Monitoring Report Period 2, VPA-2

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

| Climate Focus | 30/09/2019 | MR CPI MPII |

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MONITORING REPORT VPA-2
(GS 1174)

Indonesia Domestic Biogas Programme of Activities (IDBP)
(ID 5303)

Monitoring Period II of the First Crediting Period
(01/01/2018 – 31/12/2018, including both days)

Version 0.6

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Acronyms

BE	Baseline emissions
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
MS	Manure system
NRB	Non-Renewable Biomass
PDD	Project Description Document
PE	Project Emission
PFT	Project Performance Field Test
SD	Sustainable Development
SNV	Netherlands Development Organisation
UNFCCC	United Nation Framework Convention on Climate Change
US	User Survey
VER	Voluntary emission reduction
VS	Volatile solids

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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-2 of the IDBP Programme of Activities according to the modalities and procedures set by the Gold Standard (GS) for the second monitoring period (MPII) of the first crediting period (CPI) covering 01/01/2018 to 31/12/2018, 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-2(ID 5303)
Project scale	Small scale
GS project ID	GS1172 and GS 5303
GS website link	https://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	02/01/2017
Crediting period	02/01/2017 – 01/01/2024, including both days
Registration of PoA	31/05/2013
Inclusion date of VPA-2	04/05/2017
Monitoring period I (MPI)	02/01/2017 - 31/12/2017, including both days
Monitoring period II (MPII)	01/01/2018 - 31/12/2018, including both days

The VPA-2 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	5° 27' 0.0000'' S	105° 16' 0.0120'' E
West Java	6° 54' 53.0784'' S	107° 36' 35.3160'' E
Central Java	7° 47' 49.4448'' S	110° 22' 13.9044'' E
East Java	7° 15' 1.6020'' S	112° 46' 7.8420'' E
Bali	8° 24' 34.2648'' S	115° 11' 20.1084'' E
Nusa Tenggara Barat	8° 39' 10.5602'' S	117° 21' 41.9314'' E
Nusa Tenggara Timur	8° 39' 26.575'' S	121° 4' 45.732'' E
Yogyakarta	7 ° 47 '49.4448' 'S	110 ° 22 '13.9044' 'E
South Sulawesi	5° 8' 51.5940'' S	119° 25' 57.8352'' E

1.2 TECHNICAL PROJECT DESCRIPTION

The National Biodigester Programme

The VPA-2 started implementation of biodigesters on 2 January 2017, following the filling of the VPA-1 which ended on 31 December 2016. The overall development objective of the VPA-2, 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-2 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 biomass, 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 biomass is collected, which is physically draining and costs a lot of time, especially for women. Purchased biomass 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 high prevalence of hygiene related diseases, such as diarrhoea.

Technology and emission reductions

The technology implemented under the VPA-2 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-2 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. This biodigester type has an estimated lifetime of at least 20 years.

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 biomass 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-2 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 biomass 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].

(iii)   Economic

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[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.

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

- 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 01/01/2018 to 31/12/2018 in the VPA-2.

Table 3: Total Number of units installed by month and cumulative, VPA-2[7]

Period (months)	Number of biodigesters in VPA-2	Cumulative number of biodigesters in VPA-2
2017	2,034	2,034
01/01/18 to 31/01/18	189	2,223
01/02/18 to 28/02/18	79	2,302
01/03/18 to 31/03/18	95	2,397
01/04/18 to 30/04/18	81	2,478
01/05/18 to 31/05/18	75	2,553
01/06/18 to 30/06/18	84	2,637
01/07/18 to 31/07/18	135	2,772
01/08/18 to 31/08/18	179	2,951
01/09/18 to 30/09/18	147	3,098
01/10/18 to 31/10/18	99	3,197
01/11/18 to 30/11/18	124	3,321
01/12/18 to 31/12/18	129	3,450
		Total: 3,450

In total **3,450** biodigesters were constructed as of 31/12/2018 in the VPA-2 project boundary. Table 4 shows the distribution of the biodigesters across the nine targeted provinces.

Table 4: Distribution of biodigesters per province, until 31-12-2018[8]

Province	Number of biodigesters
Lampung	87
West Java	82
Central Java	80
East Java	451
Bali	165
Nusa Tenggara Barat	682

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

[7] As per "20190211_IDBP_Database_VPA2.xls" sheet 'Master VPA-2' cells J3512 to J3523

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

[8] As per "20190211_IDBP_Database_VPA2.xls" sheet 'Master VPA-2' cells R3498 to R3506

Nusa Tenggara Timur	462
Yogyakarta	708
South Sulawesi	733
Total:	**3,450**

The figure below shows the cumulative number of installed biodigesters as well as the number of units that are installed each month.

Figure 2: Cumulative and monthly number of units installed until 31-12-2018
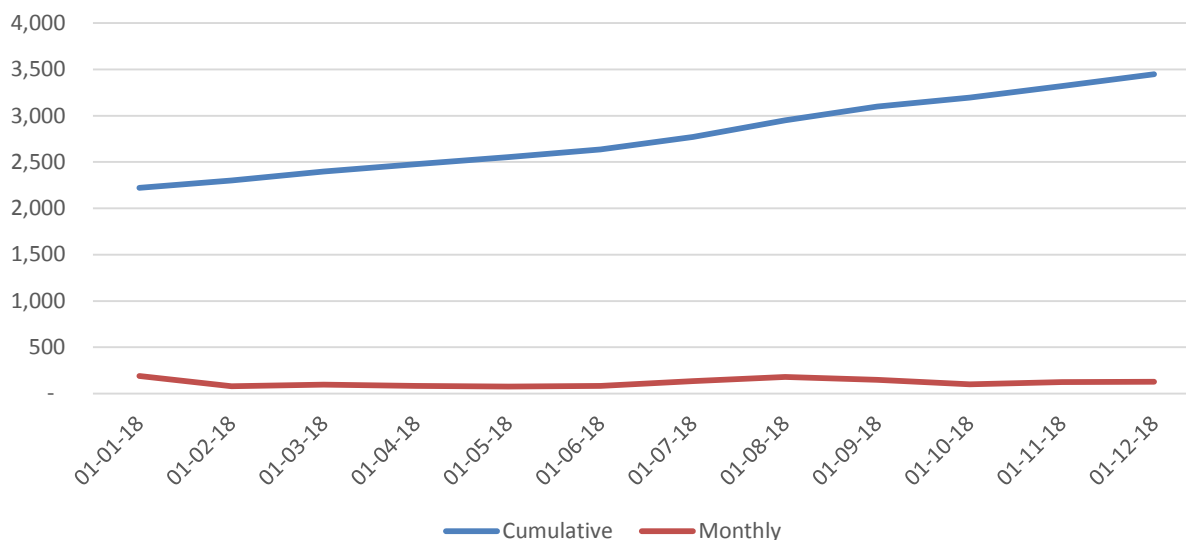

Figure 2 shows that the cumulative number of units installed is steadily increasing, and that there is a small seasonal difference in the implementation effort.

