Component project activity design document form for small-scale CDM component project activities

(Version 03.0)

Complete this form in accordance with the Attachment "Instructions for filling out the component project activity design document form for CDM small-scale component project activities" at the end of this form.

COMPONENT PROJECT DESIGN DOCUMENT (VPA-DD)	
Title of the VPA	African Biogas Carbon Programme (ABC) – Tanzania – CAMARTEC - VPA002
Version number of the VPA-DD	01
Completion date of the VPA-DD	08/02/2015
Title of the PoA to which the VPA is included	African Biogas Carbon Programme (ABC)
Host Party(ies)	Tanzania
Estimated amount of annual average GHG emission reductions	88,758

SECTION A. General description of VPA

A.1. Title of the proposed or registered PoA

African Biogas Carbon Programme (ABC)

A.2. Title of the VPA

VPA Title: African Biogas Carbon Programme (ABC) – Tanzania – CAMARTEC - VPA002

Version: 01
Date: 08/01/2015

A.3. Description of the VPA

The overall objective of the VPA is to contribute to the achievement of the Millennium Development Goals (MDGs) through the dissemination of domestic biogas systems as a local, sustainable energy source and 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.

The Centre for Agricultural Mechanisation and Rural Technology (CAMARTEC) is the VPA implementer of this VPA. CAMARTEC operate as part of the Tanzania Domestic Biogas Programme (TDBP), a component of the Africa Biogas Partnership Programme (ABPP), which is supported by this PoA.

CAMARTEC 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 United Republic of Tanzania.

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.

There is significant potential for domestic biogas in Tanzania, however, to date a viable market has not developed. The VPA is 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 VPA will stimulate the installation of domestic biogas systems of 4 m^3, 6 m^3, 9 m^3, and 13 m^3 capacities[1]. This VPA is retroactive and includes biogas systems that have been installed since 2009.

The Tanzania National Energy Policy 2003[2] indicates that biomass, particularly charcoal and fuelwood, are the main source of energy to both urban and rural areas and accounts for more than 90% of primary energy supply in Tanzania. It also states that for the foreseeable future biomass energy will remain the main energy source. This makes biogas an attractive renewable source of alternative energy.

[1] Page ii, TDBP Programme Implementation Document, 2009

[2] Pages 6 and 24

A.4. Entity/individual responsible for the operation of VPA

The Centre for Agricultural Mechanisation and Rural Technology (CAMARTEC) is the VPA implementer of the Tanzanian Domestic Biogas Programme (TDBP). TDBP is a component of the Africa Biogas Partnership Programme (ABPP). The African Biogas Carbon PoA has been set up to support the ABPP initiative with carbon finance.

Currently, CAMARTEC partners with eight Implementing Partners located in different regions of Tanzania. The Implementing Partners support the installation of biogas digesters, collection of user information through the Sales Agreement and forwarding accurate project data to CAMARTEC on a regular basis to be entered into the project database. Current Implementing Partners include FIDE, ELCT, KDA, NRCF, MIGESADO, CARITAS, Ministry of Livestock and Fisheries Development Zanzibar and KADETFU. Other Implementing Partners may be included in future.

The Biogas Construction Enterprises (BCEs) and masons are responsible for the process of plant installation and direct user data collection through the Sales Agreement.

A.5. Technical description of the VPA

The VPA will stimulate the installation of domestic biogas systems country wide, of 4 m^3, 6 m^3, 9 m^3, and 13m^3 capacities. It will install and maintain biogas systems through 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. The initial target of the VPA is to support the installation of some 11,103 biogas systems that installed between 2009 and 2014, retaining the option to fill the VPA post-2014 up until its eligible threshold defined by the small scale methodology guidance is met. See Section D.5 for a detailed calculation of this VPA's limit.

The VPA includes a biogas model that has a fixed dome based on the original CAMARTEC design with some modifications. A drawing of the modified CAMARTEC model is shown in **Error! Reference source not found.**.

CAMARTEC selected the appropriate biogas technology to be implemented through engagement with a wide range of stakeholders. They agreed on the fixed dome digester design as being the most suitable for the Tanzanian context, as shown in *Figure 1*.

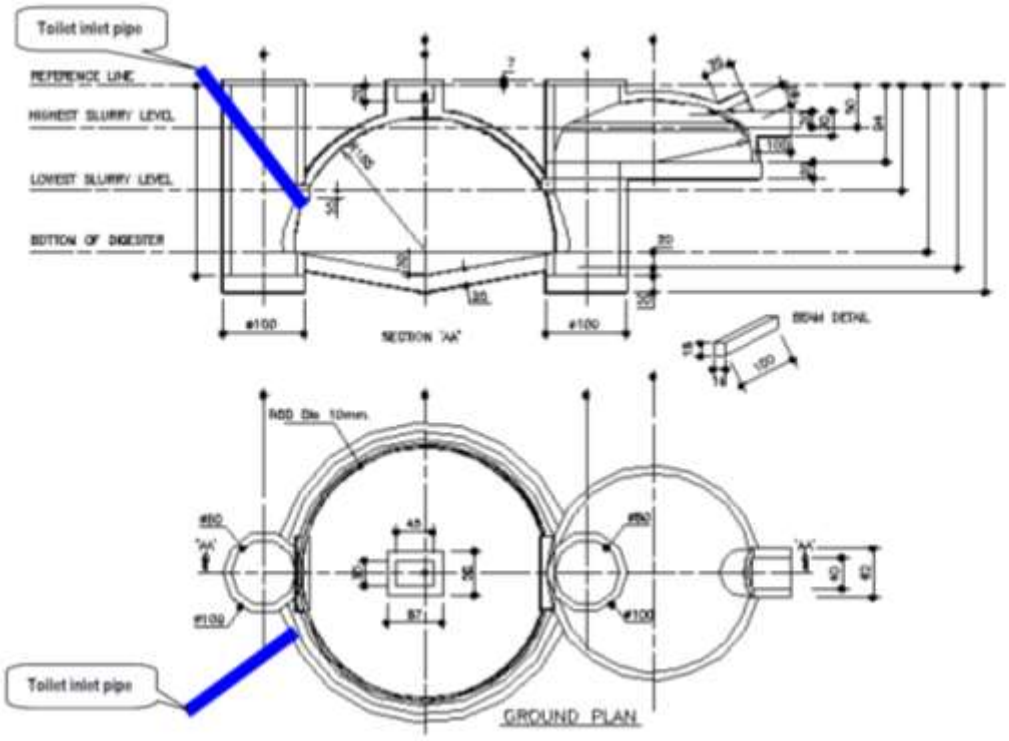

Figure 1: CAMARTEC biogas system technical drawing[3]

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.

