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| **Voluntary project activity design document form****(Version 08.0)** |
| *Complete this form in accordance with the instructions attached at the end of this form.* |
| **BASIC INFORMATION** |
| **Title of the VPA** | GS5801 African Biogas Carbon Programme (ABC) - Kenya - VPA006 |
| **Scale of the VPA** | [ ]  Large-scale[x]  Small-scale |
| **Version number of the VPA-DD** | 1.3 |
| **Completion date of the VPA-DD** | 26/01/2018 |
| **Title and UNFCCC reference number of the registered CDM PoA**  | African Biogas Carbon Programme (ABC) GS2747  |
| **Title and reference number of the corresponding generic VPA**  | N/A |
| **Coordinating/managing entity** | Hivos |
| **Host Party** | Kenya |
| **Applied methodologies and standardized baselines** | Gold Standard methodology “Technologies and Practices to Displace Decentralized Thermal Energy Consumption” (Version 1.0) |
| **Sectoral scopes linked to the applied methodologies** | 1 Energy industries (renewable - / non-renewable sources)13 Waste handling and disposal |
| **Estimated amount of annual average GHG emission reductions** | 38,966 |

1. Description of component project activity (VPA)
	* 1. General description of VPA

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The overall objective of the VPA is to contribute to the achievement of the Sustainable Development Goals (SDGs) through the dissemination of domestic biogas systems as a local, sustainable energy source, as well as the development of a commercially viable, market-oriented biogas sector. By encouraging the switch from traditional non-renewable biomass (NRB) fuels to renewable biogas the VPA is reducing greenhouse gas (GHG) emissions. Emission reductions are accounted for only from biogas used for cooking, although some customers use biogas also for lighting.

The Kenya Biogas Programme (KBP), is the sector leader with the responsibility of coordinating, facilitating and monitoring sector functions and supporting the technical, financial and institutional architecture necessary for development of the domestic biogas sector in Kenya.

The VPA is to be implemented based on private sector market oriented principles, but developing governmental support for a favourable regulatory and policy environment, as well as general buy-in promotion and extension.

The Kenya VPA006 is part of the African Biogas Carbon (ABC) PoA. The VPA is located in Kenya.

The technologies/measures employed by the VPA

The VPA will stimulate the installation of domestic biogas systems of from 4m3 capacity. Digesters of any size are permitted as long as they are demonstrated to be below the small-scale limit. The VPA implementer has selected the appropriate biogas technology to be implemented through engagement with a wide range of stakeholders. They agreed on a fixed dome digester design to be known as the Kenya National Biogas Model (KENBIM). Please refer to section A.3 for more details on the technology employed by the VPA.

The project boundary

The project boundary of the VPA is the physical boundary of the Republic of Kenya.

The baseline scenario

With wood fuel (firewood and charcoal) accounting for 68% of the total primary energy consumption, biomass fuels are the most important source of household energy in Kenya.[[1]](#footnote-2) firewood is used by the majority of rural households, whereas kerosene and charcoal are used most in urban areas.[[2]](#footnote-3) The demand for wood fuel is frequently higher than the supply, as resources are depleted faster than they are replenished, and because of inefficient methods of charcoal production and consumption.[[3]](#footnote-4) Next to the financial- and time- burden on families of relying on inefficient cook stoves, the use of biomass with basic cooking devices causes major health issues, disproportionally affecting women and children.[[4]](#footnote-5) Meals are normally prepared by women, in a hut separate from the main house. Using traditional practices, cookstoves are able to both generate high intensity heat for boiling, and low intensity heat for simmering. Moreover, cookstoves are used all day and during all types of weather.[[5]](#footnote-6) Most rural households use traditional 3-stone fireplaces for cooking, and/or different types of improved firewood cooking stoves.[[6]](#footnote-7)

The estimates of annual average and total GHG emission reductions for the chosen crediting period

Table 1 *Estimated annual average GHG emission reductions*

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| --- |
| Emission reductions during the crediting period |
| Years | Annual GHG emission reductions (in tonnes of CO2e) for each year |
| 2016 |  29,493  |
| 2017 |  34,168  |
| 2018 |  34,851  |
| 2019 |  34,851  |
| 2020 |  34,851  |
| 2021 |  34,851  |
| 2022 |  34,851  |
| 2023 |  34,851  |
| Total number of crediting years | 7 (renewable twice) |
| Annual average GHG emission reductions over the crediting period |  38,966  |
| Total estimated reductions (tonnes of CO2e) |  **272,764**  |

* + 1. Location of VPA

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This VPA will disseminate biogas systems over the entire territory of Kenya. The primary means to uniquely identify the activities under the VPA is by means of buyer information collected through a mobile phone application known as Taro works which relays collected data to Salesforce, an online cloud based archive. Information on Salesforce is then imported in a excel sheet that is used for data analysis. The information includes a serial number, customer name, address, date of sale, name of VPA implementer, biogas digester model and size.

The co-ordinates of Kenya are represented approximately by: 1 00 N, 38 00 E[[7]](#footnote-8). The VPA implementer is the Kenya Biogas Programme. The main offices are used to represent the physical location of the project, Along Lenana Road, ACS Plaza, Nairobi, P.O. Box 79875-00202 Nairobi Kenya. GPS Co-ordinates: S 1 ͦ 17’23’’ S, E 36 ͦ47’1’’.

Figure 1 *Location VPA implementer and border of Kenya*

KBP

* + 1. Technologies/measures

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The VPA will stimulate the installation of domestic biogas systems country wide, of 4m3 and above, as long as digesters remain below the small-scale limit. It will install and maintain biogas systems through over 100 biogas-related enterprises engaged in construction, appliances and parts. In order to make biogas technologies more affordable to the end-user, the digesters will be offered at a reduced price, subsidised in part by carbon revenues. As the market matures the direct subsidies may be phased out. During a transition period subsidies to biogas construction enterprises are considered. Technical assistance and after sales services (including a guarantee period) will continue to be provided free of charge. These services will be subsidized by carbon revenues.

The initial target of the VPA is to support the installation of some 4160 biogas systems that were installed from 1 January 2014 onwards.

Kenya Biogas Program selected the appropriate biogas technology to be implemented through engagement with a wide range of stakeholders. They agreed on a fixed dome digester design to be known as the Kenya National Biogas Model (KENBIM), although other types of biogas digester are permitted under this VPA as long as the technology used meets the eligibility criteria for VPA inclusion outlined in Section F. The average lifetime of the technology is over 20 years[[8]](#footnote-9). A drawing of the KENBIM is shown in Figure 2.

Figure 2 *KENBIM biogas system technical drawing*



The biogas system is made up of several interconnected parts. The specific role of each component is summarised below:

Inlet – The main purpose of the inlet is to mix organic material and water into a semi solid state. This mixture is fed into the digester via an inlet pipe.

Digester – The digester holds the mixture of manure and water, creating a conducive environment for anaerobic digestion where microorganisms produce biogas. The digester is cylindrical in shape and is usually made of brick masonry with a concave concrete cover, or dome. Typically the digester is built underground with only the plumbing, inlet and outlets visible.

Dome - The purpose of the dome is to collect the gas produced in the digester. This is typically plastered in several layers and painted with a special paint in order to minimise gas leakage. Gas accumulates under the dome creating pressure and pushing down the level of the slurry and increasing the slurry level in the connected slurry tank. It is the difference in slurry levels between the slurry tank and the inside of the dome that maintains the pressure to push the gas into the outlet pipe.

Outlet - The outlet valve releases the collected gas under the dome to biogas appliances such as stoves or lamps.

Slurry Tank - The slurry tank holds the slurry that the gas pressure from under the dome displaces. This slurry overflows into a composting tank as more manure is fed into the digester. This slurry can then be used as a fertiliser.

KENBIM is a hybrid of the modified CAMARTEC and AKUT biogas models; and incorporates the positive aspects of these and includes the following modifications:

* KENBIM has a conical floor for areas having weak soil conditions and a flat floor for relatively strong areas.
* There is no manhole on the top of the gas holder, instead the manhole is from the expansion chamber.
* The shape of expansion chamber is rectangular.
* The outlet passage is designed in such a way that it allows easy entrance inside the digester.
* The gas holder is designed to store at least 60% of the daily gas production.
* The overflow level in the expansion chamber is arranged in such a way that gravity assists the flow of slurry from the inlet to the slurry pit.
* The design incorporates options for direct feeding of dung from the cattle shed as well as separate mixing tank depending upon the site condition and user’s demand/need.
	+ 1. Coordinating/managing entity

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The coordinating/managing entity for this VPA is Hivos International.

* + 1. Parties and VPA implementers

|  |  |  |
| --- | --- | --- |
| **Parties involved**  | **VPA implementers** | **Indicate if the Party involved wishes to be considered as VPA implementer (Yes/No)** |
| Kenya (host) | Kenya Biogas Programme (KBP) | No  |

* + 1. Public funding of VPA

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The Directorate General for International Cooperation (DGIS) under the Netherlands Ministry of Foreign Affairs provides public funding. The VPA is being supported by DGIS through the Humanist Institute for Cooperation with Developing Countries (Hivos). There has been no diversion of Official Development Assistance (ODA) as demonstrated in the declarations provided to the DOE[[9]](#footnote-10).

* + 1. History of VPA

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VPA006 is the second VPA in Kenya under the African Biogas Carbon Programme (ABC). VPA001 was registered on 11/06/2015, and includes approximately 11,400 digesters installed since 06/11/09 up to and including 31/12/2013. Since then, KBP has continued to implement biogas digesters over the years 2014, 2015, 2016 and 2017 in accordance with the Gold Standard requirements. Hivos – the CME - had originally intended to include these digesters in VPA001, but it became clear during the inclusion that VPA001 was at the small-scale capacity limit, and that a new VPA would therefore need to be included to accommodate the digesters installed from 01/01/2014 onwards.

On 22/01/2015, the Gold Standard issued a rule update “Revision in the rules and requirement for Prior Consideration of Carbon Revenues for GS-VER projects”. This rule update states that “*In order to be eligible under Gold Standard, retroactive VPAs must submit the required documents to the Gold Standard (time of first submission) within one year from the project start date. Retroactive VPA documents submitted at a date later than one year from the project start date will not be eligible for Gold Standard certification. These requirements are applicable for VPAs that have a date of first submission on or after 1st June 2015*”. This had implications for the digesters installed in Kenya from 01/01/2014, since these could not have been included in VPA001 due to the capacity limit. A memo[[10]](#footnote-11) was therefore prepared to apply for an exception to this rule through demonstrating prior consideration of carbon revenues. The Gold Standard approved[[11]](#footnote-12) the exception on 30 March 2017, and invited Hivos to open a new VPA under PoA GS2747 for the inclusion of biogas digesters installed in Kenya from 2014 onwards.

The proposed VPA006 is not registered as a CDM or Gold Standard project activity, nor included in another registered CDM or Gold Standard PoA. The proposed VPA is not a project activity that has been deregistered. The proposed VPA was not a VPA that has been excluded from a registered CDM or Gold Standard PoA.

* + 1. Debundling

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According to the Guidelines on assessment of de-bundling for SSC project activities (version 03) published as annex 13 of the meeting report of EB 54[[12]](#footnote-13) the VPA is exempted from performing a de-bundling check i.e. considered as being not a de-bundled component of a large-scale activity if the following condition applies:

*10. If each of the independent subsystems/measures (e.g. biogas digester, solar home system) included in the VPA of a PoA is no greater than 1% of the small-scale thresholds defined by the methodology applied,[[13]](#footnote-14) then that VPA of PoA is exempted from performing de-bundling check i.e. considered as not being a de-bundled component of a large scale activity.*

Each of the biogas systems included in the VPA is not greater than 1% of the small-scale threshold which is 450 kWth for thermal energy as demonstrated in the ER calculations spreadsheet, sheet ‘capacity calculation’.