The VPA-2 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 2 (as per 31-12-2018)[9]
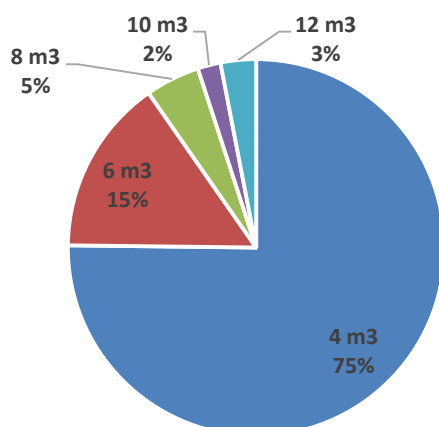
The most proliferated digester has a volume of 4 m³, followed by the 6 m³; according to the IDBP database. Other digester sizes are built to a much smaller extent, with the 10 m³ and 12 m³ joining totalling around 5% of all the digesters built. The average digester size built has a volume of 5.01 m³.[10] The VPA-2 has a cumulative digester volume of 9,192 m³.[11]

The VPA-2 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-2 is 4.87 m³. As per the calculation presented in footnote 9 below, this biodigester size requires daily feeding of (4.87 m³ * 7.5 kg =) 36.52 kg of manure, equivalent to 1.46 m³ of biogas per day. As per the Table below, this amounts to a maximum output of 1.56 kW$_{th}$, which is below the established threshold of 150 kW$_{th}$ per unit. Also, given 3,450 units implemented to date under the VPA-2, this cumulates to 5.36 MW$_{th}$, below the 45 MW$_{th}$ threshold.

The calculation is presented below:

Table 5: Calculation of total capacity under VPA-2

$Th_{cap} = \dfrac{E}{t}$ $where$ $E = \eta * H_b * V_b$		
Where:	Value:	Comments:
t = hours/day usage	2.74	See "Crosstab BUS by Province_18May2016.xls", sheet

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[9] As per "20190211_IDBP_Database_VPA2.xls" sheet 'Master VPA-2' cells R3511 to R3515
  Figures may not add up due to rounding
[10] As per "IDBP Database VPA-2 20Mar2018.xls" sheet 'Master VPA-2' cell P3518
[11] As per "IDBP Database VPA-2 20Mar2018.xls" sheet 'Master VPA-2' cell P3519

		"raw_data" cell J2683. Fixed for future verifications[12]	
η = efficiency of stove	50%	Indonesian Government standard on stove efficiency	
H_b = heat of combustion per unit volume of biogas	21.0 MJ/m³ [13]	Derived from IPCC defaults	
V_b = volume of biogas	1.46 m³/day[14]	Data provided by Hivos	
E = Energy available from the biogas system	15.34 MJ/day[15]	Calculated	
E_{th} =	4.26 kWh/day	1 MJ = 0.2778 kWh	
Th_{cap} =	1.56 kW$_{th}$	Given a 2.74 hour/day usage	
Total capacity	5.36 MW$_{th}$[16]	Given 3,450 units installed	

As each biodigester produces a maximum emission reduction of 1.624 tCO_2e from methane avoidance, given 3,450 biodigesters installed, the cumulative amount of emission reductions from the methane avoidance component is 5,602 tCO_2e. This is below the methodological threshold of 60,000 tCO_2e.

1.4 SUMMARY OF VERS CLAIMED IN CPI MPII

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

Table 6: Estimated emission reductions of MPII CPI, VPA-2

Month of program	Period, begin and end date inclusive		Cumulative number of units	Monthly ER (tCO₂e)	Cumulative ER (tCO₂e)
13	02-01-18	31-01-18	2,223	335	335
14	01-02-18	28-02-18	2,302	367	702
15	01-03-18	31-03-18	2,397	380	1,082
16	01-04-18	30-04-18	2,478	395	1,477
17	01-05-18	31-05-18	2,553	409	1,886
18	01-06-18	30-06-18	2,637	421	2,307
19	01-07-18	31-07-18	2,772	435	2,742

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[12] As per Gold Standard confirmation by email, the parameter 't' can be fixed at value 2.74 going forward to enable the definition of the VPA-2 threshold. See email communication dated 11 April 2016

[13] Methane has an energy value of 37.78 MJ/m³; thus, biogas at 55% CH_4 has an energy value of 21 MJ/m³

[14] Cow dung produces approximately 40 litres biogas per kg. Each m³ capacity of the biodigester needs 7.5 kg dung per day. Given an average biodigester size of 5.01 m³, 37.57 kg of cow dung per day is required. This translates into 1.50 m³ of gas produced per day. See Document P_Biogas_as_renewable_energy _2005.pdf, pages 79 and 140.

[15] Calculated as: 50% efficiency * 21 MJ/m³ * 1.50 m³/day

[16] Figures may not add up due to rounding – see "20190827 ER Calculation VPA 2 MP2_v03" sheet "capacity calculation" cell "C6"

20	01-08-18	31-08-18	2,951	457	3,199
21	01-09-18	30-09-18	3,098	487	3,686
22	01-10-18	31-10-18	3,197	511	4,197
23	01-11-18	30-11-18	3,321	527	4,725
24	01-12-18	31-12-18	3,450	548	5,273
				Total	**5,273**

The table shows that the total number of ERs realized is **5,273 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-2 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 Research to conduct the Biogas User Survey, which serves as the monitoring survey under the VPA-2 (BUS 2019). 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 Research on the VPA specific monitoring procedures. JRI recruited 11 surveyors and 2 supervisors for the enumeration. All these surveyors received training on survey and data collection techniques and they were supervised by the Project Leader during survey implementation. Data tabulation, analysis and reporting was prepared by JRI Research.

