Gold standard for the global goals
Monitoring report

June 2017, version 1

Title of the PoA	African Biogas Carbon Programme (ABC)
Title of VPA	African Biogas Carbon Programme (ABC) – Uganda-VPA03
Gold Standard project id	PoA GS2747 VPA: GS4236
Version number of the monitoring report	1.4
Completion date of the monitoring report	03/11 /2020
Date of project design certification	19/04/2017 (VPA inclusion review closing date)
Start date of crediting period	19/04/2015
Duration of this monitoring period	01/04/2019 – 30/04/2020 both dates inclusive
Duration of previous monitoring period	01/09/2017 to 31/03/2019 both dates inclusive
Coordinating/managing entity	Hivos Foundation
Host Country	Uganda
Certification pathway (activity certification/impact certification)	Impact certification - SDG 13: Gold Standard Emissions Reductions (carbon credits)
SDG Contributions targeted (as per approved PDD)	SDG 2: Zero Hunger SDG 3: Good Health and Well-being SDG 5: Gender Equality SDG 7: Affordable and Clean Energy SDG 8: Decent work and Economic Growth SDG 13: Climate Action
Gold Standard statement/product certification sought (GSVER/ADALYs/RECs etc.)	GSVER
Selected methodology(ies)	Technologies and Practices to Displace Decentralized Energy Consumption (version 1.0)
Estimated amount of annual average certified SDG impact (as per approved PDD)	SDG 7: 9,534[1] digesters SDG 13: 7,975 tCO_2e Other SDGs are not quantified
Total amount of certified SDG impact (as per approved methodology) achieved in this monitoring period	SDG 2: 92% of the farmers use bio-slurry SDG 3: 88% of the users report perceived health improvement SDG 5: 94% of the women report time-savings SDG 7: 8,222 digesters and 219,886 working days labour created SDG 8: 102 masons trained SDG 13: 23,791 tCO_2e

[1] Calculated ex-ante value as the PDD did not contain an average estimate, see also section E.5.

SECTION A. Description of project

A.1. Purpose and general description of project

VPA003 is part of the African Biogas Carbon PoA. The aim of VPA003, the Uganda Domestic Biogas Programme, is to disseminate domestic biogas in rural and peri-urban areas with the ultimate goal of establishing a sustainable and commercially viable biogas sector in Uganda. The goal of the programme is to improve the livelihoods and quality of life of rural and per-urban farmers in Uganda through utilizing the market and non-market benefits of domestic biogas.

Biogas Solutions Uganda Ltd, founded in 2014, is the entity responsible for coordinating, facilitating and monitoring the programme and supporting the technical, financial and institutional architecture necessary for development of the domestic biogas sector in Uganda under this VPA. The VPA is implemented based on private sector market-oriented principles, but also develops governmental support for a favourable regulatory and policy environment, as well as general buy-in promotion and extension. The VPA will stimulate the installation of domestic biogas systems of 4 m^3, 6 m^3, 9 m^3, 12 m^3, 13 m^3 and 15 m^3 capacities (other sizes may be included under the VPA). This VPA was retroactively included in the ABC PoA and includes biogas systems that have been installed since 2009.

A.2. Location of project

The host party of this VPA is Uganda. The co-ordinates of Uganda are represented approximately by: 4°12'53.79" to -1°28'19.22" N, 29°34'17.52" to 35°2'33.81" E. The VPA will disseminate biogas systems over the entire territory of Uganda.

Figure 1: Geographical boundary of Uganda and the VPA

A.3. Reference of applied methodology

Gold Standard methodology 'Technologies and Practices to Displace Decentralized Thermal Energy Consumption' (Version 1.0)

A.4. Crediting period of project

7-year renewable crediting period: 19/04/2015-18/04/2022 inclusive both dates

SECTION B. Implementation of project

B.1. Description of implemented project

The aim of VPA003, the Uganda Domestic Biogas Programme, is to disseminate domestic biogas in rural and peri-urban areas with the ultimate goal of establishing a sustainable and commercially viable biogas sector in Uganda. The goal of the programme is to improve the livelihoods and quality of life of rural and per-urban farmers in Uganda through utilizing the market and non-market benefits of domestic biogas.

Biogas Solutions Uganda Ltd (BSUL), founded in 2014, is the entity responsible for coordinating, facilitating and monitoring the programme and supporting the technical, financial and institutional architecture necessary for development of the domestic biogas sector in Uganda under this VPA. The VPA is implemented based on private sector market-oriented principles, but also develops governmental support for a favourable regulatory and policy environment, as well as general buy-in promotion and extension. The VPA will stimulate the installation of domestic biogas systems of 4 m^3, 6 m^3, 9 m^3, 12 m^3, 13 m^3 and 15 m^3 capacities (other sizes may be included under the VPA). This VPA was retroactively included in the ABC PoA and includes biogas systems that have been installed since 2009.

The following table depicts the number of units installed by size in this VPA

Table 1: Digester capacities installed in this MP[2]

Size (m^3)	Units	Percentage
4	319	3.9%
6	5,158	62.7%
9	1,785	21.7%
12	245	3.0%
13	676	8.2%
>13	39	0.5%
sum	**8,222**	100%

The most frequently installed digester capacity is the 6 m^3 followed by the 9 m^3. The technical specifications are:

[2] See VPA03 MPIII database and SDG8, sheet SDG 8 B2:D8

Table 2: Technical specification of the digesters[3]

Specifics	Unit	4m³	6m³	9m³	12m³
Plant Volume	litre	3,900	5,850	8,775	13,163
Gas Storage Volume	litre	900	1,350	2,025	3,038
Digester Volume	litre	3,000	4,500	6,750	10,125
Min. Feeding	Kg/day	25	38	56	84
Max. Feeding	Kg/day	38	56	84	127
Min. daily gas production	m³/day	1.00	1.50	2.25	3.38
Max. daily gas production	m³/day	1.50	2.25	3.38	5.06
Average daily feeding	Kg/day	31	47	70	105
Average gas production	m³/day	1.25	1.88	2.81	4.22

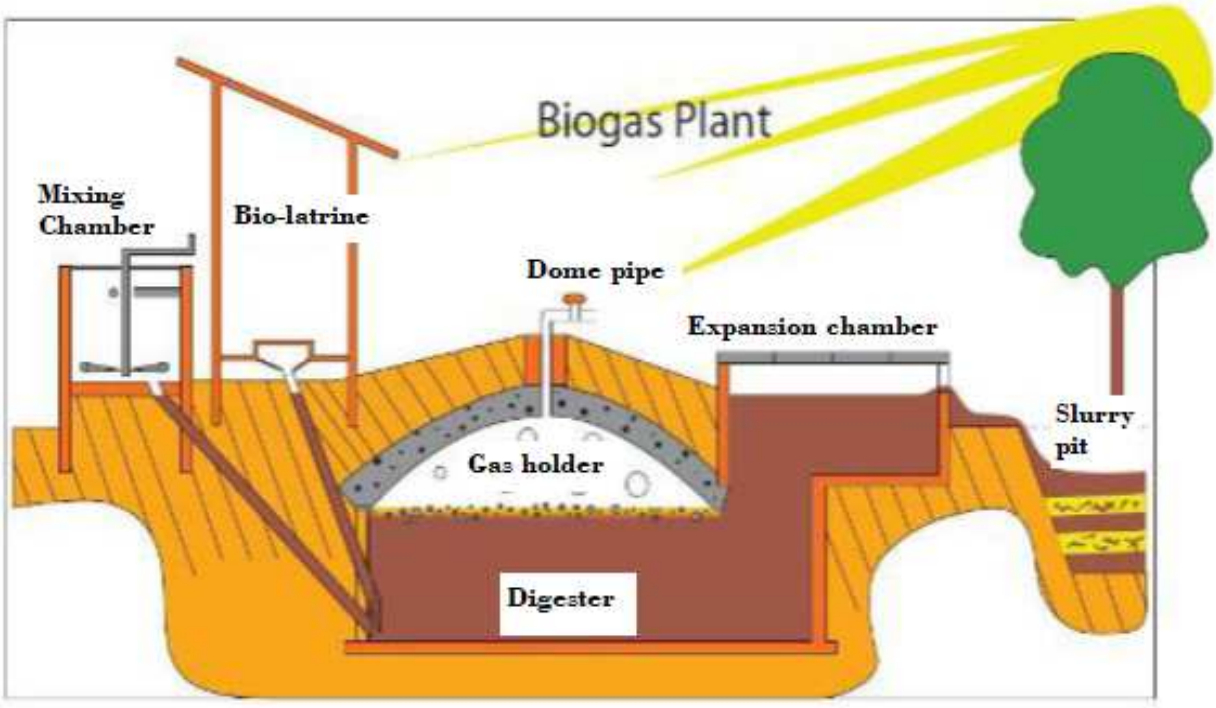
The number of units installed by age-group year:

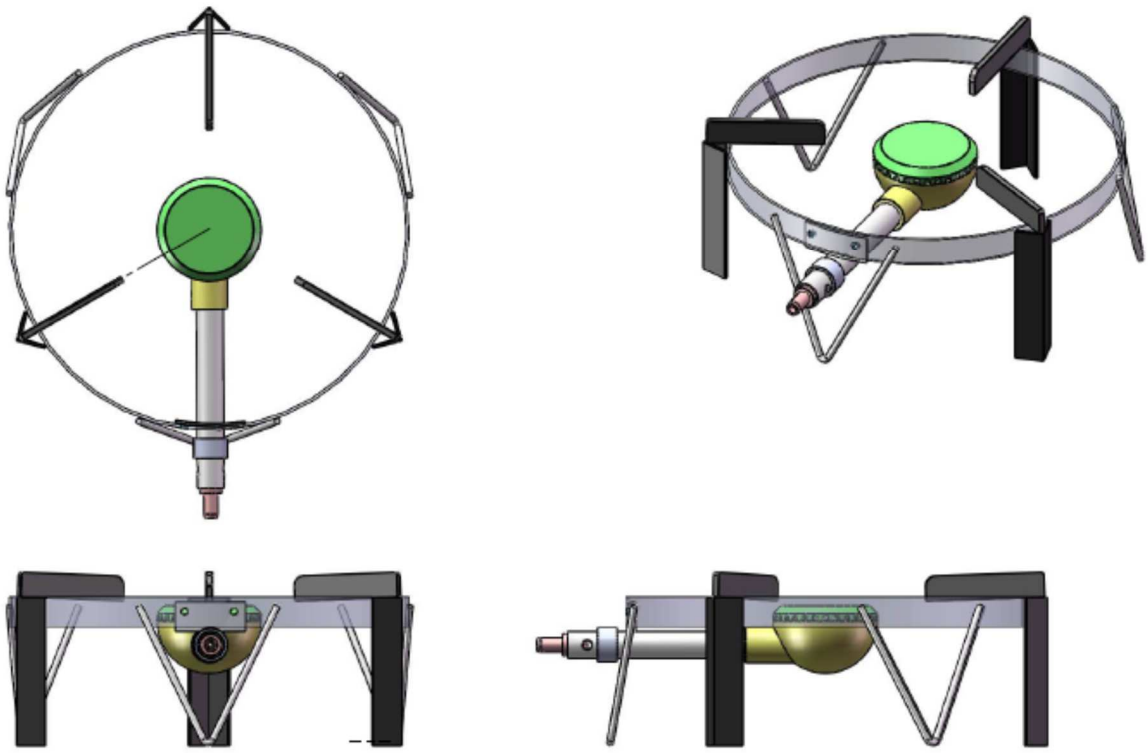
Table 3: Number of units installed by age-group year

