CLEAN DEVELOPMENT MECHANISM
SMALL-SCALE PROGRAMME OF ACTIVITIES DESIGN DOCUMENT FORM
(CDM-SSC-PoA-DD) Version 01

CONTENTS

Annexes

NOTE:

(i) This form is for the submission of a CDM PoA whose CPAs apply a small scale approved methodology.

(ii) At the time of requesting registration this form must be accompanied by a CDM-SSC-CPA-DD form that has been specified for the proposed PoA, as well as by one completed CDM-SSC-CPA-DD (using a real case).

SECTION A. General description of small-scale programme of activities (PoA)

A.1 Title of the small-scale programme of activities (PoA):

African Clean Energy Switch – Biogas (ACES-Biogas)

Version 06
Date: 20/12/2012

A.2. Description of the small-scale programme of activities (PoA):

1. General operating and implementing framework of PoA

The purpose of this small-scale Programme of Activities (PoA) is to stimulate the installation of biogas systems in East Africa to replace traditional thermal energy generation methods. The PoA will be able to encompass all types of biogas systems, depending on the supplier and the user of the biogas, serving both domestic and institutional users.

Biogas digesters produce biogas from human, animal or plant waste products that can be used in cooking and heating replacing the use of non-renewable biomass (NRB)[1], either firewood or charcoal. NRB when used in the production of thermal energy produces greenhouse gas (GHG) emissions, particularly carbon dioxide. By switching from NRB to biogas, which is a renewable fuel, the PoA reduces GHG emissions.

African Clean Energy Switch - Biogas (ACES-Biogas) Limited is the Coordinating/Managing Entity (CME) for this PoA. As such, it will coordinate the efforts from different Component Project Activity (CPA) implementers to install biogas systems in East Africa and comply with the requirements of this PoA. The CPA implementers will not be Project Participants to this PoA.

During implementation, the CME for this PoA will:

- Issue and revoke the authorisation of included CPAs
- Organise audits of CPA activities on an on-going basis
- Provide technical and administrative support to CPAs to guarantee the compliance of their activities and their record keeping with the PoA's requirements
- Oversee all communications required under the PoA
- Mediate CER agreements between the CPAs and respective biogas system users on the one hand, and CER buyers on the other
- May manage the execution of CER sales agreements and the distribution of the benefits if requested by individual CPAs
- Be responsible for the monitoring activities and data management required during the lifetime of the PoA
- Maintain a database of sales records used to compute CERs and ensure that no double-counting of systems occurs
- Be the focal point for CER verification and issuance

[1] See section A.4.3. of the PoA-DD for further information regarding the baseline scenario and the use of NRB in the host countries. The calculation of fNRB will be undertaken on CPA level.

Each CPA implementer will act individually, requesting authorisation for its CPA(s) to the CME and running the project in accordance with the demands of the local market. CPA implementers will be involved with the dissemination of biogas systems that are sold on a commercial or a non-commercial basis. Typical CPA implementers will either be organisations that manufacture biogas systems and disseminate them, potentially through a supply chain. Alternatively CPA implementers may be organisations that co-ordinate support for biogas systems to be installed. CPA implementers will have the necessary technical and administrative resources to ensure technical compliance to the PoA requirements of the biogas systems sold, as well as accurate and complete record keeping.

During implementation, each CPA implementer for this PoA will:

- Comply with PoA requirements to become an authorised CPA implementer
- Be involved with the dissemination of biogas systems
- Ensure all the participants in the distribution chain are aware that the sales are subscribed to the PoA and are trained to comply with the requirements
- Keep records of sales and users as per the monitoring plan and provide them to the CME regularly
- Keep current with regards to the UNFCCC requirements, as enforced by the CME
- Receive audits and inspections to maintain authorisation status issued by the CME

CPA implementers will be involved with the dissemination of biogas systems, and are encouraged by the CME to make biogas more affordable to users through the CER proceeds, as described below. Affordability will be stimulated as an increasing number of CPA implementers become a part of this PoA and compete in the market for customer choice. The end users of the biogas will benefit from having a choice of high-quality biogas systems, added investment in marketing (awareness) and research and development of products that reduce deforestation and improve health by reducing indoor air pollution. The exact technology to be employed will vary depending on CPA implementer and will be required to meet applicable national standards.

When purchasing the biogas system, the buyer will fill an agreement with the CPA implementer that may contain, among others, information about the biogas system, model, price and payment, the name, location/address and phone number of the user (the Sales Agreement). This information will allow the identification and the monitoring of the system and its usage. CPA implementers will be encouraged to undertake additional measures to keep in close contact with the buyer through for example, guarantee schemes on the biogas system, this will help to confirm that the biogas system is in use.

The CPA implementer may use the CER proceeds to reduce the costs of biogas systems by providing a subsidy to customers, providing free or subsidised maintenance of the biogas systems or to recoup the CPA implementer's incurred associated costs, such as research & development, training and marketing. The exact usage of the revenues obtained from CERs will vary depending on the CPA implementer.

2. Policy/measure or stated goal of the PoA

The mission of this PoA is to make biogas systems affordable and available to households and institutions across East Africa, especially for low and medium income households. This will be done by providing a carbon market access service to CPA implementers to help them overcome barriers to disseminating biogas systems in the host countries.

Sustainable Development

The PoA will meet the sustainable development criteria[2,3,4,5] of each of the host countries by achieving the following:

Environmental:
- Reducing deforestation
- Reducing greenhouse gas (GHG) emissions
- Reducing the need for artificial fertilisers

Social
- Reducing respiratory illness caused by indoor-air-pollution
- Reduction of injuries occurring in unsafe kitchen environments
- Reduction in time spent cleaning pots
- Improvement of hygiene through toilet attachment reducing bad odours of manure, decreasing environmental pollution

Economic
- Reducing time/money spent obtaining fuel wood
- Increasing employment opportunities in the biogas industry
- Improved crop yields and diversity through use of bio-slurry produced by the digester

The PoA will contribute to the achievement of the goals contained in the following national policy documents:

Ethiopia
The Energy Policy of the Transnational Government of Ethiopia, 1994, pages 2-4

Kenya
Sessional Paper No. 4 on Energy, 2004, page 13 and 44.
Energy Act, 2006, page 100

Rwanda
National Energy Policy and National Energy Strategy, 2008-12, pages 9, 35 and 60
Rwanda's National Energy Policy, 2010, page 25

Uganda
Renewable Energy Policy, 2007, pages 20, 23 and 37-38
National Development Plan, 2010, page 155

3. Confirmation that the proposed PoA is a voluntary action by the CME.

[2] Sustainable Development Benefits Delivered by the Clean Development Mechanism, National Environment Management Authority, Kenya

[3] Rwanda Sustainable Development Criteria, Rwanda Environment Management Authority

[4] Criteria for CDM Project Approval - Ethiopia

[5] Sustainable Development Criteria for Selection of CDM Projects in Uganda

Each of the host countries under the PoA is actively promoting the development of biogas as an alternative modern energy source. [6,7,8, 9] There are no laws or mandatory requirements in East Africa stipulating the adoption of biogas systems by households or institutions, nor their dissemination. This proposed PoA is a voluntary action by the CME, African Clean Energy Switch - Biogas (ACES-Biogas) Limited.

A.3. Coordinating/managing entity and participants of SSC-POA:

1. Coordinating or managing entity of the PoA as the entity which communicates with the Board.

African Clean Energy Switch - Biogas (ACES-Biogas) Limited, Plot 47, Lubowa Estate, P.O.Box 70480, Kampala, Uganda.

2. Project participants being registered in relation to the PoA.

Project Participant and CME of this PoA.

