA PDD

$\sum LE_{p1,CO2,y}$ Cumulative leakage as per methodology guidance[35]

$N_{p1,y}$ Cumulative project operational rate included in the project database for project scenario p1 against baseline scenario b1 in year y

$U_{p1,y}$ Cumulative usage rate for technologies in project scenario p1 in year y, based on cumulative adoption rate and drop off rate (fraction)

Baseline emissions are calculated as follows:

$$\sum \mathrm{BE}_{\mathrm{b1,CO2,y}} = \mathrm{B}_{\mathrm{b1,y}} * \left(\left(f_{\mathrm{NRB,y}} * \mathrm{EF}_{\mathrm{b1,fuel,CO2}} \right) + \mathrm{EF}_{\mathrm{b1,fuel,nonCO2}} \right) * \mathrm{NVC}_{\mathrm{b1,fuel}}$$

(**3**)

Where:

$\sum BE_{b1,CO2,y}$ Cumulative baseline emissions VPA1 from fuel substitution or replacement

$B_{b1,y}$ Quantity of fuel consumed in the baseline scenario b1 during year 7, in tonnes

$f_{NRB,y}$ Fraction of biomass used during year y that is considered non-renewable biomass

$EF_{b1,fuel,CO2}$ CO_2 emission factor of the fuel that is substituted or reduced

$EF_{b1,fuel,nonCO2}$ Non-CO_2 emission factor of the fuel that is substituted or reduced

$NCV_{b1,fuel}$ Net calorific value of the fuel that is substituted or reduced

The inputs for the fuel usage data was collected by the KPT survey.

The next table shows the outcome of the BFT, fuel used and the amount of energy.

Table 20: Thermal energy demand of BU

Fuel	**Average per household (tonne/year)**	**NCV (TJ/tonne)**	**Thermal energy demand (TJ/year)**

[35] Technologies and practices to displace decentralized thermal energy – 11/04/2011' p.11 - 12

Firewood	1.127	0.015	0.0169
LPG	0.078	0.0473	0.0037
Kerosene	0.0	0.0438	0

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 21: CO_2 emission factors

Fuel *i*	**$EF_{CO2,}$ (tonne/TJ)**
Firewood	112.00
LPG	63.1
Kerosene	71.6

The f_{NRB} is estimated to be 64.8%, as per registered PDD. The f_{NRB} value is applicable to CO_2 emissions from firewood and charcoal consumption and production. Methane and nitrous oxide emission are not included in the emission reduction calculation for conservativeness. The calculated ex-post baseline emissions are shown in next table:

Table 22: Ex-post baseline emission of each fuel and total from thermal energy use[36]

Fuel	**Baseline emissions from CO_2 (tCO_2e/yr)**
Firewood	1.230
LPG	0.233
Kerosene	0
Total	**1.460**

Not all fuels will be replaced by biogas. The fuels that people continue to use in the project scenario is sourced from the KPT-PFT.

Table 23: KPT PFT fuel use

Fuel	**Average per household (tonne/year)**	**NCV (TJ/tonne)**	**Thermal energy demand (TJ/year)**
Firewood	0.116	0.015	0.0017

[36] Figures may not add up due to rounding – see emission reduction calculation

LPG	0.00335	0.0473	0.00016
Kerosene	0	0.0438	0

The calculated emissions from fuel use in the project scenario are depicted in the following table:

Table 24: KPT PFT emissions[37]

Fuel	**Project emissions from CO_2 (tCO_2e/yr)**
Firewood	0.127
LPG	0.010
Kerosene	0
Total	**0.137**

Emission reductions from fuel savings are the difference between the BFT and the PFT, provided that the mean emission reductions are satisfy the 90/30[38] rule, i.e. the endpoints of the 90% confidence interval lie within +/-30% of the estimated mean. The check is calculated using the approved method that was communicated with the Gold Standards and is based on:

- GHG emission from all fuels of BFT and PFT
- fNRB of 64.8%

The calculations itself are based on the reference in the TPPDEC methodology[39] and based on two independent samples. Paired sampling in the case of a market oriented biogas programme is not possible as it is not known who will adopt the technology beforehand. The next table shows if the fuel savings meet the 90/30 rule.

Table 25: 90/30 rule check

Item	**Unit**	**Baseline**	**Project**
Sample	n	49	49
	Analysis		
	Mean		1.30
	Standard error		1.464

[37] Figures may not add up due to rounding – see emission reduction calculation

[38] The methodology specifies the 90/15 rule but also the 90/30 rule. The GS confirmed that is should be 90/30 and that 90/15 is a typo.

[39] *http://www.climatecare.org/media/documents/pdf/ClimateCare_Guidelines_for_Performance_Tests_and_KPTsx.pdf*

	Minimum requirement n	36.65
	Satisfy the 90/30 rule	Yes, as: 49 > 36.65

The KPT test meets the 90/30 rule, and even exceeds the confidence/precision interval of 95/30. This means that the mean savings can be used in the ER calculations, see the next table:

Table 26: Emission reductions from fuel switch[40]

Baseline emissions from fuel use **(tCO_2e/yr)**	**Project emissions from fuel use** **(tCO_2e/yr)**	**Leakage emissions from fuel use** **(tCO_2e/yr)**	**Emissions from fuel switch to biogas** **(tCO_2e/yr)**
1.460	0.137	0.00	**1.323**

3.1.3 Emission reduction component 2: Accounting for emission reductions due to the avoidance of methane emissions from manure handling.