Age group	Period, inclusive of all dates		
Year 1	01/01/2019	30/04/2020	910
Year 2	01/01/2018	31/12/2018	681
Year 3	01/01/2017	31/12/2017	603
Year 4	01/01/2016	31/12/2016	591
Year 5	01/01/2015	31/12/2015	624
Year 6	01/01/2014	31/12/2014	845
Year 7	01/01/2013	31/12/2013	1624
Year 8	01/01/2012	31/12/2012	993
Year 9	01/01/2011	31/12/2011	1025
Year 10	15/11/2009	31/12/2010	326
		total	8222

All installed digesters are fixed dome model constructed underground. A diagram of the biodigester and the stove is shown here below

[3] *As per BSUL technical information. Larger digesters than 13 m³ are also installed, but these compromise just 0.5% of all units installed and therefore not detailed. The performance of these digesters is proportional to the increase in digester volume. The 13 m³ digester is relatively popular with 8.2% of all digesters installed. This digester has a comparable technical specification with the 12 m3 as the size difference is small.*





To ensure operation and high user satisfaction, a number of activities are executed:

A) Quality Checks

Quality checks for plants under construction is done by Quality Service Providers (QSPs) who are contracted by the programme. For this monitoring period, 6 QSPs were contracted, and together they made sample visits to 210 bio-digesters under construction.

B) Plant Commissioning and Data capture

Plant commissioning and data capture is done by the BCE that contracts the bio-digester. For this monitoring period 817 bio-digester were commissioned by the BCEs.

C) Operations and Maintenance (O&M)

O&M activities for this monitoring period was carried out by both the BCEs and the QSPs. The BCEs carry out user training which has O&M and bio-slurry management and utilization training. QSPs come in where the household has report malfunction and the BCE has failed to respond and sort it out. For this period over 1250 households received O&M training, either through individual home visits or group training at a biogas model home.

D) After-sales

After-sales is conducted by the BCE, three months after the commissioning of the bio-digester. The BCE provides the report to BSUL which in turn uses the CSC to make confirmatory calls to the households.

For this monitoring period, after-sales was done to 748 households.

E) Repair, Maintenance and Training (RMT)

RMT is done by the QSPs. Normally clients with faulty plants report to the programme through the toll free line or the Clients Service Center (CSC), or through a promoter, or any other appropriate avenue. This is captured in the grievance tracker. The programme then informs the BCE who constructed the plant to rectify the issue. If the BCE fails to respond or sort the Issue, the programme then contracts the QSPs. The costs are normally met by the programme.

During this monitoring period, over 200 complaints were received by the office, from which 129 were sorted out using the QSPs. From the 129 complaints (technical), 52 were major repairs on the biogas installation. The cost for the repairs is met by the programme from Carbon fund

F) Monitoring calls

Monitoring calls were made by the independent Client Service Center (CSC) which is based in Nairobi but has a call center in Kampala (Uganda). It makes the following calls;

i. Plant Commission Report (PCR)
   This report is made every month. BSU provides a list of new commissioned plants on a monthly basis, for which the CSC makes calls to every household on the list to confirm if the plant has been commissioned and if functioning well.
ii. After-sales confirmation report
   The CSC also makes calls to households to confirm if the BCE has carried out after-sales and if the plant is working as indicated by the list provided by BSUL. This is also done on a monthly basis.
iii. Functionality assessment report
   Every quarter, BSUL uses the CSC to conduct functionality assessment on a sample basis for all the programme bio-digesters starting for 2009 to date.

B.2. Post-registration changes

B.2.1. Temporary deviations from Certified Key Project Information, Project Design Document, Monitoring & Reporting Plan, applied methodology or applied standardized baseline

N/A

B.2.2. Corrections

N/A

B.2.3. Changes to start date of crediting period

N/A

B.2.4. Permanent changes from registered monitoring plan, applied methodology or applied standardized baseline

The PoA transitioned to GS4GG on 23/07/2019. The transition annex is applicable to all VPAs registered under the PoA. Most monitoring parameters remained the same but are now expressed in terms of contribution to the SDGs instead to the SD parameters with the exception of the following parameters

- A new SDG is monitored: SDG5 Achieve gender equality and empower all women and girls with the following indicators:
    - Time savings of the female member in charge of cooking
    - Usage of saved time
- GS10 Technology transfer and technological self-reliance which is now SDG 8.5 (By 2030, achieve full and productive employment and decent work for all women and men) is calculated differently. In the VPA03 contribution to GS10 was monitored by listing the number of employees and mason trained. However, in the transition Annex this was modified to the number of days actually worked which is more informative.

B.2.5. Changes to project design of approved project

N/A

SECTION C. Description of monitoring system applied by the project

The objective of the monitoring effort conducted under this VPA was to meet the monitoring requirements set forth in the methodology 'Technologies and Practices to Displace Decentralized Thermal Energy Consumption' (Version 1.0), as per the PoA-DD, VPA-DD and transition annex.

Tasks and responsibilities in the monitoring system

The implementation of the monitoring system was coordinated and managed by the CME, Hivos, in cooperation with Independent consultant Eric Buysman. Survey questionnaires were prepared by ABPP (Africa Biogas Partnership Program) and BSUL (Biogas Solutions Uganda Ltd) and CIRCODU (Center for Integrated Research and Community Development Uganda) and programmed into the app Taroworks. The monitoring was implemented by CIRCODU, who carried out a review of the questionnaires, selected samples from the project database, recruited and trained enumerators[4] and implemented the carbon monitoring effort, including the biogas user survey. Finally, CIRCODU was responsible the presentation of the raw data and a report detailing the findings of the monitoring effort. Subsequently, Independent consultant Eric Buysman was responsible for preparing the monitoring report, including the calculation of emission reductions.

Data flow

The following graph provides an overview of the data flow in the monitoring process

Task	Description	Responsible actor
Data collection	Survey conducted through visiting and calling selected households	CIRCODU
Data recording	Survey data transferred from TaroWorks to electronic spreadsheet	CIRCODU
Data quality control	Collected data is cross-checked for consistency and errors	Eric Buysman
Calculations	Collected data is analysed to calculate individual parameters for input into emission reduction calculations	Eric Buysman
Reporting	Parameters input into emission reduction calculations and reported in the Monitoring Report.	Eric Buysman

Figure 2: Data flow in the monitoring process

SECTION D. Data and parameters

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

Relevant SDG	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data / Parameter:	$f_{NRB,y}$

[4] A separate training report is available for review

Data unit:	%
Description:	Fraction of biomass used in the absence of the project activity in year y that can be established as non-renewable biomass using nationally approved methods
Source of data:	Default fNRB,y factors from the CDM, available from https://cdm.unfccc.int/DNA/fNRB/index.html
Value(s) applied:	Uganda: 82%
Choice of data or Measurement methods and procedures:	GS registered PDD in which a fNRB is calculated which is valid for the whole of Uganda
Purpose of data	Calculation of baseline and project emissions
Additional comment:	Valid for this CP

Relevant SDG	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data / Parameter:	$EF_{b, bio}$
Data unit:	tCO_2/TJ
Description:	Emission factor of the woody biomass used in baseline scenario b
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied:	112
Choice of data or Measurement methods and procedures:	As per requirement of the methodology and Table 2.3, Chapter 2, Volume 2 of the 2006 IPCC Guidelines. The IPCC is a standard, credible source of emissions factors.
Purpose of data	Calculation of the baseline scenario
Additional comment:	IPCC (2006); May be updated according to any future changes by the IPCC. CO2 and non-CO2 emissions factors for charcoal may be estimated from project specific monitoring or alternatively by researching a conservative wood to charcoal production ratio (from IPCC, credible published literature, project- relevant measurement reports, or project-specific monitoring) and multiplying this value by the pertinent EF for wood.

Relevant SDG	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data / Parameter:	$EF_{p, bio}$
Data unit:	tCO_2/TJ
Description:	Emission factor of the woody biomass used in baseline scenario p
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied:	112
Choice of data or Measurement methods and procedures:	As per requirement of the methodology and Table 2.3, Chapter 2, Volume 2 of the 2006 IPCC Guidelines. The IPCC is a standard, credible source of emissions factors.
Purpose of data	Calculation of project emissions
Additional comment:	IPCC (2006); May be updated according to any future changes by the IPCC.

Relevant SDG	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data / Parameter:	$EF_{p,\ fuel}$
Data unit:	tCO2/TJ
Description:	Emission factor of fossil fuels used in project scenario p
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied:	Kerosene = 71.9 LPG = 63.1
Choice of data or Measurement methods and procedures:	As per requirement of the methodology and Table 2.3, Chapter 2, Volume 2 of the 2006 IPCC Guidelines. The IPCC is a standard, credible source of emissions factors.
Purpose of data	Calculation of baseline emissions
Additional comment:	IPCC (2006); May be updated according to any future changes by the IPCC.