African Clean Energy Switch - Biogas (ACES-Biogas) Limited, Plot 47, Lubowa Estate, P.O.Box 70480, Kampala, Uganda

Name of Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participant	Kindly indicate if the Party involved wishes to be considered as a project participant (Yes/No)
Uganda (host)	African Clean Energy Switch - Biogas (ACES-Biogas) Limited. (private entity and CME)	No
Kenya (host)	African Clean Energy Switch - Biogas (ACES-Biogas) Limited. (private entity and CME)	No
Rwanda (host)	African Clean Energy Switch - Biogas (ACES-Biogas) Limited. (private entity and CME)	No
Ethiopia (host)	African Clean Energy Switch -	No

[6] Pages 20, 22, 37-38, The Renewable Energy Policy for Uganda, 2007 (http://www.rea.or.ug/userfiles/RENEWABLE%20ENERGY%20POLIC9-11-07.pdf)

[7] Pages 9, 35 and 60, Republic of Rwanda National Energy Policy and National Energy Strategy, 2008-12 (http://www.euei-pdf.org/sites/default/files/files/field_pblctn_file/EUEI%20PDF_Rwanda_Energy%20Policy%202008-2012_Final_Jan%202009_EN.pdf)

[8] Page 13, Sessional Paper No. 4 on Energy, Ministry of Energy, Kenya, 2004 (http://www.erc.go.ke/erc/Regulations/SESSIONAL%20PAPER%204%20ON%20ENERGY%202004.pdf) .and Page 100 Energy Act 2006, Government of Kenya. http://www.erc.go.ke/energy.pdf

[9] Page 2-4, Energy Policy of the Transitional Government of Ethiopia http://ethioelectricagency.org/docs/EnergyPolicy.pdf

	Biogas (ACES-Biogas) Limited. (private entity and CME)	

This is a unilateral CDM Project involving a non-Annex I Party company.

A.4. Technical description of the small-scale programme of activities:

A.4.1. Location of the programme of activities:

A.4.1.1. Host Party(ies):

Ethiopia, Kenya, Rwanda and Uganda.

A.4.1.2. Physical/ Geographical boundary:

The geographical region within which all CPAs included in this PoA will be implemented is covering Ethiopia, Kenya, Rwanda and Uganda. These countries are represented approximately by the following geographic co-ordinates:

Ethiopia: 14°51’35.46” to 3°29’29.36” N, 32°58’38.26” to 47°57’45.53” E
Kenya: 5°2’49.82” to -4°43’7.60” N, 33°51’22.32” to 41°52’34.39” E
Rwanda: -1°2’37.11” to -2°49’20.44” N, 28°51’33.31” to 30°51’31.55” E
Uganda: 4°12’53.79” to -1°28’19.22” N, 29°34’17.52” to 35°2’33.81” E

Figure 1. Map of Ethiopia, Kenya, Rwanda and Uganda; countries within this PoA.

A.4.2. Description of a typical small-scale CDM programme activity (CPA):

A typical CPA will be implemented by a CPA implementer and will consist of the development of the biogas systems market, including the sale and installation of biogas systems on a commercial or non-commercial basis, and after-sales service (e.g. guarantee).

Location and energy limitation

Each CPA will be implemented by a CPA implementer respecting the geographical region of the PoA and a maximum rated thermal capacity of 45MW per CPA. In cases where the number of biogas systems per CPA exceeds the energy limit, the number of emission reductions (ERs) shall be capped at those generated by biogas systems saving a maximum of 45MW thermal energy equivalent. Any additional biogas systems shall not be counted. During the life of the PoA the number of CPAs implemented by each CPA implementer may increase and will be monitored according to the monitoring plan as described below.

As further discussed in section A.4.4.1 below, CPAs under this PoA are considered as not being a de-bundled component of a large-scale activity.

Operational and management plan

The CPA implementer and its supply chain will be responsible for the sale, installation and after-sales service of the biogas systems. The operation of the biogas system will be carried out by the user, and training or instructions on how to operate and maintain the systems will be given by the CPA implementer and its supply chain. The CPA implementer will be required to provide training in installation / construction of their biogas systems to masons / installers, other training needs may also be required depending of the specific technology requirements and business model of the CPA implementer.

The CPA implementer will follow the monitoring plan and procedures for identifying biogas systems sold during the course of the project and those which are still in use, so the appropriate number of emission reductions can be claimed. To facilitate this process, the CPA implementer will keep traceable information to be used by the CME and the DOE to track back to each individual system installed. The CPA implementer is also responsible for collecting the data of the customer on the Sales Agreement.

Monitoring

Each CPA is monitored and generates a separate annual count of emission reductions (ERs). Each CPA keeps a record of all biogas systems sold and a record of the location of the systems. Duplicate records are kept by the CME and all CPA implementer records are screened through spot-visits, together with cross-checks on the CPA implementer reports and logistics records to confirm that the sales record is authentic and that no double-counting occurs.

A.4.2.1. Technology or measures to be employed by the SSC-CPA:

Each CPA will encompass any of the different types of biogas systems covered by the PoA, depending on the CPA implementer and the type of user of the system. The models of biogas systems covered by the PoA will vary depending on the CPA implementer and the individual users requirements. Details of the technology will be elaborated on SSC-CPA level. Each CPA implementer will be required to ensure their technology meets any required standards in the respective host country. Currently there are no standards in the Host Countries however in a few of the countries standards are in development. It is anticipated most of the technology transfer will be South-South (i.e. between non-Annex I countries). This is because there is limited usage of small-scale biogas systems in Annex I countries. Technology transfer from Annex I countries may come from larger institutional biogas systems. Most of the technology transfer will be in the form of know-how as due to the nature, e.g. constructed from bricks or size it is not possible to import systems. Biogas appliances however will likely be imported until local capacity is developed. Biogas systems are constructed of materials that are readily available e.g. bricks, cement, plastic, piping and do not require any environmentally unsafe materials during either construction or operation.

The most common baseline for thermal energy use in households, and institutions is firewood and charcoal with more firewood being consumed in rural areas. These fuels are typically burned in inefficient processes such as the three stone fire or the traditional metal stove, such as the metal *sigiri* in Uganda or metal *jiko* in Kenya.[10]

[10] See section A.4.3. of the PoA-DD for further information

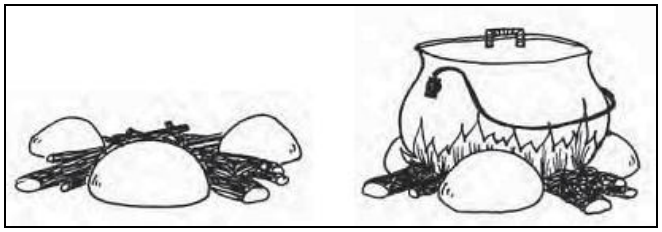

Figure 2. Three stone fire

Figure 3. Sigiri, Ugandan charcoal traditional metal stove

Biogas systems in the host countries are a fuel switch from NRB[11]. 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. The methane composition of biogas varies significantly depending on the feedstock typical values include, 65% for cattle manure, 67% pig manure and 60% poultry manure.[12] The remainder of biogas is mostly carbon dioxide with other trace gases such as hydrogen sulphide. The biogas produced in a digester is then piped to be utilised in a variety of appliances depending on the needs of the users, e.g. biogas stoves. NRB when used in the production of thermal energy produces greenhouse gas emissions, particularly carbon dioxide. By switching from NRB to biogas the PoA will result in the reduction of GHG emissions.

The biogas digesters allowed in this PoA, include, but are not limited to, fixed dome, floating drums and flexible balloons. The preferred design for biogas digesters in East Africa is currently the fixed dome design. A general description of these technologies will be given at SSC-PoA level but specific technological details will be given at SSC-CPA level.

Fixed Dome Digesters
Fixed dome digesters have been proven in several countries, the technology is robust, reliable and requires little maintenance. The size of these plants can range anywhere from 2 – 16 m^3.

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

[11] See section A.4.3. of the PoA-DD for further information regarding the baseline scenario and use of NRB in the host countries. The calculation of fNRB will be undertaken on CPA level.