1. Application of selected methodologies and standardized baselines
	1. Reference to methodologies and standardized baselines

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

This methodology is applicable to programs or activities introducing technologies and/or practices that reduce or displace greenhouse gas (GHG) emissions from the thermal energy consumption of households, communities and SMEs. This includes biogas digesters.

Table 2 *Methodological applicability conditions applied*

| **Applicability criteria** | **Justification** |
| --- | --- |
| 1. *Clearly identifiable project boundary:* The project boundary can be clearly identified, and the biodigesters counted in the project are not included in another voluntary market or CDM project activity (i.e. no double counting takes place). Project proponents must have a survey mechanism in place together with appropriate mitigation measures so as to prevent double-counting in case of another similar activity with some of the target area in common. | The project boundary is the physical, geographical site of the methane recovery and combustion systems, located within Kenya.The VPA shall demonstrate that it does not double-count any of its appliances, as specified in the eligibility criteria for inclusion in the PoA, for the ERs estimation by confirming that:* The GPS coordinates of each digester installed are recorded
* the complete address of each biogas system is recorded
* the biogas systems have a unique serial number, recorded in the project database
* the VPA implementer has not included these biogas systems in another VPA or stand-alone project.
 |
| 2. *Limited level of energy output per biodigester:* The biodigesters each have continuous useful energy outputs of less than 450 kWth per unit (defined as total energy delivered usefully from start to end of operation of a unit divided by time of operation).  | The maximum energy output of the biodigesters implemented in the project activities is 43,80 kWth[[14]](#footnote-15), below the indicated 450 kWth limit per unit. |
| 3. *Continued use of baseline technology:* The use of the baseline cook stoves as a backup in parallel with the new, biogas fuelled cook stoves introduced by the project activity is permitted as long as a mechanism is put into place to encourage the removal of the old technology and the definitive discontinuity of its use. The project documentation must provide a clear description of the approach chosen and the monitoring plan must allow for a good understanding of the extent to which the baseline cook stove is still in use after the introduction of the improved technology. The success of the mechanism put into place must therefore be monitored, and the approach must be adjusted if proven unsuccessful.  | Monitoring will include an assessment of the continued use of the baseline stove through survey methods and biennial Kitchen Performance Tests. All biogas digester users will be asked to provide feedback on the extent to which they continue to use their baseline cook stoves.  |
| 4. *Settling of ownership rights over generated emission reductions:* The project proponent must clearly communicate to all project participants to whom the ownership rights of the emission reductions resulting from the project activity belong. This must be communicated to the technology producers and the retailers of the by contract or clear written assertions in the transaction paperwork.  | As set out in the operational and management plan explained in Section C of the PoA-DD, each end user of a biodigester will be asked to confirm that they transfer the right and title to VERs to the VPA Implementer as part of the Ownership Certificates. Copies of these signed contracts will be kept by the VPA Implementer.  |
| 5. *Use of new biomass feedstock*Project activities making use of a new biomass feedstock in the project situation (e.g. shift from non-renewable to green charcoal, plant oil or renewable biomass briquettes) must comply with relevant Gold Standard specific requirements for biomass related project activities, as defined in the latest version of the Gold Standard rules. | This applicability criterion is not applicable as no new biomass feedstock is used in the project scenario. |
| *6. Climate zones*If more than one climate zone is included in the project activity, a distinction per climate zone must be considered. The distinct geographical boundary of each project area must be clearly documented in the project documentation, using representative GPS data. | The distinct geographical boundary of this VPA is the Republic of Kenya. The GPS co-ordinates of Kenya are represented approximately by: 1 00 N, 38 00 E |

* 1. Project boundary, sources and greenhouse gases (GHGs)

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The gases included are carbon dioxide and methane in the VPA-boundary that is the physical, geographical site of the biogas system.

Table 3 *Inclusion of gases in the project boundary*

|  |  |  |  |
| --- | --- | --- | --- |
| **Source** | **Gas** | **Included?** | **Justification / Explanation** |
| Baseline | Heat deliveryTreatment of manure | CO2 | Yes | CO2 emissions from* fossil fuel cook stoves
* cook stoves using non-renewable biomass
 |
| CH4 | Yes | CH4 emissions from the baseline treatment methods of manure |
| N2O | No | Excluded, insignificant source of emissions.  |
| Project Activity | Combustion of biogas | CO2 | Yes | CO2 emissions from* fossil fuel cook stoves
* cook stoves using non-renewable biomass
 |
| CH4 | Yes | Emissions due to the manure not fed into the bio digester, as per the applied methodology. |
| N2O | No | Excluded, insignificant source of emissions.  |

The project boundary is the physical, geographical site of the use of biomass or the renewable energy as demonstrated in Figure 3.

Figure 3 *Schematic diagram of biogas system project boundary*

Feedstock inlet(s)

Bio-slurry outlet

Biogas appliances

Biogas digester

* 1. Establishment and description of baseline scenario

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In Kenya, over half of the total population of 48 million[[15]](#footnote-16) has no access to electricity.[[16]](#footnote-17) Most of the rural population almost completely depends on biomass, particularly non-renewable firewood for their daily energy consumption for cooking, boiling and heating.

To determine parameters BBb,fuel and BBb,bio, this VPA applies Option 2 of the methodology. Under Option 2, BBb,fuel and BBb,bio shall be defined *ex-ante* on the VPA level through Baseline Performance Field Tests (BFT) directly. As per the PoA-DD, a separate BFT needs to be conducted per identified baseline scenario.

*Baseline ratios*

The baseline ratios are determined based on the most recent monitoring effort of VPA1, which is also located in Kenya. Monitoring was carried out in late 2016 by EcoFrontier.[[17]](#footnote-18) The following Table illustrates the different baseline scenarios and their corresponding ratios, as per the survey results. This will be updated annually as part of the monitoring survey.

Table 4 *Type of baseline scenarios and distribution per identified baseline scenario[[18]](#footnote-19)*

|  |  |  |
| --- | --- | --- |
| **Baseline scenario** | **Parameter** | **BFT results (%)** |
| Households using firewood only | BBb1,ratio | 53.3% |
| Households using charcoal only | BBb2,ratio | 13.3% |
| Households using firewood + charcoal | BBb3,ratio | 26.7% |
| Others (excluded for conservativeness) | n/a | 6.7% |

*Baseline Fuel Tests (BFT)*

The BFTs measure real, observed fuel usage within the baseline via a Kitchen Performance Test (KPT). Consumption of fuels was measured with a representative sample of end users under the defined three baseline scenarios in the absence of the project technology (BBb1,bio, BBb2,bio and BBb3,bio). BBb1,bio is established based on the BFT carried out in late 2014 at inclusion of VPA1 (GS 2750). BBb2,bio and BBb3,bio is established based on the BFT carried out in late 2016 during the second monitoring of VPA1.

The BFTs randomly selected households from the project database to take part in the BFT. The surveyed households were identified as having a similar social and economic status as their neighbours that possess bio digesters, therefore making for a realistic baseline scenario. To establish the baseline fuels used, a questionnaire based on the Berkeley Air Kitchen Performance test questionnaire was used. This document is also referenced in the applied TPDDTEC methodology. For all three BFTs, calibration of the applied weights was done with the comparison of traditional weighing scale. The scales were also compared to each other and all weighing scales were found accurate. Amongst other things, the households were asked to report on their baseline biomass and fossil fuel consumption rates over the measurement campaign. Outliers were excluded using the Grubb’s test.[[19]](#footnote-20)

The results of all three BFTs are reported in Table 5. To derive the total biomass value for households using charcoal, the tonnes of charcoal used are multiplied by a factor of 8. In Kenya, the use of traditional kilns to produce charcoal is widespread. These traditional kilns have a low biomass-to-charcoal conversion efficiency. Traditional kilns used have an estimated conversion efficiency of only 8 – 12 %. To remain conservative the lower value is used (ie. 8 kg of woodfuel from every 1 kg of fuelwood)[[20]](#footnote-21).

Table 5 *Biomass usage results in the baseline scenario*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Description** | **Amount** | **Source** |
| BBb1,bio | tonnes/HH/year | Amount of firewood used in the baseline scenario b1 | 3.659 | KPT primary data 29Sept2015 B1(firewood) (post-review), sheet ‘90/30 test’  |
| BBb2,bio | tonnes/HH/ year | Amount of charcoal used in the baseline scenario b2 | 7.48 | 20170322 B2 B3 BFT Results KE, sheet ‘B2 - 90|30 test' |
| BBb3,bio | tonnes/HH/year | Amount of charcoal \_ firewood used in the baseline scenario b3 | 7.062 | 20170322 B2 B3 BFT Results KE, sheet ‘B2 - 90|30 test' |

*Number of animals owned*

As for the number of animals raised, the results have been gathered by the VPA1 (GS2750) monitoring conducted in 2016, which surveyed 135 households with biodigesters under the ABPP throughout Kenya. The results are summarised in the table below.

Table 6 *Possession of livestock reported in the VPA1 Monitoring Survey 2016*

|  |  |
| --- | --- |
| **Animal T** | **Average amount** |
| Dairy cow | 5.33 |
| Goat | 1.30 |
| Market swine | 0.33 |
| Sheep | 2.53 |
| Other cattle | 1.39 |
| Poultry | 24.09 |

*Methane conversion factor (MCF)*

The baseline study results carried out in 2014 at inclusion of VPA1 (GS2750) indicate that daily spread is the most common manure handling method, followed by pasture/range/paddock, uncovered lagoon and drylot. The system-specific methane conversion factors applicable to the baseline are provided in the IPCCC Guidelines for National Greenhouse Gas Inventories. The applicable MCF, which is an input for the emission reduction calculation explored below, is chosen from default values presented in Table 10.17, Chapter 10, Volume 4 of the 2006 IPCC Guidelines.

Table 7 Average *MCF calculation*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Method** | **Uncovered lagoon** | **Liquid slurry** | **Solid storage** | **Drylot** | **Pasture/ Range / Paddock** | **Daily spread** | **Burned for fuel** | **Composting** |
| **Fraction observed** | 2 % | 2 % | 6 % | 30 % | 0 % | 45 % | 0 % | 16 % |
| **MCF** **(at 20 C)** | 78.0% | 50% | 4.0% | 1.5% | 1.5% | 0.5% | 10.0% | 0.5% |
|  |  |  |  |  |  |  |  |  |
| **MCFx,k** | 3.39 % |  |  |  |  |  |  |  |

* 1. Estimation of emission reductions
		1. Explanation of methodological choices

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Please see section B.4.3 below.