Relevant SDG	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data / Parameter:	NCV_{bio}
Data unit:	TJ/tonne
Description:	Net calorific value of the non-renewable biomass used in the baseline scenario
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied:	0.015
Choice of data or Measurement methods and procedures:	As per requirement of the methodology and Table 2.3, Chapter 2, Volume 2 of the 2006 IPCC Guidelines. The IPCC is a standard, credible source of emissions factors.
Purpose of data	Calculation of baseline emissions
Additional comment:	N/A

Relevant SDG	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data / Parameter:	$EF_{b,\ fuel}$
Data unit:	tCO2/TJ
Description:	Emission factor of fossil fuels used in baseline scenario b
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied:	Kerosene = 71.9 LPG = 63.1
Choice of data or Measurement methods and procedures:	As per requirement of the methodology and Table 2.3, Chapter 2, Volume 2 of the 2006 IPCC Guidelines. The IPCC is a standard, credible source of emissions factors.
Purpose of data	Calculation of baseline emissions
Additional comment:	IPCC (2006); May be updated according to any future changes by the IPCC

Relevant SDG	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to

	adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data / Parameter:	NCV_{fuel}
Data unit:	TJ/tonne
Description:	Net calorific value of fossil fuels used in the baseline scenario
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied:	Kerosene = 0.0438 LPG = 0.0473
Choice of data or Measurement methods and procedures:	As per requirement of the methodology and Table 2.3, Chapter 2, Volume 2 of the 2006 IPCC Guidelines. The IPCC is a standard, credible source of emissions factors.
Purpose of data	Calculation of baseline emissions
Additional comment:	IPCC (2006); May be updated according to any future changes by the IPCC

Relevant SDG	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data / Parameter:	VS_T
Data unit:	kg/head/day
Description:	Daily volatile solid excreted for livestock category T
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied:	Dairy cows = 1.90 Other cattle = 1.50 Market Swine = 0.30 Breeding swine = 0.30 Goats = 0.35 Sheep = 0.32 Poultry = 0.02
Choice of data or Measurement methods and procedures:	As per requirement of the methodology and sourced from Tables 10. A-4 through A-9, Chapter 10, Volume 4 of the 2006 IPCC Guidelines The IPCC is a standard, credible source of emissions factors.
Purpose of data	Calculation of baseline emissions
Additional comment:	IPCC (2006); May be updated according to any future changes by the IPCC. National data can replace the IPCC value, if available

Relevant SDG	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data / Parameter:	Bo_T
Data unit:	m^3 CH_4/kg
Description:	Maximum methane producing capacity for manure produced by animal type T
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied:	Dairy cows = 0.13 Other cattle = 0.10 Market swine = 0.29 Breeding swine = 0.29 Goats = 0.13 Sheep = 0.13 Poultry = 0.24

Choice of data or Measurement methods and procedures:	As per requirement of the methodology and sourced from Tables 10. A-4 through A-9, Chapter 10, Volume 4 of the 2006 IPCC Guidelines The IPCC is a standard, credible source of emissions factors.
Purpose of data	Calculation of baseline emissions
Additional comment:	IPCC (2006); May be updated according to any future changes by the IPCC. National data can replace the IPCC value, if available

Relevant SDG	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data / Parameter:	$\eta_{biogas\ stove}$
Data unit:	%
Description:	Combustion efficiency of the new biogas stove introduced by the programme
Source of data:	Manufacturers specification taken from VPA03-DD
Value(s) applied:	*55*
Choice of data or Measurement methods and procedures:	BSUL does not specify the type of biogas stove that should be installed by a household, however they specifically promote the following stove types:

Manufacturer	Model no./ name	No. of burners	Thermal efficiency
Puxin	JZZ2-A13	2	>57%
Wusi	JZZ.2-A1	2	56.8%
Xunda	JZZ2-99	2	>58%
Xunda	JZZ1-6128	1	>58%
SNV	Lotus III (Cambodia)	1	55%

To be conservative the lowest value of efficiency has been taken.

Purpose of data	Calculation of project emissions
Additional comment:	n/a

Relevant SDG	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data / Parameter:	$MCF_{x,k}$
Data unit:	%
Description:	The methane conversion factor for the baseline manure management systems (x) in all the regions (k).
Source of data:	'UBP Manure Management Survey 2017; Tables 10.A-4 through A-9., Chapter 10, Volume 4 of the 2006 IPCC Guidelines; World Bank Climate Change Knowledge Portal5
Value(s) applied:	15.48
Choice of data or Measurement methods and procedures:	As per requirement of the methodology and sourced from Tables 10.A-4 through A-9., Chapter 10, Volume 4 of the 2006 IPCC Guidelines. The IPCC is a standard, credible source of emissions factors.
Purpose of data	Calculation of baseline emissions

[5] Average temperatures for Uganda are available here

Additional comment:	The VPA3-DD calculated a value of 3.59% which was an ex-ante value (see page 27 of VPA03-DD), the value for the baseline was ex-post established in MRI for this CP and adopted

Relevant SDG	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data/Parameter	**$EF_{awms,T}$**
Unit	m^3 CH4/kg
Description	Emission factor for the defined livestock population category T by average temperature (Uganda: 23.4 °C)
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied	

Animal T	**m3 CH4/kg**
Dairy cow	0.0015
Goat	0.0000
Other cattle	0.0001
Sheep	0.0000
Market swine	0.0026
Poultry	0.0000
Breeding swine	0.0026

Choice of data or measurement methods and procedures	Calculated following the values provided from Tables 10.A-4 through A-9., Chapter 10, Volume 4 of the 2006 IPCC Guidelines. The IPCC is a standard, credible source of emissions factors
Purpose of data/parameter	Calculation of project emissions
Additional comments	IPCC (2006); May be updated according to any future changes by the IPCC

Relevant SDG	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data / Parameter:	PL
Data unit:	%
Description:	Physical leakage of the biodigester
Source of data:	IPCC
Value(s) applied:	Estimated using a 10% default rate of total methane production.
Choice of data or Measurement methods and procedures:	10 %
Purpose of data	Calculation of project emissions
Additional comment:	As per Annex 6 of the applied methodology

D.2. Data and parameters monitored

Relevant SDG Indicator	Indicator 2.4.1 "Proportion of agricultural area under productive and sustainable agriculture
Data/parameter	Percentage of biogas users who use slurry as a fertilizer
Unit	%
Description	Percentage of biogas users who use slurry as a fertilizer
Measured/calculated/default	Calculated
Source of data	VPA03 MPIII survey_SDG_ER, sheet Analysis A, D43
Value(s) of monitored parameter	92%
Monitoring equipment	N/A
Measuring/reading/recording frequency:	Annual
Calculation method (if applicable):	Application of slurry as fertilizer on agricultural land will be monitored through sampling as part of the annual monitoring effort. Stakeholders will be asked how they use the slurry, if at all.
QA/QC procedures:	Transparent data analysis and reporting
Purpose of data:	SDG impact monitoring
Additional comments:	Former GS-3 Soil condition indicator

Relevant SDG Indicator	3.9.1: Mortality rate attributed to household and ambient air pollution
Data/parameter:	Perceived improvement in health by the user (incidence of eye problems and respiratory illness)
Unit	%
Description	Perceived improvement in health by the user (incidence of eye problems and respiratory illness)
Measured/calculated/default	Calculated
Source of data	VPA03 MPIII survey_SDG_ER, sheet Analysis A, cell D50:D52
Value(s) of monitored parameter	88% of the user report perceived health improvement 12% report no change 0% report deterioration in health
Monitoring equipment	Survey methods: Users of the biogas digesters will be asked if they feel the incidence of eye problems and respiratory illness have a) increased, b) stayed the same or c) decreased as a result of getting a biogas digester.
Measuring/reading/recording frequency:	Annual
Calculation method (if applicable):	N/A
QA/QC procedures:	Transparent data analysis and reporting
Purpose of data:	SDG impact monitoring
Additional comments:	Former GS-1 Air Quality indicator

Relevant SDG Indicator	SDG 5.: Achieve gender equality and empower all women and girls
Data/parameter:	Time savings
Unit	Percentage
Description	Percentage of women that report time-savings attributed to the installation of a biodigester
Measured/calculated/default	Calculated
Source of data	VPA03 MPIII survey_SDG_ER, sheet Analysis A, cell D56:D59
Value(s) of monitored parameter	Yes, more time available than before having biogas: 94% No, just the same as before (between before and after having Biogas): 4% Yes, less time available than before having biogas: 1% Similar: 1%
Monitoring equipment	Survey methods
Measuring/reading/recording frequency:	Annual
Calculation method (if applicable):	The female member of the household in charge of cooking and/or cooking fuel collection, will be asked: Did you save time compared to before you have installed a biodigester? (yes/no/same time investment)
QA/QC procedures:	Transparent data analysis and reporting
Purpose of data:	SDG impact monitoring
Additional comments:	N/A

Relevant SDG Indicator	SDG 5: Achieve gender equality and empower all women and girls
Data/parameter	Usage of saved time
Unit	[-]
Description	Usage of saved time
Measured/calculated/default	Calculated
Source of data	VPA03 MPIII survey_SDG_ER, sheet Analysis A, H62:H65
Value(s) of monitored parameter	Income generating including farming: 28% Education: 4% Leisure (chat, recreation, church resting): 58% Other: 10%
Monitoring equipment	Survey methods: The female member of the household in charge of cooking and/or cooking fuel collection, will be asked: Did you save time compared to before you have installed a biodigester? (yes/no/same time investment)
Measuring/reading/recording frequency:	Annual
Calculation method (if applicable):	The same female member will be asked – What did you do with your saved time? or if no time savings were reported, the reason why will be asked
QA/QC procedures:	Transparent data analysis and reporting
Purpose of data	SDG impact monitoring
Additional comment	N/A

Relevant SDG Indicator	7.1.2: Proportion of population with primary reliance on clean fuels and technology
Data/parameter:	**Number of biogas plants installed**
Unit	Number
Description	Number of biogas units installed
Measured/calculated/default	Calculated
Source of data	VPA03 MPIII database and SDG8, sheet SDG8, cell C9
Value(s) of monitored parameter	8,222
Monitoring equipment	N/A
Measuring/reading/recording frequency:	Annual
Calculation method (if applicable):	N/A
QA/QC procedures:	Transparent data analysis and reporting
Purpose of data:	SDG impact monitoring
Additional comments:	Former GS-08 Access to affordable and clean energy services indicator