[12] Page 36 -37, Nijaguna B.T., Biogas Technology, New Age International, 2002

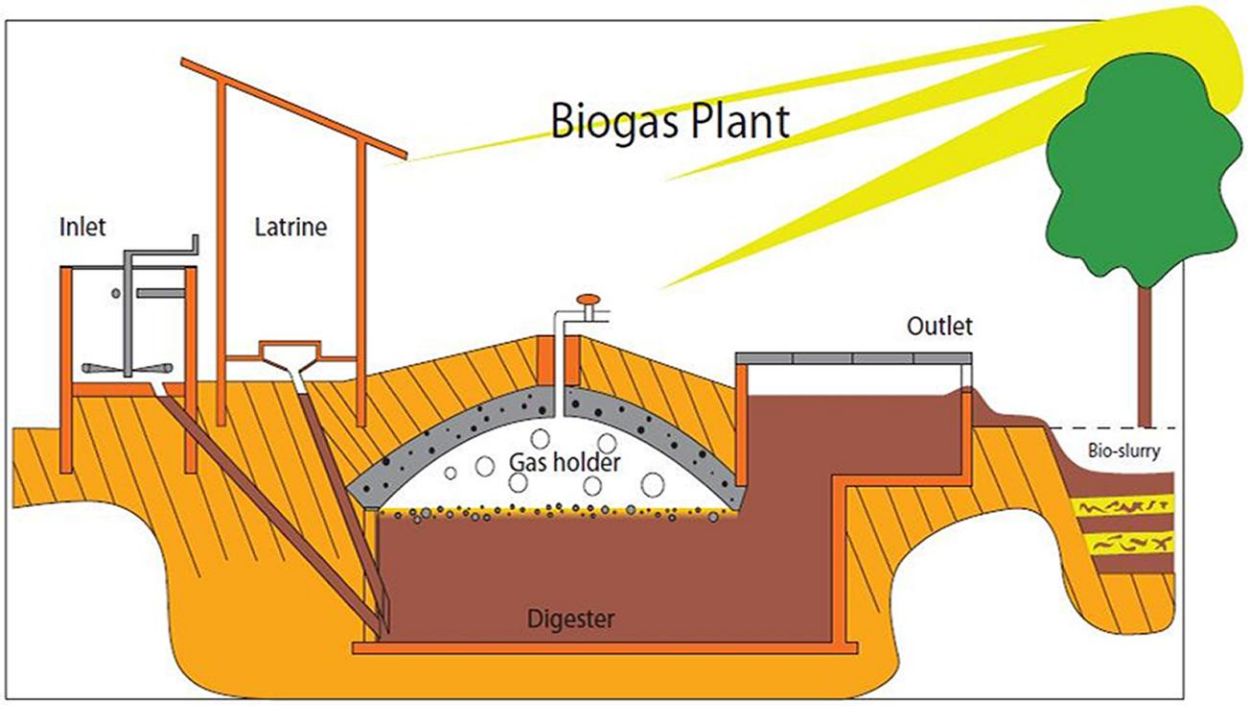

Figure 4. Schematic diagram of fixed dome digester

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 consequently 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.

Floating drum technology

The basic functioning of the floating drum digester is similar to the fixed dome. The key difference of this technology is a cylindrical or dome-shaped digester with a moving, floating gas-holder or drum that floats depending on the amount of gas in the digester. The gas-holder either floats directly in the digester slurry or in a separate water jacket. The drum in which the biogas collects will usually have an internal or external guide frame that provides stability and keeps the drum upright.

As biogas is produced and more gas is released, the drum is pushed up, indicating a rise in the amount of gas. When the gas is used up, the drum sinks. This provides a useful visual indicator of how much gas is available to users.

Costs of building/installing the floating drum type obviously depend upon the size, the materials used and the model of the digester. Floating drum digesters need some maintenance depending on how well they are managed. Maintenance involves cleaning, painting and fixing leaks.

The lifespan of these digesters vary widely, and is dependent upon the quality of materials used in construction, as well as management and maintenance. High quality, well-managed digesters can last for over 40 years, though there are some floating drums in disuse – largely because of poor management/maintenance. On the average, it is safe to say that floating drum digesters, if built with high quality materials and well managed, can give service of around 20-30 years, the same as fixed dome digesters providing cooking gas, lighting and fertiliser.[13]

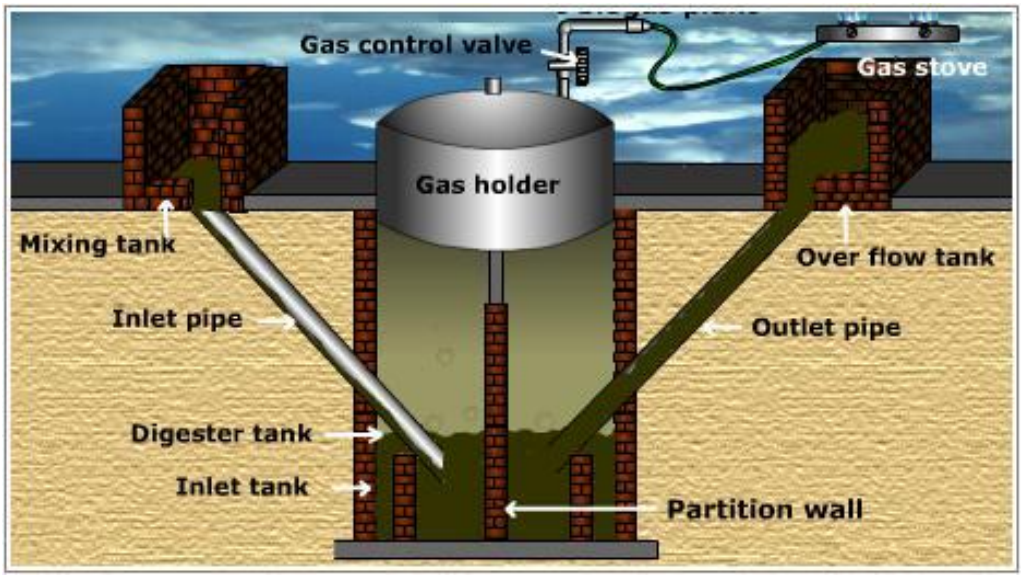

Figure 5. Floating drum biogas system

Flexible Balloon Digesters

Flexible balloon digesters are constructed from a large plastic or rubber bag and are thus mobile, which is the main difference from the fixed dome and floating drum digesters that are constructed on site. The operation however follows largely the same principle as fixed-dome or floating drum digesters. The balloon material should be weather and UV resistant, specially stabilised reinforced plastic or rubber.

A balloon digester combines both the digester and gas-holder, with the biogas stored in the upper part of the balloon which expands as biogas is produced. The gas pressure can be increased by placing weights on the balloon, however a gas pump may be required if higher gas pressures are needed. Gas safety valves are required to control the pressure inside the balloon to avoid damaging the skin of the digester. The inlet and outlet for the digester are attached directly to the skin of the balloon.

[13] www.tutorvista.com

The technology is flexible and allows for standard fabrication at low-cost and is suitable for use in areas with a high groundwater table. However, at low gas pressures a gas pump may be required; slurry cannot be removed during operation and the technology has a relatively short useful lifespan.

Biogas Appliances
Appliances for the use of biogas can vary widely from stoves, lamps or generators. There will be no specific requirements under this PoA regarding appliances however it is expected each CPA implementer will ensure that all appliances whether locally manufactured or imported meet appropriate standards. This PoA will focus on the capacity and use of biogas overall to reduce NRB usage in cooking.

This categorisation of biogas systems is only indicative, and further research and development is expected to improve the system design, and completely new designs and models are likely to come onto the market. Details of technologies to be employed will be described at SSC-CPA level.

A.4.2.2. Eligibility criteria for inclusion of a SSC-CPA in the PoA:

SSC-CPAs to be included under this PoA must meet the following requirements:

Nr.	Requirement[14]	Eligibility criteria	Evidence required
1.	The geographical boundary of the CPA including any time-induced boundary consistent with the geographical boundary set in the PoA	The CPA will demonstrate that it will be involved in the dissemination of biogas systems within the geographical region of the PoA	One of the following documents shall be provided: •Business plan •Implementation document •Contractual agreement between CME and CPA Implementer •Declaration from CPA implementer and confirmation check by CME
2.	Conditions that avoid double counting of emission reductions like unique identifications of product and end-user locations	The CPA shall demonstrate that it does not double-count any of its appliances for the ERs estimation by confirming that the biogas systems will have a unique serial number and the CPA implementer will not include these biogas systems in another CPA or stand alone CDM project.	• Contractual agreement between CME and CPA Implementer. • Declaration from CPA implementer and confirmation check by CME
3.	The specifications of technology/measure including the level and type of service, performance specifications including compliance with testing/certifications	The biogas systems disseminated are renewable energy generation units to provide thermal energy and will be required to conform to any applicable national standards.	The following documents shall be provided: •Technical documentation describing the operation of the biogas system. •Evidence of compliance with

[14] 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 CPA.