* + 1. Data and parameters fixed ex ante

|  |  |
| --- | --- |
| **Data/Parameter** | **fNRB,y** |
| 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 <http://cdm.unfccc.int/DNA/fNRB/index.html> |
| Value(s) applied | Kenya: 92% |
| Choice of data or measurement methods and procedures  | N/A |
| Purpose of data | Calculation of baseline and project emissions |
| Additional comment | The fNRB will be renewed at the renewal of the crediting period. |

|  |  |
| --- | --- |
| **Data/Parameter** | **BBb1,bio** |
| Data unit | Tonnes/year |
| Description | Amount of woody biomass used in the baseline scenario b1 |
| Source of data | KPT primary data 29Sept2015 B1(firewood), sheet ‘90/30 test’ |
| Value(s) applied | 3.66 |
| Choice of data or measurement methods and procedures  | Households have been asked how much fuelwood they use for cooking, and undergo a Kitchen Performance Test as per the requirements of the TPDDTEC methodology. |
| Purpose of data | Calculation of baseline emissions |
| Additional comment | N/A |

|  |  |
| --- | --- |
| **Data/Parameter** | **BBb2,bio** |
| Data unit | Tonnes/year |
| Description | Amount of charcoal (in fuel-wood equivalents) used in the baseline scenario b2 |
| Source of data | 20170322 Survey C BFT Sample Size - KE, sheet ‘B2 - 90|30 test' |
| Value(s) applied | 7.48 |
| Choice of data or measurement methods and procedures  | Households have been asked how much charcoal they use for cooking and undergo a Kitchen Performance Test as per the requirements of the TPDDTEC methodology. |
| Purpose of data | Calculation of baseline emissions |
| Additional comment | N/A |

|  |  |
| --- | --- |
| **Data/Parameter** | **BBb3,bio** |
| Data unit | Tonnes/year |
| Description | Amount of fuelwood and charcoal (in fuel-wood equivalents) used in the baseline scenario b3 |
| Source of data | 20170322 Survey C BFT Sample Size - KE, sheet ‘B2 - 90|30 test' |
| Value(s) applied | 7.06 |
| Choice of data or measurement methods and procedures  | Households have been asked how much fuelwood and charcoal they use for cooking, and how much charcoal they use, and undergo a Kitchen Performance Test as per the requirements of the TPDDTEC methodology. |
| Purpose of data | Calculation of baseline emissions  |
| Additional comment | N/A |

|  |  |
| --- | --- |
| **Data/Parameter** | **EFb, bio** |
| Data unit | tCO2/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. |

|  |  |
| --- | --- |
| **Data/Parameter** | **BBb1,fuel** |
| Data unit | Tonnes/year |
| Description | Amount of fossil fuels used in baseline scenario b1 |
| Source of data | Option 2: Kitchen Performance Test 2014 (Baseline) |
| Value(s) applied | 0 |
| Choice of data or measurement methods and procedures  | Households have been asked how much fossil fuels they use for cooking, and undergo a Kitchen Performance Test as per the requirements of the TPDDTEC methodology. |
| Purpose of data | Calculation of baseline emissions |
| Additional comment | N/A |

|  |  |
| --- | --- |
| **Data/Parameter** | **EFp, bio** |
| Data unit | tCO2/TJ |
| Description | Emission factor of the woody biomass used in project 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. |

|  |  |
| --- | --- |
| **Data/Parameter** | **NCVbio** |
| 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 |

|  |  |
| --- | --- |
| **Data/Parameter** | **EFb, 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 = 71.9LPG = 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 |

|  |  |
| --- | --- |
| **Data/Parameter** | **EFp, fuel** |
| Data unit | tCO2/TJ |
| Description | Emission factor of fossil fuels used in project scenario b |
| Source of data | 2006 IPCC Guidelines for National Greenhouse Gas Inventories |
| Value(s) applied | Kerosene = 71.9LPG = 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 project emissions |
| Additional comment | IPCC (2006); May be updated according to any future changes by the IPCC |

|  |  |
| --- | --- |
| **Data/Parameter** | **NCVfuel** |
| 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 = 0.0438LPG = 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 |

|  |  |
| --- | --- |
| **Data/Parameter** | **VST** |
| 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 |

|  |  |
| --- | --- |
| **Animal T** | **Average kg/head/day** |
| Dairy Cow | 1.90 |
| Goat | 0.35 |
| Market swine | 0.30 |
| Sheep | 0.31 |
| Other cattle | 1.50 |
| 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 GuidelinesThe 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 |

|  |  |
| --- | --- |
| **Data/Parameter** | **BoT** |
| Data unit | m3 CH4/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 |

|  |  |
| --- | --- |
| **Animal T** | **Average m3 CH4/kg** |
| Dairy Cow | 0.13 |
| Goat | 0.13 |
| Market swine | 0.29 |
| Sheep | 0.13 |
| Other cattle | 0.10 |
| 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 GuidelinesThe 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 |

|  |  |
| --- | --- |
| **Data/Parameter** | **EFawms,T** |
| Data unit | m3 CH4/kg |
| Description | Emission factor for the defined livestock population category T by average temperature |
| Source of data | 2006 IPCC Guidelines for National Greenhouse Gas Inventories; Indonesian Meteorological Climatological and Geophysical Agency |
| Value(s) applied |

|  |  |
| --- | --- |
| **Animal T** | **Value** |
| Dairy Cow | 0.002 |
| Other cattle | 0.001 |
| Market swine | 0.000 |
| Breeding swine | 0.000 |
| Goats | 0.000 |
| Sheep | 0.000 |
| Poultry | 0.000 |

 |
| 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 GuidelinesThe 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 |

|  |  |
| --- | --- |
| **Data/Parameter** | **MCF** |
| Data unit | kg CH4 |
| Description | Average Methane Conversion Factor for the defined livestock population category T by average temperature (Kenya: 20°C) |
| Source of data | ‘Survey A Monitoring’, sheet ‘Analysis’ (Kenya VPA1 2014 Baseline Survey Results)2006 IPCC Guidelines for National Greenhouse Gas Inventories; Temperature: World Weather Online, <http://www.worldweatheronline.com/v2/weather-averages.aspx?q=Nairobi,%20Kenya> |
| Value(s) applied | 3.39 % |
| 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 GuidelinesThe 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 |

|  |  |
| --- | --- |
| **Data/Parameter** | **ηbiogas stove** |
| Data unit | Fraction |
| Description | Combustion efficiency of the new biogas stove introduced by the programme |
| Source of data | Manufacturers specification or water boiling test result |
| Value(s) applied | 0.55 |
| Choice of data or measurement methods and procedures  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| KBP does not specify the type of biogas stove that should be installed by a household, however they specifically promote the following five stove types:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Manufacturer  |  Model No. / Name  |  No. of burners  |  Thermal Efficiency  |   |
|  Puxin  |  JZZ2-A13  |  2  |  >57% |   |
|  Wusi  |  JZZ.2-A1  |  2  |  56.8% |   |
|  Xunda  |  JZZ2-88  |  2  |  >58% |   |
|  Xunda  |  JZZ1-6128  |  1  |  >58% |   |
|  SNV  |  Lotus III (Cambodia)  |  1  |  55% |   |
| Lanneng | LJ-555 | 1 | >60%[[21]](#footnote-22) |  |
| Lanneng | LN-MC666 | 2 | >60%[[22]](#footnote-23) |  |

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

 |
| Purpose of data | Calculation of project emissions |
| Additional comment | N/A |

|  |  |
| --- | --- |
| **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  | N/A |
| Purpose of data | Calculation of project emissions |
| Additional comment | N/A |

* + 1. Ex ante calculation of emission reductions

>>

*6.4.3.1 Emission reduction component 1: Accounting for emission reductions due to the displacement of fossil fuels and non-renewable biomass*

Emission reductions are credited by comparing fuel consumption in a project scenario to the three baseline scenarios of VPA006. As the baseline fuel and the project fuel and the corresponding emission factors are different, the overall GHG reductions achieved by VPA006 in year *y* are calculated as follows:

$ER\_{CO2,y}=\sum\_{b,p1}^{}N\_{p1,y}\*U\_{p1,y}\*\left(f\_{NRB}\* ER\_{b,p1,y, CO2}+ER\_{b,p1,y,non-CO2}\right)- \sum\_{}^{}LE\_{p1,y}$ **(1)**

Where:

ERCO2,y Cumulative CO2 emission reductions from the substitution of non-renewable biomass and fossil fuels

∑b,p1 Sum over all relevant (baseline b1,b2,b3/project p1) couples

Np1,y Cumulative project operational rate included in the project database for project scenario p1 against baseline scenario b1 in year y

Up1,y  Cumulative usage rate for technologies in project scenario p1 in year y, based on cumulative adoption rate and drop off rate (fraction)

ERb,p1,y,CO2Specific CO2 emission savings for an individual technology of project p1 against an individual technology of baseline b1, b2, b3 in year y, in tCO2/year, and as derived from the statistical analysis of the data collected from the field tests

ERb,p1,y,non-CO2Specific non-CO2 emission savings for an individual technology of project p1 against an individual technology of baseline b1, b2, b3 in year y, converted in tCO2/year, and as derived from the statistical analysis of the data collected from the field tests

*f*NRB Fraction of biomass used that can be established as non-renewable biomass

LEp1,y Leakage for project scenario p1 in year y (tCO2e/yr)

As specific non-CO2 emission savings are treated in a separate equation (equation **7** onwards), the VPA006 can apply the following formula for calculating emission reductions:

$\sum\_{}^{}ER\_{CO2,y}=(\sum\_{}^{}BE\_{b,CO2,y}- \sum\_{}^{}PE\_{p1,CO2,y}- \sum\_{}^{}LE\_{p1,CO2,y} ) \*N\_{p1,y}\* U\_{p1,y}$ **(2)**

Where:

∑ERCO2,y Cumulative CO2 emission reductions from the substitution of non-renewable biomass and fossil fuels

∑BEb,CO2,y Cumulative baseline emissions as calculated below under formula (**3**) of the VPA PDD

∑PEp1,CO2,y Cumulative project emissions as calculated below under formula (**4**) of VPA PDD

∑LEp1,CO2,y Cumulative leakage as per methodology guidance[[23]](#footnote-24)

Np1,y Cumulative project operational rate included in the project database for project scenario p1 against baseline scenario b1 in year y

Up1,y  Cumulative usage rate for technologies in project scenario p1 in year y, based on cumulative adoption rate and drop off rate (fraction)

Baseline emissions:

Applicable baseline scenarios for this VPA006 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 for this VPA has been defined through a series of baseline Kitchen Performance Tests, and a survey. The survey determines the ratio of users for each identified baseline scenario. The following formula calculates the three baseline emissions per household:

$BE\_{bCO2, y}= \sum\_{b}^{}(BB\_{b,fuel}\* NCV\_{fuel }\* EF\_{b,fuel} )+( BB\_{b,bio}\*NCV\_{bio }\* EF\_{b,bio}\* f\_{NRB}) $ (**3)**

Where:

BEb,CO2,y Cumulative baseline CO2 emissions from the use non-renewable biomass and fossil fuels at households during year y

BBb,fuel The quantity of fossil fuel consumed in the baseline scenario, in tonnes/year

NCVfuel Net calorific value of fossil fuel, in TJ/tonne

EFb,fuel CO2 emission factor of fossil fuel in baseline scenario, in tonnes/TJ

BBb,bio The quantity of biomass consumed in the baseline scenario, in tonnes/year

NCVbio Net calorific value of biomass, in TJ/tonne

EFb,bio CO2 emission factor of biomass in baseline scenario, in tonnes/TJ

*f*NRB Fraction of non-renewable biomass, in percentage

Project emissions:

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:

$PE\_{p1,CO2,y}= \sum\_{}^{}( BB\_{p1,fuel}\* NCV\_{fuel }\* EF\_{p1,fuel} )+( BB\_{p1,bio}\*NCV\_{bio }\* EF\_{p1,bio}\* f\_{NRB})$ **(4)**

Where:

PEp1,CO2,y Cumulative project CO2 emissions from the use non-renewable biomass and fossil fuels at households during year y

BBp1,fuel The quantity of fossil fuel consumed in the project scenario 1, in tonnes/year

NCVfuel Net calorific value of fossil fuel, in TJ/tonne

EFp1,fuel CO2 emission factor of fossil fuel in project scenario 1, in tonnes/TJ

BBp1,bio The quantity of biomass consumed in the project scenario 1, in tonnes/year

NCVbio Net calorific value of biomass, in TJ/tonne

EFp1,bio CO2 emission factor of biomass in project scenario 1in tonnes/TJ

*f*NRB Fraction of non-renewable biomass, in percentage

Fuel usage data for the three baseline scenarios and project scenario was collected by the KPT survey, as explained above. The results include the baseline usage of firewood only (b1), charcoal only (b2) and both firewood and charcoal (b3).