[3] Tanzania Domestic Biogas Programme (no date) *Biogas Plant Construction Manual Solid State Digester,* page 14

A.6. Party(ies)

Name of Party involved (host) indicates host Party	Private and/or public entity(ies) VPA implementer(s) (as applicable)	Indicate if the Party involved wishes to be considered as VPA implementer (Yes/No)
United Republic of Tanzania (host)	Centre for Agricultural Mechanisation and Rural Technology (CAMARTEC)	No

A.7. Geographic reference or other means of identification

This VPA will disseminate biogas systems over the entire territory of Tanzania. The primary means to uniquely identify the activities under the VPA is by means of buyer information collected through Sales Agreements. These include a serial number, customer name, address, GPS coordinates (for non-retroactively included digesters), date of sale, name of VPA implementer (CAMARTEC), biogas model and size.

The unique identification of the VPA is the code (CAMARTEC-VPA002).

The VPA implementer is the Centre for Agricultural Mechanisation and Rural Technology (CAMARTEC). The main offices are used to represent the physical location of the project, Njiro Road, Themi, Arusha, United Republic of Tanzania[4].

The co-ordinates of Tanzania are represented approximately by: 6 00 S, 35 00 E[5]

[4] Further contact details of the VPA implementer can be found in Annex 1

[5] Coordinates include rounded latitude and longitude figures for the centroid or center point of a country expressed in degrees and minutes; it is based on the locations provided in the Geographic Names Server (GNS), maintained by the National Geospatial-Intelligence Agency on behalf of the US Board on Geographic Names. Available from https://www.cia.gov/library/publications/the-world-factbook/fields/2011.html

Figure 2: Location of CAMARTEC and border of Tanzania.

A.8. Duration of the VPA

A.8.1. Start date of the VPA

The starting date of this programme activity is 10/09/2009, the date of the first Sales Agreement signed for the first digester to be included under this VPA. Retroactive inclusion is pursued.

A.8.2. Expected operational lifetime of the VPA

The expected lifetime of the VPA is the full duration of the crediting period, at 21 years.

CAMARTEC's partnership with ABPP began the development of a commercially viable biogas sector in Tanzania in 2009.[6] The total installed capacity of the initially planned 11,103 units amounts to 35.70 MW_{th}, below the 45 MW_{th} threshold. The VPA will be available for future biodigesters as long as the threshold defined by the small scale methodology guidance is met. See capacity calculation in the Eligibility Section (Section D.5) for a detailed calculation of this VPA's limit.

Table 1: Implementation schedule of the VPA

Year	Number of biogas digesters installed	

[6] Details of the implementation schedule can be found in p19-48, Kenya National Domestic Biogas Programme, Programme Implementation Document, 2010

2009	106	*Retroactively included in VPA-1*
2010	1,021	
2011	1,444	
2012	2,409	
2013	3,819	
2014	2,304	
2015	0	
2017	0	
2018	0	
Total	**11,103**	

A.9. Choice of the crediting period and related information

Renewable crediting period

A.9.1. Start date of the crediting period

The starting date of the crediting period will be 01/01/2014, or two years before the date of inclusion in the registered PoA, which ever occurs earlier.

A.9.2. Length of the 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.

A.10. Estimated amount of GHG emission reductions

This VPA is retroactive and will therefore claim credits for two years prior to inclusion in the PoA as per the Gold Standard guidance on retroactive crediting, which 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."[7]

Table 2: Estimated emission reductions over the crediting period

Emission reductions during the crediting period	
Years	Annual GHG emission reductions (in tonnes of CO_2e) for each year
2013	57,997
2014	84,922
2015	95,677
2016	95,677
2017	95,677
2018	95,677
2019	95,677

[7] Gold Standard Version 2.2, Annex F ´The Gold Standard PoA Rules and Guidance – Annex F (GSv2.2), Paragraph 3,4,2

Total number of crediting years	7
Annual average GHG emission reductions over the crediting period	88,758
Total estimated reductions (tonnes of CO_2e)	621,303

A.11. Public funding of the VPA

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.

A.12. Debundling of small-scale component project activities

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[8] 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[9], 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 150 kW for thermal energy as shown in Table 2[10]:

Table 3: Capacity of CAMARTEC biogas systems

Size of digester (m^3)	Maximum daily feed (kg)	Maximum daily gas production (m^3)	Maximum capacity of digester (kW)
4	30	1.2	1.00
6	45	1.8	1.47
9	60	2.4	2.21
13	90	3.6	3.34

A.13. Confirmation for VPA

This VPA is neither registered as an individual carbon project activity or is part of another registered PoA. Double counting is avoided through recording the unique serial number and name and address of users of each biodigester in a centralised database system operated by the CME.

A.14. Contact information of responsible persons/ entities for completing the CDM-SSC-CPA-DD-FORM

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The CDM-SSC-CPA-DD-FORM was completed by Climate Focus (Hilda Galt, email: h.galt@climatefocus.com; and Szymon Mikolajczyk, email: s.mikolajczyk@climatefocus.com).

8 EB 54 Annex 13

9 i.e. 150 kW installed capacity or 0.6 GWh annual energy savings or 0.6 $ktCO_2e$ annual emission reductions. See EB65 Report, page 25. Guidelines changed from 15kW to 150kW electrical, or 450kW thermal

10 Detailed calculations were provided to the DOE on Emission Reduction spreadsheet.

SECTION B. Environmental analysis

B.1. Analysis of the environmental impacts

An environmental impact assessment is not required for activities implementing household biodigesters. The Environment Management Act, 2004[11], states that only projects which are under the Third Schedule of the act are required to undertake an EIA. As biogas is not contained in this Schedule (pages 127 -128) no EIA is required by a VPA installing small biogas systems

A broad environmental impact assessment has been carried out during the stakeholder consultation, as reported in both the Local Stakeholder Consultation Report and the VPA Passport.

SECTION C. Local stakeholder comments

C.1. Solicitation of comments from local stakeholders

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 VPA. The meeting was held on 23/02/2012 at 08:30 till 13:00, at the Landmark Hotel in Dar es Salaam, Tanzania. Invitations were distributed to specific stakeholders via e-mail and telephone between 09/02/2012 – 20/02/2012 and a public invitation was advertised in the national newspaper Daily News on 09/02/2012. The process for identifying stakeholders is described in more detail in the Local Stakeholder Consultation report. 41 people, who represented a wide range of stakeholders, attended the meeting.