Nr.	Requirement[14]	Eligibility criteria	Evidence required
			national standard (if applicable).
4.	Conditions to check the start date of the CPA through documentary evidence	The CPA implementer will demonstrate the start date of the CPA shall not be before the commencement of validation of the PoA i.e. the 16/11/2011 on which the PoA-DD was published for global stakeholder consultation. Moreover, the start date shall be compliant with the latest version of the Glossary of CDM terms.	Sales Agreements (first)
5.	Conditions that ensure compliance with applicability and other requirements of single or multiple methodologies applied by CPAs	The CPA complies with baselines and monitoring methodology requirements of AMS-I.E version 05. Namely: *1. This category comprises activities to displace the use of non-renewable biomass by introducing renewable energy technologies. Examples of these technologies include, but are not limited to biogas stoves, solar cookers, passive solar homes, renewable energy based drinking water treatment technologies (e.g. sand filters followed by solar water disinfection; water boiling using renewable biomass).* As per the list of examples biogas stoves and hence biogas systems are included. Each CPA will be required to demonstrate that they will disseminate biogas systems for thermal energy production. *2. Project participants are able to show that non-renewable biomass has been used since 31 December 1989, using survey methods or referring to published literature, official reports or statistics.*	One of the following documents shall be provided for each criterion: Criterion 1 •Contractual agreement between CME and CPA Implementer. •Business plan / implementation document Criterion 2 Demonstration of the use of NRB since 31 December 1989 will be found in the CPA-DD Criterion 3 Not applicable and no leakage is considered. Criterion 4 As per option (c) the adjustment factor of 0.95 will be used Criterion 5 CPAs will use either option (a) or (b) CPAs will use default values when available as per option (b)

Nr.	Requirement[14]	Eligibility criteria	Evidence required
		Information will be found in the CPA-DD to demonstrate the fraction of NRB used in the host country. Further information is also found in section A.4.3 of the PoA-DD demonstrating the use of NRB in each of the host countries. The CPA implementer will provide evidence showing that the CPA will operate in the host country. *3. If the equipment currently being utilised is transferred from outside the boundary to the project boundary, leakage is to be considered.* This paragraph is not applicable for this project type (biogas system installation) as biogas systems are earthwork and huge concrete structure which can not be transferred from one place to another once constructed. *4. The use of this methodology in a project activity under a programme of activities (POA) is legitimate if the following leakages are estimated and accounted for, if required, on a sample basis using a 90/30 precision for the selection of samples, and accounted for:* *(a) Use of non-renewable woody biomass saved under the project activity to justify the baseline of other CDM project activities can also be a potential source of leakage. If this leakage assessment quantifies a portion of non-renewable woody biomass saved under the project activity that is then used as the baseline of other CDM project activities then y B is adjusted to account*	

Nr.	Requirement[14]	Eligibility criteria	Evidence required
		for the quantified leakage; *(b) Increase in the use of non-renewable woody biomass outside the project boundary to create non-renewable woody biomass baselines can also be a potential source of leakage. If this leakage assessment quantifies an increase in the use of non-renewable woody biomass outside the project boundary, then y B is adjusted to account for the quantified leakage;* *(c) As an alternative to subparagraphs (a) and (b), By can be multiplied by a net to gross adjustment factor of 0.95 to account for leakages, in which case surveys are not required.* Option (c) will be used in all CPAs *5. The following further conditions apply for the value of fraction of non-renewable (fNRB) applied in a component project activity (CPA) of a POA. The choice between (a) conduct own studies to determine the local fNRB value and then apply those values in the CPAs; and (b) use default national values approved by the Board; shall be made ex ante. A switch from national value i.e. choice (b) to sub-national values i.e. choice (a) is permitted, under the condition that the selected approach is consistently applied to all CPAs.* CPAs will use either option (a) or (b)	
6.	The conditions that ensure that CPAs meet the requirements	The CPA will prove additionality as per the criteria	The following evidences shall be provided for one of the

Nr.	Requirement[14]	Eligibility criteria	Evidence required
	pertaining to the demonstration of additionality as specified in Section A of EB65 Annex 3	in section E.5.2 of the PoA-DD for one of the three approaches: ***First Approach***[15] 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). ***Second Approach*** [16] 1. Cost of baseline technology 2. Cost of biogas system 3. Evidence that baseline technology will produce higher emissions. ***Third Approach***[17] 1. CPA aims to achieve energy savings at a scale of no more than 15MW of thermal energy equivalent per year 2. Location of the CPA is in one of the LDCs of Ethiopia, Rwanda or Uganda, or in a SUZ(s) of Kenya.	approaches: First approach 1. Calculation showing the capacity of the biogas system(s) in MW 2. Business plan / Implementation document Second approach 1. Report, study, survey or quotation for baseline technology including justification of choice of baseline technology 2. Business plan / quotation / implementation document 3. Demonstrated by the use of NRB in the host country as per CPA-DD Third approach 1. Calculation showing the capacity of the biogas system(s) in MW and sales projections 2. Business plan / Contractual agreement between CME and CPA Implementer / Letter of Approval
7.	The PoA-specific requirements stipulated by the CME including any conditions related to undertaking local stakeholder consultations and environmental impact analysis	1. The CPA organised a local stakeholder consultation 2. The CPA got environmental clearance for the project related activities, if applicable	The following documents shall be provided: 1. Local Stakeholder Report including comments of stakeholders and how the comments were taken into account by the CPA implementer 2. Environmental clearance letter and/or EIA if required by

[15] As per the "Guidelines on the Demonstration of Additionality of Small-Scale Project Activities" Version 09, EB68 Annex 27 clause 2 (c) as further described in section E.5.1 and E.5.2. of the PoA-DD

[16] As per the "Guidelines on the Demonstration of Additionality of Small-Scale Project Activities" Version 09, EB68 Annex 27 clause 1 (a) as further described in section E.5.1 and E.5.2. of the PoA-DD

[17] As per the "Guidelines for demonstrating additionality of microscale project activities (Version 04)" EB68 Annex 26.

Nr.	Requirement[14]	Eligibility criteria	Evidence required
			national regulations
8.	Conditions to provide an affirmation that funding from Annex I parties, if any, does not result in a diversion of official development assistance	CPAs will demonstrate that no public Official Development Assistance funding has been used for the implementation or operation of the CPA, which requires the purchase of CERs from this CPA	Confirmation Letter of No Diversion of ODA from CPA implementer and ODA provider, if applicable
9.	Where applicable, target group (e.g. domestic / commercial / industrial, rural / urban, grid connected / off-grid) and distribution mechanisms (e.g. direct installation)	The CPA will demonstrate which target group(s) is/are to be targeted by the CPA and the distribution mechanism.	Any of the following documents shall be provided: •Sales forecast •Marketing plan •description of technology (e.g. domestic or institutional biogas system) •Implementation document
10.	Where applicable, the conditions related to sampling requirements for a PoA in accordance with the approved guidelines/standard from the Board pertaining to sampling and surveys	The CPA Implementer will agree to support the sampling and survey activities of CME.	Contractual agreement between CME and CPA Implementer
11.	Where applicable, the conditions that ensure that every CPA in aggregate meets the small-scale or microscale threshold criteria6 and remains within those thresholds throughout the crediting period of the CPA	The CPA Implementer shall meet the limits for sales or installations for a specific CPA as provided by CME to ensure that the small scale or microscale threshold criteria are met.	Any of the following documents shall be provided: •Contractual agreement between CME and CPA Implementer •Sales forecast •Calculation showing the capacity of the biogas system(s)
12.	Where applicable, the requirements for the debundling check, in case CPAs belong to small-scale (SSC) or microscale project categories.	The CPA implementer will demonstrate that the CPA is not a de-bundled component via one of the following two approaches: 1. The biogas systems are less than 1% of the SSC threshold (as per paragraph 10 EB54 Annex 13) 2. (a) (i) The CME does not manage a large scale PoA of the same type. (ii) The CPA implementer has not registered or applied to register another small-scale activity	The following evidence shall be provided for one of the two options: 1. Calculation showing the capacity of the biogas system(s) 2. (a)(i) Statement from CME (ii) Statement from CPA implementer (b) Check of GPS co-ordinates of project boundary to determine closet point