The fNRB is estimated to be 92.0%, as per the UNFCCC’s default fNRB values. The fNRB value is applicable to CO2 emissions from firewood and charcoal consumption and production. Methane and nitrous oxide emission are not included in the emission reduction calculation for conservativeness. The calculated ex-post baseline emissions are shown in next table:

Table 8 *Emission reductions due to the displacement of fossil fuels and non-renewable biomass*

|  |  |  |  |
| --- | --- | --- | --- |
| **Baseline emissions from fuel use****(tCO2e/yr)** | **Project emissions from fuel use** **(tCO2e/yr)** | **Leakage emissions from fuel use** **(tCO2e/yr)** | **Emissions from fuel switch to biogas****(tCO2e/yr)** |
| 11.54 | 3.28 | 0.000 | 8.26 |

For more details, please see the emission reduction calculation spreadsheet.

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

The emissions from the animal waste management system of the baseline are determined using the IPCC 2006 Tier 2 approach The Tier 2 approach is applicable to situations where baseline data for an estimation of the methane emission factor per category of livestock are available. The baseline emissions per household shall be calculated as follows:

$BE\_{b,CH4,h,y}= \frac{\left(VS\_{T}\*365\right)\*(B\_{0,T}\*0.67kg/m^{3} \* MCF\_{x,k}\* MS\_{T,x,k}\* GWP\_{CH4}\* N\_{T,h})}{1000}$ **(5)**

Where:

BEb,CH4,h,y Baseline emissions from manure handling during the year y in tCO2e for manure handling method h

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

B0,T Maximum methane producing capacity for manure produced by livestock category T in m3 CH4

MCFx,k Methane conversion factors for the animal waste handling system in the baseline situation by climate zone k, (%)

MST,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)

GWPCH4 Global Warming Potential of methane

NT,h Number of livestock category T in premise h

MCFx,k, MST,x,k and NT,h is defined *ex-ante* on the VPA level referencing a baseline survey applicable to the target user . The conversion factors applicable to the baseline scenario will be sourced from default values presented in Table 10.17 of the IPCC Guidelines for National Greenhouse Gas Inventories.

VST and B0,T can be defined *ex-ante­* as per the default values presented in the IPCC Guidelines for National Greenhouse Gas Inventories, where no country-specific data is available. These can be found in Tables 10A-4 through 10A-9 of the referenced report.

**Step 1: Determination of NT,h**

According to the Monitoring Survey 2016 for VPA1, the dominant type of cattle owned by the respondents was dairy cows. See Section B.3. for an overview of the values applied.

**Step 2: Determination of manure characteristic of targeted animals**

Manure characteristics are determined by default IPCC values as no national specific data is available. These include the amount of volatile solids (VS) produced in the manure from animal category T and the maximum amount of methane able to be produced from that manure (BOT).

Table 9 *Manure characteristics of different livestock categories[[24]](#footnote-25)*

|  |  |  |
| --- | --- | --- |
| **Animal type** | **VS** (kg/head/day) | **BO** (m3 CH4/kg VS) |
| Dairy Cow | 1.9 | 0.13 |
| Goat | 0.35 | 0.13 |
| Market swine | 0.3 | 0.29 |
| Sheep | 0.32 | 0.13 |
| Other cattle | 1.5 | 0.1 |
| Poultry | 0.01 | 0.36 |

**Step 3: Determination of the applicable Methane Conversion Factor (MCF)**

The system-specific methane conversion factors applicable to the baseline are provided in the IPCC Guidelines for National Greenhouse Gas Inventories[[25]](#footnote-26). The applicable MCF is chosen from the default values presented in Table 10.17, Chapter 10, Volume 4 of the 2006 IPCC Guidelines. Average temperatures are defined at the country level. The resulting average MCF is 3.39%.

**Step 4: Determining baseline emissions from manure handling**

With the data from the previous tables the baseline emission can be determined. The emission per household of all the animals under the VPA are calculated and depicted in the next table.

The baseline methane emissions per household per yearunder the VPA006 are[[26]](#footnote-27):

1.85 \* 0.00067 \* 3.39% \* 1 \* 25 = 0.382 tCO2e/year

**Step 5: Determining project emissions from manure handling**

Project emissions of the methane avoidance component include both the physical leakage of biogas from the biodigester and the incomplete combustion of biogas. These shall be accounted for in accordance with equation (8) of the PoA-DD:

$PE\_{p,CH4,y}=GWP\_{CH4}\*\sum\_{ }^{}( N\_{T, h,y}\*EF\_{awms,T})\* PL\_{y}+\sum\_{ }^{}( N\_{T, h,y}\*EF\_{awms,T})\*(1- η\_{new stove})\* (1- PL\_{y})$ **(6)**

Where:

PEp,CH4,y Project emissions from manure handling during the year y in tCO2e

GWPCH4 Global Warming Potential of methane

NT,h Number of livestock category T in premise h

EFawms, T Emission factor for the defined livestock population category T

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

η new stove Combustion efficiency of the used type of biogas stove

PEawms,NT Project emission from the animal waste not treated in the biodigester

In the above equation, EFawms, T is further defined as:

$EF\_{awms,h}= \frac{\left(VS\_{T}\*365\right)\*(B\_{0,T}\*0.67kg/m^{3} \* MCF\_{x,k}\* MS\_{T,x,k})}{1000}$ **(7)**

Where:

EFawms(T) CH4 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)

DCH4 CH4 density (0.00067 t per m3 at room temperature

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 emissions from manure handlingper household per year under the VPA006 are therefore[[27]](#footnote-28):

25 \* 0.01 \* 0.1 + 0.01 \* (1 - 0.55) \* (1 - 0.10) = 0.136 tCO2e

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

Project emissions from bio-slurry

In order to estimate the project emissions occurring from bioslurry, the following steps are followed:

**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 9.24 kgVS.day-1.

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

The second step is the assessment of remaining VS content. 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:

9.24 kgVS.day-1 \* 45% = 4.16 kgVS.day-1.

**Step 3: assessment of the methane potential of bioslurry**

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 CH4 production capacity of liquid digestate (Fww,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 m3CH4/kgVS per day.

**Step 4: calculation of bio-slurry emissions**

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

PEp1 bio-slurry = (total VS in biodigesters \* 365) \* Bo,dig \* ƩDMS \* MCF \*(Dch4 /1000) \* GWPCH4

Where:

PEp1 bio-slurry Project emissions from bio-slurry

Bo,dig Maximum methane production capacity for the biodigester (m3CH4/kgVS)

DMS Bioslurry management practice, as a fraction

MCF Methane conversion factor

Dch4 Density of methane conversion factor

GWPCH4 Global Warming Potential of methane

Therefore:

PEp1 bio-slurry = (4.16 \*365) \* 0.026 \* 36.14% \* (0.67/1000) \* 25

PEp1 bio-slurry = 0.236

As this is greater than 1% of emissions reductions per digester, emissions from bioslurry must be considered.

Emission Reduction

Emission reductions per VPA will be calculated as:

$ER\_{CH4,y}=\left(BE\_{b,CH4,y }- PE\_{p,CH4,y}\right)\* N\_{p,y}\* U\_{p,y}$ **(8)**

Where:

ERCH4,y Methane emissions reductions in year y (tCO2)

BEb,CH4,y Baseline methane emissions during the year y (tCO2)

PEp,CH4,y Project methane emissions during the year y (tCO2)

Np,y Cumulative project operational rate included in the project database for project scenario p against baseline scenario b in year y

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

The emission reductions from methane avoidance per household per yearunder the VPA006 are 0.01 tCO2e/year.[[28]](#footnote-29)

*6.4.3.3 Leakage emissions*

The project proponent investigated the following potential sources of leakage:

Table 10 *Leakage emission assessment*

|  |  |  |
| --- | --- | --- |
| **#** | **Leakage source** | **Applicability** |
| **a** | The displaced baseline technologies are reused outside the project boundary in place of lower emitting technology or in a manner suggesting more usage than would have occurred in the absence of the project. | The baseline technologies are not reused outside the project boundary. The baseline technologies include three-stone fires and basic, inefficient cookstoves.[[29]](#footnote-30)  |
| **b** | The non-renewable biomass or fossil fuels saved under the project activity are used by non-project users who previously used lower emitting energy sources. | Most household rely on wood and charcoal in Kenya. The small share of household that use a lower emitting energy source, such as LPG, will not switch back to NRB due to the project activity.  |
| **c** | The project significantly impacts the NRB fraction within an area where other CDM or VER project activities account for NRB fraction in their baseline scenario. | The project is not large enough to significantly impact the NRB component of another CDM or VER project. It is therefore not likely that the NRB fraction is impacted significantly. |
| **d** | The project population compensates for loss of the space heating effect of inefficient technology by adopting some other form of heating or by retaining some use of inefficient technology | Space heating does not occur in Kenya. |
| **e** | By virtue of promotion and marketing of a new technology with high efficiency, the project stimulates substitution within households who commonly used a technology with relatively lower emissions, in cases where such a trend is not eligible as an evolving baseline. | The baseline is not fixed in this project, and the combustion of biogas always leads to lower emissions compared to all baseline fuels as it is 100% renewable. |
| **F** | Physical leakage emissions | It is considered as project emissions - see ER spreadsheet |
| **G** | Emissions from biogas slurry | It is considered as project emissions –see ER spreadsheet  |

* + 1. Summary of ex ante estimates of emission reductions

The cumulative ex-post emission reductions are calculated with the following calculation in order to take into account the proportional ratio of each identified baseline scenario:



Where:

ERb*x*,CO2,y CO2 emissions reductions in year y for the respective baseline scenario (tCO2)

ERCH4,y Methane emissions reductions in year y (tCO2)

BBbx,ratio The ratio of project population exhibiting the respective baseline scenario (%)

Np,y Cumulative project operational rate included in the project database for project scenario p against baseline scenario b in year y

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

The usage rate is used to discount the ERs and is calculated in section 3.1. The next table shows the ex-ante estimate of the emission reductions over the crediting period[[30]](#footnote-31):

Table 11 *Project emissions, baseline emissions, leakage and overall emissions per year*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Year | Baseline emissions(t CO2e) | Project emissions(t CO2e) | Leakage(t CO2e) | Emission reductions(t CO2e) |
| 2016 |  42,508  |  13,015  |  -  |  29,493  |
| 2017 |  49,246  |  15,078  |  -  |  34,168  |
| 2018 |  50,230  |  15,379  |  -  |  34,851  |
| 2019 |  50,230  |  15,379  |  -  |  34,851  |
| 2020 |  50,230  |  15,379  |  -  |  34,851  |
| 2021 |  50,230  |  15,379  |  -  |  34,851  |
| 2022 |  50,230  |  15,379  |  -  |  34,851  |
| 2023 |  50,230  |  15,379  |  -  |  34,851  |
| Total |  393,134  |  120,370  |  -  |  **272,764**  |
| Total number of crediting years | 7 |
| Annual average over the crediting period  |  |  38,966  |