The emissions from the animal waste management system of the baseline are determined using the IPCC 2006 Tier 1 approach. The Tier 1 approach is applicable to situations where baseline data required for the estimation of the methane emission factor per category of livestock in *not* available, or where it is difficult to define a distinct practice of manure handling within the programme boundary. This formula calculates the baseline emissions per household:

$$\mathbf{BE_{b1,CH4,y}} = GWP_{CH4} * \sum_T (EF_{awms,T} * N_{T,h}) \quad \textbf{(4)}$$

Where:

$BE_{b1,CH4,y}$	Baseline emissions from manure handling during the year y in tCO_2e
GWP_{CH4}	Global Warming Potential of methane (21 for pre-2013 ERs; 25 post-2013)
$EF_{awms,\ T}$	Emission factor for the defined livestock population category T
$N_{T,h}$	Number of livestock category T in premise h

Step 1: Determination of $EF_{awms,\ T}$

The relevant default methane emission factor ($EF_{awms,\ T}$) for Asian livestock is sourced from Tables 10.14 – 10.16 of the IPCC Guidelines for National Greenhouse Gas Inventories[41]. These values are reported in Table 27. A national average temperature of 27.1°C applies, as reported by the Indonesian Meteorological Climatological and Geophysical Agency.[42]

[40] Figures may not add up due to rounding – see emission reduction calculation

[41] IPCC Guidelines for National Greenhouse Gas Inventories (2006) 'Chapter 10: Emissions from Livestock and Manure Management'

[42] http://www.bmkg.go.id

Table 27: IPCC 2006 default values for $EF_{awms, T}$

Animal T	$EF_{awms, T}$
Dairy cow	0.031 tonne CH_4
Market swine	0.007 tonne CH_4

Step 2: Determination of $N_{T,h}$

The dominant type of cattle owned by the respondents was dairy cows (91%). Market swine were also raised by a number of households (5%)[43]. The average number of animals kept was 5.21 dairy cows and 0.28 market swine. Most of the households raised a tertiary animal type, predominantly poultry or goat. For conservativeness, methane emissions from tertiary and any following animal types are not included in the baseline calculation.

Table 28: Possession of livestock

	Total	Year of use				
		Year 1	Year 2	Year 3	Year 4	Year 5
Base :	181	34	38	36	37	36
Dairy cow	91%	91%	95%	94%	100%	100%
Avg number	**5.21**					
Market swine	5%	9%	5%	8%	3%	0%
Avg number	**0.28**					

Baseline methane emissions

With the data from the previous tables the baseline emission can be determined. The emission per household of all the animals under the VPA are calculated and depicted in the next table. The number of animals originates from the BUS survey and based on the $EF_{awms,T}$ from the relevant default methane emission factor.

Table 29: Ex-post Baseline emission from animal waste management[44]

Animal T	Average population $N_{T,h}$/hh	$EF_{awms, T}$ (tonneCH_4/year)	GWP_{CH4}	$BE_{b1,CH4,y}$ (tCO_2e/year)
Dairy cow	5.21	0.031	25	4.035
Market swine	0.28	0.007	25	0.050

[43] See BUS 2015, 'Analysis' sheet

[44] Figures may not add up due to rounding – see emission reduction calculation

		Total (rounded up)	**4.085**

Project methane emissions

Project emissions include both the physical leakage of biogas from the biodigester and the incomplete combustion of biogas. This formula calculates the project emissions per household:

$$\mathbf{PE_{p1,CH4,y}} = \mathrm{GWP_{CH4}} * \sum(\mathrm{N_{T,h,y}} * \mathrm{EF_{awms,T}}) * \mathrm{PL_y} + \sum(\mathrm{N_{T,h,y}} * \mathrm{EF_{awms,T}}) * (1 - \eta_{new\ stove})(1 - \mathrm{PL_y}) + \mathrm{PE_{awms,NT}} \quad (5)$$

Where:

$PE_{p1,CH4,y}$	Project emissions from manure handling during the year y in tCO_2e
GWP_{CH4}	Global Warming Potential of methane (25)
$N_{T,h}$	Number of livestock category T in premise h
$EF_{awms,\ T}$	Emission factor for the defined livestock population category T
PL_y	Physical leakage of the biodigester (through measurement or application of 10% default)
$\eta_{\ new\ stove}$	Combustion efficiency of the used type of biogas stove
$PE_{awms,NT}$	Project emission from the animal waste not treated in the biodigester

Project emissions from the animal waste not treated in the biodigester in the project scenario will be zero since the non-treated animals in the project scenario will have the same situation as they would have had in the baseline.

Table 30: Ex-post Project emission from animal waste management[45]

Animal T	$BE_{b1,CH4,y}$ (tCO_2e/year)	PL_y	$\eta_{\ new\ stove}$	$PE_{b1,CH4,y}$ (tCO_2e/year)
Dairy cow	4.035	10%	50%	2.219
Market swine	0.050	10%	50%	0.028
		Total (rounded up)		**2.247**

The emission reductions from animal waste are the difference between the baseline and the project, see the next table:

[45] Figures may not add up due to rounding – see emission reduction calculation

Table 31: Emission reductions from animal waste management[46]

$BE_{b1,CH4,y}$ (tCO_2e/year)	$PE_{b1,CH4,y}$ (tCO_2e/year)	$ER_{CH4,y}$ (tCO_2e/year)
4.085	2.247	**1.838**

3.1.3 LEAKAGE EMISSIONS

The project proponent investigated the following potential sources of leakage:

Table 32: 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. Traditional firewood stoves cannot be moved as they are fixed to the floor of the kitchenette. LPG stoves are retained by households and are needed for days with larger cookeries, such as festivals or national celebrations.
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 Indonesia. The small share of household that use a lower emitting energy source, such as LPG, will not switch back to NRB 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 is no registered project in Indonesia that has a NRB component in the project. It is therefore not likely that the NRB fraction is impacted significantly.
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 does not occur in Indonesia.
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 combustion of biogas is both more efficient than using open-source fires for cooking purposes and leads to lower emissions compared to the baseline fuels (firewood and LPG) as it is 100% renewable.
F	Physical leakage emissions	It is considered as project emissions - see chapter 3.24
G	Emissions from biogas slurry	It is considered as project emissions – see chapter 3.26.

3.1.4 Emissions from bio-slurry (digestate)

[46] Figures may not add up due to rounding – see emission reduction calculation

The following leakage emission source is accounted for in this section: CH_4 emissions from the anaerobic decay of the residual organic content of bio-slurry subjected to anaerobic storage. Bio-slurry typically has low biodegradability because easily biodegradable organic matter has been converted in the anaerobic digester and therefore the biodegradability of bio-slurry is much lower than manure. This approach has been approved by the GS for the project GS1083 and is therefore followed.

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 bio-slurry
3. Assessment of methane potential of bio-slurry
4. Calculation of project emissions from bio-slurry using the information obtained in the previous steps

1. <u>Estimation of the total amount of VS entering the biodigester</u>

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 section 3.22, and is calculated as:

$$\mathbf{MS_{T,S,k}} = 1 - \mathbf{MS_{P,S,K}}$$

Where, $MS_{T,S,k}$ is the share of manure fed into the digester and $MS_{P,S,K}$ the share not fed into the digester of animal category T.