Stakeholders included representatives from the Regional Government and Local Authority, the National Environmental Management Council (NEMC), the Ministry of Health and Social Welfare (ILALA), the Ministry of Natural Resources and Tourism (MNRT), the Ministry of Livestock and Fisheries Development, as well as a number of journalists.

Participants were briefed on the background to the CDM and the PoA 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. 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.

The Gold Standard Local Stakeholder Consultation Report for this VPA provides a detailed description of the consultation and the results.

C.2. Summary of comments received

The comments received were addressed, as summarised in *Table 4* below. A summary of the action items raised and CAMARTEC's response to these actions appear below.

Most negative comments related to the modalities of CDM since this consultation was originally carried out with the intention to develop the project under the CDM. However, these comments are still relevant under the Gold Standard and have therefore been considered below. Other comments

[11] The Environmental Management Act, page 56, paragraph 81, 2004. Available from : http://faolex.fao.org/docs/pdf/tan61491.pdf

regarded the set up and implementation of the Tanzania Domestic Biogas Programme as opposed to concern over the impacts of the project.

Table 4: Summary of comments received during the stakeholder consultations.

Stakeholder comment	Was comment taken into account (Yes/ No)?	Explanation (Why? How?)
It takes long to realise the carbon credits from the programme	No, not necessary	This is as a result of the nature of the UNFCCC CDM modalities, which the project proponents are not in a position to change. This is also relevant under the Gold Standard.
Even with the subsidy, the cost of constructing a biogas digester is still relatively high. The subsidy is still small.	Yes	We acknowledge that the price of biogas digesters is prohibitively high for some groups. However, given current market conditions, both with regards to carbon price and the state of the biogas digester market in Tanzania as a whole, the subsidy on biogas digesters cannot be increased. The payback period for households is estimated at around three years.
The Programme does not specify how the private sector will be engaged or supported.	Yes	It was further clarified that TDBP will mainly work via the private sector and CSOs/NGOs working as Implementation Partners of TDBP to install the digesters on the ground. It is then up to these organisations to drive the number of digesters installed.
The farmers need access to loan facilities to further support the implementation of biogas systems.	Yes	Financing is one issue that the Africa Biogas Partnership Programme (ABPP) is already looking into, especially being aware that the remaining cost of the biogas digesters even with a subsidy is unaffordable to many people. TDBP will further investigate the possibility for micro-financing options for biogas digesters.

Details on comments that have been received during the stakeholder consultation process are contained in the Gold Standard Local Stakeholder Consultation Report.

C.3. Report on consideration of comments received

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

SECTION D. Eligibility of VPA and estimation of emissions reductions

D.1. Reference of methodology(ies) and standardized baseline(s)

The VPA applies the Gold Standard methodology 'Technologies and Practices to Displace Decentralized Thermal Energy Consumption' (Version 1.0, 11/04/2011)

D.2. Applicability of methodology(ies) and standardized baseline(s)

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 biodigesters.

Table 5: 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 Tanzania. 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 complete address of each biogas system is recorded – the biogas systems have a unique serial number (only for non-retroactively included digesters) – the GPS coordinates of each digester are recorded (only for non-retroactively included digesters) – the VPA implementer has not included these biogas systems in another VPA or stand-alone project. The unique serial number is recorded in the project database.
2. *Limited level of energy output per biodigester:* The biodigesters each have continuous useful energy outputs of less than 150 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 40.7 kWth[12], below the indicated 150 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 cookstoves.
4. *Settling of ownership rights over generated emission reductions:*	As set out in the operational and management plan explained in Section C of the PoA-DD,

[12] As demonstrated in section B.3. of the PoA-DD

Applicability criteria	Justification
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.	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 Sales Agreement. 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 Tanzania. The GPS co-ordinates of Tanzania are represented approximately by: 6 00 S, 35 00 E[13].

D.3. Sources and GHGs

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

Source		Gas	Included?	Justification / Explanation
Baseline	Heat delivery Treatment of manure	CO_2	Yes	CO_2 emissions from - fossil fuel cook stoves - cook stoves using non-renewable biomass
		CH_4	Yes	CH_4 emissions from the baseline treatment methods of manure
		N_2O	No	Excluded, insignificant source of emissions.
Project Activity	Combustion of biogas	CO_2	Yes	CO_2 emissions from - fossil fuel cook stoves - cook stoves using non-renewable biomass
		CH_4	Yes	Emissions due to the manure not fed into the biodigester, as per the applied methodology.
		N_2O	No	Excluded, insignificant source of emissions.

[13] Coordinates include rounded latitude and longitude figures for the centroid or center point of a country expressed in degrees and minutes; it is based on the locations provided in the Geographic Names Server (GNS), maintained by the National Geospatial-Intelligence Agency on behalf of the US Board on Geographic Names. Available from https://www.cia.gov/library/publications/the-world-factbook/fields/2011.html

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

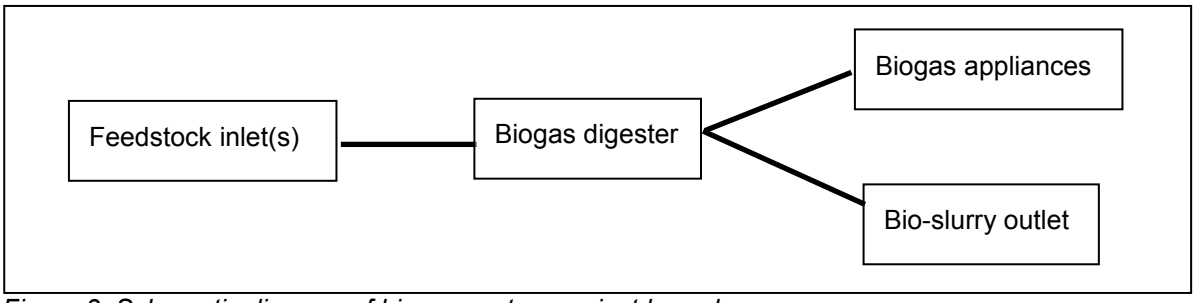

Figure 3: Schematic diagram of biogas system project boundary

D.4. Description of the baseline scenario

Biomass fuels are the most important source of primary energy in Tanzania with fuelwood and charcoal accounting for over 90% of the total primary energy consumption[14]. In the foreseeable future, biomass energy is likely to remain a main energy source. The CDM's EB 67, Annex 22[15] reports an fNRB value of 96% for Tanzania.

Biogas systems in Tanzania are a fuel switch from NRB. Biogas is a renewable fuel produced by waste products of humans, animals and/or plants by placing them in a digester under anaerobic conditions. Biogas is mostly made up of methane, which is combustible and enables biogas to be used as a fuel.