* 1. Monitoring plan

* + 1. Data and parameters to be monitored

|  |  |
| --- | --- |
| **Data/Parameter** | **Up1,y** |
| Data unit | Fraction |
| Description | Cumulative usage rate for technologies in project scenario p1 in year y, based on cumulative adoption rate and drop off rate (fraction) |
| Source of data | Collected through the annual Monitoring Survey. |
| Value(s) applied | 1 |
| Measurement methods and procedures | 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. 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’ V. 1 |
| Monitoring frequency | Annual |
| QA/QC procedures | 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. |
| Purpose of data | Calculation of project emissions |
| Additional comment | 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. |

|  |  |
| --- | --- |
| **Data/Parameter** | **Np1,y** |
| Data unit | Number |
| Description | Cumulative number of project technology-days included in the projectdatabase for project scenario p1 against baseline scenario b in year y |
| Source of data | Total sales record from the Project Database |
| Value(s) applied | 4,160 |
| Measurement methods and procedures | 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. 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. |
| Monitoring frequency | Continuous |
| QA/QC procedures | 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). The equation is therefore (Np,y = Nop,y \* (Op,y / 365)). The average operational days will be confirmed upon verification. |
| Purpose of data | Calculation of project emissions |
| Additional comment | N/A |

|  |  |
| --- | --- |
| **Data/Parameter** | **Nop1,y** |
| Data unit | Number |
| Description | Cumulative number of project technologies included in the project database for project scenario p1 in year y |
| Source of data | Project Database |
| Value(s) applied | 4,160 |
| Measurement methods and procedures | The date presented in the Sales Agreement for each biogas digester is recorded in the Project Database. On average, biogas is produced and used 45 – 50 days after completion. **N0p,y** will be calculated from this date. |
| Monitoring frequency | Continuous |
| QA/QC procedures | As per procedures of the Project Database |
| Purpose of data | Calculation of project emissions |
| Additional comment | The actual cumulative number of biodigester operational days will be confirmed upon verification. |

|  |  |
| --- | --- |
| **Data/Parameter** | **Op1,y** |
| Data unit | Number |
| Description | The average technology-days during which the biodigesters are operational for project scenario p1 against baseline scenario b1 in year y |
| Source of data | Project Database |
| Value(s) applied | 365 |
| Measurement methods and procedures | 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. |
| Monitoring frequency | Continuous |
| QA/QC procedures | The average operational days will be confirmed upon verification. |
| Purpose of data | As per procedures of the Project Database. |
| Additional comment | The actual cumulative number of biodigester non-operational days will be confirmed upon verification. The equation to calculate this is (Op,y = 365 – non-operational days) |

|  |  |
| --- | --- |
| **Data/Parameter** | **LEp1,y** |
| Data unit | tCO2e/year |
| Description | Leakage in project scenario p1 during year y |
| Source of data | N/A |
| Value(s) applied | 0.0 |
| Measurement methods and procedures | N/A |
| Monitoring frequency | N/A |
| QA/QC procedures | N/A |
| Purpose of data | Calculation of leakage |
| Additional comment | According to the methodology applied “leakage risks deemed very low can be ignored as long as the case for their insignificance is substantiated” (p.13). Section *6.4.3.3* of the VPA-DD provides an overview of potential sources of leakage, including their applicability and justification for excluding the sources of leakage. |

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| --- | --- |
| **Data/Parameter** | **N,T** |
| Data unit | Number of animals |
| Description | Number of livestock category T in premise |
| Source of data | ABC VPA1 KE MP2 Surveys + Analysis, sheet ‘Analysis A’  |
| Value(s) applied |

|  |  |
| --- | --- |
| **Animal T** | **Average amount** |
| Dairy cow | 5.3 |
| Goat | 1.3 |
| Market swine | 0.3 |
| Sheep | 2.5 |
| Other cattle | 1.4 |
| Poultry | 24.1 |

 |
| Measurement methods and procedures | Households/communities/SMEs will be asked how many animals of different categories they own. |
| Monitoring frequency | Annual |
| QA/QC procedures | N/A |
| Purpose of data | Calculation of baseline emissions |
| Additional comment | N/A |

|  |  |
| --- | --- |
| **Data/Parameter** | **BBb ratio** |
| Data unit | % |
| Description | Baseline scenario ratios |
| Source of data | ABC VPA1 KE MP2 Surveys + Analysis, sheet ‘Analysis A’  |
| Value(s) applied | B1: households using firewood only = 53.3%B2: households using charcoal only = 13.3%B3: households using firewood + charcoal only = 26.7%B4: Other = 6.7% |
| Measurement methods and procedures | Households/communities/SMEs will be asked which baseline scenario they fell into before receiving a biogas digester. The four baseline scenarios are defined by asking the households *“what is your primary fuel source for cooking purposes?”*. The purpose of this question is to allocate a household to a baseline scenario, whereby ‘primary’ fuel consumption is defined as that fuel meeting more than 50% of their fuel needs for cooking purposes. The households that respond *“firewood”*, for example, are subsequently allocated to the baseline scenario b1. This means that households in, for example, baseline scenario b1 may also use small amounts of fossil fuels (i.e. secondary and tertiary fuels) for cooking, which will be included in the baseline emissions. |
| Monitoring frequency | Annually |
| 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 should be questioned. |
| Purpose of data | Calculation of baseline emissions |
| Additional comment | The ratio to apply for each baseline scenario in the project population will be determined as part of the monitoring survey on a sampling basis. The survey results will be applied to the project population to calculate the emission reductions. |

|  |  |
| --- | --- |
| **Data/Parameter** | **BBb1, bio** |
| Data unit | Tonnes/year |
| Description | Amount of woody biomass used in the baseline scenario b1 |
| Source of data | KPT primary data 29Sept2015 B1(firewood) (post-review), sheet ‘90/30 test’ |
| Value(s) applied | 3.659 |
| Measurement methods and procedures | Fixed baseline through Baseline Fuel Test. Households/communities/SMEs have been asked how much woody biomass they use, and undergone a Kitchen Performance Test as per the requirements of the TPDDTEC methodology. |
| Monitoring frequency | Not applicable: Option B BFT conducted once upfront and parameter fixedthroughout the crediting period. |
| 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 comment | As per Annex 5 of the Technologies and Practices to Displace DecentralizedThermal Energy Consumption methodology. |

|  |  |
| --- | --- |
| **Data/Parameter** | **BBb2, bio** |
| Data unit | Tonnes/year |
| Description | Amount of woody biomass used in the baseline scenario b2 |
| Source of data | 20170322 B2 B3 BFT Results KE, sheet ‘B2 - 90|30 test' |
| Value(s) applied | 7.48 |
| Measurement methods and procedures | Fixed baseline through Baseline Fuel Test. Households/communities/SMEs have been asked how much woody biomass they use, and undergone a Kitchen Performance Test as per the requirements of the TPDDTEC methodology. |
| Monitoring frequency | Not applicable: Option B BFT conducted once upfront and parameter fixedthroughout the crediting period. |
| 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 comment | As per Annex 5 of the Technologies and Practices to Displace DecentralizedThermal Energy Consumption methodology. |

|  |  |
| --- | --- |
| **Data/Parameter** | **BBb3, bio** |
| Data unit | Tonnes/year |
| Description | Amount of woody biomass used in the baseline scenario b3 |
| Source of data | 20170322 B2 B3 BFT Results KE, sheet ‘B2 - 90|30 test' |
| Value(s) applied | 7.062 |
| Measurement methods and procedures | Fixed baseline through Baseline Fuel Test. Households/communities/SMEs have been asked how much woody biomass they use, and undergone a Kitchen Performance Test as per the requirements of the TPDDTEC methodology. |
| Monitoring frequency | Not applicable: Option B BFT conducted once upfront and parameter fixedthroughout the crediting period. |
| 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 comment | As per Annex 5 of the Technologies and Practices to Displace DecentralizedThermal Energy Consumption methodology. |

|  |  |
| --- | --- |
| **Data/Parameter** | **BBb1,2,3, fuel** |
| Data unit | Tonnes/year |
| Description | Amount of fossil fuel used in the baseline scenarios b1, b2 and b3 |
| Source of data | KPT primary data 29Sept2015 B1(firewood) (post-review), sheet ‘90/30 test’; 20170322 B2 B3 BFT Results KE, sheet ‘B2 - 90|30 test' |
| Value(s) applied | 0.00 |
| Measurement methods and procedures | *H*ouseholds/communities/SMEs have been asked how much woody biomass they use, and undergo a Kitchen Performance Test as per the requirements of the TPDDTEC methodology. |
| Monitoring frequency | Not applicable: Option B BFT conducted once upfront and parameter fixedthroughout the crediting period. |
| 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 project emissions |
| Additional comment | As per Annex 5 of the Technologies and Practices to Displace DecentralizedThermal Energy Consumption methodology. |

|  |  |
| --- | --- |
| **Data/Parameter** | **BBp1, bio** |
| Data unit | Tonnes/year |
| Description | Amount of woody biomass used in the project scenario p1 (one value) |
| Source of data | Survey C PFT Sample Size - KE, sheet 'Project - 90|30 test' |
| Value(s) applied | 2.12 |
| Measurement methods and procedures | *H*ouseholds/communities/SMEs have been asked how much woody biomass they, and undergo a Kitchen Performance Test as per the requirements of the TPDDTEC methodology. |
| Monitoring frequency | *Ex post,* once every two years |
| 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 project emissions |
| Additional comment | Project Performance Field Test (PFT) will be updated once every two years. |

|  |  |
| --- | --- |
| **Data/Parameter** | **BBp1,fuel** |
| Data unit | Tonnes/year |
| Description | Amount of fossil fuels used in the project scenario p1  |
| Source of data | Survey C PFT Sample Size - KE, sheet 'Project - 90|30 test' |
| Value(s) applied | 0 |
| Measurement methods and procedures | *H*ouseholds/communities/SMEs have been asked how much fossil fuels they use, and undergo a Kitchen Performance Test as per the requirements of the TPDDTEC methodology. |
| Monitoring frequency | *Ex-post*, once every two years |
| 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 comment | Project Performance Field Test (PFT) will be updated once every two years. |

|  |  |
| --- | --- |
| **Data/Parameter** | **MST,S,k** |
| Data unit | % |
| Description | Fraction of livestock category T's manure fed into the bio-digester, Sin climate region k |
| Source of data | ABC VPA1 KE MP2 Surveys + Analysis, sheet ‘Analysis A’ |
| Value(s) applied |

|  |  |
| --- | --- |
| **Animal T** | **Fraction**  |
| Dairy cattle | 81.7% |
| Other cattle | 42.4% |
| Market swine | 50.0% |
| Breeding swine | 62.5% |
| Poultry | 0.0% |
| Sheep | 0.0% |
| Goat | 0.0% |

 |
| Measurement methods and procedures | Households/communities/SMEs have been asked to estimate the fraction of their animal’s manure that is fed into the biogas digester for the different relevant livestock categories. |
| Monitoring frequency | Annual |
| 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 comment | Applicable to VPAs applying Tier 2 only |

|  |  |
| --- | --- |
| **Data/Parameter** | **MSP,S,K** |
| Data unit | % |
| Description | Fraction of livestock category T's manure not fed into the bio-digester,in climate region k |
| Source of data | ABC VPA1 KE MP2 Surveys + Analysis, sheet ‘Analysis A’ |
| Value(s) applied |

|  |  |
| --- | --- |
| **Animal T** | **Fraction**  |
| Dairy cattle | 18.3% |
| Other cattle | 57.6% |
| Market swine | 50.0% |
| Breeding swine | 37.5% |
| Poultry | 100.0% |
| Sheep | 100.0% |
| Goat | 100.0% |

 |
| Measurement methods and procedures | Households/communities/SMEs have been asked to estimate the fraction of their animal’s manure that is not fed into the biogas digester for the different relevant livestock categories. |
| Monitoring frequency | Annual |
| 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 comment | N/A |

|  |  |
| --- | --- |
| **Data/Parameter** | **GWPCH4** |
| Data unit | Unit |
| Description | Global Warming Potential of methane |
| Source of data | IPCC Fourth Assessment Report |
| Value(s) applied | 25 |
| Measurement methods and procedures | The IPCC guidelines will be checked on an annual basis during verification to determine if the GWP of methane has changed from the above. |
| Monitoring frequency | Annual |
| QA/QC procedures | As per the Gold Standard’s rule update ‘The application of Global Warming Potentials for Gold Standard project activities’ |
| Purpose of data | Calculation of project emissions |
| Additional comment | N/A |

|  |  |
| --- | --- |
| **Data/Parameter** | **Bio** |
| Data unit | N/A |
| Description | Use of bio-slurry |
| Source of data | Monitoring Survey |
| Value(s) applied | Not applicable, no effect on emission reductions |
| Measurement methods and procedures | Households/communities/SMEs will be asked how they use the bio-slurry produced as a bio-product of the anaerobic digestion process. |
| Monitoring frequency | Annual |
| 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 comment | To be used for the calculation of project emissions associated with bio-slurry usage – the CH4 emissions from the anaerobic decay of the residual organic content of digestate subjected to anaerobic storage. |