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 $MS_{T,S,k}$ into the biodigester.

Table 33: Daily VS production of the average biodigester[47]

Animal T	VS excretion kgVS/hd/day[48]	Head/average biodigester[49]	Total amount of VS excreted kgVS.day^{-1}	$MS_{T,S,k}$ Share fed into biodigester	Total VS entering the biodigester kgVS.day^{-1}
	A	B	AxB =C	D	CxD
Dairy Cow	2.80	5.21	14.57	69.94%	10.20
Market swine	0.30	0.28	0.085	100.00%	0.08

[47] Figures may not add up due to rounding – see sheet 'Annex' of 'Primary data BUS 2015'
[48] Source: Tables 10.A-4 to 10.A-8 from:
http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_10_Ch10_Livestock.pdf
[49] Source: Primary data BUS 2015, 'Raw Data' sheet (Columns MF & LB)

Sum	**10.28**

2. Assessment of remaining VS content of bio-slurry

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 many factors and is 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%[50]. This means that bio-slurry contains 40-50% of the initial organic dry matter, primarily as fibers.

In 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 bio-slurry. This means that the $MS_{T,S,k}$ is 55% and the $MS_{P,S,K}$ 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 34: Average amount of VS in digester effluent

(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}**
10.28	55%	45%	4.63

3. Assessment of the methane potential of bio-slurry

As the nature of VS has changed during anaerobic conversion, the default methane potential (B_o) value is no longer applicable to VS in bio-slurry. According to EB66 Annex 32[51] the remaining fraction of the original methane potential is 20% for the liquid bio-slurry of conventional digesters. The effluent from biodigesters in Indonesia is liquid and therefore this fraction was applied. The B_0 of bio-slurry is calculated with the following equation:

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

Equation 1: Calculation of methane potential of bio-slurry

Where:

[50] P55 http://www.lemvigbiogas.com/BiogasHandbook.pdf
[51] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-14-v1.pdf

$B_{o,dig,T}$	=	Methane potential of bio-slurry from animal type T manure
$F_{ww,CH4,}$	=	Default factor representing the remaining CH_4 production capacity of liquid bio-slurry
$B_{0,T}$	=	Methane potential of manure from animal type T

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

Table 35: 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)**
Dairy cow	0.20	0.13	0.026
Market swine	0.20	0.29	0.058

However, since farmers often have a mix of animals it is necessary to calculate the average methane potential of bio-slurry from mixed sources and that average has to be weighted as the population of dairy cows is, for example, much larger than the other animals, relevant calculation is shown in the table below:

Table 36: Average methane potential of bio-slurry from manure by animal type

Animal T	**Number**	**Fraction**	**Average $B_{o,dig}$ (m^3CH4/kgVS)**
Dairy cow	5.21	95%	0.025
Market swine	0.28	5%	0.003
			0.028

Based on this, the weighted averaged $B_{0,dig}$ is 0.028 (m^3CH4/kgVS)

4. Calculation of bio-slurry emissions 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 bio-slurry, see equation 6 of EB 66 Annex 32. However, as it is now known what the COD concentration of liquid bio-slurry is, the proxy VS remaining in bio-slurry is used. The next table shows the calculated emissions from bio-slurry using the IPCC tier 1 approach.

Equation 2: Calculation of methane potential of bio-slurry

$$PE_{bio\text{-}slurry} = (VS_{\ dig} * 365) \times B_{0,dig} \times (\sum DMS \times MCF) \times (D_{CH4}/1000) \times GWP\ CH4$$

Where:

$PE_{bio\text{-}slurry}$ Annual average project emissions from bio-slurry, tCO2e/hh/yr

VS_{dig} = Daily volatile solid remaining in the bio-slurry, kgVS/day

365 = Basis for calculating annual VS production, days yr-1

$B_{0,dig}$ = Weighted methane producing capacity of the bio-slurry, $m^3CH_4/kgVS$

∑MCF = Cumulative methane conversion factors for digestate management system DMS, %

D_{CH4} = Conversion factor of m3 CH4 to kilograms CH4

GWP CH4 = Global Warming Potential of methane: 25

75% of the farmers apply the bio-slurry as fertilizer on land. The digestate management system is daily spread as the bio-slurry is used by farmers as fertilizer through spread directly on the field. The corresponding MCF for this handling method is 0.75%.[52,53] Of the remaining 25%, 13% dump it into drains, 6% dump it into a nearby river or irrigation channel, 4% leave it in the biodigester, 1% gives it away to other farmers to be used as fertilizer, and 1% sells it to other farmers to be used as fertilizer. The resulting MCF for this remaining bio-slurry is 24.23%. Given that this only applies to 25% of the households, the MCF becomes 3.14%[54]. The two MCF values combined (0.75% + 3.14%) equal to 3.89%. The table below indicates the usage method of the bio-slurry and the corresponding MCF.

Table 37: Overview of bio-slurry handling methods

Bio-slurry handling method[55]	**Percentage[56]**	**Corresponding IPCC definition[57]**	**MCF**
Use as fertilizer	75%	Daily spread	1%
Dumped into open drain	13%	Aerobic treatment	0%
Dumped into river/irrigation	6%	Aerobic treatment	0%
Left inside the biodigester	4%	Liquid/slurry	78%
Given out for free for fertilizer use	1%	Daily spread	1%
Sold for fertilizer use	1%	Daily spread	1%
		Average MCF	**3.89%**

[52] Calculated as: 0.75 * 1% (MCF of 'daily spread')
[53] IPCC Chapter 10: Emissions from Livestock and Manure Management; Table 10A-4 p.77
[54] Calculated as: 0.25 *((19%*0%)+(4%*78%)+(1%*1%)+(1%*1%)
[55] Source: Biogas User Survey 2015
[56] Source: see Primary Data BUS 2015 cells OO211 – OO216
[57] Source: IPCC Chapter 10 on Livestock Emissions

Table 38: Calculated emissions from bio-slurry

Total VS in bio-slurry kgVS.day^{-1}	$B_{0,dig}$ (m^3CH4/kgVS)	∑DMSxMCF	D_{CH4} (kg/m^3CH_4)	$PE_{bio\text{-}slurry}$ (tCO_2/year/hh)
4.63	0.028	3.89%	0.67	0.030

The emissions from bio-slurry are minimal. The emissions from bio-slurry are less than 1% of the total emission reductions of fuel switch and manure handling. A general rule to emission sources it to rule them out if <1% of total emission and for that reason the emissions from bio-slurry are not considered and included in the ER assessment.