Relevant SDG Indicator	7.1.2: Proportion of population with primary reliance on clean fuels and technology
Data/parameter:	Number of masons and biogas enterprise staff attending training programmes
Unit	number
Description	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 will be monitored.
Measured/calculated/default	Calculated
Source of data	Training records (SDG 07 VPA03 MPIII Masons, BCE staff training spreadsheet, F17)
Value(s) of monitored parameter	102
Monitoring equipment	Records will be kept of attendance at the vocational training programmes, including general training extended to entities outside of the programme.
Measuring/reading/recording frequency:	Annual
Calculation method (if applicable):	N/A
QA/QC procedures:	Transparent data analysis and reporting
Purpose of data:	SDG impact monitoring
Additional comments:	Former GS-12 Technology transfer and technological self-reliance indicator

Relevant SDG Indicator	8.5 By 2030, achieve full and productive employment and decent work for all women and men,
Data/parameter:	Employment generated
Unit	Number
Description	Number of man-days employment generated due to the construction of biogas plants
Measured/calculated/default	Calculated
Source of data	VPA03 MPIII database and SDG8, sheet SDG8, cell F9
Value(s) of monitored parameter	219,886
Monitoring equipment	N/A
Measuring/reading/recording frequency:	Annual

Calculation method (if applicable):	Calculated by multiplying the number of days required to install a digester times the number of units installed by size. Models above 12 m3 are assumed to require the same number of days as the 12 m3, that is conservative.
QA/QC procedures:	Transparent data analysis and reporting
Purpose of data:	SDG impact monitoring
Additional comments:	Former GS-10 Technology transfer and technological self-reliance indicator

Relevant SDG Indicator	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data/parameter:	$U_{p1,y}$
Unit	Fraction
Description	Cumulative usage rate for technologies in project scenario p in year y, based on cumulative adoption rate and drop-off rate (fraction)
Measured/calculated/default	Calculated
Source of data	VPA03 MPIII survey_SDG_ER, sheet Analysis B, cell G15
Value(s) of monitored parameter	63.35%
Monitoring equipment	Survey methods
Measuring/reading/recording frequency:	Annual
Calculation method (if applicable):	An assessment of the drop-off rate of usage requires that digesters of different age groups are assessed. Monitoring shall be carried out on a random sample of digesters of different ages. The minimum total sample size is 100, with at least 30 samples for biogas digesters of each age bracket (measured in annual increments) being surveyed. To account for void responses and lack of availability of some households on the day of the survey, additional households within each age group should be questioned. To ensure conservativeness, participants in a usage survey with technologies in the first year of use (age 0-1) must have technologies that have been in use on average longer than 0.5 years. For technologies in the second year of use (age 1-2), the usage survey must be conducted with technologies that have been in use on average at least 1.5 years, and so on. The usage rate of thermal applications will be monitored annually using survey methods to satisfy the requirements put forth by the methodology 'Technologies and practices to displace decentralized thermal energy consumption' (11/04/2011).
QA/QC procedures:	Transparent data analysis and reporting
Purpose of data:	Calculation of project emissions

Additional comments:	A single usage parameter is weighted to be representative of the quantity of project technologies of each age being credited in a given project scenario. In brackets are the cells which contain the values referred to in the spreadsheet Analysis_B The weighted average usage rate of all age groups is: 60.15% (G13). That percentage has been adjusted downward to account for the off-time of plants to 59.72% (Cell G14) and subsequently adjust upward for plants that went out of operation but worked for a period during this MP, see cell G15.

Relevant SDG Indicator	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data/parameter:	$N_{p1,y}$
Unit	Number
Description	Cumulative number of project technology-days included in the project database for project scenario p against baseline scenario b in year y
Measured/calculated/default	Calculated
Source of data	VPA03 MPIII survey_SDG_ER, sheet Analysis B, cell C57
Value(s) of monitored parameter	2640215
Monitoring equipment	N/A
Measuring/reading/recording frequency:	Annual
Calculation method (if applicable):	New biogas digesters included under the PoA will be entered into the Project Database as and when they come online. This will enable a running cumulative total of biogas digesters installed to be kept. The operational rate is determined on a sampling basis through annual monitoring surveys. Np,y shall be calculated from (a) the number of installed system (parameter Nop,y); and (b) the average operational days of the system (Op,y).
QA/QC procedures:	Transparent data analysis and reporting
Purpose of data:	Calculation of project emissions
Additional comments:	N/A

Relevant SDG Indicator	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production". 7.1.2: Proportion of population with primary reliance on clean fuels and technology
Data/parameter:	$N_{op1,y}$
Unit	Number
Description	Cumulative number of project technologies included in the project database for project scenario p in year y
Measured/calculated/default	Calculated
Source of data	VPA03 MPIII survey_SDG_ER, sheet Analysis B, cell C58

Value(s) of monitored parameter	8,222
Monitoring equipment	N/A
Measuring/reading/recording frequency:	Annual
Calculation method (if applicable):	The date presented in the Sales Agreement for each biogas digester is recorded in the Project Database. The average length of time between when a digester is completed and when biogas begins to be used will be established on VPA level. $N_{0p1,y}$ will be calculated from this date.
QA/QC procedures:	Transparent data analysis and reporting
Purpose of data:	Calculation of project emissions
Additional comments:	N/A

Relevant SDG Indicator	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data/parameter:	$O_{p1,y}$
Unit	Number
Description	The average technology-days during which the biodigesters are operational for project scenario p1 against the identified baseline scenario's (b1,b2,b3) in year y
Measured/calculated/default	Calculated
Source of data	VPA03 MPIII survey_SDG_ER, sheet Analysis B, cell C56
Value(s) of monitored parameter	321.12
Monitoring equipment	N/A
Measuring/reading/recording frequency:	Annual
Calculation method (if applicable):	The operational rate is determined on a sampling basis through annual monitoring surveys. In addition, households are required to notify provincial office staff in a situation when a biodigester stops working. This information is recorded in the Project database, allowing the identification per included biodigester the amount of operational days per year. In a scenario where the biodigester stops operating, the number of non-operational days is recorded in the database.
QA/QC procedures:	Transparent data analysis and reporting
Purpose of data:	Calculation of project emissions
Additional comments:	The actual cumulative number of biodigester non-operational days will be confirmed upon verification. The equation to calculate this is (Op1,y = 365 – non- operational days)

Relevant SDG Indicator	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data/parameter:	$LE_{p1,y}$
Unit	tCO2e/year
Description	Leakage in project scenario p during year y
Measured/calculated/default	Calculated
Source of data	GS MPII issuance review
Value(s) of monitored parameter	0

Monitoring equipment	Non-biogas digester users will be surveyed through a questionnaire to determine whether leakage has occurred.
Measuring/reading/recording frequency:	The leakage will be monitored annually using survey methods to satisfy the requirements put forth by the methodology 'Technologies and practices to displace decentralized thermal energy consumption' (11/04/2011).
Calculation method (if applicable):	N/A
QA/QC procedures:	Transparent data analysis and reporting
Purpose of data:	Calculation of project emissions
Additional comments:	This approach was approved by the Gold Standard on 20 October 2016 during the initial validation and confirmed in the MPII issuance review - leakages are negligible and can be ignored

Relevant SDG Indicator	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data/parameter:	$N_{T,h}$
Unit	Number
Description	Number of animals of livestock category T in premise h
Measured/calculated/default	Calculated
Source of data	VPA03 MPIII survey_SDG_ER, sheet Analysis A, cell C7:C13
Value(s) of monitored parameter	

Number of animals	**#/hh**
Number of dairy cattle	5.63
Number of other cattle	0.89
Number of pigs (for market)	1.01
Number of pigs (for breeding)	0.59
Number of poultry	10.08
Number of sheep	0.86
Number of goats	2.88

Monitoring equipment	Survey methods
Measuring/reading/recording frequency:	Annual
Calculation method (if applicable):	Households/communities/SMEs will be asked how many animals of different categories they own, and the conditions under which they are kept (i.e. freely or in a confined space).
QA/QC procedures:	Transparent data analysis and reporting
Purpose of data:	Calculation of project emissions
Additional comments:	N/A

Relevant SDG Indicator	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data/parameter:	$BB_{b\ ratio}$
Unit	%
Description	Baseline scenario ratios
Measured/calculated/default	Calculated
Source of data	VPA03 MPIII survey_SDG_ER, sheet Analysis A, cell D16:D19

Value(s) of monitored parameter	

Baseline scenario	#	Percentage
B1: Firewood used to meet (more than 50%) of my cooking needs	103	67.8%
B2: Charcoal used to meet (more than 50%) of my cooking needs	30	19.7%
B3: Firewood & charcoal used to meet (more than 50%) of my cooking	18	11.8%
B4:Other fuels	1	0.7%

Monitoring equipment	Survey methods
Measuring/reading/recording frequency:	Annual
Calculation method (if applicable):	Households/communities/SMEs are asked which baseline scenario they fell into before receiving a biogas digester.
QA/QC procedures:	Transparent data analysis and reporting
Purpose of data:	Calculation of project emissions
Additional comments:	N/A

Relevant SDG Indicator	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data/Parameter	**$BB_{b1,bio}$**
Unit	Tonnes/year
Description	Amount of woody biomass used in the baseline scenario b1
Measured/calculated/ default	Measured
Source of data	Survey C – BFT Sample Size UG-B1
Value(s) of monitored parameter	3.527
Monitoring equipment	N/A
Measuring/reading/recording frequency	Not applicable: Option B BFT conducted once upfront and parameter fixed throughout the crediting period.
Calculation method (if applicable)	N/A
QA/QC procedures	To account for void responses and lack of availability of some households/communities/SMEs on the day of the survey, additional households were questioned.
Purpose of data	Calculation of baseline emissions
Additional comments	Value is verified in MPI and applicable to this MP

Relevant SDG Indicator	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data/Parameter	**$BB_{b2,bio}$**
Unit	Tonnes/year
Description	Amount of woody biomass used in the baseline scenario b2
Measured/calculated/ default	Measured
Source of data	Sample size UG-B2 updated version
Value(s) of monitored parameter	7.042