The VPA will also monitor the following social and environmental parameters, as defined under the Gold Standard[[31]](#footnote-32):

|  |  |
| --- | --- |
| **Data/Parameter** | **GS-01 Air quality** |
| Data unit | Percentage |
| Description | Perceived improvement in health by the user. (incidence of eye problems and respiratory illness) |
| Source of data | Annual monitoring surveys |
| Value(s) applied | Not applicable, no effect on emission reductions |
| Measurement methods and procedures | 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. |
| Monitoring frequency | Annual |
| QA/QC procedures | Not applicable |
| Purpose of data | Monitoring of sustainable development benefits |
| Additional comment | N/A |

|  |  |
| --- | --- |
| **Data/Parameter** | **GS-02 Soil condition** |
| Data unit | % |
| Description | Percentage of biogas users who use slurry as a fertilizer |
| Source of data | Annual monitoring surveys |
| Value(s) applied | Not applicable, no effect on emission reductions |
| Measurement methods and procedures | 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. |
| Monitoring frequency | Annual |
| QA/QC procedures | N/A |
| Purpose of data | Monitoring of sustainable development benefits |
| Additional comment | N/A |

|  |  |
| --- | --- |
| **Data/Parameter** | **GS-03 Quality of employment** |
| Data unit | Number |
| Description | Number of masons attending training programmes |
| Source of data | Annual monitoring |
| Value(s) applied | Not applicable, no effect on emission reductions |
| Measurement methods and procedures | All vocational training attendees will be issued with a certificate proving their attendance, and a record of their names, contact details and gender, will be kept as part of the CME’s consolidated monitoring database. This will be updated as and when trainings are conducted. |
| Monitoring frequency | Annual |
| QA/QC procedures | N/A |
| Purpose of data | Monitoring of sustainable development benefits |
| Additional comment | N/A |

|  |  |
| --- | --- |
| **Data/Parameter** | **GS-04 Livelihood of the poor** |
| Data unit | % |
| Description | Percentage of users reporting changes in expenditure on fuel for cooking |
| Source of data | Monitoring survey |
| Value(s) applied | Not applicable, no effect on emission reductions |
| Measurement methods and procedures | Stakeholders will be asked:Has your expenditure of fuel for cooking a) increased, b) decrease or c) stayed the same since purchasing the biogas digester? |
| Monitoring frequency | Annual |
| QA/QC procedures | N/A |
| Purpose of data | Monitoring of sustainable development benefits |
| Additional comment | N/A |

|  |  |
| --- | --- |
| **Data/Parameter** | **GS-05 Access to affordable and clean energy services** |
| Data unit | Number |
| Description | Number of biogas units installed |
| Source of data | Electronic Project Database |
| Value(s) applied | To be determined per VPA |
| Measurement methods and procedures | The total number of biogas digesters will be determined via the electronic Project Database. |
| Monitoring frequency | Annual |
| QA/QC procedures | N/A |
| Purpose of data | Monitoring of sustainable development benefits  |
| Additional comment | N/A |

|  |  |
| --- | --- |
| **Data/Parameter** | **GS-06 Quantitative employment and income generation** |
| Data unit | Number |
| Description | Number of employees and jobs created in the project |
| Source of data | Employment records |
| Value(s) applied | Not applicable, no effect on emission reduction calculations |
| Measurement methods and procedures | Records will be kept of all employees and jobs created as part of the programme. Hard copies of employment contracts will be kept by VPA Implementers as evidence. Will include part-time work |
| Monitoring frequency | Annual |
| QA/QC procedures | N/A |
| Purpose of data | Monitoring of sustainable development benefits |
| Additional comment | N/A |

|  |  |
| --- | --- |
| **Data/Parameter** | **GS-07 Technology transfer and technological self-reliance** |
| Data unit | Number |
| Description | Number of employees attending training programmes |
| Source of data | Electronic Project Database |
| Value(s) applied | Not applicable, no effect on emission reduction calculations |
| Measurement methods and procedures | All vocational training attendees will be issued with a certificate proving their attendance, and a record of their names, contact details and gender, will be kept as part of the CME’s consolidated monitoring database. This will be updated as and when trainings are conducted. |
| Monitoring frequency | Annual |
| QA/QC procedures | N/A |
| Purpose of data | Monitoring of sustainable development benefits |
| Additional comment | N/A |

* + 1. Sampling plan

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The data collection will follow the standard “Sampling and surveys for CDM project activities and programme of activities (Version 07)"[[32]](#footnote-33).

*Objectives and reliability requirements*

The objective of the sampling effort is to meet the monitoring requirements set forth in the methodology ‘*Technologies and Practices to Displace Decentralized Thermal Energy Consumption’*. Monitoring will be carried out on an annual basis, with those parameters that can be monitored on a biennial basis monitored once every two years.

*Target population*

The target population for the application of monitoring procedure is the households, local communities and SMEs with installed biodigesters, as identified through the Project Database managed by the CME.

*Sampling method*

KBP, with support from Hivos, is responsible for the production of periodical monitoring reports for each VPA. Multi-stage sampling will be applied within the PoA, where clusters consist of regions and the subunits (biogas digesters) within them. It is more cost effective to monitor several subunits within each region. In order to account for the fact that not all regions have the same number of biogas digesters commissioned, sampling will be employed proportionate to cluster size. Clusters will be selected with a probability proportionate to the size of the target population within each cluster such that larger clusters have a greater probability of selection, and smaller clusters a lower probability. This helps to ensure that sampling remains representative of the entire population.

*Sample size*

In order to combine monitoring with an assessment of the drop-off rate of usage (which requires that digesters of different age groups are assessed), monitoring should 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. Alternatively, the monitoring survey and usage rate survey sample groups can be selected separately, such that at least 100 biogas digester users are surveyed for the monitoring survey, and at least 30 biogas digester users within each age group of digesters are surveyed.

To determine the average fuel savings as per the Kitchen Performance Test (ie. the Project Field Test), the sample size shall be determined through ensuring that the results comply with a 90% confidence interval and 30% margin of error, as per Annex 4 of the applied methodology.

For more details on the sample size determination, refer to Section B.7.2 of the PoA-DD.

*Sampling frame*

The sampling frame shall be defined based on the information in the Project Database, which outlines the location of each biogas digester and the number installed in each geographical region. The sample selection consists of two stages: the first step considers the larger sample units (country regions) whilst the second step involves randomly selecting biogas digesters to be monitored within these units.

* + 1. Other elements of monitoring plan

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*Data collection: field measurements*

KBP will collect the data necessary for the monitoring and for the emission reductions calculation. Field measurements and data to be collected are listed in section B.5.1 above. To account for seasonal fluctuations, monitoring of fuel wood consumption (KPT) should by preference be carried out during the dry season. This ensures conservativeness since during this season less wood is needed for cooking purposes as the wood fuel, the primary fuel for cooking purposes of most households, contains less moisture. Seasonality does not impact usage rate of other fuels such as LPG and kerosene. Measurements conducted during the dry season can therefore be assumed to be conservative. In case monitoring of fuel wood consumption is not taking place during the dry season moisture meters should be used.

The parameters to be monitored within VPA006, as outlined in the applied methodology, will be collected through a Monitoring Survey. This shall be completed periodically and covers the following data:

* Number of users applying the final biodigester slurry on agricultural fields;
* Perceived improvement of living conditions;
* Number of individuals attending trainings;
* Percentage of biodigester in use in the given year (y).
* The number of operational days of the biodigesters in the given year (y).
* The fraction of manure that is not treated in the biodigester.
* Ratio of households falling in separate baseline fuel scenarios.
* Continued use of baseline stoves: biogas digester users will be asked to confirm whether they use their baseline stove in addition to (or instead of) their biogas digester, and if so, how often they use it.
* Quantity of biomass and fossil fuel that is used for cooking in a given project scenario in a given year (y) – once every two years;

The application of bioslurry shall be monitored according to the applied methodology. If there is any anaerobic use/storage of bioslurry under anaerobic conditions reported from the monitoring survey, project emissions shall be accounted for accordingly. The following approach shall be followed:

* Estimation of the total amount of VS entering the biodigester;
* Assessment of remaining VS content of digestate;
* Assessment of methane potential of bio-slurry;
* MCF of the digestate management systems;
* Calculation of project emissions using the information obtained in the previous steps.

*Quality assurance/Quality control*

The CME will provide the necessary training to the VPA implementers and the parties involved in the monitoring to ensure that the data recorded is complete and accurate. The VPA Implementer, KBP, will prepare data collection protocols to be given to the research assistants to guide them during the data collection exercise.

Response rates will be maximized by sampling over the minimum required number to compensate for any non-responses. In special cases where participants refuse to participate in the monitoring, the surveyor will explain that monitoring is part of the requirements of the programme and try to arrange an alternative date for a site visit, or carryout monitoring with another member of the households, community or SME.

Sales Agreements will be stored by the KBP with copies sent to the CME, if requested. A back-up of the project database will also be stored on an electronic medium by the CME. All data monitored and required for verification and issuance will be kept for at least five years after the end of the crediting period or the last issuance of VERs for the project activity, whichever is later.

*Analysis*

All the sales data and the survey data will be captured in a computerised database. The analysis will include a calculation of the proportion of biogas system in use and of the emission reductions according to the methodology applied. For the Project Field Test, outliers will be excluded using the Grubb’s Test.[[33]](#footnote-34)

**Implementation plan**

KBP will be responsible for the collection of all Sales Agreement data and the creation of the Monitoring Report at the end of each Monitoring Period. KBP will also be responsible for entering user data into the Project Database and for ensuring that the information in the Sales Agreements is complete and correct. The total number of Sales Agreements will reveal the quantity of biogas systems sold at the end of a Monitoring Period. Appropriate record keeping procedures will be implemented to ensure that each Monitoring Period dataset can be transparently attributed to its corresponding VPA, preventing any occurrences of double counting.

*Monitoring Responsibilities*

KBP is responsible for all the monitoring activities carried out within this VPA, including data collection, data monitoring, and writing the Monitoring Report.

1. Start date, crediting period type and duration
	1. Start date of VPA

>>

The start date of the project is the earliest date at which either the implementation or construction or real action of a project begins. Therefore, the start date of VPA006 is 01/01/2014, the day on which the first biogas digester was implemented under the VPA. Retroactive inclusion is pursued as permitted by the Gold Standard.[[34]](#footnote-35)

* 1. Expected operational lifetime of VPA

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The expected operational lifetime of the VPA is the full duration of the crediting period, at 21 years. A well maintained fixed-dome biogas system has an operational lifetime of over 30 years[[35]](#footnote-36). This means that the systems should be operational beyond the potential crediting period of the VPA.

* 1. Crediting period of VPA
		1. Type of crediting period

>>

Renewable crediting period.

* + 1. Start date of crediting period

>>

The start date of the crediting period is on 01/01/2016 (estimated date) or 2 years prior to the end date of the inclusion review period, whichever is later.[[36]](#footnote-37)

* + 1. Duration of crediting period

>>

The crediting period for the VPA is 7 years, renewable twice. The duration of the crediting period will not exceed the end date of the programme.