3.1.4: EX-POST ESTIMATE OF THE EMISSION REDUCTIONS

The next table shows the ex-ante estimate of the emission reductions for each biogas unit[58]:

Table 39: Average annual emission reductions

Emission source	$BE_{b1,y}$ (tCO_2e/year)	PE_{b1y} (tCO_2e/year)	$ER_{,y}$ (tCO_2e/year)
Biomass and fossil fuel substitution	1.460	0.138	**1.322**
Manure handling	4.085	2.247	**1.838**
Sum (rounded up)			**3.160**

The cumulative ex-post emission reductions are calculated with the following calculation:

$$\mathbf{ER_{Total}} = (\mathrm{ER_{CO2,y}} + \mathrm{ER_{CH4,y}}) * \mathrm{N_{p,y}} * \mathrm{U_{p,y}}$$

Where:

$ER_{CO2,y}$ CO_2 emissions reductions in year y (tCO_2)

$ER_{CH4,y}$ Methane emissions reductions in year y (tCO_2)

$N_{p,y}$ Cumulative project operational rate included in the project database for project scenario p against baseline scenario b in year y

$U_{p,y}$ Cumulative usage rate for technologies in project scenario p in year y, based on cumulative adoption rate and drop off rate (fraction)

The usage rate is used to discount the ERs and is calculated in section 3.1. The next table shows the ER by month.

[58] Figures may not add up due to rounding

Table 40: Emission reductions realised by the VPA 1

Month of program	Period, begin and end date inclusive		Cumulative number of units	Monthly ER (tCO_2e)	Cumulative ER (tCO_2e)
25	1/6/2013	30/06/2013	9,358	2,251	2,251
26	1/7/2013	31/07/2013	9,699	2,317	4,568
27	1/8/2013	31/08/2013	9,922	2,402	6,970
28	1/9/2013	30/09/2013	10,322	2,457	9,427
29	1/10/2013	31/10/2013	10,614	2,556	11,983
30	1/11/2013	30/11/2013	10,955	2,628	14,611
31	1/12/2013	31/12/2013	11,249	2,713	17,324
32	1/1/2014	31/01/2014	11,491	2,786	20,110
33	1/2/2014	29/02/2014	11,644	2,846	22,955
34	1/3/2014	31/03/2014	11,828	2,883	25,839
35	1/4/2014	30/04/2014	11,951	2,929	28,768
36	1/5/2014	31/05/2014	12,091	2,960	31,727
37	1/6/2014	30/06/2014	12,343	2,994	34,722
38	1/7/2014	31/07/2014	12,571	3,057	37,778
39	1/8/2014	31/08/2014	12,759	3,113	40,891
40	1/9/2014	30/09/2014	13,126	3,160	44,051
41	1/10/2014	31/10/2014	13,459	3,250	47,301
42	1/11/2014	30/11/2014	13,846	3,333	50,634
43	1/12/2014	31/12/2014	14,139	3,429	54,063
				Total	**54,063**

The table shows that the total number of ERs realized is **54,063** tCO_2 for the monitoring period II.

Table 41: Emission reductions realised by the VPA 1, per vintage

Vintage	Start	End	Volume
2013	1/6/2013	31/12/2013	17,324
2014	1/1/2014	31/12/2014	36,739
			54,063

3.1.5 JUSTIFICATION FOR ER DIFFERENCE WITH PDD

The BE, PE and ER that were estimated in the PP are shown in the next table:

Table 42: BE, PE and ER as estimated in the PDD

Scenario	BE (tCO_2e)	PE (tCO_2e)	LE (tCO_2e)	ER(tCO_2e)
Biomass and fossil fuel substitution	2.03	0.56	0.073	**1.394**
Methane avoidance	2.71	1.49	0.00	**1.221**
Total	4.75	2.06	0.073	**2.610**

The ex-ante estimated ER is somewhat lower to the ER estimated in this MR, see section 3.26.

The observed differences are caused by:

- On the household level: The amounts of firewood reported in the baseline study (1.64 tonnes/year) is somewhat higher than the amounts measured in the KPT (1.13 tonnes/year); however, the KPT results indicate a higher usage of LPG (0.078 tonnes/year compared to 0.065 tonnes/year, ex-ante). These factors combined explain the slight decrease of the ex-ante ER of 1.394 tCO_2e to ex-post 1.323 tCO_2e due to biomass and fossil fuel substitution.
- On the household level: The number of dairy cows reported in the baseline study (average of 4.2 per household) is lower than the number reported in the BUS 2015 (average of 5.21 per household). Furthermore, some households raise market swine as per the KPT results, while the baseline study indicated several households raising buffalo. The emission factor of market swine is higher than that of the buffalo. Finally, for the post-2012 ERs, a GWP for methane of 25 is applied, rather than the 21 used for the ex-ante calculation. These three factors combined explain the increase of the ex-ante ER of 1.221 tCO_2e to ex-post 1.838 tCO_2e due to methane avoidance.

The difference between the ex-ante (2.610 tCO_2e) and ex-post (3.161 tCO_2e) emission reductions on the household level explain part of the variation of the total annual differences between the ex-ante and ex-post emission reductions.

- On the VPA level: total annual ex-post emission reductions (36,739 tCO_2e)[59] exceed the ex-ante annual emission reduction reported in the VPA-DD (20,874 tCO_2e)[60]. Part of this difference is also attributed to the fact that the total amount of biodigesters increased from 9,090 to 14,139 over the second monitoring period, ending 31 December 2014. The VPA-DD bases the annual emission reduction calculation on an ex-ante amount of 7,983 units only.