Monitoring equipment	Survey methods and newton scales
Measuring/reading/recording frequency	Not applicable: Option B BFT conducted once upfront and parameter fixed throughout the crediting period.
Calculation method (if applicable)	N/A
QA/QC procedures	To account for void responses and lack of availability of some households/communities/SMEs on the day of the survey, additional households were questioned.
Purpose of data	Calculation of baseline emissions
Additional comments	Value is verified in MPI and applicable to this MP

Relevant SDG Indicator	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data/Parameter	$BB_{b3,bio}$
Unit	Tonnes/year
Description	Amount of woody biomass used in the baseline scenario b3
Measured/calculated/ default	Measured
Source of data	Sample Size UG-B3
Value(s) of monitored parameter	10.034
Monitoring equipment	Survey methods and newton scales
Measuring/reading/recording frequency	Not applicable: Option B BFT conducted once upfront and parameter fixed throughout the crediting period.
Calculation method (if applicable)	N/A
QA/QC procedures	To account for void responses and lack of availability of some households/communities/SMEs on the day of the survey, at least 10 additional households should be questioned
Purpose of data	Calculation of baseline emissions
Additional comments	Value is verified in MPI and applicable to this MP

Relevant SDG Indicator	**Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".**
Data/Parameter	$BB_{b1,2,3,\,fuel}$
Unit	Tonnes/year
Description	Amount of fossil fuel used in the baseline scenarios b1, b2 and b3
Measured/calculated/ default	Measured
Source of data	Survey C BFT Sample Size – UG-B1 Sample size UG-B2 updated version Sample Size UG-B3
Value(s) of monitored parameter	0
Monitoring equipment	Survey methods and newton scales
Measuring/reading/recording frequency	The BFT was conducted during MPI and fixed for the crediting period

Calculation method (if applicable)	N/A
QA/QC procedures	To account for void responses and lack of availability of some households/communities/SMEs on the day of the survey, at least 10 additional households should be questioned.
Purpose of data	To calculate baseline emissions
Additional comments	Project Performance Field Test will be updated once every two years.

Relevant SDG Indicator	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data/parameter:	$BB_{p1,\,bio}$
Unit	Tonnes/year
Description	Amount of woody biomass used in the project scenario p
Measured/calculated/default	Calculated
Source of data	VPA03 MPIII survey_SDG_ER, sheet PFT, cell F66
Value(s) of monitored parameter	2.846
Monitoring equipment	Survey methods and newton scales
Measuring/reading/recording frequency:	Project Performance Field Test (PFT) will be updated once every two years
Calculation method (if applicable):	Households/communities/SMEs will both be asked how much woody biomass they use per week, and undergo a Kitchen Performance Test as per the requirements of the TPDDTEC methodology.
QA/QC procedures:	Transparent data analysis and reporting
Purpose of data:	Calculation of project emissions
Additional comments:	N/A

Relevant SDG Indicator	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data/parameter:	$BB_{p1,fuel}$
Unit	Tonnes/year
Description	Projected amount of fossil fuels used in the project scenario p
Measured/calculated/default	Calculated
Source of data	VPA03 MPIII survey_SDG_ER, sheet PFT, cell I63 and H63
Value(s) of monitored parameter	0
Monitoring equipment	Survey methods
Measuring/reading/recording frequency:	Project Performance Field Test (PFT) will be updated once every two years.
Calculation method (if applicable):	Households/communities/SMEs will be asked how much fossil fuels they use per week for cooking.
QA/QC procedures:	account for void responses and lack of availability of some households/communities/SMEs on the day of the survey, at least 10 additional households should be questioned.
Purpose of data:	Calculation of project emissions
Additional comments:	N/A

Relevant SDG Indicator	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data/parameter:	$MS_{P,S,K}$
Unit	%
Description	Fraction of livestock category T's manure not treated in bio-digester, in climate region *k*
Measured/calculated/default	Calculated
Source of data	VPA03 MPIII survey_SDG_ER, sheet Analysis A, cell C33:C39
Value(s) of monitored parameter	**Animal T** / **Average amount** Dairy cow / 12.5% Cattle / 13.1% Market swine / 48.8% Breeding swine / 67.5% Poultry / 95.4% Sheep / 92.9% Goat / 95.0%
Monitoring equipment	Survey methods
Measuring/reading/recording frequency:	Annual
Calculation method (if applicable):	Households/communities/SMEs will be asked to estimate the fraction of their animal's manure that is fed into the biogas digester for the different relevant livestock categories.
QA/QC procedures:	account for void responses and lack of availability of some households/communities/SMEs on the day of the survey, at least 10 additional households should be questioned.
Purpose of data:	Calculation of project emissions
Additional comments:	N/A

Relevant SDG Indicator	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data/parameter:	$MS_{T,S,k}$
Unit	%
Description	Fraction of livestock category T's manure fed into the bio-digester, *S* in climate region *k*
Measured/calculated/default	Calculated
Source of data	VPA03 MPIII survey_SDG_ER, sheet Analysis A, cell C24:C30
Value(s) of monitored parameter	**Animal T** / **Average amount** Dairy cow / **87.5%** Cattle / **86.9%** Market swine / **51.3%** Breeding swine / **32.5%** Poultry / **4.6%** Sheep / **7.1%** Goat / **5.0%**
Monitoring equipment	Survey methods
Measuring/reading/recording frequency:	Annual

Calculation method (if applicable):	Households/communities/SMEs will be asked to estimate the fraction of their animal's manure that is fed into the biogas digester for the different relevant livestock categories.
QA/QC procedures:	To account for void responses and lack of availability of some households/communities/SMEs on the day of the survey, at least 10 additional households should be questioned.
Purpose of data:	Calculation of project emissions
Additional comments:	N/A

Relevant SDG Indicator	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data/parameter:	GWP_{CH4}
Unit	Unit
Description	Global Warming Potential of methane
Measured/calculated/default	IPCC default
Source of data	IPCC (2006); May be updated according to any future changes by the IPCC
Value(s) of monitored parameter	25
Monitoring equipment	N/A
Measuring/reading/recording frequency:	Annual
Calculation method (if applicable):	The IPCC guidelines will be checked on an annual basis during verification to determine if the GWP of methane has changed from the above.
QA/QC procedures:	Transparent data analysis and reporting
Purpose of data:	Calculation of project emissions
Additional comments:	N/A

Relevant SDG Indicator	Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".
Data/parameter:	Bio
Unit	-
Description	Use of bio-slurry
Measured/calculated/default	Calculated
Source of data	VPA03 MPIII survey_SDG_ER, sheet bio-slurry, cell D14:D20
Value(s) of monitored parameter	
Monitoring equipment	Survey methods
Measuring/reading/recording frequency:	Annual
Calculation method (if applicable):	N/A

How do you apply bio-slurry	**% of farmers**
Used as fertilizer	47%
Used as animal feed	4%
Bio-slurry is sold	1%
Used as an insecticide/pesticide	2%
Used as animal feed	4%
Store it first	39%
I don't use it / discarded	3%

QA/QC procedures:	Sampling in accordance with the procedures in the methodology applied shall be carried out.
Purpose of data:	Calculation of project emissions
Additional comments:	The total is more than 100% as some farmers have multiple application methods

D.3. Implementation of sampling plan

Target respondents

The data collection targeted users of biogas technologies under the African Biogas Carbon Programme (ABC) - Uganda. The users/respondents will be drawn from the project database which will be provided by Hivos. The data collection will be obtained by three household surveys, that is: -

- Survey A (User Survey); which will gather information about household socio-economic indicators, fuel use for cooking, renewability and non-renewability indicators, animal waste handling, use of bio-slurry on agricultural fields, perceived improvement of living conditions, financial and time savings, and user satisfaction with biogas, bio-slurry and trainings.
- Survey B (Usage Survey); this will collect data about the actual functioning of the biogas digesters.
- Survey C (Project Fuel Test-PFT); the consultant team will collect fuel use data of households with a biodigester in operation in form of Kitchen Performance Tests (KPTs).

Survey A and B

i. Objectives and reliability requirements

The objective of the sampling effort was to meet the monitoring requirements set forth in the methodology 'Technologies and Practices to Displace Decentralized Thermal Energy Consumption' (version 1.0).

ii. Target population / sampling frame

The target population for this survey were VPA03 households from ten age clusters of biogas plants commissioned between 15 November 2009[6] and 28 February 2020 in all regions of Uganda.

iii. Sampling method

A multi-stage sampling approach was used in selection biogas plants, considering the proportionate representation of different regions and counties in the sample. The sampling frame was stratified by age of biogas plant (10 age groups) and in those age group households were randomly sampled.

The survey consultant sampled 70 households in each age-group with the aim to reach at least 30 households[7] in each age group. This oversampling was required as some sampled households could not be reached by telephone or were unwilling to be surveyed. Those households were replaced by other households from the list of 70 in each age group randomly sampled from the database. Considering that more than a dozen enumerators were conducting the survey at the same time and

[7] 30 household per age group is the minimum requirement as per applied methodology.

in different regions, real time aggregating of the number of households surveyed was usually difficult. As such, more households than required were surveyed as reflected in Table 2 below:

Table 4: Age group and households interviewed

Age group	Age group period		Sampled period (conservative)		Sample Reached Survey B	Sample Reached survey A
Year 1	01/01/2019	30/04/2020	01/01/2019	31/08/2019	34	18
Year 2	01/01/2018	31/12/2018	01/01/2018	30/06/2018	38	15
Year 3	01/01/2017	31/12/2017	01/01/2017	30/06/2017	37	15
Year 4	01/01/2016	31/12/2016	01/01/2016	30/06/2016	40	16
Year 5	01/01/2015	31/12/2015	01/01/2015	30/06/2015	38	16
Year 6	01/01/2014	31/12/2014	01/01/2014	30/06/2014	44	14
Year 7	01/01/2013	31/12/2013	01/01/2013	30/06/2013	41	13
Year 8	01/01/2012	31/12/2012	01/01/2012	30/06/2012	35	13
Year 9	01/01/2011	31/12/2011	01/01/2011	30/06/2011	44	18
Year 10	15/11/2009	31/12/2010	15/11/2009	30/06/2010	38	14
				sum	**389**	**152**[8]

Year 1 is a little bit longer than 1 year; 1 year and 4 months and year 10 1 year, 1 month and 15 days. This was the consequence of covering a period that is not dividable into even age groups and the preference to synchronize age groups with calendar years (done for year 2 to 9). The survey was implanted in 58 districts and in 4 regions. Please refer to chapter 2 and 3 of the CIRCORDU BUS Report[9] on more details regarding the sampling method, and the regions selected. That report, and the sampling files are available as separate documents.