1. Environmental impacts
	1. Analysis of environmental impacts

>>

An environmental impact assessment is not required for activities implementing household biodigesters in Kenya, as stipulated by the Environmental Management and Coordination Act, 1999, which states that only projects that fall under the Second Schedule are required to submit a Project Report and then potentially an Environmental Impact Assessment (EIA). The VPA will not be required to submit an EIA as the activities are not contained in the Second Schedule.

* 1. Environmental impact assessment

>>

N/A

1. Local stakeholder consultation
	1. Modalities for local stakeholder consultation

>>

The Kenya VPA006 is retroactively included in the African Biogas Carbon Programme (ABC) PoA, and is the second VPA of the PoA located in Kenya. The design and implementation of the Kenya VPA006 is exactly as per the design and implementation of VPA001 of the ABC PoA. Moreover, the geographical location of VPA001 and VPA006 are identical, as both cover the entire territory of Kenya. The reason for inclusion of VPA006 is simply that VPA001 has reached capacity; the project remains the same in all other aspects.

As part of the registration process of VPA001, a Local Stakeholder Consultation (LSC) was carried out on 19 October 2011 in Nairobi. There were 38 participants. A further LSC was carried out on 29 May 2015[[37]](#footnote-38) as part of an effort to account for carbon reductions from soil carbon sequestration occurring as a result of bioslurry usage as fertilizer. There were 75 participants.

Given that the LSCs carried out in 2011 and 2015 covers the people and area affected by the VPA001, there is no need to carry out an additional local stakeholder consultation for the registration of the VPA006. The 2011 and 2015 LSCs are used as stakeholder input for VPA006. Additionally, Hivos will carry out a Stakeholder Feedback Round for the Kenya VPA006, seeking feedback from stakeholders through electronic communication.

The following description of the modalities for the LSC applies to the implementation of the 2011 and 2015 LSCs.

19 October 2011 at Panafric Hotel, Nairobi

Comments were solicited from stakeholders in accordance with the Gold Standard’s procedures. Stakeholders were invited to attend a public meeting to be informed and give their comments on the SSC-VPA. The meeting was held on 19/10/2011 at 09:00 AM, at Panafric Hotel, Nairobi. Invitations were distributed to specific stakeholders via e-mail and telephone between 05/10/11 – 07/10/11 and a public invitation was advertised in the weekly regional newspaper the East African on 10/10/11. The process for identifying stakeholders is described in more detail in the Local Stakeholder Consultation report. 38 people who represented a wide range of stakeholders attended the meeting. Women were well represented and were outspoken in the meeting, making up 39% of the attendees. Stakeholders included representatives from government ministries, non-governmental organisations, private businesses, financiers and farmers including some that had already installed biogas systems.

Participants were briefed on the background to the CDM mechanism, the basic concept of which is the ability to generate carbon credits for a programme which applies also under the Gold Standard, and the PoA-DD with questions and answer sessions for each topic. Participants were then presented with the specifics of the VPA and invited to make comments and ask any questions. The participants then engaged in an exercise to examine the sustainability of the VPA, as per Gold Standard requirements. Participants were also invited to provide written feedback, evaluation forms were received in English. Stakeholders that were unable to attend the meeting were invited to send in comments via e-mail.

A follow-up Stakeholder Feedback Round was also organized from 9th January to 9th March 2015. Stakeholders were invited to review the LSC Report, PDDs and Passports for the PoA and VPA.

29 May 2015 at Heron Portico Hotel, Nairobi

Comments were solicited from stakeholders in accordance with the Gold Standard’s procedures. Stakeholders were invited to attend a public meeting to be informed and give their comments on the SSC-VPA. The meeting was held on 29/05/2015 at 09:00 AM, at the Heron Portico Hotel, Nairobi. Invitations were distributed to stakeholders via an add in the Daily Nation paper, e-mail and telephone from 19/05/2015 onwards. The consultation was also advertised on the ABPP website (africabiogas.org). 75 people, representing a wide range of stakeholders, attended the meeting.

Participants were briefed on the background to the Gold Standard mechanism, the basic concept of which is the ability to generate carbon credits for a programme which applies also under the Gold Standard, with questions and answer sessions for each topic. Participants were then presented with the specifics of the VPA and invited to make comments and ask any questions. The participants then engaged in an exercise to examine the sustainability of the programme, as per Gold Standard requirements. Participants were also invited to provide written feedback, and evaluation forms were received.

* 1. Summary of comments received

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The table below summarizes the comments received during the 2011 and 2015 Local Stakeholder Consultation, as well as the response by the programme. The comments received were overall very positive. Their responses mainly called for KENDBIP[[38]](#footnote-39) to be expanded beyond domestic fixed dome installations.

Table 12 *Summary of comments received during the stakeholder consultations*

|  |  |  |
| --- | --- | --- |
| **Stakeholder comment** | **Was comment taken into account (Yes/ No)?** | **Explanation (Why? How?)** |
| Poor construction could lead to effluent seepage into the groundwater | Yes | It was agreed that for the KENDBIP[[39]](#footnote-40) project this was a relatively low risk considering the quality control procedures required and training provided to all masons. |
| It was mentioned that the extra water required by the biogas system might put added pressure on household’s water resources | Yes | Agreed this can be considered a minor risk as these systems would be installed in areas where there is a ready supply of water. The demands of water from each biogas system are also not extremely high, and a decreased rate of deforestation would help to improve watersheds. |
| The project will result in increased access to clean energy services however biogas systems even subsidised will not be affordable to the poorest. | No | The project already offers biogas digesters at a reduced cost and works with microfinance institutions to allow farmers the ability to access capital for the purchase of a digester. |
| Do you have a standard for quality control? | Yes | There are a number of different quality controls built into the programme. On the carbon credits side of the project it will be registered with Gold Standard. also have a number of quality control checks to ensure quality of construction. When new digesters are included for other VPAs they will need to go through a quality check to ensure they will have a long lifetime. |
| Where does carbon credit go? | No – only a clarification was required | The households own the carbon credits initially, but in providing a subsidy the ownership of the credit is transferred to KENDBIP. Currently, we are working on tools to explain the process of the carbon credit transfer to households, it is intended this will be done in a pictogram in English and local language.[[40]](#footnote-41) ACES-Biogas is working on ways to ensure that benefits will be passed on to households.[[41]](#footnote-42) |
| Why does the programme only cover small domestic installations would it not be more effective at a larger scale on community or industrial level? | No – only a clarification was needed. | The programme has been initially designed and funded for domestic installations and therefore we are limited in scope. In the future we would be keen to promote these larger scale digesters. |

* 1. Consideration of comments received

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All comments received were taken into account within the overall design of the VPA. No comments required modifying the design of the VPA.

1. Eligibility for inclusion

This VPA follows the stated goal of the PoA and eligibility criteria for inclusion in the PoA as determined in Section B.2. of the PoA-DD:

Table 13 *VPA eligibility check*

| **No.** | **Eligibility criterion - Category** | **Eligibility criterion - Required condition** | **Supporting evidence for inclusion** | **Description of this VPA in relation to the criterion and supporting evidence** |
| --- | --- | --- | --- | --- |
| 1 | The geographical boundary of the VPA including any time-induced boundary consistent with the geographical boundary set in the PoA | All biogas systems included in the VPA will demonstrate they fall within the geographical boundary of the PoA through:* Recording the address/location of the system in the Sales Agreement
* Recording the GPS coordinates of the systems
* Physically attaching a Programme or VPA logo to the digester which identifies it as being part of the African Biogas Partnership Programme on a national scale.
 | One of the following documents shall be provided: * Business plan
* Implementation document
* Contractual agreement between CME and VPA Implementer
* Declaration from VPA implementer and confirmation check by CME
* Sales Agreement
 | The following document is provided:* Implementation document (KBP) Programme Implementation Document ‘
* Ownership certificates
 |
| 2 | Conditions that avoid double counting of emission reductions like unique identifications of product and end-user locations | The VPA shall demonstrate that it does not double-count any of its appliances for the ERs estimation by confirming that:* The complete address of each biogas system will be recorded
* The biogas systems have unique serial numbers
* The VPA implementer has not included these biogas systems in another VPA or carbon project.
 | * Contractual agreement between CME and VPA Implementer.
* Declaration from VPA implementer
* Sales Agreement
 | The following documents are provided:* Contractual agreement between CME and VPA implementer
* Declaration from VPA implementer
* Ownership certificates
 |
| 3 | The specifications of technology/measure including the level and type of service, performance specifications including compliance with testing/certifications | The biogas systems disseminated are renewable energy generation units to provide thermal energy and will be required to conform to any applicable national standards. | The following documents shall be provided: * Technical documentation describing the operation of the biogas system.
* Evidence of compliance with national standard (if applicable).
 | The following document is provided:* Technical documentation describing the operation of the biogas system (Operation Manual of Biogas plants)

There are no national standards regulating biogas digester technologies in Kenya. |
| 4 | Conditions to check the start date of the VPA through documentary evidence | The VPA implementer will demonstrate the start date of the VPA is on or after the start date of the PoA. The start date of the VPA will be defined as the date on which the first Sales Agreement is signed under the VPA.  | * Sales Agreements for the first digester included under the VPA.
 | The following documents are provided:* Sales Agreements for the first digester included under the VPA.
* Project Database
 |
| 5 | Conditions that ensure compliance with applicability and other requirements of single or multiple methodologies applied by VPAs | The VPA complies with the baseline and monitoring methodology requirements of the ‘Technologies and Practices to Displace Decentralised Thermal Energy Consumption’ (version 1.0). and should meet its eligibility criteria as discussed in Section B.2 of the PoA-DD.  | The following documents shall be provided as evidence: * Project database
* Sales Agreement
 | The following documents are provided as evidence:* Project Database
* Sales Agreement
* KPT Reports
 |
| 6 | The conditions that ensure that VPAs meet the requirements pertaining to the demonstration of additionality | The VPA will prove additionality as per the following approach:***1) Positive List[[42]](#footnote-43)***1. Biogas system rated capacity is less than 2.25MWth each
2. Biogas systems are disseminated to households or communities or Small and Medium Enterprises (SMEs).
 | The following evidences shall be provided: 1. Calculation showing the capacity of the biogas system(s) in MW
2. Business plan / Implementation document
 | The following evidence is provided:1. Calculation showing the capacity of the biogas system(s) in MW
2. Implementation document (KBP Programme Implementation Document)
 |
| 7 | The PoA-specific requirements stipulated by the CME including any conditions related to undertaking local stakeholder consultations and environmental impact analysis | 1. The VPA, organised a local stakeholder consultation (LSC) in accordance with Gold Standard requirements2. The VPA, or a group of VPAs, got environmental clearance for the project related activities, if applicable | The following documents shall be provided: 1. Local Stakeholder Report including comments of stakeholders and how the comments were taken into account by the VPA implementer 2. Environmental clearance letter and/or EIA if required by national regulations | The following document is provided:* Local Stakeholder Report (Kenya) for VPA1