Nr.	Requirement[14]	Eligibility criteria	Evidence required
		(b)The project boundary is not within 1km of the boundary of another small-scale CPA, at the closet point.	
13.	A programme of activities (PoA) is a voluntary coordinated action by a private or public entity which coordinates and implements any policy/measure or stated goal (i.e. incentive schemes and voluntary programmes), which leads to anthropogenic GHG emission reductions or net anthropogenic greenhouse gas removals by sinks that are additional to any that would occur in the absence of the PoA, via an unlimited number of CDM programme activities (CPAs)	As demonstrated in section A.2. of the PoA-DD there are no laws in the host countries that require the implementation of biogas systems, however the CPA implementer must also demonstrate that the proposed CPA is a voluntary action	Any of the following documents shall be provided: •Contractual agreement between CPA implementer and CME •Published statement, vision or mission of the CPA Implementer
14.	The proposed CPA must ensure that sufficient training has been carried out to ensure the construction / installation of the biogas system is done by competent persons	The CPA implementer will provide sufficient evidence of training or qualification to implement the proposed CPA.	Any of the following documents shall be provided: •Training certificates •Training records •Qualification certificates •Planned training schedules

A.4.3. Description of how the anthropogenic emissions of GHG by sources are reduced by a SSC-CPA below those that would have occurred in the absence of the registered PoA (assessment and demonstration of additionality):

The host countries have no national laws, policies or mandatory requirements stipulating the adoption of biogas systems by households[18]. Hence, this proposed PoA is a voluntary action coordinated by African Clean Energy Switch - Biogas (ACES-Biogas) Limited, the CME. The target of this PoA is to up-scale and standardise the use of biogas, which cannot be achieved without the use of carbon credit revenues as explained below.[19]

[18] As described in Section A.2.

[19] As described in EB50 Annex 13, Guidelines for Objective Demonstration and Assessment of Barriers, Guideline 7 states: *For projects in Least Developed Countries it is sufficient to transparently describe the relevant barriers, as less stringency is needed with regards to data availability in the actual demonstration of barrier, as compared to the projects in other countries. Projects in Least Developed Countries are not bound by the provisions in this guideline and may use other approaches that are more adapted to the local circumstances.* All the host countries are Least Developed Countries with the exception of Kenya.

The technical viability of small-scale biogas technology has been repeatedly proven in field tests and pilot projects, but until now mass dissemination of this technology has not been accomplished in East Africa.[20] The following are seen as the main barriers:

Investment barrier

The baseline scenario in the host countries is the use of woodfuel to provide thermal energy requirements. Wood users tend to use the three stone fire method, meaning the technology is freely available and the fuel can be gathered or bought at relatively low prices. Charcoal users on a domestic level normally use unimproved cook stoves that can be bought for less than 5 USD.[21]

The cost of installing a fixed dome domestic biogas system ranges between 600-2200 USD,[22] this initial cost is many times the cost of using the traditional appliances and presents a major barrier to households and institutions.

Disposable income for households and surplus revenue for most institutions in the countries of this PoA are low. As an indicator Table 5 shows GDP per capita in each country of the PoA.

Country	GDP per capita (USD)
Ethiopia	344
Kenya	759
Rwanda	506
Uganda	481

Table 5 GDP per capita in the host countries[23]

When GDP per capita is compared to the average cost of a small biogas system of $600 (this does not include any costs other than that of construction e.g. training and marketing) it can be seen to be greater than all the countries except for Kenya, which is only slightly larger.

A biogas system has multiple benefits and can eliminate the purchase of woodfuel. However, when deciding on its acquisition an individual will compare the price of the biogas system with a cooking stove. In East Africa a small biogas system is much more expensive than an improved cook stove.

[20] Page 25,Eshete, G et al., Report on the feasibility study of a national programme for domestic biogas in Ethiopia, 2006
Page 48, Winrock International, Report on the Feasibility for a National Household Biogas Commercialization Program in Uganda, 2007
Page 19-20, Gichohi, P., Analysis of the Market Potential for Domestic Biogas in Rural Kenya Supported by GTZ-PSDA, 2009
Page 15-16, SNV, Report on the Feasibility Study for a Biogas Support Programme in the Republic of Rwanda, Guy Dekelver, Silas Ruzigana & Jan Lam, 2005

[21] Page 48, The World Bank, Household Cookstoves, Environment, Health, and Climate Change, A new look at an old problem, 2011

[22] The price varies according to the size and location, which can effect the price considerably.

[23] Taken from www.worldbank.org

Biogas systems are therefore not an option for the vast majority of households and institutions. For these reasons, the majority of programmes that have achieved any success in sales have been subsidised by NGOs or donors, which requires additional external finance to make these programmes sustainable.

Technology barriers

The technology that a biogas system will replace will typically be a three stone fire or metal charcoal stove. These baselines technologies are extremely simple and have a long history amongst the target market. A biogas system although relatively simple is considerably more complicated than these baseline technologies.

Many of the early-piloted biogas systems have fallen into disrepair due to lack of maintenance, this is normally due to a lack of local knowledge about how to properly maintain the systems as previously demonstrated.[24]

The reputation of biogas systems has been damaged by these pilot plants as it is seen as an complicated, expensive technology that will not last. To overcome the challenges in the biogas market, CPA implementers need to train local people to manufacture biogas digesters and be able to supply biogas appliances from either local manufacturers or importers. Being a new technology, training is a vital component for the smooth implementation. Masons, their supervisors, other staff as well as the actual users will all receive appropriate training courses.

The technology required to manufacture / install biogas systems is available locally in East Africa. The biogas stoves and other appliances can be manufactured locally or imported by local distributors. Market acceptance of biogas system technology has yet to be demonstrated on a large scale in East Africa. In all cases these technologies are available at a cost that is far higher than the acceptable market price, which creates the need for external sources of finance.

Barrier due to prevailing practice

The prevailing practice in the host countries is the use of wood fuel for thermal energy requirements.[25] Although there has been a considerable donor-funded effort to promote biogas systems over the past ten years, the actual dissemination of biogas systems is very low across East Africa so far, particularly considering the low operational rate of previously installed biogas systems. The table below shows information on biogas systems installed in East Africa up to 2007.

Country	Installed biogas systems	Operational biogas systems
Ethiopia[26]	1000	600

[24] Pages 29-31, 58-59 and 71, Eshete, G et al., Report on the feasibility study of a national programme for domestic biogas in Ethiopia, 2006
Page 94, Winrock International, Report on the Feasibility for a National Household Biogas Commercialization Program in Uganda, 2007
Page 22-23, Gichohi, P., Analysis of the Market Potential for Domestic Biogas in Rural Kenya Supported by GTZ-PSDA, 2009

[25] Page 9, Strategy on scaling up access to modern energy services. East African Community. http://www.eac.int/energy/index.php?option=com_docman&task=doc_download&gid=14&Itemid=70 and Page (ii), Eshete, G et al., Report on the feasibility study of a national programme for domestic biogas in Ethiopia, 2006

[26] Page 1, SNV & Ethiopia Rural Energy Development and Promotion Centre (EREDPC), National Biogas Programme Ethiopia, Programme Implementation Document, Jan 2008

Kenya[27]	2000	1400
Rwanda[28]	200	150[29]
Uganda[30]	700	560

Switching to biogas poses a number of barriers due to prevailing practice. For many years families have used either charcoal or wood stoves and cooking on biogas is a significant change in a number of ways. There is a social barrier to cooking with animal and especially with human manure in some parts of East Africa. There is also significant local preference for some local dishes cooked with wood or charcoal.[31]

Therefore, the use of traditional stoves and other appliances still imposes a very strong adoption barrier, which could result in the continuation of the use of traditional cooking methods; even after partial adoption of biogas. Overcoming this "inertia" requires a significant amount of sensitisation, marketing, demonstration and personal recommendation, and the maintenance of the systems over a sustained period.[32]

Current market penetration of biogas systems is currently very low with a very high failure rate due to poor quality control systems as well as lack of user trainings, improper selection of beneficiaries and other factors that have been described previously.