Out of the 389 survey B households, 222 were physically visited (57%) and 167 (43%) called[10]. This is meeting the requirement that at least 50% of the households have to visited physically[11]. Survey A households are a sub-set from survey B and were all physically visited.

iv. Execution:

Survey A was executed in the period February to March 2020. The period of execution includes contracting, data gathering, analysis, QC and reporting.

v. Analysis

Analysis was performed on the monitoring surveys' results to establish the required monitored parameters. For Survey A and B, please refer to the Excel sheet 'VPA03 MPIII survey_SDG_ER, sheet Analysis A and sheet Analysis B and sheet bio-slurry for a complete run-through of how the analysis for each parameter was conducted.

[8] Initially 153 households, however 1 household was removed (see sheet remove hh row 9 in the VPA03 MPIII survey_SDG_ER file) – that household did not have a working biodigester. The total number of valid interviews is then 152.

[9] See chapter 2 in CIRCODU (2020) Biogas User Survey Report (available as separate report)

[10] VPA03 MPIII survey_SDG_ER, sheet survey B cell L394 and L395

[11] See the table in VPA03 MPIII Survey_SDG_ER sheet Analysis B cells: B60:D63

For detailed explanations regarding parameter calculations, please refer to section D.2.

vi. Demonstration that the required confidence/precision level has been met

Demonstration of the required confidence/precision level is not relevant for Survey A and B, where instead a minimum sample size applies as per the Technologies and Practices to Displace Decentralized Thermal Energy Consumption methodology. The minimum sample is 100 for survey A and 30 per age group for survey B. In both cases more households were reached and therefore the requirement has been met.

Survey C –Project Fuel Test

i. Objectives and reliability requirements - PFT

The objective of the sampling effort was to meet the monitoring requirements set forth in the methodology 'Technologies and Practices to Displace Decentralized Thermal Energy Consumption' (version 1.0).

ii. Target population – PFT

The Project Fuel Test targeted households that owned biodigesters in all regions of Uganda

iii. Sampling method - PFT

Survey C was a sub-set of Survey A, and targeted a randomly selected 60 households proportionally divided over the age groups.

iv. Objectives and reliability requirements - PFT

The objective of the sampling effort was to meet the monitoring requirements set forth in the methodology 'Technologies and Practices to Displace Decentralized Thermal Energy Consumption' (version 1.0).

v. Execution

The PFT was conducted during the period February and March 2020 including data entry and analysis. PFT – the PFT was done within a 24-hour period, with 68 (60+8 oversampling) pre-selected households. Fuel measurements were taken based on the predetermined KPT procedure, and all measurements using weighing scales were undertaken using calibrated weighing scales of 50 kg capacity with an accuracy of 5 gram.

The KPT data were entered in the relevant results sheets provided by the BSUL. All data were subjected to a quality control/quality assurance process to prepare it for an accurate analysis. This included getting rid of extra spaces and filling blank spaces with N/A; removing duplicates in the data; where there was inconsistencies or lack of clarity in data captured, the households were contacted in order to clarify any information that was not clear. Out of the 67 visited households, 50 valid interviews were conducted and the data of 1 hh was lost due to a synchronisation issue between Taroworks and Salesforce and 17 hh were deemed invalid due to unforeseen consequences, such as more eaters than normal, out of the ordinary cooking etc. The survey consultant followed up on 35 households with telephone calls as part of QA/QC processes[12]

vi. Analysis

All collected data were subjected to the Grubb test to eliminate outliers – 0 outliers were removed. Subsequently, it was checked whether the 90/30 confidence/precision level had been met. All implemented surveys have met the required confidence/precision level.

[12] See sheet VPA03 MPIII survey_SDG_ER sheet PFT for the PFT raw data

vii. Demonstration that the desired confidence and precision level was met

The requirement 90/30 was met in the PFT – the obtained level of precision and confidence was 90/16%, see VPA03 MPIII survey_SDG_ER, sheet PFT.

Responds to GS FAR MPII review

The GS issued a FAR during MPII review: *It's requested to conduct usage survey by Feb 2020 to meet the monitoring frequency and the usage survey shall cover all age groups. If the usage survey demonstrates lower rate in different age groups than the value used in this MP [this MP means MPII], emission reduction of MP2 shall be adjusted in next MP*[13] *[the next MP is this MP].*

- The usage survey is executed by February/March 2020
- The calculated operational rate is 63.35% and the operation rate in MPII was 64.75% (see VPA03-DD section E.2 Data and parameters monitored). The MPII ER claim was 33,350 tCO2e, the amount to be adjusted is then (1-63.35%/64.75%) * 33,350 = 720 tCO2e[14]
- Age-groups are 1 yearlong by default. Age group 10 however was a bit longer than 1 year (1 year, 1 month and 15 days) which was an adjustment to synchronize age-group with calendar years. Age group 1 was as a result of the MP end-date (April 2020), also a bit longer than 1 year (1 year and 4 months). It was due to GS requirements not possible to identify an age-group of 4 months old as only households can be surveyed that have digesters in use for more than half a year) in age-group 1, which 1 spans the period 01/01/2019 to 30/04/2020. Only the first 8 months of that age-group were surveyed (up to 31 August 2019). The results were applied to all plants up to the 30/4/2020 – which is conservative.

SECTION E. Calculation of SDG outcomes

E.1. Calculation of baseline value or estimation of baseline situation of each SDG outcome

Methodological approach to calculating the contribution to SDG2

SDG 2.4.1: Proportion of agricultural area under productive and sustainable agriculture

The contribution will be reported as the: *Percentage of biogas users who use slurry as a fertilizer*

The occurrence of application of slurry to agricultural land will be monitored through sampling as part of the annual monitoring effort. Stakeholders will be asked how they use the slurry, if at all. The outcome of the survey is the share of households that use bio-slurry.

A biodigester is required to produce and use bio-slurry, the baseline, the absence of the project, therefore is 0 household use bio-slurry

Methodological approach to calculating the contribution to SDG3

3.9.1: Mortality rate attributed to household and ambient air pollution

[13] The next MP is this MP

[14] See VPA03 MPIII survey_SDG_ER sheet SDG 13, cell A59:C62 for the calculations

The contribution will be reported as the: *number of users with a reduced, increased or no change in the incidence of eye problems and respiratory illness.*

Users of the biogas digesters will be asked if they feel the incidence of eye problems and respiratory illness have a) increased, b) stayed the same or c) decreased as a result of getting a biogas digester. The incidence will be monitored through sampling as part of the annual monitoring effort.

The baseline is 0 households report a reduce incidence as before the project no biodigesters were installed in the target population

Methodological approach to calculating the contribution to SDG5
SDG 5: Achieve gender equality and empower all women and girls

The contribution will be reported as: *(1) Percentage of women that report time-savings attributed to the installation of a biodigester and (2) usage of saved time.*

1. Time savings will be determined as follows:

The female member of the household in charge of cooking and/or cooking fuel collection, will be asked:

- Did you save time compared to before you have installed a biodigester? (yes/no/same time investment)

2. The same female member will be asked
   - What did you do with your saved time? or if no time savings were reported, the reason why will be asked

The contribution will be monitored through sampling as part of the annual monitoring effort.

The baseline is 0 females report time savings as before the project no biodigesters were installed in the target population

Methodological approach to calculating the contribution to SDG7
7.1.2: Proportion of population with primary reliance on clean fuels and technology

The contribution to this target will be determined by:

- Number of biogas units installed (captured in parameter $N_{op1,y}$(Cumulative number of project technologies included in the project database for project scenario p1 in year y). This data originates from the project database

The baseline is 0 as before the project no biodigesters were installed in the target population

- Number of masons and biogas enterprise staff attending training programmes. The source of data will be training records such as participants lists.

The baseline is 0 as before the project no masons and biogas enterprise staff could attend trainings.

Methodological approach to calculating the contribution to SDG8

8.5 By 2030, achieve full and productive employment and decent work for all women and men

The contribution to this target will be determined by calculating the *number of man-days involved in the construction of biodigesters.*

$$MD_y = \sum_{DT,S}^{1} N_{DT,S} \times MD_{DT,S}$$

Where

MD_y	=	Man-days of employment generated through the construction of biodigesters (days)
$N_{DT,S}$	=	Number of biodigester constructed by type and size
$MD_{DT,S}$	=	Number of man-days required for the construction of a particular type and size of biodigester

The number of days required by digester type will be determined based on the bill of quantities (BoQ) of each digester type and size. A small number of masonry digesters are larger than 12 m^3, in absence of reliable estimates on the labour requirements, the labour requirement of the 12 m^3 digester is used for those digesters, which is conservative.

The baseline is 0 as before the project no biodigesters were installed in the target population

Methodological approach to calculating the contribution to SDG13

Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".

1. Baseline emissions from fuel use:

Applicable baseline scenarios are defined by the typical baseline fuel consumption patterns in a population that is targeted for adoption of the biodigester technology. The amount of baseline scenarios were defined in the VPA-DD through a baseline survey. The ratio of each scenario are monitored, see the equation below:

$$BE_{b,CO2,y} = \sum_b BB_{b,fuel} * NCV_{fuel} * EF_{b,fuel}) + (BB_{b,bio} * NCV_{bio} * EF_{b,bio} * f_{NRB})$$

Where:

$BE_{b,CO2,y}$ Cumulative baseline CO_2 emissions from the use non-renewable biomass and fossil fuels during year *y*

$BB_{b,fuel}$ The quantity of fossil fuel consumed in the baseline scenario *b*, in tonnes/year

NCV_{fuel} Net calorific value of fossil fuel, in TJ/tonne

$EF_{b,fuel}$ CO_2 emission factor of fossil fuel in baseline scenario *b*, in tonnes/TJ

$BB_{b,bio}$ The quantity of biomass consumed in the baseline scenario *b*, in tonnes/year

NCV_{bio} Net calorific value of biomass, in TJ/tonne

$EF_{b,bio}$ CO_2 emission factor of biomass in baseline scenario *b*, in tonnes/TJ

f_{NRB} Fraction of non-renewable biomass, in percentage

The table below provides and overview of the input variables and the obtained baseline scenario ratio from survey A.