A baseline Field Performance Test in the form of a Kitchen Performance Test (KPT) was implemented in January 2015 by the University of Dar es Salam targeting 50 households across Tanzania. The surveyed households were identified as having a similar social and economic status as their neighbours that possess biodigesters, therefore making for a realistic baseline scenario. Amongst other things, the households were asked to report on their baseline biomass and fossil fuel consumption rates over a 24 hour measurement campaign.

The results of the KPT are reported in Table 6 – a total of 8.917 tonnes of biomass are used annually per household. The results include both the usage of firewood and charcoal. To derive the total biomass value, the tonnes of firewood have been combined with the tonnes of charcoal multiplied by a factor of ten. This charcoal-to-biomass ratio has been approved by another registered biogas programme in the region.

Table 6: Biomass usage results in the baseline scenario

Item	Unit	Description	Amount	Source
$BB_{b1,bio}$	tonnes/ year	Amount of woody biomass used in the baseline scenario b1	Firewood: 1.49 Charcoal: 0.742 * 10 Total: **8.917**	KPT data and analysis, dated 03/02/2015

As for the number of animals raised and the manure handling methods, the baseline results have been gathered by the Biogas User Survey conducted in 2014, which also looked at the baseline conditioned and surveyed 180 households without biodigesters throughout Tanzania. According to

[14] Tanzania National Energy Policy (2003), pages 6 and 24

[15] '*Default values of fraction of non-renewable biomass for least developed countries and small island developing states'* (version 01.0) Information Note

the results of this survey, the dominant type of cattle owned by the respondents was dairy cows, with the average amount of cows being 3.9 per household. This was followed by goats and other cattle.

Table 7: Possession of livestock reported in the BUS 2014

Animal T	Average amount
Dairy cow	3.9
Goat	3.2
Other cattle	2.3
Market swine	0.4
Poultry	19.9

The baseline study results indicate that solid storage is the most common manure handling method, followed by dry lot, liquid slurry and uncovered lagoons. The system-specific methane conversion factors applicable to the baseline are provided in the IPCC Guidelines for National Greenhouse Gas Inventories. The applicable MCF, which is an input for the emission reduction calculation explored below, is chosen from the default values presented in Table 10.17, Chapter 10, Volume 4 of the 2006 IPCC Guidelines. Average temperatures are defined on the province level. The resulting average MCF, in line with these guidelines, is 18.53%.

Table 8: Applicable MCF at national average temperature of 24.0 C

Method	Uncovered lagoon	Liquid slurry	Solid storage	Drylot	Pasture/ Range / Paddock	Daily spread	Burned for fuel	Compo sting
Fraction observed	11.5%	12.7%	35.8%	17.0%	10.3%	5.8%	0.00%	7.0%
MCF (at 24 C)	79.0%	60.0%	4.0%	1.5%	1.5%	0.5%	10.0%	1.0%

$MCF_{x,k}$	18.53%

D.5. Demonstration of eligibility for a VPA

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 9: Eligibility criteria for VPA inclusion in the PoA

Nr.	Requirement[16]	Eligibility criteria	Evidence provided
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 (not relevant for	The following document is provided: – TDBP Programme Implementation document – Sales Agreement

[16] Requirements 1-12 are taken from EB65 Annex 3 paragraph 14. Requirement 13 is taken from EB47, Annex 29, paragraph 3. Requirement 14 is a CME requirement to ensure successful implementation of the VP.

Nr.	Requirement[16]	Eligibility criteria	Evidence provided
		retroactive digesters) – 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.	
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 (not relevant for the retroactive digesters) – the VPA implementer has not included these biogas systems in another VPA or carbon project.	The following documents are provided: – Contractual agreement between CME and CAMARTEC (signed ERPA) – Declaration from CAMARTEC – Sales Agreement
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 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 Tanzania.
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.	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	The following documents are provided as evidence: – Project Database – Kitchen Performance Test (KPT) reports – Sales Agreement

Nr.	Requirement[16]	Eligibility criteria	Evidence provided
		discussed in Section B.2 of the PoA-DD.	
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***[17] 1. Biogas system rated capacity is less than 2.25MW_{th} each 2. Biogas systems are disseminated to households or communities or Small and Medium Enterprises (SMEs).	The following evidence is provided: 1. Calculation showing the capacity of the biogas system(s) in MW 2. Implementation document (TDBP 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 requirements 2. The VPA, or a group of VPAs, got environmental clearance for the project related activities, if applicable	The following document is provided: – Local Stakeholder Report (Tanzania) An environmental impact assessment is not required for activities implementing household biodigesters in Tanzania, as stipulated by the Environment Management, 2004 (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[18].	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	The following document is provided: Implementation document (TDBP 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	The VPA Implementer will agree to support the sampling and survey activities of CME in accordance with B.7.2 of the PoA-DD.	The following document is provided: Contractual agreement between CME and CAMARTEC

[17] As per the "Guidelines on the Demonstration of Additionality of Small-Scale Project Activities" Version 09, EB68 Annex 27 clause 2 (c)

[18] Gold Standard Toolkit, Version 2.1, Section 1.2.5.

Nr.	Requirement[16]	Eligibility criteria	Evidence provided
	guidelines/standard from the Board pertaining to sampling and surveys		
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[19], each VPA in aggregate will remain below 15 MW ($45MW_{th}$) per year. For activities falling under Type III [20], each VPA will achieve below 60,000 tCO_2e in emission reductions annually.	The following documents are provided: – Capacity calculation of the biogas system(s), showing that the VPA Type I installed capacity is below the 15MW ($45MW_{th}$)[21] threshold. – Emission reduction calculation, showing that the VPA Type III emissions are below the 60,000 tCO_2e threshold.[22]
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 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.	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 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 CAMARTEC

[19] Type I activities are "renewable energy project activities with a maximum output capacity of 15 MW (or an appropriate equivalent)", CDM Project Standard (version 07.0), paragraph 89 (a)

[20] 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 CO_2e per year in any year of the crediting period", CDM Project Standard, (version 07.0), paragraph 89 (b)

[21] Explanation: Section B.3. of the PoA-DD indicates that the thermal capacity of the largest possible biodigester allowed under the programme (100m3) is 40.7 kW_{th}. In this VPA, we expect the average biodigester size to be 8.78 m^3, resulting in a capacity of 3.57 kW_{th} per unit. Given 11,103 units installed, this results in a total of 39.64 MW_{th} installed capacity under VPA-1. This is lower than the 45 MW_{th} threshold.