Hivos internally designed and implemented the KPT in December 2017, which was supervised by Mr. Agung Lenggono and supported by Mr. Szymon Mikolajczyk. Data collection for the KPT was conducted by JRI, employing an experienced team (also responsible to carry out the Biogas User Survey). 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:
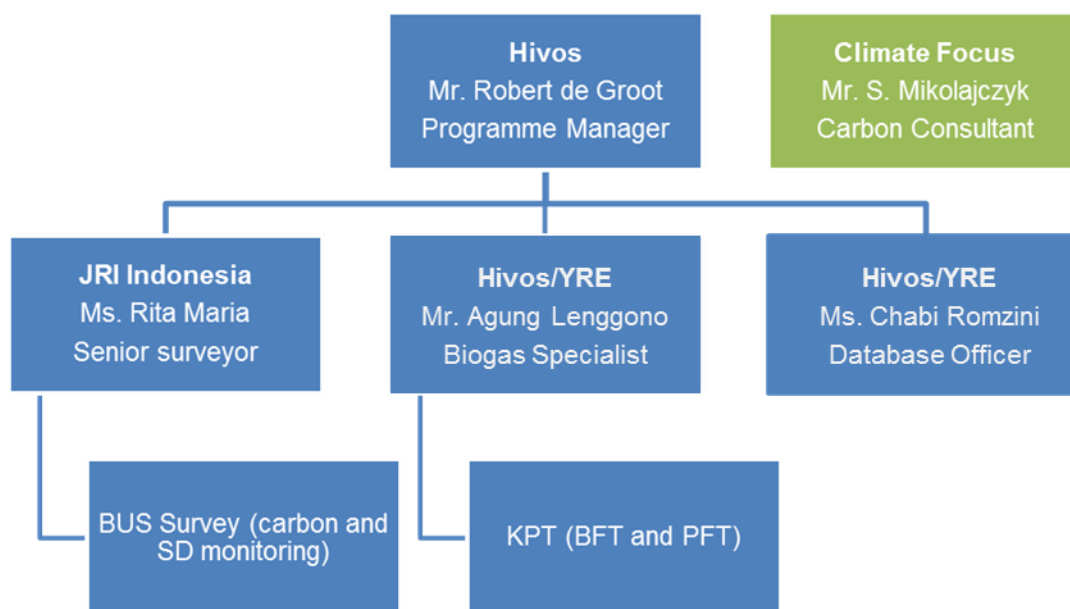

Figure 4: Surveys executed and entities involved

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. 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 2017, as well as previous versions of this survey (including BUS 2016 applied in the previous monitoring period).

Agung Lenggono: Agung was responsible for the preparation of the KPT (BFT and PFT) that was implemented in December 2017. He works as the senior biogas expert coordinating in the IDBP programme in Indonesia and has been involved in overseeing the carbon asset development process of the programme since 2015.

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 Dian Legowo in Jakarta, Kristian Chandra as a data entry staff in East Java and Baiq Herni as a data entry staff in NTB. They 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 of VPA-2.

2.3 SURVEY DESIGN

The next table summarizes the design of the surveys:

Table 7: Survey designs summary (combined with the BUS used for both VPA-1 and VPA-2)

Item	BUS 2019 (US + CMS)	KPT (PFT)	KPT (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 year of use	Simple random sampling	Simple random sampling using PFT sampling frame
Cluster	Age group	N/A	N/A
Cluster size	36 - 37 households	N/A	N/A
Number of clusters	2 cluster is relevant to this MR	N/A	N/A
Total sample size	**73**	**55**	**55**

2.4 BIOGAS USER SURVEY (US + CMS)

The Biogas User Survey (BUS) is the survey implemented under the VPA-2 annually that includes both the a) User Survey (US) and b) the Carbon Monitoring Survey (CMS). The survey was executed in December 2018 (referred to in this document as "BUS 2019") 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 2019. 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 2019.

Table 8: BUS studies

#	Name of study	Monitoring interval	Conversion in MPII 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 MPII.
2	Project studies (PS) of target population characteristics;	Annual	Included in BUS 2019
3	Monitoring of the SD parameters.	Annual	Included in BUS 2019
4	Leakage emission assessment	Every two year after first verification	Investigated alongside BUS 2018
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 MPI still covers the first crediting period, 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 3.1.4 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 and Usage Survey design

In the period from December 23rd up to December 30th 2018, the surveys were executed by a team of surveyors from IDBP. The BUS 2019 monitoring procedure applied consisted of the following steps:

  I. Details of the biogas households of each age group were gathered;
 II. Random selection of at least 30 households from each age group, proportional to the overall population size of the province (multi-stage sampling). Sample selection in accordance to age groups was applied to the BUS as this survey also covers part of the Usage Survey, which needs to be arranged by age group. The sampling was executed using a web based random number generator.[17] The sample size for each province was determined based on the biodigester user populations derived from the IDBP database to ensure representativeness.
III. IDBP staff surveyed the sampled households, and the gathered data was entered into a database at the head office following a data quality check.

To establish the sample size and the sample distribution, guidance from the applied Gold Standard methodology was applied relating to both the Carbon Monitoring Survey (i.e. minimum of 100 households) and the Usage Survey (i.e. at least 30 households per age group). As per the guidance, to ensure conservativeness, participants in a user survey with technologies in the first year of use must have technologies that have been in use on average longer than 0.5 years. For technologies in the second year of use, the user survey must be conducted with technologies that have been in use on average at least 1.5 years, and so on. For the VPA-2, the BUS approached a sample of **73** households. This exceeds the 2 age groups * 30 households = 60 households minimum threshold. The Usage Survey was fully included in the BUS.

For the BUS 2019, biogas users classified as the 2nd year of use are those who have been using an IDBP biodigester in the first year of VPA-2 (i.e. implementation between 02/01/2017 to 31/12/2017) and 1st year as the second (i.e. most recent) year of the VPA-2 (i.e. implementation between 02/01/2018 to 31/12/2018).

The BUS 2019 covered all nine provinces that have become intervention areas of the VPA-2. Total sample of respondents per province determined proportionally to the total population of the respected province. A total of **72** households was reached, with **52** households completing the interview. The difference (**20** households) have been reported as drop-offs. Some households did not respond due to a non-functioning biodigester. The distribution of respondent sample for each province, and each year of use, is described in Table 9.

Table 9: BUS 2019 random sample size selection and geographical distribution (Age groups 1 through 2 are applicable to this MR)

PROVINCES	Status	Y 1	Y 2	TOTAL
Bali	**Total interviewed**	0	2	2

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

	Total completed	0	2	2
West Java	**Total interviewed**	1	1	2
	Total completed	1	1	2
Central Java	**Total interviewed**	1	1	2
	Total completed	1	1	2
East Java	**Total interviewed**	5	6	11
	Total completed	5	2	7
Lampung	**Total interviewed**	1	1	2
	Total completed	1	1	2
NTB	**Total interviewed**	6	10	16
	Total completed	6	10	16
NTT	**Total interviewed**	6	4	10
	Total completed	0	1	1
South Sulawesi	**Total interviewed**	8	5	13
	Total completed	8	5	13
Yogyakarta	**Total interviewed**	7	7	14
	Total completed	6	1	7
	Total			
9 provinces	**Total sampled**	48	39	87
	Total interviewed	35	37	72
	Total completed	28	24	52
	Total drop-off	7	13	20

The described BUS sampling plan is developed using guidance of the applied GS methodology and the UNFCCC standard on sampling (EB 86 Annex 03: Standard for Sampling and Survey for CDM Project Activities and Programme of Activities)[18], see the next table:

Table 10: 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. The actual design of the survey was done to ensure a confidence / precision level of 95/5, exceeding this requirement.
2	Target population	Households that have installed an IDBP certified biodigester.