Table 5: Baseline emissions from fuel use

Baseline scenario	Quantity of biomass used (tonnes/hh/yr)	f_{NRB} %	NCV TJ/ton	$EF_{b1,bio}$ tCO_2/TJ	Baseline emissions (tCO_2e/yr)	Ratio
$BB_{b1,bio}$	3.527	82.0%	0.015	112	**4.86**	67.8%
$BB_{b2,bio}$	7.042				**9.70**	19.7%
$BB_{b3,bio}$	10.034				**13.82**	11.8%
$BB_{b4,LPG}$	0.00	1	0.0473	63.1	**0.00**	0.7%

Finally, to account for the fact that not all baselines feature equally within the project population, the baseline emissions were then weighted by the baseline ratios to determine the baseline emissions from fuel substitution and are: 6.844 tCO2/year/hh[15]

2. Accounting for baseline emissions from manure handling.

The baseline emissions from the handling of animal waste is determined with IPCC Tier 2. The baseline emissions per household shall be calculated as follows:

$$BE_{b,CH4,h,y} = \frac{(VS_T * 365) * (B_{0,T} * 0.67 kg/m^3 * MCF_{x,k} * MS_{T,x,k} * GWP_{CH_4} * N_{T,h})}{1000}$$

Where:

$BE_{b,CH4,h,y}$ Baseline emissions from manure handling during the year *y* in tCO_2e for manure handling method h

VS_T Daily volatile solid excreted for livestock category T in kg dry matter per animal per day

$B_{0,T}$ Maximum methane producing capacity for manure produced by livestock category T in m^3 CH_4

[15] Cell E60 in VPA03 MPIII survey_SDG_ER sheet BE

$MCF_{x,k}$ Methane conversion factors for the animal waste handling system in the baseline situation by climate zone *k*, (%)

$MS_{T,x,k}$ Fraction of livestock category T's manure handled using manure management system *x* in climate region *k* (determined through survey method ex-post)

GWP_{CH4} Global Warming Potential of methane

$N_{T,h}$ Number of livestock category T in premise *h*

$MCF_{x,k}$, $MS_{T,x,k}$ and VS_T and $B_{0,T}$ are defined *ex-ante*. $N_{T,h}$, the average number of animals per household (for each type of animal) is established as a monitored parameter, as part of Survey A - Biogas User Survey, see section D.2 for the ex-post values. Using these values, the calculated baseline methane emissions are: 1.778 tCO2/year/hh[16].

E.2. Calculation of project value or estimation of project situation of each SDG outcome

Please refer to chapter E.1 for the calculation approach regarding SDG 2.4.1, 3.9.1 and 5

SDG	Indicator	Estimation of project situation of each SDG outcome
2.4.1	Percentage of biogas users who use slurry as a fertilizer	92%
3.9.1	Perceived improvement in health by the user (incidence of eye problems and respiratory illness)	88% report improvement
5	Female time savings	94% report having more time available
	Usage of saved time	Income generating including farming: 28% Education: 4% Leisure (chat, recreation, church resting): 58% Other: 10%
7.1.2	Number of units installed	8,222
	Number of man-days involved in the	Number of mason days: 219,886

[16] Cell E37 in VPA03 MPIII survey_SDG_ER sheet BE

	construction of biodigesters.	
8.3.1	Number of employees attending training programmes	102

SDG 13: Project emissions

Source 1: *Accounting for project emissions due to the continued use of fossil fuels and non-renewable biomass*

The project scenario is defined by the fuel consumption of end users within the targeted population that adopts the biodigester technology. This formula calculates the project emissions per household:

$$PE_{p,CO2,y} = \sum(BB_{p,fuel} * NCV_{fuel} * EF_{p,fuel}) + (BB_{p,bio} * NCV_{bio} * EF_{p,bio} * f_{NRB})$$

Where:

$PE_{p,CO2,y}$ Cumulative project CO_2 emissions from the use non-renewable biomass and fossil fuels during year y
$BB_{p,fuel}$ The quantity of fossil fuel consumed in the project scenario *p*, in tonnes/year NCV_{fuel} Net calorific value of fossil fuel, in TJ/tonne
$EF_{p,fuel}$ CO_2 emission factor of fossil fuel in project scenario *p*, in tonnes/TJ
$BB_{p,bio}$ The quantity of biomass consumed in the project scenario p, in tonnes/year
NCV_{bio} Net calorific value of biomass, in TJ/tonne
$EF_{p,bio}$ CO_2 emission factor of biomass in project scenario *p*, in tonnes/TJ
f_{NRB} Fraction of non-renewable biomass, in percentage

Therefore:

$PE_{p1,CO2,y}$ = 2.846 tonne/year * 0.015 TJ/tonne x 112 Tonne CO_2/TJ x 82.0%+ 0.00 tonne/year*0.0473 TJ/tonne x 63.1 Tonne CO_2/TJ = 3,921[17] tCO_2/hh/year

Source 2: *Accounting for project emissions due to the methane emissions from manure handling*

Project emissions of the methane avoidance component include both the physical leakage of biogas from the bio digester and the incomplete combustion of biogas. These shall be accounted for in accordance with equation (17) of the applicable methodology:

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

Where:

[17] Cell E63 in VPA03 MPIII survey_SDG_ER sheet PE

$PE_{p,CH4,y}$	Project emissions from manure handling during the year y in tCO_2e
GWP_{CH4}	Global Warming Potential of methane (25)
$N_{T,h}$	Number of livestock category T in premise h
$EF_{awms,T}$	Emission factor for the defined livestock population category T
PL_y	Physical leakage of the biodigester (through measurement or application of 10% default)
$\eta_{new\ stove}$	Combustion efficiency of the used type of biogas stove

In the above equation, $EF_{awms,T}$ is further defined as:

$$EF_{awms,h} = \frac{(VS_T * 365) * (B_{0,T} * 0.67 kg/m^3 * MCF_{x,k} * MS_{T,x,k})}{1000}$$

Where

$EF_{awms(T)}$	CH_4 emission factor for livestock category *T*, (tCH4per animal per year)
VS(T)	Daily volatile solid excreted for livestock category *T*, (kg dry matter per animal per day)
365	Basis for calculating annual VS production, (days per year)
Bo(T)	Maximum methane production capacity for manure produced by livestock category *T*, (m3CH4 per kg of VS excreted)
$MCF_{(BL,k)}$	Methane conversion factors for the animal waste handling system in the baseline situation by climate zone k, (%)
$MS_{(T,S,k)}$	Fraction of livestock category *T*'s manure treated in the animal waste management system, in climate region *k* (dimensionless)

The project methane emissions per household per year under the VPA03 are therefore:

$PE_{p,CH4,y} = 0.151$ tCO2/year/hh[18]

Source 3: *Accounting for project emissions due to bio-slurry*

Emissions from bio-slurry (i.e. the product excreted from the biogas digester in addition to combustible biogas) must be taken into account if it is found they account for more than 1% of project emissions. In order to estimate the project emissions occurring from bioslurry, the following steps are followed (see sheet bio-slurry in the file VPA03 MPIII survey_SDG_ER for the calculations):

Step 1: estimation of the total amount of VS entering the biodigester
To estimate the total amount of Volatile Solids (VS) that enters the biogas digester, for each animal, the VS excretion in kg/day is multiplied with the average number of animals owned by households with a biodigester. This results in a total amount of VS excreted per animal per day. Next, these totals are multiplied with the share of bioslurry fed into the biodigester for each animal, resulting in the total VS entering the biodigester per day. The sum of VS entering the biodigester from all animals combined is 10.82 $kgVS.day^{-1}$.

Step 2: assessment of remaining VS content of bio-slurry

[18] Cell D49 in MPIII survey_SDG_ER sheet PE

The second step is the assessment of remaining VS content. A 55% efficiency is assumed for the digesters implemented through this project; the remaining VS content of bio-slurry is therefore 45% of total VS introduced to the digester. The figure is calculated by subtracting the percentage of VS that is destroyed in the biodigester from the total VS entering the biodigester. The resulting total VS in bio-slurry is:

$$10.82\ kgVS.day^{-1} \times 45\% = 4.87\ kgVS.day^{-1}.$$

Step 3: Assessment of the methane potential of bio-slurry

To assess the methane potential of bio-slurry under the project scenario, for each animal the maximum methane producing capacity of the manure is multiplied by the remaining CH_4 production capacity of liquid digestate ($F_{ww,CH4}$) (EB 96 Annex 7). The resulting figure is multiplied with the total VS entering the biodigester per animal and proportionally weighted, resulting in an average methane potential per digester of 0.026 m^3CH_4/kgVS per day.

Step 4: calculation of bio-slurry emissions

Next, to calculate the total project bio-slurry emissions, the following formula is applied:

$$\mathbf{PE_{p1\ bio\text{-}slurry} = (total\ VS\ in\ biodigesters * 365) * Bo_{,dig} * \Sigma DMS * MCF * (D_{CH4}/1000) * GWP_{CH4}} \quad [19]$$

Where:

$PE_{p1\ bio\text{-}slurry}$	Project emissions from bio-slurry
$Bo_{,dig}$	Maximum methane production capacity for the biodigester ($m^3CH4/kgVS$)
DMS	Bio-slurry management practice, as a fraction
MCF	Methane conversion factor
D_{CH4}	Density of methane conversion factor
GWP_{CH4}	Global Warming Potential of methane

The calculated DMS is 7.06%, see sheet bioslurry, cell H9 in VPA06 MPIII survey_SDG_ER

Therefore:

$PE_{p1\ bio\text{-}slurry}$ = (4.87*365) * 0.026 * 7.06% * (0.67/1000) * 25

$PE_{p1\ bio\text{-}slurry}$ = 0.002[20] tCO_2/yr

Parameter $PE_{p1\ bio\text{-}slurry}$ represents less than 1% of total emission reductions generated by the project. $PE_{p1\ bio\text{-}slurry}$ is therefore excluded from calculation (see spreadsheet "VPA03 MPIII survey_SDG sheet "Bio-slurry" for detailed step-by-step calculation and explanation).