Potential users are unaware of the multiple benefits of biogas including the potential of financial gains made when applying slurry on agricultural products. All potential users must be reached and awareness on biogas will have to be raised to create a strong market. For those who have taken the decision to invest in a biogas system, training will be organised to provide the necessary knowledge and skills for the proper operation and maintenance to use the system efficiently and effectively. An effective after sales service will keep the systems in good order that in turn will serve 'word of mouth' promotion. Quality control on systems in operation and under construction is a key aspect of quality enforcement and the long-term success of the market. Carbon finance can be used to fund these activities, which are required to shift the common practice from traditional stoves to biogas systems.

[27] Page 3, ETC Group, Promoting Biogas Systems in Kenya, A feasibility study, Final Draft, 20 August 2007

[28] Estimated based on Chapter 4, SNV, Report on the Feasibility Study for a Biogas Support Programme in the Republic of Rwanda, Guy Dekelver, Silas Ruzigana & Jan Lam, 2005

[29] Estimate

[30] Page 14, Heifer International, Programme Implementation Document for Uganda Domestic Biogas Programme, 2010

[31] Page 38, Eshete, G et al., Report on the feasibility study of a national programme for domestic biogas in Ethiopia, 2006
Page 21, Winrock International, Report on the Feasibility for a National Household Biogas Commercialization Program in Uganda, 2007

[32] Pages 29-31, 58-60 and 71, Eshete, G et al., Report on the feasibility study of a national programme for domestic biogas in Ethiopia, 2006
Page 94, Winrock International, Report on the Feasibility for a National Household Biogas Commercialization Program in Uganda, 2007
Page 9-10, Mugo, F. and Gathui, T. (2010) Biomass energy use in Kenya. A background paper prepared for the International Institute for Environment and Development (IIED) for an international ESPA workshop on biomass energy, 19-21 October 2010, Parliament House Hotel, Edinburgh. Practical Action, Nairobi, Kenya.
Page 22-23, Gichohi, P., Analysis of the Market Potential for Domestic Biogas in Rural Kenya Supported by GTZ-PSDA, 2009

Conclusion
Until now, in most cases, biogas has been introduced through a pilot or demonstration project at the premises of a few households and or a compound of a governmental institute. It can be concluded that most initiatives in Africa failed to grow from a product-based project approach implemented by a single actor, towards a market-oriented programme approach. To develop a sustainable biogas market it may require CPA implementers to directly or indirectly provide credit for households or institutions to pay for the biogas systems in a number of instalments, and to provide guarantees and maintenance. Hence, a successful biogas project entails significant investment to cover the above-mentioned costs.

So far no organisation has been able to achieve a sustainable long-term biogas programme, despite the high potential that exists in East Africa. This is due to the above mentioned barriers facing the adoption of this technology. In conclusion, a sustainable biogas programme at scale will not be implemented within the host countries in the absence of this PoA.

It has been demonstrated that the baseline technology of three stone fires or unimproved charcoal stoves produce more GHG emissions due to the existence of NRB in the host countries. These technologies are many times cheaper and simpler than a biogas system that produce no GHG emissions.

A.4.4. Operational, management and monitoring plan for the programme of activities (PoA):

A.4.4.1. Operational and management plan:

Each authorised CPA implementer under this PoA will sign a standard contractual agreement with the CME to participate in the PoA as a CPA implementer in which the CPA implementer will commit itself to the following requirements:

- Those operating the CPA are aware of and have agreed that their activity is being subscribed to the PoA.
- The CPA implementer shall not assign a new CPA that has been already registered either as a CDM project activity or as a CPA of another PoA.

During the sales of biogas systems, vendors shall complete Sales Agreements with the customers containing at least the information contained in Table 6.

Mandatory
- Name of customer
- Address/location
- Date of purchase
- Date of commissioning
- Serial number of the digester
- Name of CPA implementer
- Biogas model and size
- Phone number

Table 6. Mandatory information for the Sales Agreement

The mandatory items for the Sales Agreement are sufficient for some CPAs to estimate correctly the number of GHG emission reductions corresponding to each CPA. For instance, the name of the customer and the address will be needed to track back the system during monitoring, and the serial number of the

biogas systems will identify the biogas digester unit. For some CPAs the date of purchase can be assumed to be the date of commissioning, when the biogas system starts operating. For CPAs that involve the construction of biogas systems the CPA implementer will also be required to record the date of commissioning when the biogas system begins operating. The date of purchase / commissioning will show the CERs earned in the respective monitoring period.

The Sales Agreements from vendors will be gathered by the CPA implementer and transferred to an electronic record kept by the CPA implementer and precisely assigned to its corresponding CPA. Copies of the Sales Agreements as well as the electronic records will be periodically delivered to the CME. The CME will carry out or will organise third party site visits, together with cross-checks to confirm that the records are authentic. These checks will be undertaken by telephone on receipt of new records by the CME and annually with site visits. The database allows for the verification of the actual number of systems sold, and the avoidance of double-counting emission reductions in the PoA by automatically checking each biogas system sold and any duplication of serial numbers. The contact point for the end user of the biogas system will be the staff of the CPA implementer responsible for the CPA's implementation and its network of installers/sellers.

It is the responsibility of the CME to register the PoA. The CME prepares all the necessary documentation for validation to be passed to the DOE, including the Letters of Approval from the DNAs. The CME will also be responsible for organising the inclusion of CPAs, and the finalisation of the respective CPA-DDs.

The CME will organise the monitoring of the PoA through field monitoring surveys. The CPA implementers will support the monitoring as required by the CME, but it is the CME that maintains the monitoring reports and makes them available for submission to the DOE for verification.

Finally the CME will be the focal point with the EB and will receive the CERs generated. The CERs will be assigned among their corresponding CPAs, and the respective CPA implementers will each decide on their sale. The CPA implementers may or may not handle the selling of their CERs themselves. In cases where the capacity of the CPA implementers to sell the CERs is limited or they have decided otherwise, the CME may offer a sales service resulting in the transfer of CERs to the respective CER buyers, and the resulting revenues to the CPA implementers.

The CME operational management system will ensure that the following requirements are met:

(i) A record keeping system for each CPA under the PoA.
To identify each biogas system participating in the PoA, all the biogas systems sold will have a unique serial number that will be recorded in the Sales Agreement. The Sales Agreement details, and if applicable the commissioning date will be transferred into the electronic records database of each CPA implementer where the CME will identify its corresponding CPAs, and the Sales Agreements will be kept by the CME for unique record-keeping. The serial numbers will be used to monitor the system and determine the emission reductions for each CPA.

(ii) A system/procedure to avoid double accounting.
This will avoid the risk of including a new CPA that has been already registered either as a CDM project activity or as a CPA of another PoA. The electronic database will be used for double counting checks to be performed. The unique serial number will avoid the same system being counted twice in different CPAs in the PoA. The database will not allow two biogas systems to have the same serial number, and each serial number will belong to only one CPA. The CPA implementers will be aware by their contractual agreement with the CME, that they

must not count the same biogas system under another PoA or CDM project activity. The CPA implementer must certify that the proposed CPA is not registered under another CDM project activity. Before submitting a new CPA for inclusion to a DOE, the CME will carry out a search in the UNFCCC CDM registry to ensure that the proposed CPA is not included in another registered PoA, or registered as a CDM project activity. Should such a case occur the CME will not include the CPA under the PoA. If the contractual agreement between the CME and the CPA implementer has been signed, the agreement will automatically terminate and the ER crediting operations of the CPA implementer will be suspended.

(iii) The CPA included in the PoA is not a de-bundled component of another CPA or CDM project activity.

As per the *Guidelines on assessment of de-bundling for SSC project activities, version 03* issued at the EB's 54th meeting, article 10 allows exemption from de-bundling check as follows: *"If each of the independent subsystems/measures (e.g., biogas digester, solar home system) included in the CPA of a PoA is no larger than 1% of the small-scale thresholds defined by the methodology applied, then that CPA of PoA is exempted from performing de-bundling check i.e., considering as not being a de-bundled component of a large scale activity"*. Biogas systems distributed under the PoA should be no larger than the 1% SSC threshold of the methodology that is 0.45MW. Domestic biogas systems are more likely to be 100 times under the 1% limit set for de-bundling. The potential technology under a CPA will vary according to the CPA implementer and therefore a capacity calculation will be carried out at CPA level. In the unlikely case that a CPA includes a biogas system that goes beyond the 1% limit, the corresponding de-bundling check will be carried out at the CPA level as described in articles 8 and 9 of the Guidelines on assessment of de-bundling for SSC project activities, version 03[33].