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

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.
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 11 surveyors and 2 supervisors for data collection with face-to-face interviews using structured questionnaire. All these surveyors received training on survey and data collection techniques and they were supervised by JRI's supervisors during implementation each province. Analysis and reporting were prepared by JRI Research.

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 JRI team. Based on the results of this field test, questionnaire were finalised and sent to Hivos for approval.

The fieldwork process was carried out by JRI staff through house-to-house personal interviews using the structured questionnaire. To ensure good data quality, oversight of the fieldwork process was conducted by field supervisors, 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.

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. For the purpose of MPI of VPA-2, a new BFT and PFT has been conducted in December 2017 ("KPT 2018"). The results from this KPT remain valid for MPII of VPA-2 and have been applied in this MR.

The KPT 2018 was executed according to this protocol:
- Test period shall be 1 days[19] = 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).
- 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:

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[19] A MC of 1 days (24 hour) is allowed by the Gold Standard

Table 11: KPT 2018 target groups

Group	Description of target group	Sample size
PFT household	Randomly selected household from the project database with a biodigester	55
BFT household	Nearest equivalent households[20] to the randomly selected project household without a biodigester	55
	Total sample	**110**

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

Table 12: 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 the 14th and 24th of December 2017. 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.

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[20] 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 13: 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 December 2017, which is during the dry season[21]. 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 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.
4	Representativeness	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.
5	Biodigester size distribution	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.

Size (m³)	n	% in Sample	% in Project database
4	18	33%	67%
6	11	38%	20%
8	16	29%	7%
10	0	0%	2%
12	0	0%	3%

2.5.2 KPT IMPLEMENTATION

KPT Implementation

KPT survey was performed with the same team who carried out the BUS. The surveying team is composed of 11 surveyors and 2 field supervisors.

Questionnaire development and training

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

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 KPT survey used a similar questionnaire structure as past years and therefore did not require any additional piloting test.

All selected surveyors received a 1 day office training by IDBP and 1 day field training by JRI supervisor. Office training was conducted 5 days prior the field survey; meanwhile field training was conducted a day prior to the field survey. The lead trainers were Mr. Agung Lenggono from IDBP and Rita Maria from JRI (survey coordinator).

Data Collection Tools

As discussed above, the questionnaire was based on Berkeley Air KPT questionnaire.[22] 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;

KPT execution

The KPT was executed in the period from the 14th and 24th of December 2017. A day prior to the KPT, target respondents were visited to answer a set of screening questions[23], and asking their willingness to participate to the survey. In total, 55 households participated in the KPT testing. Another 55 samples of non-biogas households residing close to the biogas households participants were also chosen for becoming comparison sample used for the baseline KPT. Care

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[22] Household Energy and Health Programme: Kitchen Performance Test. Available on:
https://cleancookstoves.org/binary-data/DOCUMENT/file/000/000/83-1.pdf
[23] Determining their eligibility to take part in the KPT. For instance no changes in the number of family members at the selected households, or no event or any other festive ceremonies scheduled during the test period.

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 8 provinces: Bali, West Java, Central Java, Lampung, West Nusa Tenggara, East Nusa Tenggara, South Sulawesi and Yogyakarta. All surveyed data were checked and processed by JRI Research, and then reported to head office in Jakarta (NBPSO).

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 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.[24] All data has been deemed consistent and passes the Grubb's test assessment.

Table 14 describes the approach applied in converting the obtained results to monitoring parameters as per PDD requirements.

Table 14: 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 measured by calibrated weights.

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[24] 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

3. RESULTS

3.1 BUS SURVEY RESULTS

The emission reductions are calculated based on the data collected during the BUS 2019 (73 households for VPA-2). The BUS 2019 includes both the CMS survey and part of the US survey.

Usage rate

User survey (US survey) results indicate that the IDBP is successful and maintaining installed biodigesters operational. The BUS 2019 sampled **73** households and reached **53** households from VPA-2. When approaching the households, **20** households reported not using their biodigester. Of the 36 units in age 1, 8 were not operational (8/36 = 22.22%); and of the 37 units in age 2, 12 were not operational (12/37 = 32.43%). The following table indicates the original results and the derived drop-off rate.

Table 15: BUS 2019 drop-off calculation (Age groups 1 and 2 are applicable to this MR)[25]

	Age 1	Age 2	Total Sample
	01/07/2017 – 31/06/2018	01/07/2016 – 31/06/2017	
Total surveyed households	35	37	72
Total reported dropped-off	7	13	20
Drop-off rate	20.00%	35.14%	

The drop-off usage is explained due to long-term technical issues which stopped the production of biogas and due to the lack of availability of raw materials to feed biogas due to livestock being sold.

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

Table 16: User Survey results (Age groups 1 and 2 are applicable to this MR)[26]

Age group	Dates of units survey corresponding to age group	% in operation (A)[27]	Corresponding date as per the IDBP Database	Units built in that period (B)	Number of biogas plants in operation (A*B)
2	01/07/2016 – 31/06/2017	64.86%	02/01/2017 - 31/12/2017	2,034	1,319
1	01/07/2017 – 31/06/2018	80.00%	01/01/2018 - 31/12/2018	1,416	1,133

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[25] As per "20190215 BUS 2019 Tabulation JRI" sheet "Drop-off" cells C5 – D8

[26] As per "20190215 BUS 2019 Tabulation JRI" sheet "Drop-off" cells D20 – G21. Figures may not add up due to rounding – see emission reduction calculation

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

Weighted average drop-off	**71.08%**			
	Sum		3,450	2,452

The table above outlines the two different age-groups, with age group '1' representing the most recently installed units, and age group '2' dating back to the first year of implementation (i.e. the year before). Given the Gold Standard requirement of including in the age group assessment only units that have been in operation for at least half a year, the surveyed data includes units constructed in months January – May of each year. The derived % in operation values are then applied across the total amount of units constructed in the respective full year. The final column represents a multiplication of the total units constructed per year by the reported % value. The weighted average of units in operation is then simply calculated by dividing the units in operating with the total population for age groups 1 through 2, which is 71.08%.[28] This means that in total 998 units have dropped off up until 31/12/2018.[29]

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 MPII, a total of 375 households reported non-functioning of their biodigester.[30] Assuming a total of 15 non-operational days for each household[31] for the purpose of calculating the missed emission reductions, this amounts to a total of (375*15=) 5,625 non-operational days, or 15.4 non-operational years.