Total Project Emissions under the VPA (and per household) are equal to the three above components (i.e. related to displacement of fossil fuels and non-renewable biomass, avoidance of methane emissions from manure handling, and bio-slurry):

$$PE = PE_{p1,CO_2,y} + PE_{p1,CH_4,y} + PE_{p1,bio-slurry}$$

PE = 4.072 tCO_2/year/hh

[19] This equation is not mentioned in the VPA03-DD, PoA-DD nor in the transition Annex. It is copied from section F.2 in MRII

[20] Cell E72 in VPA03 MPIII survey_SDG_ER sheet bio-slurry

Leakage emissions
The methodology states that the following potential sources of leakage are to be considered:

- The displaced baseline cook stoves- are reused outside the project boundary in place of lower emitting technology or in a manner suggesting more usage than would have occurred in the absence of the project;
- The non-renewable biomass or fossil fuels saved under the project activity are used by non-project users who previously used lower emitting energy sources;
- 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.
- 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;
- By virtue of promotion and marketing of a new technology with high efficiency, the project stimulates substitution within users who commonly used a technology with relatively lower emissions, in cases where such a trend is not eligible as an evolving baseline.

A leakage investigation shall be conducted every two years using relevant survey methods that can be combined with monitoring surveys as is applicable. Leakage risks deemed very low will be ignored where the case for their insignificance can be substantiated. The latter was the case in the review of VPA03 MPI, as per GS MPII issuance review - leakages are negligible and can be ignored

E.3. Calculation of net benefits as difference of baseline and project values or direct calculation for each SDG outcome

SDG	Indicator	Baseline	Project	Net difference
2.4.1	Percentage of biogas users who use slurry as a fertilizer	0	92%	92%
3.9.1	Perceived improvement in health by the user (incidence of eye problems and respiratory illness)	0	88%	88%
5	Female time savings	0	94%	94%
	Usage of saved time	N/A	Income generating including farming: 28% Education: 4% Leisure (chat, recreation, church resting): 58%	See project levels

			Other 10%	
7.1.2	GS-08 Access to affordable and clean energy services	0	8,222	8,222
	GS-12 Technology transfer and technological self-reliance	0	Number of mason days: 219,886	219,886
8.3.1	Number of employees attending training programmes	0	102	102

SDG 13.2.1 Net benefit

The emission reductions are calculated with the following calculation:

$$\boldsymbol{ER_{y,h} = U_{y,h} \times (BE_{y,h} - PE_{y,h})} \text{ x } \mathbf{No_{p1,y}}$$

Where:

$ER_{y,h}$	=	Annual average emission reductions in year y
$U_{y,h}$	=	Cumulative usage rate for technologies in project scenario p in year y, based on cumulative adoption rate and drop off rate revealed by usage surveys
$BE_{y,h}$	=	Annual average baseline emissions per household in year y
$PE_{y,h}$	=	Annual average project activity emissions per household in year y
$No_{p1,y}$	=	Total number of biogas units commissioned as of year y

The calculated usage rate and number of installed units are as per section D.2 is 63.35% and 8,222. With those values and taking into account the installation rate during this MP, the ERs are shown here below:

VPA Gold Standard reference number (PoA / VPA)	Baseline GHG emissions or baseline net GHG removals ($t CO_2e$)	Project GHG emissions or actual net GHG removals ($t CO_2e$)	Leakage GHG emissions ($t CO_2e$)	MPII adjustment [21] (GS FAR) ($t CO_2e$)	GHG emission reductions or net anthropogenic GHG removals ($t CO_2e$)		
					Before 01/01/2013	From 01/01/2013	Total amount
GS 2747 /4236	46,449	21,938	0	720	N/A	23,791	23,791
Total	**46,449**	21,938	**0**	720	**N/A**	23,791	**23,791**

See sheet SDG 13 in file VPA03 MPIII survey_SDG_ER, cell A41:G45

E.4. Summary of ex-post values of each SDG outcome for the current monitoring period

SDG	Baseline estimate	Project estimate	Net benefit
2.4.1	0	92%	92%
3.9.1	0	88%	88%
5	0	94%	94%
	N/A	Income generating including farming: 28% Education: 4% Leisure (chat, recreation, church resting): 58% Other: 10%	See project levels
7.1.2	0	8,222	8,222
	0	Number of mason days: 219,886	219,886
8.3.1	0	102	102
13.2.1	**46,449**	21,938	24,511 or 23,791 including FAR adjustment[22]

E.5. Comparison of actual value of outcomes with estimates in approved PDD

SDG	Values estimated in ex ante calculation of approved PDD e	Actual values achieved during this monitoring period
2.4.1	Not estimated	92%
3.9.1	Not estimated	88%
5	Not estimated	94%

[21] See section D.3

[22] Including the correction of 720 ERs as per FAR, see section D.3

	Not estimated		Income generating including farming	28%
			Education	4%
			Leisure (chat, recreation, church resting)	58%
			Other	10%
7.1.2	9,534[23]	8,222		
	Not estimated	219,886		
8.3.1	Not estimated	102		

SDG 13.2.1.: Comparison of emission reductions or net anthropogenic removals achieved with estimates in the included VPA-DDs'

NOTE this is calculated without the adjustment based on the GS-FAR

Period	Amount achieved during this monitoring period (t CO_2e)	Amount estimated ex ante (t CO_2e)
01/03/19 to 31/12/2019	16649	7445
01/01/2020 to 30/04/2020	7862	3685
Total	**24,511[24]**	**11130**

See sheet SDG13 in VPA03 MPIII Survey_SDG A48:C52 for an overview how these values are derived.

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

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The PDD was registered under GS V2.1 and does not contain estimates on SDG 2,5,8. For that reason, the estimates were not included.

The ex-post emission reductions (24,511[24] ERs) are higher than the estimated ex-ante emission reductions (11,130 ERs) due to the following main reasons:

- Methane Conversion Factor (MCF): the ex-ante MCF was 3.59%, based on a survey of similar smallholder farmers in Kenya in 2014. Ex-post, the MCF was 15.48%, based on the MPI which asked customers how they managed their animal's manure before receiving a biogas digester.
- The emission reductions from fuel use were just 0.666 $tCO_2/hh/yr$ in the VPA03-DD while this is 6.844 $tCO_2/hh/yr$ in this MR. In VPA03-DD no ex-ante values were available of

[23] See cell C57 in sheet SDG13 of the file VPA03 MPIII survey_SDG_ER

[24] Excluding the adjustment due to the FAR – this has been excluded as it would otherwise lead to an unfair comparison with the ex-ante values.

scenario b2 and b3 and fuel use in those scenario's were assumed to be 0. Consequently, in the ex-ante emission reductions from fuel use were underestimated.

SECTION F. Stakeholder inputs and legal disputes

F.1. List all inputs/grievances which have been received for the project during the monitoring period together with their respective answers/actions

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Clients call directly to the Biogas Solutions Uganda Limited (BSUL) office to raise any complaints/comments they may have. These are recorded in the 'Complaints Tracker' tool by BSUL. Any issues are picked up by the Quality Control Manager, who then contacts the relevant Biogas Construction Enterprise (BCE) or Mason who constructed the biogas digester to address the issue at the client's premises. The Monitoring and Evaluation officer then follows up the progress of this intervention by making weekly phone calls to the households in the complaints tracker to make sure the issues are resolved or are at least being followed up on until rectification is achieved.

The status of the resolution of the grievances is recorded in the complaint tracker. Please refer to this file for a full list of all inputs/grievances received[25].

242 queries were received, most of them were questions related to the bio-digester and repair requests, see below

Row Labels	Count of Name of client
Complaint	9
Interested in biogas	23
Operation & Maintenance	4
Others	2
Searching for Appliance/Spare	1
Technical fault	203
Grand Total	**242**

[25] Excel file 14Jul20 VPA03 MPIII Grievance tracker

Out of the 242, 141 cases are closed, 16 on-going and 82 pending. Five out of 9 complaints are closed, 3 relate to incomplete construction due to COVID-19 travel restrictions, 1 household want a biogas lamp and 1 where the household claims that the promotor took the money. That case #232 on the list, was followed up after flagging that case in this MR. The issue is being addressed; the plant is completed but the stove is not working well – this being addressed at time of writing.

F.2. List all inputs/grievances from previous monitoring period where follow up action is to be verified in this monitoring period

In MPII 627 grievances were presented of which 84 were not addressed. An overview is provided below[26]:

Status MPII	#	How issues was resolved/addressed
Being handled	19	Complaint is being handled
Not yet rectified	65	Complaint recorded but not yet handled.
Excavated	2	Plant construction has begun
Grand Total	**84**	

In MPIII these plants were followed up, the status of those 84 is now[27]

Status MPIII of MPII open cases	#	Comment
rectified	13	Complaint is closed
not yet rectified	33	Complaint recorded but not yet handled.
being handled	38	The complaint is being handled
Grand Total	**84**	

The number of cases being handled is larger than in MPII, which is the consequence of the VPA implementer of handling cases not yet rectified of MPII in MPIII.

The rectified cases include 3 clients who reported that their plant was dismantled, or they have no interested in restoring the system. These plants have been removed from the database. These are BSU/05315, BSU1/03569)[28] and another plant was excluded by the VPA implementer prior to this MP[29]

BSUL will follow up on the not yet rectified cases and those being handled in MPIV

[26] See MPII VPA03

[27] See sheet 'overview of status update' in VPA03 MPII complaints tracker update 19thJuly20

[28] Respectively HH 29 and 56 in the VPA03 MPII compliance tracker_update 19thJuly20 spreadsheet

[29] #53 in the VPA03 MPII compliance tracker_update 19thJuly20 spreadsheet – this plant was already removed from the database by BSUL

F.3. Provide details of any legal contest or dispute that has arisen with the project during the monitoring period

There is one dispute that have arisen with this project during this monitoring period, that is household #232. BSUL is following up on this case, and this case is almost closed. The digester is constructed but there is an issue with the stove which is being addressed at time of writing.