[22] Explanation: Per biodigester, emission reductions from methane avoidance (Type III) are 1.09 tCO_2e/year. Given 11,103 planned digesters, total emission reductions from Type III activities amounts to 12,102 tCO_2e per year.

D.6. Estimation of emission reductions

D.6.1. Explanation of methodological choices

Please see D.6.3 below.

D.6.2. Data and parameters fixed ex-ante

(Copy this table for each data and parameter.)

Data / Parameter	$\mathbf{f_{NRB,y}}$
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 $\mathbf{f_{NRB,y}}$ factors from the CDM, available from http://cdm.unfccc.int/DNA/fNRB/index.html
Value(s) applied	Tanzania: 96%
Choice of data or Measurement methods and procedures	N/A
Purpose of data	Calculation of baseline and project emissions
Additional comment	N/A

Data / Parameter	$\mathbf{EF_{b,\,bio}}$
Unit	tCO_2/TJ
Description	Emission factor of the woody biomass used in baseline scenario b
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied	112
Choice of data or Measurement methods and procedures	As per requirement of the methodology and Table 2.3, Chapter 2, Volume 2 of the 2006 IPCC Guidelines. The IPCC is a standard, credible source of emissions factors.
Purpose of data	Calculation of the baseline scenario
Additional comment	IPCC (2006); May be updated according to any future changes by the IPCC. CO_2 and non-CO_2 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	$\mathbf{EF_{p,\,bio}}$
Unit	tCO_2/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	**NCV_{bio}**
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	**$EF_{b, fuel}$**
Unit	tCO_2/TJ
Description	Emission factor of fossil fuels used in baseline scenario b
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied	Kerosene = 71.9 LPG = 63.1
Choice of data or Measurement methods and procedures	As per requirement of the methodology and Table 2.3, Chapter 2, Volume 2 of the 2006 IPCC Guidelines. The IPCC is a standard, credible source of emissions factors.
Purpose of data	Calculation of baseline emissions
Additional comment	IPCC (2006); May be updated according to any future changes by the IPCC

Data / Parameter	**$EF_{b, fuel}$**
Unit	tCO_2/TJ
Description	Emission factor of fossil fuels used in baseline scenario b
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied	Kerosene = 71.9 LPG = 63.1
Choice of data or Measurement methods and procedures	As per requirement of the methodology and Table 2.3, Chapter 2, Volume 2 of the 2006 IPCC Guidelines. The IPCC is a standard, credible source of emissions factors.
Purpose of data	Calculation of baseline emissions
Additional comment	IPCC (2006); May be updated according to any future changes by the IPCC

Data / Parameter	**NCV_{fuel}**
Unit	TJ/tonne
Description	Net calorific value of fossil fuels used in the baseline scenario
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied	Kerosene = 0.0438 LPG = 0.0473
Choice of data or Measurement methods and procedures	As per requirement of the methodology and Table 2.3, Chapter 2, Volume 2 of the 2006 IPCC Guidelines. The IPCC is a standard, credible source of emissions factors.

Purpose of data	Calculation of baseline emissions
Additional comment	IPCC (2006); May be updated according to any future changes by the IPCC

Data / Parameter	VS_T
Unit	kg/head/day
Description	Daily volatile solid excreted for livestock category T
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied	Dairy Cow: 1.9 Goat: 0.35 Market swine: 0.3 Sheep: 0.32 Other cattle: 1.5 Poultry: 0.01
Choice of data or Measurement methods and procedures	As per requirement of the methodology and sourced from Tables 10. A-4 through A-9, Chapter 10, Volume 4 of the 2006 IPCC Guidelines The IPCC is a standard, credible source of emissions factors.
Purpose of data	Calculation of baseline emissions
Additional comment	IPCC (2006); May be updated according to any future changes by the IPCC. National data can replace the IPCC value, if available

Data / Parameter	Bo_T
Unit	m^3 CH_4/kg
Description	Maximum methane producing capacity for manure produced by animal type T
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied	Dairy Cow: 0.13 Goat: 0.13 Market swine: 0.29 Sheep: 0.13 Other cattle: 0.10 Poultry: 0.36
Choice of data or Measurement methods and procedures	As per requirement of the methodology and sourced from Tables 10. A-4 through A-9, Chapter 10, Volume 4 of the 2006 IPCC Guidelines The IPCC is a standard, credible source of emissions factors.
Purpose of data	Calculation of baseline emissions
Additional comment	IPCC (2006); May be updated according to any future changes by the IPCC. National data can replace the IPCC value, if available

Data / Parameter	$\eta_{biogas\ stove}$
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

<table>
<tr><td>Choice of data or Measurement methods and procedures</td><td>CAMARTEC does not specify the type of biogas stove that should be installed by a household, however they specifically promote the following five stove types:

<table><tr><td>Manufacturer</td><td>Model No. / Name</td><td>No. of burners</td><td>Thermal Efficiency</td></tr><tr><td>Puxin</td><td>JZZ2-A13</td><td>2</td><td>>57%</td></tr><tr><td>Wusi</td><td>JZZ.2-A1</td><td>2</td><td>>57%</td></tr><tr><td>Xunda</td><td>JZZ2-88</td><td>2</td><td>>58%</td></tr><tr><td>Xunda</td><td>JZZ1-6128</td><td>1</td><td>>58%</td></tr><tr><td>SNV</td><td>Lotus III (Cambodia)</td><td>1</td><td>55%</td></tr></table>
To be conservative the lowest value of efficiency has been taken.</td></tr>
<tr><td>Purpose of data</td><td>Calculation of project emissions</td></tr>
<tr><td>Additional comment</td><td>-</td></tr>
</table>

D.6.3. Ex-ante calculation of emission reductions

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6.3.1 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 baseline scenario of this first Tanzanian VPA. As the baseline fuel and the project fuel and the corresponding emission factors are different, the overall GHG reductions achieved by this first Tanzanian VPA in year *y* are calculated as follows:

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

Where:

$ER_{CO2,y}$	Cumulative CO_2 emission reductions from the substitution of non-renewable biomass and fossil fuels
$\sum_{b1,p1}$	Sum over all relevant (baseline b1/project p1) couples
$N_{p1,y}$	Cumulative project operational rate included in the project database for project scenario p1 against baseline scenario b1 in year y
$U_{p1,y}$	Cumulative usage rate for technologies in project scenario p1 in year y, based on cumulative adoption rate and drop off rate (fraction)
$ER_{b1,p1,y,CO2}$	Specific CO_2 emission savings for an individual technology of project p1 against an individual technology of baseline b1 in year y, in tCO_2/year, and as derived from the statistical analysis of the data collected from the field tests
$ER_{b1,p1,y,non-CO2}$	Specific non-CO_2 emission savings for an individual technology of project p1 against an individual technology of baseline b1 in year y, converted in tCO_2/year, and as derived from the statistical analysis of the data collected from the field tests
f_{NRB}	Fraction of biomass used that can be established as non-renewable biomass
$LE_{p1,y}$	Leakage for project scenario p1 in year y (tCO_2e/yr)