[59] See cell K34 of the ER1_Emission reduction calculation VPA 1 MRII 9June2015

[60] See pages 5-6 of the VPA-DD (total amount of digesters as per VPA DD (7,983) * ER per unit (2.61) = 2,084)

While the amount of biodigesters has surpassed the ex-ante implementation schedule, the small-scale thresholds of 45MW_{th} (Type I) and 60,000 tCO2e (Type III) are not surpassed by the VPA. Given 14,139 units implemented to date under the VPA-1, this cumulates to 35.86 MW_{th} (see Section 1.3 for the calculation). As each biodigester produces a maximum emission reduction of 1.838 tCO_2e from methane avoidance, given 14,139 biodigesters installed, the cumulative amount of emission reductions from the methane avoidance component is 21,364 tCO_2e (after adjustment for drop-off rate and operational rate). Annualised, the results are as follows:

Table 43: Overview of ex-ante and ex-post VPA results versus applicable small-scale thresholds

Type	1/6/2013 to 31/12/2013	1/1/2014 to 31/12/2014
Ex-ante		
Type I (45 MW_{th})	15.39 MW_{th}	15.39 MW_{th}[61]
Type III (60,000 tCO_2e)	12,214 tCO_2e	12,214 tCO_2e[62]
Ex-post		
Type I (45 MW_{th})	23.67 MW_{th} to 28.46 MW_{th}	28.46 MW_{th} to 35.77 MW_{th}[63]
Type III (60,000 tCO_2e)	10,074 tCO_2e	21,364 tCO_2e[64]

[61] See footnote 9 on page 10 of the VPA-DD

[62] See page 11 of the VPA-DD

[63] For calculation, refer to cells BC19 – BU19 of the ER1_Emission reduction calculation VPA 1 MRII 9June2015

[64] Calculated as total period emission reduction (36,739) multiplied by Type III ER / total ER per unit (1.838/3.61) = 21,364

As each biodigester produces a maximum emission reduction of 1.838 tCO_2e from methane avoidance (assuming GWP of 25 for methane), given 14,139 biodigesters installed, the cumulative amount of emission reductions from the methane avoidance component is 25,988 tCO_2e. This is below the methodological threshold of 60,000 tCO_2e.

4. SUSTAINABILITY MONITORING CONFORM MONITORING PLAN IN PASSPORT

4.1 SAFEGUARD PRINCIPLES

The next table summarizes the outcome of the 'Do no Harm' Assessment in the Gold Standard Passport, and lists the safeguard principles for which a mitigation principles has been identified, if any.

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 GS Passport.

4.2 SUSTAINABILITY DEVELOPMENT ASSESSMENT

4.2.1 SD MONITORING AS PER GS REQUIREMENTS

In this section the identified GS parameters are scored and supplemented with information gathered through the IDBP database and other relevant sources. The SD items have been monitored through the BUS 2015 executed from December 12th 2014 to January 28th 2015.

Soil condition

Table 44: Scoring on SD indicator soil condition

No		GS-03
Indicator		**Soil condition**
Mitigation measure		*n/a*
Chosen parameter		Number of users applying the final biodigester slurry on agricultural land.
Situation on or before 1/06/2011		No slurry is used as fertiliser on agricultural land.
Estimation of baseline situation of parameter		No slurry remains used as fertiliser on agricultural land.
Situation on 31/05/2013		**87%**of the households reported usage of bio-slurry (BUS 2012). Given 9.090 installed units, this equals 7,908 households.
Situation on 31/12/2014		**75%** of the households reported usage of bio-slurry (BUS 2015). Given 14,139 installed units, this equals 10,604 households. See cell OO211 of the 'I_Primary Data BUS 2015' document, 'Raw Data' sheet. 75.
Future target for parameter		A portion of the users apply biodigester slurry on agricultural land.
Way of monitoring	How	Collected through the annual Biogas User Survey.
	When	Annually; conducted in January 2015
	By who	External consultant specialised in surveying – JRI Indonesia

Quality of employment

Table 45: Scoring on SD indicator quality of employment

No	GS-06
Indicator	**Quality of employment**
Mitigation measure	*n/a*
Chosen parameter	Quality of employment refers to changes compared to the baseline in the qualitative value of employment, such as whether the jobs resulting from the project activity are highly or poorly qualified, temporary or permanent. The proportion of employees attending vocational training programs, as proven through issuance of a certificate to all constructors, will be monitored.
Situation on or before 1/06/2011	A historical lack of demand for biogas systems has meant that few constructors have the knowledge required to adequately build, market and maintain a reliable system.

Estimation of baseline situation of parameter		Limited training and employment opportunities continue to exist.
Situation on 31/05/2013		**418** vocational trainings
Situation on 31/12/2014		**1239** vocational trainings. See the 'L_IDBP Database 24Mar2015' document, sheet 'OPERATION&MAINT_TRAINING' total inputs.
Future target for parameter		New certificates issued by the programme as implementation figures grow. The proportion of employees attending vocational training programs, as proven through issuance of a certificate to all constructors, will be monitored.
Way of monitoring	How	Collected through by the IDBP Database. All vocational training attendees will be issued with a certificate proving their attendance, and a record of their names, contact details and gender, will be kept as part of the CME's consolidated monitoring database. The exact figure can be traced back to the 'Mason' sheet in the IDBP database document, selecting the respective 2011 – 2013 training dates.
	When	Annually; last update per March 2015
	By who	IDBP staff

Livelihood of the poor

Table 46: Scoring on SD indicator livelihood of the poor

No	GS-07
Indicator	**Livelihood of the poor**
Mitigation measure	*n/a*
Chosen parameter	Livelihood of the poor refers to changes compared to the baseline in living conditions, access to healthcare services including affordability and poverty alleviation. To indicate improvement, as part of the Biogas User Survey users will be asked whether they have perceived an improvement in their living conditions after the installation of the biodigester. As per the VPA DD, this parameter is monitored through the following question included in the BUS: "Do you feel that your living conditions have a) improved, b) stayed the same, c) worsened; since the installation of the biogas digester?"
Situation on or before 1/06/2011	Health issues related to respiratory diseases are occurring. Additionally, users, and especially women, experience limited available time due to the need to invest time in firewood collection and cooking. Overall, current livelihood of the poor is inadequate and can be enhanced.
Estimation of baseline situation of parameter	Health issues related to respiratory diseases continue to occur. Additionally, users, and especially women, continue to experience limited available time due to the need to invest time in firewood collection and cooking. Livelihood of the poor will remain

		unchanged.
Situation on 31/05/2013		BUS 2012 results: 'Improved': **7544** (equivalent to 83% of total) 'The same': **1,454** (equivalent to 16% of total) 'Worsened': **91** (equivalent to 1% of total)
Situation on 31/12/2014		BUS 2015 results: 'Improved': **9,897** (equivalent to 70% of total) 'The same': **4,100** (equivalent to 29% of total) 'Worsened: **141** (equivalent to 1% of total) See page 6 of the BUS 2015 Report.
Future target for parameter		Householders perceive an improvement in living conditions as a result of the installation of biogas digesters.
Way of monitoring	How	Collected through the annual Biogas User Survey. To indicate improvement, as part of the Biogas User Survey the following question will be included: "Do you feel that your living conditions have a) improved, b) stayed the same, c) worsened; since the installation of the biogas digester?"
	When	Annually; conducted in January 2015
	By who	External consultant specialised in surveying – JRI Indonesia