(iv) The provisions to ensure that those operating the CPA are aware of and have agreed that their activity is being subscribed to the PoA.

The contractual agreement between the CME and the CPA implementer will ensure that those operating the CPA are aware of their involvement in the PoA. Each of the levels of biogas system distribution will be informed of its involvement in the PoA and its registration as a CDM project.

(v) A clear definition of roles and responsibilities of personnel involved in the process of inclusion of CPAs, including a review of their competencies.

The CME has the competencies to review and include CPAs in the PoA.

1. The Managing Director of African Clean Energy Switch - Biogas (ACES-Biogas) Limited initially signs a Confidentiality & Non-Disclosure Agreement with each applicant CPA implementer whereby there is a mutual exchange of information about the PoA and the activities of the applicant CPA implementer. An initial review of the applicant's information is carried out by the Project Specialist. This review is then considered and approved by the General Manager and Managing Director.

[33] EB 54 Annex 13

2. Once the CME team has positively reviewed the initial information provided by the applicant CPA, a Memorandum of Understanding is signed between the parties whereby the CME management team undertakes a full due diligence assessment of the applicant, largely based on KYC (Know Your Client) principles. Shortcomings in the applicant's information and its proposed activities are communicated, and remedial actions are proposed, which the CME may mobilise support to rectify.

3. Once the due diligence assessment is positive, a Biogas Supplier Organisation Approval Agreement (BSOAA) is signed between the parties which sets out the mutual obligations of the CME and the applicant. The BSOAA carefully documents the way in which the PoA's CME will work with CPAs, and sets out both CDM and PoA requirements, and makes binding references to the PoA's Management Rules and the CME's Terms & Conditions of Business. Once the BSOAA is signed the Approved Biogas Supplier Organisation (BSO) is at liberty to submit individual Proposed CPAs for inclusion.

4. Once a Proposed CPA is submitted to the CME by an Approved BSO it is reviewed by the CME management team and, if found to be both satisfactory in terms of its compliance with the PoA-DD, the International Rules and the CME's Management Rules, an Inclusion Agreement is signed between the parties whereby the CME undertakes to submit the CPA to its validating DOE for inclusion into the PoA. The CME handles all issues raised by the DOE. The CME's Managing Director is the direct contact point for the CDM EB.

Project Specialist
Project Specialists in the CME will be responsible for information dissemination about the PoA to CPA implementers the training of CPA staff, supervising the collection of monitoring data, the preparation of monitoring reports and routine CME operations. These posts require a good understanding of CDM procedures, a thorough understanding of the CME's operations and a basic knowledge about biogas appliances.

Monitoring Manager
The Monitoring Manager is a senior level position. The role requires excellent organisational, analytical and communication skills to ensure the compliance of CPAs with their obligations that will result in successful verifications of CPAs' emission reductions and sustainable development outcomes. The post requires a good understanding of CDM procedures and experience in project monitoring.

General Manager
The General Manager is a senior level position requiring a broad background in business management. The person will need a thorough knowledge of CDM procedures, and must be competent in all aspects of the CME's operations. The post requires significant project management experience in East Africa and a working knowledge of biogas appliances.

Managing Director
The Managing Director is responsible for the strategic management of the CME. This senior position requires appropriate management training, many years of experience in project management, in-depth CDM knowledge and experience of the East African region.

(vi) Records of arrangements for training and capacity development for personnel.
All CME staff will be provided with training organised by the CME's senior management, African Clean Energy Switch – Biogas (ACES-Biogas) Limited's parent company (Uganda

Carbon Bureau) or from external consultants as appropriate. The CME will provide training to the staff of the CPA implementers who are responsible for the operation of the CPAs to ensure their ability to comply with all aspects of the PoA's requirements.

(vii) ***Procedures for technical review of inclusion of CPAs.***
In accordance with the sequence of events described in *(v)* above, the CME will conduct a full technical review of each CPA prior to inclusion. This will involve ensuring that each CPA meets the required eligibility criteria for compliance with the approved methodology, the baseline, additionality, double counting and de-bundling. It will also ensure that the CPA complies with all the regulatory requirements of the host country(s).

(viii) ***Measures for continuous improvements of the PoA management system.***
The CME will periodically review the management system of the PoA to ensure that there is a continuous improvement in its efficiency.

A.4.4.2. Monitoring plan:

The CME opts for a verification method that does not use overall sampling but verifies each CPA.

To ensure full transparency and to avoid double-counting, the verification method will treat all CPAs under each CPA implementer as a single population, excluding special circumstances where the CPA implementer requests that their CPAs are sampled individually. Hence, there should be the same number of verification populations as there are CPA implementers.

The CME will keep an electronic database of the data contained in all the Sales Agreements. Verification will be done using a statistically sound sample of each CPA implementer population. Verification of the Sales Agreements can be done by phone, post, email or physical visits to households as required, thus ensuring that the status of the verification can be determined anytime for each CPA.

Monitoring of biogas system usage and continued use of NRB will be carried out annually or biennially by the CME and/or by organisations authorised by the CME for each CPA implementer. The detailed monitoring plan and the parameters to be verified are included in E.7.

A.4.5. Public funding of the programme of activities (PoA):

Public funding is being provided by the Directorate General for International Cooperation (DGIS) of the Netherlands Ministry of Foreign Affairs through the Humanist Institute for Cooperation with Developing Countries (Hivos) as support for the process towards registration of the PoA e.g. validation cost, study support.

Official Development Assistance (ODA) is not being diverted to the implementation of the PoA as the Netherlands does not require to purchase any credits from this PoA as confirmed in the declarations provided to the DOE by all parties.

SECTION B. Duration of the programme of activities (PoA)

B.1. Starting date of the programme of activities (PoA):

The starting date of the SSC-PoA-DD is 28/02/2013 or the effective date of registration, whichever is the

later.

B.2. Length of the programme of activities (PoA):

28 years

SECTION C. Environmental Analysis

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C.1. Please indicate the level at which environmental analysis as per requirements of the CDM modalities and procedures is undertaken. Justify the choice of level at which the environmental analysis is undertaken:

1. Environmental Analysis is done at PoA level ☐
2. Environmental Analysis is done at SSC-CPA level ✓

It has been decided to undertake the environmental analysis at the CPA level due to the differing circumstances of the CPA implementers in relation to the manufacturing and the supplying of biogas systems. Furthermore, due to the multiple host country locations of the PoA, each CPA will need to comply with the respective host country environmental documentation requirements depending on which of them the CPA is operating in.

C.2. Documentation on the analysis of the environmental impacts, including transboundary impacts:

N/A, as this will be provided at the CPA level.

C.3. Please state whether in accordance with the host Party laws/regulations, an environmental impact assessment is required for a typical CPA, included in the programme of activities (PoA),:

For a typical CPA the requirements of the host country regarding Environmental Impact Assessment (EIA) are as follows:

Ethiopia
Directive No.1/ 2008, A Directive Issued to Determine Projects Subject to Environmental Impact Assessment indicates that biogas systems are not included under the list of projects that require to conduct an EIA[34]. The Environmental Impact Assessment Procedural Guidelines, 2003[35] however state that the construction of biogas plants normally requires a Preliminary Environment Impact Study to be undertaken and submitted to the Environmental Protection Authority (EPA) following an initial processes of pre-screening and screening.

Kenya

[34] Page 5, Directive No.1/ 2008, A Directive Issued to Determine Projects Subject to Environmental Impact Assessment

[35] http://www.epa.gov.et/Download/Guidelines/EIA%20Procedural%20Guideline%202003.pdf

The Environmental Management and Coordination Act, 1999[36] states that only projects that fall under the Second Schedule are required to submit a Project Report and then potentially an Environmental Impact Assessment (EIA). A CPA will not be required to submit a Project Report or EIA if they are installing small biogas systems, however a CPA that involves the construction of a factory or a large biogas system(s) may be required to submit a Project Report and then an EIA. Decisions on this will be taken at CPA level in consultation with the National Environment Management Authority of Kenya.