3.1.1 PARAMETERS MONITORED AND NOT MONITORED

Table 17: 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)	**71.08%**	"20190215 BUS 2019 Tabulation JRI" sheet "Drop-off" cell H24

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[28] See spreadsheet "20190215 BUS 2019 Tabulation JRI" sheet "Drop-off" cell H24
[29] See spreadsheet "20190215 BUS 2019 Tabulation JRI" sheet "Drop-off" cell M24
[30] See "20190211_IDBP_Database_VPA2" sheet "Non-functioning" cell H421
[31] See instruction memo sent out to CPOs, dated 1 May 2013

$N_{p1,y}$	number	Cumulative project operational rate included in the project database for project scenario p1 against baseline scenario b1 in year y	2,228[32]		"20190827 ER Calculation VPA 2 MP2_v03" sheet GS VER 2019" cell E86
$No_{p1,y}$	number	Cumulative number of project technologies included in the project database for project scenario p1 in year y	3,450		"20190211_IDBP_Database_VPA2" sheet "Master VPA-2" cell R3507
$O_{p1,y}$	number	The average technology-days during which the biodigesters are operational for project scenario p1 against baseline scenario b1 in year y	363.37[33]		"20190827 ER Calculation VPA 2 MP2_v03" sheet GS VER 2019" cell E85
$LE_{p1,y}$	$tCO_2e/year$	Leakage in project scenario p1 during year y	0.037		"20190827 ER Calculation VPA 2 MP2_v03" sheet GS VER 2019 (CPI)" cell E77
$N_{T,h}$	number	Number of animals of livestock category T in premise h	Dairy cow[34]	4.78	"20190215 BUS 2019 Tabulation JRI sheet "BUS", cell U2109
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	1.435		"20180407 KPT December 2017" sheet 90-30 Test, cell F65
$BB_{p1,bio}$	tonnes/year	The quantity of biomass consumed in the project scenario 1, in tonnes/year	0.719		"20180407 KPT December 2017" sheet 90-30 Test, cell S65
$BB_{b1,fuel}$	tonnes/year	Amount of fossil fuels used in the baseline scenario 1: households	LPG	0.088	"20180407 KPT December 2017" sheet 90-30 Test, cell I65

[32] Calculated as $U_{p1,y}$* $No_{p1,y}$ * ($O_{p1,y}$/365), therefore 71.08% * 3,450 * (363.37/365) = 2,228

[33] Calculated as 365 - (malfunctioning digesters * maximum amount of days of malfunctioning)/ $No_{p1,y}$, therefore = 365 – ((375*15)/ 3,450) = 363.37

[34] According to the BUS 2019, 94% of VPA-2 households dairy cows were the primary animals. For this reason, no other animals are included in this MPII. Some households reported pigs and poultry, but their figures are immaterial and have been excluded from the calculation for conservativeness

Parameter	Data unit	Description	Applied value		Source
$BB_{p1,fuel}$	tonnes /year	Quantity of fossil fuel consumed in project scenario 1 during year y, in tonnes	LPG	**0.048**	"20180407 KPT December 2017" sheet 90-30 Test, cell V65
$MS_{P,S,K}$	%	Fraction of livestock category T's manure not treated in bio-digester, in climate region k	Dairy cow	**22.0%**	1 - $MS_{T,S,k}$ (see below)
$MS_{T,S,k}$	%	Fraction of livestock category T's manure fed into the bio-digester, in climate region k	Dairy cow	**78.0%**	"20190215 BUS 2019 Tabulation JRI sheet "BUS" cell P2494
GWP_{CH4}		Global Warming Potential of methane	**25**		IPCC[35]
Bio		Use of bio-slurry	**64%**		"20190215 BUS 2019 Tabulation JRI sheet "BUS" cell Y2704

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.	**2,206** households using bio-slurry for fertiliser As per the VPA-DD, this parameter is monitored through the parameter 'Bio' reported above.	See "20190215 BUS 2019 Tabulation JRI" sheet "BUS" cell Y2704 Calculation: 64% * 3,450 units installed
GS-06 Quality of employment	number	Quality of employment refers to changes compared to the baseline in the qualitative value of employment	**51** vocational trainings attended 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.	"20190211_IDBP_Database_VPA2 sheet "SPV" cell L217

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

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': **2,721** (equivalent to 79.00% of total units in operation) 'The same': **729** (equivalent to 21.00% of total units in operation) 'Worsened': **0** (equivalent to 0% of total units in operation) 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?"	"20190215 BUS 2019 Tabulation JRI sheet "BUS" cells U3162-U3163
GS-08 Access to affordable and clean energy services	number	Access to energy services refer to changes in unsustainable energy use.	**3,450** units in operation 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 '$N_{p1,y}$'.	"20190211_IDBP_Da tabase_VPA2" sheet "Master VPA-2" cell J3526
GS-09 Human and institutional capacity	number	Changes compared to the baseline in education and skills, gender equality and empowerment.	**774** Operation and Maintenance trainings 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. This data concerns cumulative results over the VPAs lifetime	"20190211_IDBP_Da tabase_VPA2" sheet "This data concerns cumulative results over the VPAs lifetime training" cell I3238
GS-10 Quantitative	number	The number of jobs generated by within the IDBP as well as	**58** number of direct jobs created by the VPA	"20190211_IDBP_Da tabase_VPA2" sheet "SPV" cell L221

employment and income generation		the number of constructors employed	**7** number of constructors employed under the VPA **0** households sell the bio-slurry on the market (0% of total)[36] 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.	"20190211_IDBP_Database_VPA2" sheet "SPV" cell L219 "20190215 BUS 2019 Tabulation JRI" sheet "BUS" cell O2727
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.	**3,235** 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 biogas market are monitored. This data concerns cumulative results over the VPAs lifetime	"20190211_IDBP_Database_VPA2" sheet "O&M training" cell I3240

Table 18: 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

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[36] Calculated as 0% * 3,450 = 0

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	

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-2. As the baseline fuel and the project fuel and the corresponding emission factors are different, the overall GHG reductions achieved by VPA-2 in year *y* are calculated as follows:

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

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-2 can apply the following formula for calculating emission reductions:

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

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[37]

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

$N_{p1,y}$ 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:

$$\sum BE_{b1,CO2,y} = B_{b1,y} * \left(\left(f_{NRB,y} * EF_{b1,fuel,CO2} \right) + EF_{b1,fuel,nonCO2} \right) * NVC_{b1,fuel} \tag{3}$$

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 19: Thermal energy demand based on KPT results

Fuel	Average per household (tonne/year)	NCV (TJ/tonne)	Thermal energy demand (TJ/year)
Biomass	1.435	0.015	0.0215
LPG	0.088	0.0473	0.0042
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 20: CO_2 emission factors

Fuel *i*	EF_{CO2}, (tonne/TJ)
Biomass	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 biomass 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 21: Ex-post baseline emission of each fuel and total from thermal energy use[38]

Fuel	Baseline emissions from CO_2 (tCO$_2$e/yr)
Biomass	1.562
LPG	0.263
Kerosene	0
Total	**1.825**

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 22: KPT PFT fuel use

Fuel	Average per household (tonne/year)	NCV (TJ/tonne)	Thermal energy demand (TJ/year)
Biomass	0.719	0.015	0.0108
LPG	0.048	0.0473	0.0023
Kerosene	0	0.0438	0

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

Table 23: KPT PFT emissions[39]

Fuel	Project emissions from CO_2 (tCO$_2$e/yr)
Biomass	0.783
LPG	0.143

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

Kerosene	0
Total	**0.926**

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 rule[40], 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[41] 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 tables show that both baseline emissions and project emissions calculations meet the 90/30 rule.