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

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

Where:

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

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

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

$\sum LE_{p1,CO2,y}$ Cumulative leakage as per methodology guidance[23]

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

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

Fuel usage data was collected by the KPT survey, as explored above. The results include both the usage of firewood and charcoal. To derive the total biomass value, the tonnes of firewood have been combined with the tonnes of charcoal multiplied by a factor of ten. This charcoal-to-biomass ratio has been approved by another registered biogas programme in the region.[24]

Table 10: Biomass usage results in the baseline and project scenario

Item	Unit	Description	Amount	Source
$BB_{b1,bio}$	tonnes/ year	Amount of woody biomass used in the baseline scenario b1	Firewood: 1.49 Charcoal: 0.742 * 10 Total: **8.917**	KPT data and analysis, dated 03/02/2015
$BB_{p1,bio}$	tonnes/ year	Quantity of biomass consumed in project scenario p1 during year y	Firewood: 1.01 Charcoal: 0.324 * 10 Total: **4.250**	KPT data and analysis, dated 03/02/2015

The f_{NRB} is estimated to be 96.0%, as per the PoA-DD. The f_{NRB} value is applicable to CO_2 emissions from firewood and charcoal consumption and production. Methane and nitrous oxide emission are not included in the emission reduction calculation for conservativeness. The calculated ex-post baseline emissions are shown in next table:

Table 11: Emission reductions from fuel switch[25]

Baseline emissions from fuel use (tCO_2e/yr)	Project emissions from fuel use (tCO_2e/yr)	Leakage emissions from fuel use (tCO_2e/yr)	Emissions from fuel switch to biogas (tCO_2e/yr)
14.386	6.854	0	7.532

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

[24] See https://cdm.unfccc.int/ProgrammeOfActivities/cpa_db/ JWAK1UTZSNFL479D2YG0QIR5VB8XEC/view

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

6.3.2 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:

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

Where:

$BE_{b,CH4,h,y}$	Baseline emissions from manure handling during the year y in tCO_2e for manure handling method h
VS_T	Daily volatile solid excreted for livestock category T in kg dry matter per animal per day
$B_{0,T}$	Maximum methane producing capacity for manure produced by livestock category T in m^3 CH_4
$MCF_{x,k}$	Methane conversion factors for the animal waste handling system in the baseline situation by climate zone k, (%)
$MS_{T,x,k}$	Fraction of livestock category T's manure handled using manure management system x in climate region k (determined through survey method ex-post)
GWP_{CH4}	Global Warming Potential of methane (25)
$N_{T,h}$	Number of livestock category T in premise h

$MCF_{x,k}$, $MS_{T,x,k}$ and $N_{T,h}$ 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.

VS_T and $B_{0,T}$ 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 $N_{T,h}$
According to the Biogas User Survey 2014, the dominant type of cattle owned by the respondents was dairy cows, with the average amount of cows being 3.9 per household. This was followed by goats and other cattle.

Table 12: Possession of livestock reported in the BUS 2014

Animal T	Average amount
Dairy cow	3.9
Goat	3.2
Other cattle	2.3
Market swine	0.4
Poultry	19.9

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 (B_{OT}).

Table 13: Manure characteristics of different livestock categories

Animal type	**VS** (kg/head/day)	**B_O** (m^3 CH_4/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[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 on the province level.

The *ex-ante* data is collected through the Biogas User Survey 2014. The baseline study results indicate that daily spread is the most common manure handling method, followed by dry lot, composting and solid storage. The resulting average MCF is 18.53%.

Table 14: Applicable MCF at national average temperature of 24.0 C

Method	**Uncovered lagoon**	**Liquid slurry**	**Solid storage**	**Drylot**	**Pasture/ Range / Paddock**	**Daily spread**	**Burned for fuel**	**Compo sting**
Fraction observed	11.5%	12.7%	35.8%	17.0%	10.3%	5.8%	0.00%	7.0%
MCF (at 24 C)	79.0%	60.0%	4.0%	1.5%	1.5%	0.5%	10.0%	1.0%

$MCF_{x,k}$	18.53%

With the data from the previous tables the baseline emission can be determined. The emission per household of all the animals under the VPA are calculated and depicted in the next table. The number of animals originates from the BUS survey and based on the manure handling methods and resulting average MCF established above.

The baseline methane emissions per household per year under the first Tanzanian VPA are[27]:

$$\mathbf{BE_{b1,CH4,h,y}} = \frac{\sum \mathrm{VS_T} * \mathrm{Bo_T} * 0.67 kg/m^3 * 18.53\% * 1 * 25 * 365)}{1000} = \mathbf{1.824\ tCO_2e}$$

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

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

Therefore[28]:

$$\mathbf{BE_{b1,CH4,h,y}} = \frac{(1.00) * (1{,}824)}{1000} = \mathbf{1.824\ tCO_2e}$$

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:

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

Where:

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

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

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

Where:

$EF_{awms(T)}$	CH_4 emission factor for livestock category *T*, (tCH_4 per 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*, (m^3CH_4 per kg of VS excreted)
D_{CH4}	CH_4 density (0.00067 t per m^3 at room temperature)
$MCF_{(BL,k)}$	Methane conversion factors for the animal waste handling system in the baseline situation by climate zone *k*, (%)

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

$MS_{(T,S,k)}$ Fraction of livestock category *T*'s manure treated in the animal waste management system, in climate region *k* (dimensionless)

The project methane emissions per household per year under the first Tanzanian VPA are therefore[29]:

$$\mathbf{PE_{p1,CH4,y}} = 25 * (\mathbf{0.0729}) * (1 - 55\%) * (1 - 10\%))) = \mathbf{0.739\ tCO_2e}$$

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

Emission reductions per VPA will be calculated as:

$$\mathbf{ER_{CH4,y}} = \left(BE_{b,CH4,y} - PE_{p,CH4,y}\right) * N_{p,y} * U_{p,y} \quad \textbf{(5)}$$

Where:

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

$BE_{b,CH4,y}$ Baseline methane emissions during the year y (tCO_2)

$PE_{p,CH4,y}$ Project methane emissions during the year y (tCO_2)

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

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

Calculation
The emission reductions from methane avoidance per household per year under the first Tanzanian VPA are[30]:

1.824– 0.739 **= 1.085 tCO_2e**

6.3.3 Leakage emissions

The project proponent investigated the following potential sources of leakage:

Table 15: Leakage emission assessment

#	Leakage source	Applicability
a	The displaced baseline technologies are reused outside the project boundary in place of lower emitting technology or in a manner suggesting more usage than would have occurred in the absence of the project.	The baseline technologies are not reused outside the project boundary. Traditional firewood stoves cannot be moved as they are fixed to the floor of the kitchenette.
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 Tanzania. 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

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

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

		activity.
c	The project significantly impacts the NRB fraction within an area where other CDM or VER project activities account for NRB fraction in their baseline scenario.	There is no registered project in Tanzania that has a NRB component in the project. It is therefore not likely that the NRB fraction is impacted significantly.
d	The project population compensates for loss of the space heating effect of inefficient technology by adopting some other form of heating or by retaining some use of inefficient technology	Space heating does not occur in 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 chapter 3.24
G	Emissions from biogas slurry	It is considered as project emissions – see chapter 3.26.

D.6.4. Summary of the ex-ante estimates of emission reductions

The next table shows the ex-ante estimate of the emission reductions for each biogas unit[31]:

Table 16: Average annual emission reductions

Emission source	**$BE_{b,CH4,y}$ (tCO_2e/year)**	**$PE_{b,CH4,y}$ (tCO_2e/year)**	**$ER_{CH4,y}$ (tCO_2e/year)**
Biomass and fossil fuel substitution	14.386	6.854	**7.532**
Manure handling	1.824	0.739	**1.085**
Sum (rounded up)			**8.617**

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

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

Where:

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

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

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

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

[31] Figures may not add up due to rounding

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

Table 17: Project emission, baseline emissions, leakage and overall emissions per year

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
Year 1 (2013)	109,102	51,105	0	57,997
Year 2 (2014)	159,754	74,831	0	84,922
Year 3 (2015)	179,984	84,307	0	95,677
Year 4 (2016)	179,984	84,307	0	95,677
Year 5 (2017)	179,984	84,307	0	95,677
Year 6 (2018)	179,984	84,307	0	95,677
Year 7 (2019)	179,984	84,307	0	95,677
Total			0	621,303
Total number of crediting years	7			
Annual average over the crediting period				88,758

D.7. Application of the monitoring methodology and description of the monitoring plan

D.7.1. Data and parameters to be monitored

(Copy this table for each data and parameter.)

Data / Parameter	$\mathbf{U_{p1,y}}$
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 Biogas User 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' (11/04/2011).
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	$\mathbf{N_{p1,y}}$

Unit	Number
Description	Cumulative number of project technology-days included in the project database for project scenario p1 against baseline scenario b1 in year y
Source of data	Total sales record from the Project Database.
Value(s) applied	Reported as a result of ($No_{p1,y}$ * ($O_{p1,y}$ / 365)), which equals (11,103* 365/365) = 11,103
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	$N_{p,y}$ shall be calculated from (a) the number of installed system (parameter $No_{p,y}$); and (b) the average operational days of the system ($O_{p,y}$). The equation is therefore ($N_{p,y}$ = $No_{p,y}$ * ($O_{p,y}$ / 365)). The average operational days will be confirmed upon verification.
Purpose of data	Calculation of project emissions
Additional comment	N/A

Data / Parameter	**$No_{p1,y}$**
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	11,103
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. **$N_{0p,y}$** 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	**$O_{p1,y}$**
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 ($O_{p,y}$ = 365 – non-operational days)

Data / Parameter	**$LE_{p1,y}$**
Unit	tCO_2e/year
Description	Leakage in project scenario p1 during year y
Source of data	Collected through the annual Biogas User Survey.
Value(s) applied	0.00
Measurement methods and procedures	Non-biogas digester users will be surveyed through a questionnaire to determine whether leakage has occurred.
Monitoring frequency	Every two years
QA/QC procedures	The leakage will be monitored annually using survey methods to satisfy the requirements put forth by the methodology 'Technologies and practices to displace decentralized thermal energy consumption' (11/04/2011).
Purpose of data	Calculation of leakage
Additional comment	N/A

Data / Parameter	**PL**
Unit	%
Description	Physical leakage of the biodigester
Source of data	IPCC
Value(s) applied	Estimated using a 10% default rate of total methane production
Measurement methods and procedures	Not applicable
Monitoring frequency	Annual
QA/QC procedures	As per Annex 6 of the applied methodology
Purpose of data	
Additional comment	

Data / Parameter	**$BB_{b1,bio}$**
Unit	Tonnes/year
Description	Amount of woody biomass used in the baseline scenario b1
Source of data	Kitchen Performance Test 2014 (Baseline)
Value(s) applied	8.920
Measurement methods and procedures	*H*ouseholds/communities/SMEs have been asked how much woody biomass they use per week, 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 baseline emissions
Additional comment	Baseline Performance Field Test will be updated once every two years.

Data / Parameter	**$BB_{p1,\ bio}$**
Unit	Tonnes/year
Description	Amount of woody biomass used in the project scenario p1
Source of data	Kitchen Performance Test 2014 (Baseline)

Value(s) applied	4.250
Measurement methods and procedures	*H*ouseholds/communities/SMEs have been asked how much woody biomass they use per week, 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 will be updated once every two years.

Data / Parameter	**$BB_{b1,fuel}$**
Unit	Tonnes/year
Description	Amount of fossil fuels used in baseline scenario b1
Source of data	Kitchen Performance Test 2014 (Baseline)
Value(s) applied	0
Measurement methods and procedures	*H*ouseholds/communities/SMEs have been asked how much woody biomass they use per week, 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 baseline emissions
Additional comment	Baseline Performance Field Test will be updated once every two years.

Data / Parameter	**$BB_{p1,fuel}$**
Unit	Tonnes/year
Description	Projected amount of fossil fuels used in the project scenario p1
Source of data	Kitchen Performance Test 2014 (Baseline)
Value(s) applied	0
Measurement methods and procedures	*H*ouseholds/communities/SMEs have been asked how much woody biomass they use per week, 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 will be updated once every two years.