Access to affordable and clean energy services

Table 47: Scoring on SD indicator access to affordable and clean energy services

No	GS-08
Indicator	**Access to affordable and clean energy services**
Mitigation measure	*n/a*
Chosen parameter	Access to energy services refer to changes in unsustainable energy use. This will be monitored through the number of biogas units commissioned.
Situation on or before 1/06/2011	Combustion of LPG, kerosene and firewood lead to particulate matter and carbon monoxide pollution and deforestation, and therefore do not provide clean energy services. Also, prices of all fuels are increasing, presenting a rising financial burden to users.
Estimation of baseline situation of parameter	Combustion of LPG, kerosene and firewood continues to lead to particulate matter and carbon monoxide pollution and deforestation, and therefore fails to provide clean energy services. Also, prices of all fuels continue to increase, presenting a rising financial burden to users.
Situation on 31/05/2013	**9,090** biodigesters had been implemented under the VPA.
Situation on 31/12/2014	**14,139** biodigesters had been implemented under the VPA. See the 'L_IDBP Database 24Mar2015' document, sheet 'tblPCRmaster' total inputs.
Future target for parameter	The commissioning of several thousands of biodigesters per

		project activity.
Way of monitoring	How	Collected through by the IDBP Database. The unique serial number of each installation will be recorded upon commissioning and entered into the electronic database, with clear divisions between VPAs. This will allow a count of the number of systems commissioned.
	When	Annually; conducted in January 2015
	By who	IDBP staff

Human and institutional capacity

Table 48: Scoring on SD indicator human and institutional capacity

No		GS-09
Indicator		**Human and institutional capacity**
Mitigation measure		*n/a*
Chosen parameter		Changes compared to the baseline in education and skills, gender equality and empowerment. Women spend much of their time collecting firewood and cooking, and have little spare time to undertake activities that stimulate personal and entrepreneurial development. The number of women attending the Operation and Maintenance training as well as the bio-slurry utilization training will be monitored.
Situation on or before 1/06/2011		Women spend much of their time collecting firewood and cooking, and have little spare time to undertake activities that stimulate personal and entrepreneurial development.
Estimation of baseline situation of parameter		Women continue to spend much of their time collecting firewood and cooking, and remain with little spare time to undertake activities that stimulate personal and entrepreneurial development.
Situation on 31/05/2013		**2173** women attending Operation and Maintenance training
Situation on 31/12/2014		**3247** women attending Operation and Maintenance training See the 'L_IDBP Database 24Mar2015' document, sheet 'OPERATION&MAINT_TRAINING' total inputs.
Future target for parameter		New women receiving training as the programme grows. The number of women attending trainings will be monitored.
Way of monitoring	How	Either confirmed through the IDBP Database or carried out as part of the annual Biogas User Survey conducted by the IDBP.
	When	Annually; conducted in March 2015
	By who	External consultant specialised in surveying; JRI Indonesia, IDBP staff

Quantitative employment and income generation

Table 49: Scoring on SD indicator quantitative employment and income generation

No	GS-10
Indicator	**Quantitative employment and income generation**

Mitigation measure		*n/a*
Chosen parameter		The number of jobs generated by within the IDBP as well as the number of constructors employed will be monitored. To evidence income generation, the amount of users selling biodigester slurry on the market will be monitored.
Situation on or before 1/06/2011		Limited training and employment opportunities currently exist in the target regions outside of farming. Also, farmers have low income generation capacity from farming activities alone.
Estimation of baseline situation of parameter		Limited training and employment opportunities as well as income generation capacity continue to exist in the target regions outside of farmin
Situation on 31/05/2013		**242** number of direct jobs created by the VPA **84** number of constructors employed under the VPA **727** households sell the bio-slurry on the market (8% of total).
Situation on 31/12/2014		**1258** number of direct jobs created by the VPA **99** number of constructors employed under the VPA **424** households sell the bio-slurry on the market (3% of total). See the 'L_IDBP Database 24Mar2015' document, cumulative of sheet 'CPO', 'Mason', 'Supervisor' total inputs. See the 'L_IDBP Database 24Mar2015' document, sheet 'CPO' total inputs. See page 93 of the BUS 2015 Report.
Future target for parameter		New jobs created through the programme as implementation figures grow, as well as a growing amount of farmers selling biodigester slurry on the market.
Way of monitoring	How	Employment records and through the IDBP Database; Biogas User Survey. Through the Biogas User Survey, the amount of users selling biodigester slurry on the market will be monitored.
	When	Annually; conducted in March 2015
	By who	External consultant specialised in surveying; IDBP staff, JRI Indonesia

Technology transfer and technological self-reliance

Table 50: Scoring on SD indicator technology transfer and technological self-reliance

No	GS-12
Indicator	**Technology transfer and technological self-reliance**
Mitigation measure	*n/a*
Chosen parameter	Refers to changes compared to the baseline in activities that build usable and sustainable know-how in a region/country for a technology, where know-how was previously lacking. The number of constructors trained and users attending the operation and maintenance training will be monitored.
Situation on or before 1/06/2011	Limited training opportunities and transfer of technology in the biogas sector, both on the constructors and user levels.
Estimation of baseline situation of	Limited training opportunities and transfer of technology in the

parameter		biogas sector continues, both on the constructors and user levels.
Situation on 31/05/2013		**6,492** Operation and Maintenance trainings
Situation on 31/12/2014		**10,294** Operation and Maintenance trainings See the 'L_IDBP Database 24Mar2015' document, sheet 'OPERATION&MAINT_TRAINING' total inputs.
Future target for parameter		New jobs created and trainings organised through the programme as implementation figures grow.
Way of monitoring	How	Records will be kept of all staff and their attendance at the vocational training programmes. All attendees will be issued with a certificate proving attendance and skills gained. Monitoring of this parameter will be combined with the monitoring of GS- 10. A record of all training held, and attendees, will be kept in the IDBP Database.
	When	Annually; conducted in March 2015
	By who	External consultant specialised in surveying; IDBP staff, JRI Indonesia

In total seven GS indicators have been scored positively under this VPA. The monitoring results indicate that the activities carried out under this VPA do bring about clear positive impacts on the identified and monitored parameters.