Table 24: 90/30 rule check on baseline emissions

Item	Unit	Baseline	Project
Sample	n	55	55
	Analysis		
	Mean		1.83
	Standard error		1.4231
	Minimum requirement n		18.15
	Satisfy the 90/30 rule		Yes, as: 55 > 18.15

Table 25: 90/30 rule check on project emissions

Item	Unit	Baseline	Project
Sample	n	55	55
	Analysis		
	Mean		0.93
	Standard error		0.7467
	Minimum requirement n		19.40
	Satisfy the 90/30 rule		Yes, as: 55 > 19.40

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[40] 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.

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

The KPT test meets the 90/30 rule allowing the use of mean saving values for ER calculations, see the next table:

Table 26: Emission reductions from fuel switch[42]

Baseline emissions from fuel use (tCO$_2$e/yr)	Project emissions from fuel use (tCO$_2$e/yr)	Leakage emissions from fuel use (tCO$_2$e/yr)	Emissions from fuel switch to biogas (tCO$_2$e/yr)
1.825	0.926	0.037	**0.862**

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:

$$\textbf{BE}_{\textbf{b1,CH4,y}} = GWP_{CH4} * \sum_T(EF_{awms,T} * N_{T,h}) \tag{4}$$

Where:

$BE_{b1,CH4,y}$ Baseline emissions from manure handling during the year y in tCO$_2$e

GWP_{CH4} Global Warming Potential of methane (25)

$EF_{awms,T}$ 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[43]. 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.[44]

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

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

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

Table 27: IPCC 2006 default values for $EF_{awms, T}$[45]

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

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

Analysis of animal ownership from the BUS (2019) shows that dairy cows are the dominant type of animal owned by almost all biodigesters users (94%[46]) under VPA-2. Given the marginal emission impact of the latter two categories and for conservativeness, only methane emissions from dairy cows will be considered in this emissions reduction calculation. Methane emissions from secondary and any following animal types are not included for conservativeness.

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 28: Ex-post Baseline emission from animal waste management[47]

Animal T	Average population $N_{T,h}$/hh[48]	$EF_{awms, T}$ (tonneCH$_4$/year)	GWP_{CH4}	$BE_{b1,CH4,y}$ (tCO$_2$e/year)
Dairy cow	4.78	0.031	25	3.705
		Total (rounded down)		**3.705**

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:

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

Where:

$PE_{p1,CH4,y}$ Project emissions from manure handling during the year y in tCO$_2$e

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

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[45] According to the BUS 2019, 94% of VPA-2 households dairy cows were the primary animals. For this reason, no other animals are included in this MPII

[46] Source: "20190215 BUS 2019 Tabulation JRI" sheet "BUS" cell U2082

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

[48] Source: "20190215 BUS 2019 Tabulation JRI" sheet "BUS" cell U2109

PL_y Physical leakage of the biodigester (through measurement or application of 10% default)

$\eta_{\text{new stove}}$ 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 29: Ex-post Project emission from animal waste management[49,50]

Animal T	$BE_{b1,CH4,y}$ (tCO$_2$e/year)	PL_y	$\eta_{\text{new stove}}$	$PE_{p1,CH4,y}$ (tCO$_2$e/year)
Dairy cow	4.78	10%	50%	2.037
			Total (rounded up)	**2.037**

The emission reductions from animal waste are the difference between the baseline and the project, as per the table below. Please note that here project emissions from bio-slurry are not included – refer to Section 3.1.5 for an overview of the calculation of project emissions from bio-slurry and Section 3.1.6 for how these project emissions have been accounted for in the final calculation.

Table 30: Emission reductions from animal waste management (including project emissions from bio-slurry, see Section 3.1.5)[51]

$BE_{b1,CH4,y}$ (tCO$_2$e/year)	$PE_{p1,CH4,y}$ (tCO$_2$e/year)	$PE_{p1 \text{ bio-slurry}}$ (tCO$_2$e/year)	$ER_{CH4,y}$ (tCO$_2$e/year)
3.705	2.037	0.042	**1.625**

3.1.4 LEAKAGE EMISSIONS

The project proponent investigated the following potential sources of leakage:

Table 31: Leakage emission assessment

#	Leakage source	Applicability
a	The displaced baseline technologies are reused outside the project boundary in place of lower emitting	The baseline technologies are not reused outside the project boundary. Traditional biomass stoves

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

[50] According to the BUS 2019, 94% of VPA-2 households dairy cows were the primary animals. For this reason, no other animals are included in this MPII

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

	technology or in a manner suggesting more usage than would have occurred in the absence of the project.	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.	It is considered as project emissions. A leakage assessment has been conducted as part of the BUS 2018, and is valid for a period of two years as per Gold Standard guidance. According to the results reported by households that are neighbors to biogas users, 4.58% of the households uses more biomass because of the neighbor having a biogas digester. On average, the increased amount of biomass for these households is 1030 kg per year. This amounts to leakage emissions of 0.037 tCO_2e per year.[52]
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 (biomass and LPG) as it is 100% renewable.
F	Physical leakage emissions	It is considered as project emissions - see section 3.1.3 and the emission reduction calculation spreadsheet
G	Emissions from biogas slurry	It is considered as project emissions - see section 3.1.5 and the emission reduction calculation spreadsheet. This amounts to leakage emissions of 0.042 tCO_2e per year.[53]

3.1.5 EMISSIONS FROM BIO-SLURRY (DIGESTATE)

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

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[52] See "20190027 ER Calculation VPA 1 MP2_v01" sheet "GS VER 2019 (CPI)" cell E77
[53] See "20190827 ER Calculation VPA 1 MP2_v01" sheet "GS VER 2018" cell E72

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

The total amount of VS entering the biogas plant depends on the type of animal and the share of manure that is fed into the biogas plant. The share of manure fed into the biogas plant can be found in section 3.22, and is calculated as:

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

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 32: Daily VS production of the average biodigester[54,55]

Animal T	VS excretion kgVS/hd/day[56]	Head/average biodigester[57]	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	4.78	13.384	78.00%	10.44
				Sum	10.44

2. **Assessment of remaining VS content of bio-slurry**

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[54] Figures may not add up due to rounding – see sheet emission reduction calculation sheet
[55] According to the BUS 2019, 94% of VPA-2 households dairy cows were the primary animals. For this reason, no other animals are included in this MPII
[56] 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
[57] Source: "20190215 BUS 2019 Tabulation JRI" sheet "BUS" cell U2109