Data / Parameter	**MCF**
Unit	kg CH_4
Description	Average Methane Conversion Factor for the defined livestock population category T by average temperature (Tanzania: 24°C)
Source of data	Baseline Biogas User Survey 2014 2006 IPCC Guidelines for National Greenhouse Gas Inventories;

Value(s) applied	Average MCF at 20C temperature: 18.53% **Method** / **Uncovered lagoon** / **Liquid slurry** / **Solid storage** / **Dryl ot** / **Pasture/ Range / Paddock** / **Daily spread** / **Burned for fuel** / **Composting** **Fraction observed**: 11.5% / 12.7% / 35.8% / 17.0 % / 10.3% / 5.8% / 0.00% / 7.0% **MCF (at 24 C)**: 79.0% / 60.0% / 4.0% / 1.5% / 1.5% / 0.5% / 10.0% / 1.0% **$MCF_{x,k}$**: 18.53%
Measurement methods and procedures	As per requirement of the methodology and sourced from Tables 10.A-4 through A-9., Chapter 10, Volume 4 of the 2006 IPCC Guidelines The IPCC is a standard, credible source of emissions factors.
Purpose of data	Calculation of baseline emissions
Additional comment	IPCC (2006); May be updated according to any future changes by the IPCC

Data / Parameter	**$N_{,T}$**
Unit	Number of animals
Description	Number of livestock category T in premise
Source of data	Baseline Biogas User Survey 2014
Value(s) applied	**Animal T** / **Average amount** Dairy cow: 3.9 Goat: 3.2 Other cattle: 2.3 Market swine: 0.4 Poultry: 19.9
Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	**$MS_{T,S,k}$**
Unit	%
Description	Fraction of livestock category T's manure fed into the bio-digester, S in climate region k
Source of data	Biogas User Survey 2014
Value(s) applied	1
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	Applicable to VPAs applying Tier 2 only

Data / Parameter	$MS_{P,S,K}$
Unit	%
Description	Fraction of livestock category T's manure fed into the bio-digester, in climate region k
Source of data	Biogas User Survey 2014
Value(s) applied	1
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	GWP_{CH4}
Unit	Unit
Description	Global Warming Potential of methane
Source of data	IPCC (2006); May be updated according to any future changes by the IPCC
Value(s) applied	As per the Gold Standard's rule update 'The application of Global Warming Potentials for Gold Standard project activities': 25 for VPAs seeking issuance for emission reductions incurred after 1 January 2013
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**
Unit	-
Description	Use of bio-slurry
Source of data	Biogas User Survey
Value(s) applied	Not applicable, no effect on emission reductions
Measurement methods and procedures	Households 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 CH_4 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[32]:

Data / Parameter	**GS-01 Air quality**
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	-

Data / Parameter	**GS-03 Soil condition**
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-06 Quality of employment**
Unit	Number
Description	Number of masons attending training programmes
Source of data	Electronic Project Database
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-07 Livelihood of the poor**

[32] Refer to accompanying Gold Standard PoA-Passport for further details.

Unit	%
Description	Percentage of users reporting changes in expenditure on fuel for cooking
Source of data	Annual user 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-08 Access to affordable and clean energy services**
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-10 Quantitative employment and income generation**
Unit	Number
Description	Number of employees 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-12 Technology transfer and technological self-reliance**
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

D.7.2. Description of the monitoring plan

The monitoring plan describes how to collect, assess and archive all relevant data to be monitored according to the methodology. Data from the monitoring procedures will be recorded in the electronic project database and summarised in an annual Monitoring Report. The data collection will follow the standard "Sampling and surveys for CDM project activities and programme of activities (Version 04)"[33]. The guidelines 'Sampling and surveys for CDM project activities and programmes of activities' (Version 03) has been used to structure the monitoring plan.

Sampling Design

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. Those parameters required to assess the extent of leakage for non-biogas users every two years will be asked to similar households in the same region.

Sampling method

CAMARTEC, with support from the CME, 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. 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.

Data to be collected

Field measurements

CAMARTEC 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.6.2. 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

33 EB 74, Annex 6

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 VPA-1, as outlined in the applied methodology, are as follows:

A Biogas User Survey shall be completed annually 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.

A Monitoring Survey shall be completed periodically and covers the following data:
- Continued use of baseline stoves – once per year. 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 baseline scenario in a given year (y) – once every two years;
- 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;
- Leakage in the given project scenario in the given year (y) – once every two years.

The application of bioslurry shall be monitored according 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, CAMARTEC, 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 contacting all randomly-selected biogas digester users beforehand to arrange a practical site visit date and sampling over the minimum required number to compensate for any non-responses. The right of the CME to perform these monitoring efforts will be included in the Sales Agreement signed with each user. In special cases where participants refuse to participate in the monitoring, the reason shall be documented in the CME's Project Database. 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 CAMARTEC 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. Outliers will be excluded using the Grubb's Test.[34]

Implementation plan

CAMARTEC 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. CAMARTEC 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. The Project Database will record the start and end dates of each selling year *y* for each biogas system ($t_{fraction}$), and calculate the emission reductions attributable to each 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
KENAFF is responsible for all the monitoring activities carried out within this VPA, including data collection, data monitoring, and writing the Monitoring Report.

SECTION E. Approval and authorization

Obtaining a Letter of Approval is not applicable to voluntary Gold Standard projects.

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[34] 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.

Appendix 1. Contact information of VPA implementer(s) and responsible person(s)/ entity(ies) for completing the CDM-SSC-CPA-DD-FORM

VPA implementer and/or responsible person/ entity	☐ VPA implementer(s) ☒ Responsible person/ entity for completing the CDM-SSC-CPA-DD-FORM
Organization	Centre for Agricultural Mechanisation and Rural Technology (CAMARTEC)
Street/P.O. Box	Njiro Road, P.O. Box 764
Building	Themi hill, Opp General Tyre,
City	Themi hill, Arusha
State/Region	Arusha Region
Postcode	P.O. Box 764
Country	United Republic of Tanzania
Telephone	+255 27 254 9214
Fax	+225272549000
E-mail	clshila@yahoo.com
Website	www.biogas-tanzania.org
Contact person	Lehada Shila
Title	Programme Coordinator, CAMARTEC/Tanzania Domestic Biogas Programme (TDBP)
Salutation	Mr
Last name	Shila
Middle name	Cyprian
First name	Lehada
Department	CAMARTEC/Tanzania Domestic Biogas Programme (TDBP)
Mobile	+255 714 739 661
Direct fax	+225272549000
Direct tel.	+255 27 254 9214
Personal e-mail	clshila@yahoo.com

Appendix 2. Affirmation regarding public funding

Please see Official Development Assistance (ODA) Declaration dated 08/09/2014

Appendix 3. Applicability of methodology(ies) and standardized baseline(s)

Please see section D.2 of the VPA-DD for details.

Appendix 4. Further background information on ex ante calculation of emission reductions

No further background information necessary.

Appendix 5. Further background information on monitoring plan

No further background information necessary.

Appendix 6. Summary of post registration changes

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