The VPA has lowered the use of chemical fertilizer significantly by replacing it with bio slurry resulting from the biodigesters. It is known that long use of chemical fertiliser negatively impacts the process of humus regeneration, populations of soil microorganisms and makes the soil desiccated and infertile. Majority of the households reported applying the bio-slurry on land, with most of the users acknowledging improved harvests and stronger, more resistant plants.

Next, the VPA has created new work places for both skilled and non-skilled labourers. In total, 1258 vocational trainings have been given to over the timeframe of the VPA, including 983 masons, 176 supervisors and 99 CPOs. This job creation and enhanced human capacity creates a ripple-effect that has a significant socio-economic impact on the wider local community. Furthermore, 33247 women have attended Operation and Maintenance training as well as bio-slurry utilization trainings.

The mason training extended under the VPA-1 comprised of practical exercises where trainees were tasked to construct a biodigester following instruction through a theoretical training course. A construction manual is used as training material which was given to each trainee. Also, a Power Point presentation was used at each of the trainings with pictures and explanation of how a biodigester works. A construction video was also developed for clearer understanding, which was shown during the trainings. The second part of the training includes a session on the health and safety measures associated with biodigester construction, and each mason is mandatory to also to attend this session. Both the vocational and the health and safety sessions were given to the masons on the same day.

It comes as no surprise that when asked about the perceived state of livelihood before and after installation of the biodigester, most households (75%) clearly indicate that improvement is visible.

5. STAKEHOLDER FEEDBACK

The IDBP is an open and transparent programme, and offers a variety of opportunities that can be utilised to comment on the programme or to provide feedback. Besides offering feedback opportunities, all information concerning IDBP can be found on the following website: http://www.biru.or.id/en/

The opportunities to provide feedback are, inter alia:

Type	Contact point	Comments
Continuous Input Process Book	These books are stationed at the provincial offices (PBPO)	It is important to provide access to a physical log book. The provincial offices of the IDBP offer a convenient location for these log books, allowing users in the area easy access. However, most comments received go through the telephone access option.
Telephone Access	+62 (0) 812 8030 2020 +62(0) 21 789 24 89	The provided number is a mobile phone number to enable users to either call or text their comments to IDBP. Mobile phone use is the primary means of communication nationwide, especially since landlines are expensive.
Internet/email access	www.biru.or.id email: info@biro.or.id	For users with access to the internet, direct contact with the IDBP through the programme's website is important.

Assessment of comments: No complaints were received and therefore no action was undertaken. A lot of sms messages and phone calls are however received through the telephone access option – in most cases the communication relates to households inquiring into the price and availability of biodigesters under IDBP as well as other technical questions facilitating them to make the decision to purchase a biodigester and join the programme.

6. DATA QUALITY CONTROL AND ASSURANCE

IDBP implements an elaborate QC/QA mechanism on the construction of the biodigester. This process is described into detail in the PoA PDD section E.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.

- **Training of staff**

Training has been given to IDBP staff responsible for the data collection system on the management system to has been put in place as part of the overall PoA. This included:

- Data to be recorded in the database (as per A.4.4.1 of the PoA-DD) and how to complete the Household Agreement and Completion Report correctly;
- How to identify the serial number of the biodigester in use;
- How to fill out and where to submit copies of the Household Agreement and Completion Report and any associated documentation;
- How to complete Baseline and Project Performance Tests in accordance with Gold Standard guidelines;
- Monitoring procedures, in accordance section A.4.4. of the PoA-DD.

On completion of these trainings, trained staff received a letter confirming their attendance.

- **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. Primary Quality Assurance is carried out by Sundar Bajgain who works in SNV as the senior biogas expert coordinating in the IDBP programme in Indonesia. He has previous monitoring experience by working for the Nepal Biogas Programme, which is registered under the CDM. Final Quality Assurance of this process is carried out by Szymon Mikolajczyk who has been involved with the Gold Standard document preparation since 2011.

- **Quality assurance of questionnaire design**

The main tool to capture information required for this report is the household survey questionnaire. Chapter 2 details the QC on the questionnaire design and other data collection tools.

- **Quality assurance of the IDBP database**

The quality standards and quality control data are already ingrained in the design of the IDBP database. Double counting is avoided by keeping a record of the serial number of each biogas installation in the centralised IDBP database operated and maintained by Hivos. Input of identical serial numbers is flagged, may such an input occur.

Additional quality control is done through a standard questionnaire. The survey checks the systems through sampling to ensure that:

- The recorded address at which the biodigesters are installed is still correct;
- The biodigesters are still operational (as part of the monitoring procedure);
- Serial numbers are unique and correspond with the numbers on the installed systems.

These data are analysed periodically and sent to the CPO for verification and possible improvements on the defaults. In fact whole QC system is fully insured through the IDBP database. The regular data from QC are also compared with the BUS at the end of every year to verify the correctness and identify any deviation.

- **QC/QA on monitoring report**

The monitoring report is developed by an independent consultant with relevant experience of CDM and carbon monitoring of domestic biogas projects, his name is Szymon Mikolajczyk. The consultant is selected in a tender process, and selected based on a quality cost basis. The monitoring report is checked before release by IDBP staff. The contracted DOE will assess the report on compliance and final approval after review on compliance with the GS procedures and the PDD will be provided by 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 fulfil 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.

- **Data Storage**

All data is stored in a project database. On a daily basis a backup is made on an external hard disk and every month a copy is made which is stored at a separate location (Hivos office). In a case of an emergency, the most recent back up will be used to restore the project database.

7. FARS RAISED DURING MPI

Based on the assessment provided in the GS Issuance Review prepared by The Gold Standard dated 14/07/2014, the following FARs are addressed:

- **GS FAR #1:** The CME is requested to conduct the survey for usage rate in line with the methodology (page 24). The CME shall make sure that usage survey shall be able to capture the usage pattern of project technology. A single weighted average usage rate value shall be applied to the whole project population instead of age-group wise usage for the emission reduction calculation.

Response: The usage rate applied in the ER calculation is in line with the applied methodology. A single weighted average usage rate value has been applied to the whole project population instead of age-group wise usage for the emission reduction calculation. The calculation of the single weighted average usage rate value is explored in Section 3.1, and equates to 94.1 %.