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%[58]. 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 33: Average amount of VS in digester effluent[59]

(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}
10.44	55%	45%	4.70

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[60] 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:

$B_{o,dig,T}$ =   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

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

[59] According to the BUS 2019, 94% of households dairy cows were the primary animals. For this reason, no other animals are included in this MPII

[60] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-14-v1.pdf

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

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

Table 34: Calculated methane potential of digestate from manure by animal type[61]

Animal T	$F_{ww,CH4,}$	Bo(T) $(m^3CH4/kgVS)$	$B_{o,dig}$ $(m^3CH4/kgVS)$
Dairy cow	0.20	0.13	0.026

As discussed above, only dairy cows are taken into consideration for analysis, relevant calculation is shown in the table below:

Table 35: Average methane potential of bio-slurry from manure by animal type[62]

Animal T	Number	Fraction	Average $B_{o,dig}$ $(m^3CH4/kgVS)$
Dairy cow	5.87	100%	0.026
			0.026

Based on this, the weighted averaged $B_{0,dig}$ is 0.026 $(m^3CH4/kgVS)$

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

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

Where:

$PE_{bio-slurry}$ Annual average project emissions from bio-slurry, $tCO_2e/hh/yr$

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

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

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[61] According to the BUS 2019, 94% of VPA-2 households dairy cows were the primary animals. For this reason, no other animals are included in this MPII

[62] According to the BUS 2019, 94% of VPA-2 households dairy cows were the primary animals. For this reason, no other animals are included in this MPII

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

$\sum MCF$ = Cumulative methane conversion factors for digestate management system DMS, %

D_{CH4} = Conversion factor of m^3 CH_4 to kilograms CH_4

GWP CH4 = Global Warming Potential of methane (25)

The MCF applied to the bio-slurry emissions is 5.59%. The table below indicates the usage method of the bio-slurry and the corresponding calculation of the MCF.

Table 36: Overview of bio-slurry handling methods[63]

Bio-slurry handling method	Percentage	Corresponding IPCC definition	MCF
Use as fertilizer	64%	Daily spread	0.64%
Given away for free	2%	Daily spread	0.02%
Left where it is	6%	Liquid/slurry	4.68%
Dumped into open drain	4%	Aerobic treatment	0.00%
Dumped into river or lake	6%	Aerobic treatment	0.00%
Solid storage	2%	Solid storage	0.09%
Dumped on land	15%	Daily spread	0.15%
Composting	2%	Composting	0.01%
		Average MCF	**5.59%**

Table 37: Calculated emissions from bio-slurry, per household

Total VS in bio-slurry kgVS.day^{-1}	$B_{0,dig}$ (m^{3}CH4/kgVS)	$\sum$DMSxMCF	D_{CH4} (kg/m^3 CH$_4$)	PE$_{bio-slurry}$ (tCO$_2$/year/hh)
4.70	0.026	5.59%	0.67	0.042

The project emissions from bio-slurry equate to 0.042 tCO$_2$e. These have been included in the ER assessment.

3.1.6: EX-POST ESTIMATE OF THE EMISSION REDUCTIONS

The next table shows the ex-ante estimate of the emission reductions for each biogas unit:[64]

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[63] Source: "20190215 BUS 2019 Tabulation JRI" sheet "BUS" cell Z2704 to Z2714

[64] Figures may not add up due to rounding

Table 38: Average annual emission reductions

I	$BE_{b1,y}$ (tCO$_2$e/year)	PE_{p1y} (tCO$_2$e/year)	PE bio-slurry (tCO$_2$e/year)	LE_{b1y} (tCO$_2$e/year)	$ER_{,y}$ (tCO$_2$e/year)
Biomass and fossil fuel substitution	1.825	0.926	-	0.037	**0.862**
Manure handling	3.705	2.037	0.042	-	**1.625**
Sum (rounded down)					**2.487**

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

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

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.

Table 39: Emission reductions realised by the VPA 2

Month of program	Period, begin and end date inclusive		Cumulative number of units	Monthly ER (tCO$_2$e)	Cumulative ER (tCO$_2$e)
13	02-01-18	31-01-18	2,223	335	335
14	01-02-18	28-02-18	2,302	367	702
15	01-03-18	31-03-18	2,397	380	1,082
16	01-04-18	30-04-18	2,478	395	1,477
17	01-05-18	31-05-18	2,553	409	1,886
18	01-06-18	30-06-18	2,637	421	2,307
19	01-07-18	31-07-18	2,772	435	2,742
20	01-08-18	31-08-18	2,951	457	3,199
21	01-09-18	30-09-18	3,098	487	3,686
22	01-10-18	31-10-18	3,197	511	4,197
23	01-11-18	30-11-18	3,321	527	4,725
24	01-12-18	31-12-18	3,450	548	5,273
				Total	**5,273**

The table shows that the total number of ERs realized is **5,273 tCO$_2$e.**

Table 40: Emission reductions realised by the VPA 2, per vintage

Vintage	Start	End	Volume
2018	01/01/2018	31/12/2018	5,273
Total			**5,273**

3.1.7 JUSTIFICATION FOR ER DIFFERENCE WITH PDD

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

Table 41: BE, PE and ER as estimated in the PDD (per household, per year)

Scenario	BE (tCO$_2$e)	PE (tCO$_2$e)	LE (tCO$_2$e)	ER(tCO$_2$e)
Biomass and fossil fuel substitution	1.720	0.557	0.058	**1.104**
Methane avoidance	3.464	1.905	-	**1.559**
Bio-slurry	0.000	0.000	0.000	**0.000**
Total	5.36	2.40	0.074	**2.663**

The ex-ante estimated ER is higher to the ER estimated in this MR. The observed differences are caused by:

- On the household level: The amounts of biomass reported in the baseline study (1.259 tonnes/year) is lower than the amounts measured in the KPT (1.435 tonnes/year); and the KPT results indicate a slightly lower usage of LPG (0.088 tonnes/year compared to 0.117 tonnes/year, ex-ante). These factors combined explain the decrease from the ex-ante ER estimate of 1.104 tCO_2e to ex-post 0.862 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 4.59 per household) is slightly lower than the number reported in the BUS 2019 (average of 4.78 per household). This factor explains the increase from the ex-ante ER of 1.586 tCO_2e to ex-post 1.625 tCO_2e due to methane avoidance.

The difference between the ex-ante (2.663 tCO_2e) and ex-post (2.487 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 (5,273 tCO_2e) are above the ex-ante annual emission reduction reported in the VPA-DD (191,177 tCO_2e). This is due to the fact that VPA-2 just commenced implementation, while the VPA-DD assumes emission reductions once 20,000 units are installed by 2023.