An environmental impact assessment is not required for activities implementing household biodigesters in Kenya, as stipulated by the Environmental Management and Coordination Act, 1999 (see Section B.1 above) |
| 8 | Conditions to provide an affirmation that funding from Annex I parties, if any, does not result in a diversion of official development assistance | The VPA will demonstrate that any Official Development Assistance received for the VPA has not occurred on the condition that the resulting credits are transferred to the donor country[[43]](#footnote-44). | Verifiable evidence: * ODA Declaration
 | The following document is provided:* ODA Declaration
 |
| 9 | Where applicable, target group (e.g. domestic / commercial / industrial, rural / urban, grid connected / off-grid) and distribution mechanisms (e.g. direct installation) | The VPA will demonstrate which target group(s) is/are to be targeted by the VPA and the distribution mechanism. Target groups shall include:* Households
* Small/Medium Enterprises
* Communities
 | Any of the following documents shall be provided: * Sales forecast
* Marketing plan
* Description of technology (e.g. domestic or institutional biogas system)
* Implementation document
 | The following document is provided:* Implementation document (KENDBIP Programme Implementation Document)
* The VPA shall include households as the target group.
* The biogas digesters are directly installed at the user’s household.
 |
| 10 | Where applicable, the conditions related to sampling requirements for a PoA in accordance with the approved guidelines/standard from the Board pertaining to sampling and surveys | The VPA Implementer will agree to support the sampling and survey activities of CME in accordance with B.7.2 of the PoA-DD. | Contractual agreement between CME and VPA Implementer | The following document is provided:Contractual agreement between CME and VPA implementer |
| 11 | Where applicable, the conditions that ensure that every VPA in aggregate meets the small-scale threshold criteria and remains within those thresholds throughout the crediting period of the VPA | The VPA Implementer will ensure that each VPA remains below the small scale limits. For activities falling under Type I[[44]](#footnote-45), each VPA in aggregate will remain below 15 MW (45MWth) per year. For activities falling under Type III[[45]](#footnote-46), each VPA will achieve below 60,000 tCO2e in emission reductions annually. | Any of the following documents shall be provided: * Contractual agreement between CME and VPA Implementer
* Sales forecast
* Calculation showing the capacity of the biogas system(s)
* Project database
 | The following documents are provided:* Capacity calculation of the biogas system(s), showing that the VPA Type I installed capacity is below the 15MW (45MWth)[[46]](#footnote-47) threshold.
* Emission reduction calculation, showing that the VPA Type III emissions are below the 60,000 tCO2e threshold.[[47]](#footnote-48)
 |
| 12 | Where applicable, the requirements for the debundling check, in case VPAs belong to small-scale (SSC) or microscale project categories. | The VPA implementer will demonstrate that the VPA is not a de-bundled component via the following approach:1. The biogas systems are less than 1% of the SSC threshold (as per paragraph 10 EB54 Annex 13)
 | The following evidence shall be provided: 1. Calculation showing the capacity of the biogas system(s)
2. Project Database showing size of systems.
 | The following evidence is provided: 1. Calculation showing the capacity of the biogas system(s)
 |
| 13 | The proposed VPA must ensure that sufficient training has been carried out to ensure the construction / installation of the biogas system is done by competent persons | The VPA implementer will provide sufficient evidence of training or qualification to implement the proposed VPA. | Any of the following documents shall be provided:* Training certificates
* Training records
* Qualification certificates
* Planned training schedules
 | The following documents are provided:* Training certificates
* Training records
* Qualification certificates
* Planned training schedules
 |
| 14 | Transfer of rights to carbon credits. | The end user of each biogas digester has been properly informed during the stake holders consultation on the transfer of credit ownership and agreed to transfer all rights to any carbon credits to the VPA Implementer. | The following documents are provided: * Sales Agreement
* Contractual agreement between CME and the VPA Implementer
 | The following documents are provided:* Sales Agreement
* Contractual agreement between CME and VPA implementer
 |
| 15 | Prior consideration of carbon revenues | For retroactive VPAs, prior consideration of carbon revenues shall be checked at the time of inclusion by checking that carbon revenues are considered in early project documentation before the date of VPA inclusion (e.g. in a feasibility report, a programme implementation document or similar documentation).  | The following documents are provided: * Feasibility study
* Business plan
* Implementation document
* Any other such documents demonstrating compliance
 | The following documents are provided:* KBP Programme Implementation Document
* Memo demonstrating the prior consideration of carbon revenues
 |

1. Contact information of VPA implementers

|  |  |
| --- | --- |
| **Organization name** | Kenya Biogas Program (KBP) |
| **Country** | Kenya |
| **Address** | P.O. Box 79875-00202 Nairobi |
| **Telephone** | 0791496964 |
| **Fax** | Not applicable |
| **E-mail** | info@kbp.co.ke |
| **Website** | <http://kenyabiogas.com> |
| **Contact person** | Kevin Kinusu |

Affirmation regarding public funding





1. Applicability of methodologies and standardized baselines

Please see section B.1. of the VPA-DD for details.

1. Further background information on ex ante calculation of emission reductions

No further background information necessary

1. Further background information on monitoring plan

No further background information necessary

1. Summary report of comments received from local stakeholders
2. Summary of post-registration changes

N/A

1. Global Alliance for Clean Cookstoves (2013) Kenya Country Action Plan (CAP) p. 16 [↑](#footnote-ref-2)
2. Global Alliance for Clean Cookstoves (2013) p. 18 [↑](#footnote-ref-3)
3. Global Alliance for Clean Cookstoves (2013) p. 16 [↑](#footnote-ref-4)
4. Global Alliance for Clean Cookstoves (2013) p. 17 [↑](#footnote-ref-5)
5. Global Alliance for Clean Cookstoves (2013) p. 18 [↑](#footnote-ref-6)
6. Global Alliance for Clean Cookstoves (2013) p. 23 [↑](#footnote-ref-7)
7. Available from <https://www.cia.gov/library/publications/the-world-factbook/geos/ke.html> [↑](#footnote-ref-8)
8. 20160330 Biogas Course Reader.pdf [↑](#footnote-ref-9)
9. Please refer to the ODA declaration in Appendix 2 [↑](#footnote-ref-10)
10. Please see the file ‘20170131 Hivos Prior Consideration Memo Kenya’ for the demonstration of prior consideration of carbon revenues for PoA GS2747 Kenya activities [↑](#footnote-ref-11)
11. Please see the file ‘20170330 GS Confirmation Prior Consideration Kenya’ for the approval of exception to the rule update by the Gold Standard [↑](#footnote-ref-12)
12. EB 54 Annex 13 [↑](#footnote-ref-13)
13. i.e. 150 kW installed capacity or 0.6 GWh annual energy savings or 0.6 ktCO2e annual emission reductions. See EB65 Report, page 25. Guidelines changed from 15kW to 150kW electrical, or 450kW thermal [↑](#footnote-ref-14)
14. As demonstrated in section B.3. of the PoA-DD [↑](#footnote-ref-15)
15. The World Bank (2016) Available from <https://data.worldbank.org/indicator/SP.POP.TOTL?locations=KE> [↑](#footnote-ref-16)
16. The World Bank (2014) Available from <https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?end=2014&start=2014&view=bar> [↑](#footnote-ref-17)
17. For more details, see the Monitoring Report for VPA1 [↑](#footnote-ref-18)
18. See survey results from ‘ABC VPA1 KE MP2 Surveys + Analysis’, Sheet ‘Analysis A’ [↑](#footnote-ref-19)
19. Further details in the supporting excel sheet, ‘Grubb’s test’ sheets. [↑](#footnote-ref-20)
20. United Nations World Food Programme (2010) Safe Access to Firewood and Alternative Energy in Kenya: An Appraisal Report (pg 21), World Bank; and Africa Renewable Energy Access Program (AFREA) (2011) Wood-Based Biomass Energy Development for Sub-Saharan Africa (Section 3.2.2, pg 21); and Njenga, M. et al (2014) Additional cooking fuel supply and reduced global warming potential from recycling charcoal dust into charcoal briquette in Kenya, Journal of Cleaner Production (pg 81, pg 82); and International Network for Sustainable Energy (INFORSE) (2011) Case: Kenya Afforestation for Charcoal [online] Available from: <http://www.inforse.org/Case/Case-Kenya-Afforestation.php3> [↑](#footnote-ref-21)
21. Please see [Table type stainless steel single burner gas stove](https://zsbidi.en.ecplaza.net/products/table-type-stainless-steel-single-burner_3889154) for more information [↑](#footnote-ref-22)
22. Please see [Table type stainless steel single burner gas stove](https://zsbidi.en.ecplaza.net/products/table-type-stainless-steel-single-burner_3889154) for more information [↑](#footnote-ref-23)
23. Technologies and practices to displace decentralized thermal energy – 11/04/2011’ p.11 - 12 [↑](#footnote-ref-24)
24. Chapter 10: Emissions from Livestock and Manure Management. 2006 IPCC Guidelines for National Greenhouse Gas Inventories [↑](#footnote-ref-25)
25. IPCC Guidelines for National Greenhouse Gas Inventories: Chapter 10: Emissions from Livestock and Manure Management (2006) [↑](#footnote-ref-26)
26. Figures may not add up due to rounding – see emission reduction calculation [↑](#footnote-ref-27)
27. Figures may not add up due to rounding – see emission reduction calculation [↑](#footnote-ref-28)
28. Figures may not add up due to rounding – see emission reduction calculation [↑](#footnote-ref-29)
29. GACC (2013) p. 23 [↑](#footnote-ref-30)
30. Figures may not add up due to rounding [↑](#footnote-ref-31)
31. Refer to accompanying Gold Standard PoA-Passport for further details. [↑](#footnote-ref-32)
32. CDM-EB50-A30-STAN [↑](#footnote-ref-33)
33. For more on the Grubbs’ test, please refer to <http://www.itl.nist.gov/div898/handbook/eda/section3/eda35h1.htm>.

For a cross-check of the significance of the results, please refer to an online tool available on: <http://www.graphpad.com/quickcalcs/Grubbs1.cfm>. [↑](#footnote-ref-34)
34. See GS confirmation of Prior Consideration of Carbon Revenues, 30 March 2017 [↑](#footnote-ref-35)
35. ETC Group, Promoting Biogas Systems in Kenya, A feasibility study, Final Draft, 20 August 2007 [↑](#footnote-ref-36)
36. The Gold Standard’s Annex F (V2.2) states that “A VPA submitted for Gold Standard inclusion/registration

under the regular/retroactive project cycle is potentially eligible to receive credits for realised emission reductions generated prior to Gold Standard inclusion/registration for a maximum period of two years.” [↑](#footnote-ref-37)
37. See report ‘2015 LSC Report Bioslurry Kenya’ [↑](#footnote-ref-38)
38. Please note that KBP has now assume the role of VPA implementer [↑](#footnote-ref-39)
39. Please note that KBP has now assumed the role of VPA implementer [↑](#footnote-ref-40)
40. Please note that KBP is no longer working on this [↑](#footnote-ref-41)
41. ACES-Biogas is not actively participating in this project anymore, Hivos has taken over this role. As such, Hivos will use carbon revenues to support affordability of the bio digesters and ensure sustainable after sales support. [↑](#footnote-ref-42)
42. As per TOOL21 “Demonstration of Additionality of Small-Scale Project Activities” Version 10.0, EB83 Annex 14 [↑](#footnote-ref-43)
43. Gold Standard Toolkit, Version 2.1, Section 1.2.5. [↑](#footnote-ref-44)
44. Type I activities are “renewable energy project activities with a maximum output capacity of 15 MW (or an appropriate equivalent)”, CDM Project Standard for Programmes of Activities (version 01.0) [↑](#footnote-ref-45)
45. Type III activities are “other project activities not included in Type I or Type II that result in GHG emission reductions not exceeding 60 kt CO2e per year in any year of the crediting period”, CDM Project Standard for Programmes of Activities (version 01.0) [↑](#footnote-ref-46)
46. Explanation: Section B.3. of the PoA-DD indicates that the thermal capacity of the largest possible biodigester allowed under the programme (100 m3) is 44.77 kWth. In VPA-1, the average biodigester size is 8.45 m3, resulting in a capacity of 3.78 kWth per unit. Given 11,578 units installed, this results in a total of 43.80 MWth installed capacity under VPA-1. This is lower than the 45 MWth threshold. [↑](#footnote-ref-47)
47. Explanation: Of the total annual emission reduction of 52,706 tCO2e, only 2,246 tCO2e are attributed to methane avoidance (Type III) – 0.194 tCO2e from TIER 2 emission reductions multiplied by 11,578 digesters installed. [↑](#footnote-ref-48)