- **GS FAR #2:** The CME is requested to categories the waste treatment/disposal system clearly as per the IPCC table for default emission factor for various type of disposal methods in future monitoring period.

Response: The MCF is determined through the different storage methods of the bio-slurry as reported in the BUS 2015. 75% of the farmers apply the bio-slurry as fertilizer on land. The digestate management system is daily spread as the bio-slurry is used by farmers as fertilizer through spread directly on the field. The corresponding MCF for this handling method is 0.75%.[65,66] Of the remaining 25%, 13% dump it into drains, 6% dump it into a nearby river or irrigation channel, 4% leave it in the biodigester, 1% gives it away to other farmers to be used as fertilizer, and 1% sells it to other farmers to be used as fertilizer. The resulting MCF for this remaining bio-slurry is 24.23%. Given that this only applies to 25% of the households, the MCF becomes 3.14%[67]. The two MCF values combined (0.75% + 3.14%) equal to 3.89%. The table below indicates the usage method of the bio-slurry and the corresponding MCF.

Table 51: Overview of bio-slurry handling methods

Bio-slurry handling method[68]	Percentage[69]	Corresponding IPCC definition[70]	MCF
Use as fertilizer	75%	Daily spread	1%
Dumped into open drain	13%	Aerobic treatment	0%
Dumped into river/irrigation	6%	Aerobic treatment	0%

[65] Calculated as: 0.75 * 1% (MCF of 'daily spread')
[66] IPCC Chapter 10: Emissions from Livestock and Manure Management; Table 10A-4 p.77
[67] Calculated as: 0.25 *((19%*0%)+(4%*78%)+(1%*1%)+(1%*1%)
[68] Source: Biogas User Survey 2015
[69] Source: see Primary Data BUS 2015 cells OO211 – OO216
[70] Source: IPCC Chapter 10 on Livestock Emissions

Left inside the biodigester	4%	Liquid/slurry	78%
Given out for free for fertilizer use	1%	Daily spread	1%
Sold for fertilizer use	1%	Daily spread	1%
		Average MCF	**3.89%**

The data can be traced back to the Primary Data BUS 2015 excel document, under the sheet 'Raw Data' Cells OO211 – OO216.

Based on the assessment provided in the first Verification Report prepared by TUV Rheinland dated 07/07/2014, the following FARs are addressed:

- **MPI FAR #1:** The application of sludge/slurry shall be monitored according the applied methodology. If there is any anaerobic use/storage of bio slurry under anaerobic conditions reported from monitoring survey, the PP shall account the project emission accordingly. The PP can propose a method to account the emissions.

Response: According to Section 3.22 of the MR, the application of bio-slurry is monitored by BUS 2015 in accordance with the monitoring plan of the registered VPA-DD. As per the BUS 2015, 75% of the households have applied bio-slurry as fertilizer. In other word, it can be assumed 25% of the households use the bio-slurry anaerobically. According to Section 3.26 of the MR, the emissions from bio-slurry of each biodigester is calculated by 5-steps approach which was approved for another similar GS biogas project (i.e. GS 1083). As per the calculations presented in the shared Emission Reduction Calculation (dated 1 May 2015), the emissions are calculated to be 0.030 tCO2/year/hh which is 0.96% of the total annual ER per households.

With reference to paragraph 87 of VVS, these emissions can be ruled out from the total ER calculation since the emission from the bio-slurry is less than 1% of the annual ER of each biodigester system.

- **MPI FAR #2:** The PP shall conduct the baseline and project performance field test in line with the applied methodology prior to the first verification. The outcome of the performance tests (baseline and project) shall be used to claim the emission reductions.

A KPT has been carried out by the VPA-1 implementer (i.e. Hivos) which includes baseline performance field test and project performance field test.

- **MPI FAR #3:** Regarding to the implementation of KPT, the LPG consumption is monitored by means of recording the time spent on LPG cooking during the first monitoring period. Then derive the weight of LPG consumption with reference to the average usage time of 3 kg LPG tank. This approach is deviated from the applied methodology TPDDTEC, however, it is accepted by the GS for the 1st monitoring period.

For the forth-coming verifications, the DOE shall check whether the KPT measurement is implemented in line with the applied methodology or GS's requirement.

Response: As the KPT results are valid for a period of two years, and the first KPT was conducted in September 2013, a new KPT will need to be implemented by the CME in September 2015. This KPT will present the first opportunity for the CME to apply the suggested changes raised by FAR 2.

- **MPI FAR #4:** The CME is requested to conduct the survey for usage rate in line with the methodology (page 24). The CME shall make sure that usage survey shall be able to capture the usage pattern of project technology. A single weighted average usage rate value shall be applied to the whole project population instead of age-group wise usage for the emission reduction calculation.

Response: Please refer to response for GS FAR #1.

- **MPI FAR #5:** The CME is requested to categories the waste treatment/disposal system clearly as per the IPCC table for default emission factor for various type of disposal methods in future monitoring period.

Response: Please refer to response for GS FAR #2.

ANNEX 1: CONTACT DETAILS OF THE PROJECT PARTICIPANTS

Organisation:	Hivos Netherlands
Street/P.O.Box:	Raamweg 16
Building:	
City:	Den Haag
State/Region:	Zuid Holland
Postfix/ZIP:	2508 CG
Country:	Netherlands
Telephone:	+31703765500
FAX:	+31703624600
E-Mail:	h.clemens@hivos.nl
URL:	www.hivos.nl
Title:	Mr.
Salutation:	
Last Name:	Clemens
Middle Name:	
First Name:	Harry
Department:	Hivos Head Office
Mobile:	+31703765500
Direct FAX:	
Direct tel:	
Personal E-Mail:	h.clemens@hivos.nl

Organisation:	Hivos Indonesia
Street/P.O.Box:	Jl. Keman Selatan XII No. 1
Building:	Cilandak Timur - Pasar Minggu
City:	Jakarta
State/Region:	Java
Postfix/ZIP:	12561
Country:	Indonesia
Telephone:	+62-21 7892489
FAX:	
E-Mail:	hivos@hivos.or.id
URL:	www.biru.or.id
Title:	Mr.
Salutation:	
Last Name:	de Groot
Middle Name:	
First Name:	Robert
Department:	
Mobile:	+62 812 1059119
Direct FAX:	
Direct tel:	+62 812 1059119
Personal E-Mail:	rdegroot@hivos.or.id