The small-scale thresholds of 45MW_{th} (Type I) and 60,000 tCO2e (Type III) are not surpassed by the VPA. Given 3,450 units implemented to date under the VPA-2, this cumulates to 5.37 MW_{th} (see Section 1.3 for the calculation). As each biodigester produces a maximum emission reduction of 1.625 tCO_2e from methane avoidance, given 3,450 biodigesters installed, the cumulative amount of emission reductions from the methane avoidance component is 5,606 tCO_2e (after adjustment for drop-off rate and operational rate). Annualised, the results are as follows:

Table 42: Overview of ex-ante and ex-post VPA results versus applicable small-scale thresholds

Type	01/01/2018 to 31/12/2018
Ex-ante	
Type I (45 MW_{th})	39.20 MW_{th}[65]
Type III (60,000 tCO_2e)	30,000 tCO_2e[66]
Ex-post	
Type I (45 MW_{th})	5.37MW_{th}[67]
Type III (60,000 tCO_2e)	5,606tCO_2e[68]

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[65] See page 15 of the VPA-DD

[66] See page 15 of the VPA-DD

[67] For calculation, refer to "20190827 ER Calculation VPA 2 MP2_v03" sheet "Capacity calculation"

[68] For calculation, refer to "20190827 ER Calculation VPA 2 MP2_v03" sheet "GS VER 2019" Cell E90

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 2019 executed in December 2018.

Soil condition

Table 43: 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 02/01/2017		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 31/12/2018		64% of the households reported usage of bio-slurry (BUS 2018). Given 3,450 installed units, this equals **2,206 households.**[69]
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 December 2018
	By who	External consultant specialised in surveying – JRI Research

Quality of employment

Table 44: 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 02/01/2017	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.

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[69] See "20190215 BUS 2019 Tabulation JRI" sheet "BUS" cell Y2704. Calculation: 64% * 3,450 units installed

Estimation of baseline situation of parameter		Limited training and employment opportunities continue to exist.
Situation on 31/12/2018		**51** vocational trainings[70]
Future target for parameter		New certificates issued by the programme as implementation figures remained stable as no new units have been added to the VPA-2 in 2018. 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 supervisor sheet in the IDBP database of 2018, which marked the end of the implementation of new units under VPA-2.
	When	Annually; conducted in December 2018
	By who	IDBP staff

Livelihood of the poor

Table 45: 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 02/01/2017	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 biomass 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 biomass collection and cooking. Livelihood of the poor will remain unchanged.

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[70] See "20190211_IDBP_Database_VPA2 sheet "SPV" cell L217

Situation on 31/12/2018		BUS 2018 results[71] 'Improved': **2,721** (equivalent to 81.00% of total) 'The same': **729** (equivalent to 19.00% of total) 'Worsened': **0** (equivalent to 0% of total)
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 December 2018
	By who	External consultant specialised in surveying – JRI Research

Access to affordable and clean energy services

Table 46: 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 02/01/2017		Combustion of LPG, kerosene and biomass 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 biomass 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 31/12/2018		**3,450** biodigesters implemented[72]
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 December 2018
	By who	IDBP staff

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[71] See "20190215 BUS 2019 Tabulation JRI sheet "BUS" cells U3162-U3163
[72] See "20190211_IDBP_Database_VPA2" sheet "Master VPA-2" cell J3526

Human and institutional capacity

Table 47: 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 biomass 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 02/01/2017		Women spend much of their time collecting biomass 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 biomass and cooking, and remain with little spare time to undertake activities that stimulate personal and entrepreneurial development.
Situation on 31/12/2018		**744** women attending Operation and Maintenance training[73]
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 December 2018
	By who	External consultant specialised in surveying; JRI Research, IDBP staff

Quantitative employment and income generation

Table 48: 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 02/01/2017	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.

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[73] This data concerns cumulative results over the VPAs lifetime. See "20190211_IDBP_Database_VPA2" sheet "O&M training" cell I3238

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 farming activities.
Situation on 31/12/2018		**58** number of direct jobs created by the VPA[74] **7** number of constructors employed under the VPA **0** households sell the bio-slurry on the market (0% of total)[75]
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 December 2018
	By who	External consultant specialised in surveying; IDBP staff, JRI Research

Technology transfer and technological self-reliance

Table 49: 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 02/01/2017		Limited training opportunities and transfer of technology in the biogas sector, both on the constructors and user levels.
Estimation of baseline situation of parameter		Limited training opportunities and transfer of technology in the biogas sector continues, both on the constructors and user levels.
Situation on 31/12/2018		**3,235** Operation and Maintenance trainings[76]
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 December 2018

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[74] See "20190211_IDBP_Database_VPA2" sheet "SPV" cell L221

[75] Calculated as 0% * 3,450 = 0

[76] This data concerns cumulative results over the VPAs lifetime. See "20190211_IDBP_Database_VPA2" sheet "O&M training" cell I3240

	By who	External consultant specialised in surveying; IDBP staff, JRI Research

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, 58 job positions were created over the timeframe of the VPA, including 44 masons, 7 supervisors and 7 CPOs. The achieved job creation and enhanced human capacity creates a ripple-effect that has a significant socio-economic impact on the wider local community. Furthermore, 774 women have attended Operation and Maintenance training as well as bio-slurry utilization trainings.

The mason training extended under the VPA-2 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 (79.00%) 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) 21 782 10 86 | 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@rumahenergi.org | 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 that 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 Mr. Agung Lenggono who works at Hivos as the senior biogas expert. 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

ANNEX 1: CONTACT DETAILS OF THE PROJECT PARTICIPANTS

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Annex 2: List of CPOs

CPO ADDRESS	CONTACT PERSON	PROVINCE
JL. KOSAR NO. 9, KEL. PASIR ENDAH, KEC. UJUNG BERUNG, BANDUNG	ARIS SURYANA	JAWA BARAT
DESA JETAK, GETASAN, SEMARANG	YUSMIN	JAWA TENGAH
JL. PAHLAWAN RT. 09/02, REJOAGUNG, BATANGHARI	DARMOKO	LAMPUNG
JAMBU RT 01/RW 01, DESA KAMANGGIH, KEC. KAHAUNGU ETI, SUMBA TIMUR	YOSAFAT UMBU U'LI HANJATA	NUSA TENGGARA TIMUR
JL. ABDUL KUDDUS, KOMP. BAROMBONG PERMAI A/5, MAKASSAR	ROSMIATY LANTARA	SULAWESI SELATAN
JL. GAJAH MADA, WAIKABUBAK	DOMINIKUS D. MOURE	NUSA TENGGARA TIMUR
DUSUN AMBENGAN, DESA PENEDA GANDOR, KEC. LABUHAN HAJI, LOMBOK TIMUR	AHMAD WAHIDIN, S.SOS	NUSA TENGGARA BARAT