Rwanda
According to the Rwanda General Guidelines and Procedures for Environment Impact Assessment[37] all CPAs will be required to submit a Project Brief to the Rwanda Environment Management Authority (REMA) to enable the Authority and Lead Agencies establish whether or not the proposed activities are likely to have significant environmental impacts, and also enable to determine the level of EIA required. A CPA will be unlikely to require a full EIA if they are installing small biogas systems as they should easily meet the ten criteria stipulated in Appendix 2 of the Rwanda General Guidelines and Procedures for Environment Impact Assessment (page 40). A CPA that involves the construction of a factory or a large biogas system(s) may be required to submit full EIA. Decisions on this will be decided at CPA level by the Rwanda Environment Management Authority after the submission of a Project Brief.

Uganda
In terms of the National Environment Act of 19 May, 1995, an EIA is required by law where, after the submission of a Project Brief, the Executive Director of the National Environment Management Authority finds that the project will have significant impacts on the environment and that the Project Brief discloses no sufficient mitigation measures to cope with the anticipated impacts.[38] A CPA will not require to submit a Project Brief if they are installing small biogas systems as these activities do not fall under the Third Schedule of the National Environment Act (pages 55-58). A CPA that involves the construction of a factory or a large biogas system(s) will be required to submit a Project Brief, after which the National Environmental Management Authority of Uganda will decide if a full EIA is required.

SECTION D. Stakeholders' comments

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D.1. Please indicate the level at which local stakeholder comments are invited. Justify the choice:

1. Local stakeholder consultation is done at PoA level ☐
2. Local stakeholder consultation is done at SSC-CPA level ✓

It has been decided to do the stakeholder consultation at the CPA level due to the different nature of the CPA implementers in relation to the manufacturing and the supplying of biogas systems. Furthermore, due to the multiple host country locations of the PoA stakeholders may greatly vary in their comments.

[36] http://www.nema.go.ke/index.php?option=com_content&view=article&id=132&Itemid=487

[37] http://www.rema.gov.rw/rema_doc/publications/RW_EIA_Guidelines_FinaL%20versionl__Nov_2006%5B1%5D.pdf, pages 7-9

[38] Available from: http://nemaug.org/regulations/national_environment_act.pdf, page 15 paragraph 19

D.2. Brief description how comments by local stakeholders have been invited and compiled:

N/A, as this will be provided at the CPA level

D.3. Summary of the comments received:

N/A, as this will be provided at the CPA level

D.4. Report on how due account was taken of any comments received:

N/A, as this will be provided at the CPA level

SECTION E. Application of a baseline and monitoring methodology

E.1. Title and reference of the approved SSC baseline and monitoring methodology applied to a SSC-CPA included in the PoA:

The small-scale project activity to be applied by CPAs included in this PoA is a Type I project: "Renewable energy projects" and applies the small scale baseline and monitoring methodology AMS I.E, Version 05, entitled "Switch from non-renewable biomass for thermal applications by the user"[39]

E.2. Justification of the choice of the methodology and why it is applicable to a SSC-CPA:

The category "Type I – Renewable energy projects" is applicable according to the methodology AMS I.E, Version 05, entitled "Switch from non-renewable biomass for thermal applications by the user"[40] because the "category comprises activities to displace the use of non-renewable biomass by introducing renewable energy technologies.

There exist no similar registered CDM project activities in the region of this PoA. Therefore, this project activity does not save the non-renewable biomass accounted for by an already registered project activity.

Applicability conditions applied:

The applicability criteria of AMS I.E. v05 are the following:	Methodology AMS I.E. v05 is applicable to an CPA under the proposed PoA because:
This category comprises activities to displace the use of non-renewable biomass by introducing renewable energy technologies. Examples of these technologies include, but are not limited to biogas stoves, solar cookers, passive solar homes, renewable energy based drinking water treatment technologies (e.g. sand filters followed by solar water disinfection; water boiling using renewable biomass).	CPAs will install biogas systems including biogas stoves that are listed in the examples of technologies included.
Project participants are able to show that non-renewable biomass has been used since 31 December 1989, using survey methods or referring to published literature, official reports or statistics.	NRB has been in use in the host countries since 1989 as demonstrated in more detail in section E.4 however each CPA will be required to calculate the fraction of biomass that is non-renewable.
If the equipment currently being utilised is transferred from outside the boundary to the project boundary, leakage is to be considered.	This applicability criterion is not applicable for this project type (biogas system installation) as biogas systems are earthwork and huge concrete structure which can not be transferred from one place to another once constructed.

[39] http://cdm.unfccc.int/methodologies/DB/WHTQUFLWCVNB9CIUZC198A712WGQR4, EB68 Annex 22

[40] Ibid

The use of this methodology in a project activity under a programme of activities (POA) is legitimate if the following leakages are estimated and accounted for, if required, on a sample basis using a 90/30 precision for the selection of samples, and accounted for: (a) Use of non-renewable woody biomass saved under the project activity to justify the baseline of other CDM project activities can also be a potential source of leakage. If this leakage assessment quantifies a portion of non-renewable woody biomass saved under the project activity that is then used as the baseline of other CDM project activities then B_y is adjusted to account for the quantified leakage; (b) Increase in the use of non-renewable woody biomass outside the project boundary to create non-renewable woody biomass baselines can also be a potential source of leakage. If this leakage assessment quantifies an increase in the use of non-renewable woody biomass outside the project boundary, then B_y is adjusted to account for the quantified leakage; (c) As an alternative to subparagraphs (a) and (b), B_y can be multiplied by a net to gross adjustment factor of 0.95 to account for leakages, in which case surveys are not required.	CPAs will follow option (c) and will use an adjustment factor of 0.95.
The following further conditions apply for the value of fraction of non-renewable (fNRB) applied in a component project activity (CPA) of a POA. The choice between (a) conduct own studies to determine the local fNRB value and then apply those values in the CPAs; and (b) use default national values approved by the Board; shall be made ex ante. A switch from national value i.e. choice (b) to sub-national values i.e. choice (a) is permitted, under the condition that the selected approach is consistently applied to all CPAs.	CPAs will use either option (a) or (b) CPAs will use default values when available as per option (b)

E.3. Description of the sources and gases included in the SSC-CPA boundary

The gas included is carbon dioxide in the CPA-boundary that is the physical, geographical site of the biogas system.

Source		Gas	Included?	Justification / Explanation
Baseline	Combustion of charcoal or firewood	CO_2	yes	Source of baseline emissions
		CH_4	no	Excluded as per methodology
		N_2O	no	Excluded as per methodology
Project Activity	Combustion of biogas	CO_2	no	Excluded as per methodology
		CH_4	no	Excluded as per methodology
		N_2O	no	Excluded as per methodology

The project boundary is the physical, geographical site of the use of biomass or the renewable energy as demonstrated in Figure 6.

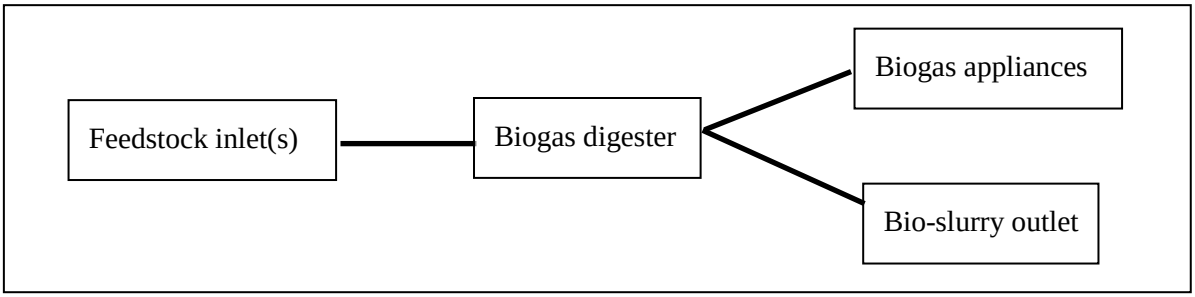

Figure 6. Schematic diagram of biogas system project boundary

E.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

More than 81% of East African households rely on traditional biomass cooking methods[41], typically charcoal or firewood for urban dwellers, and firewood for rural households. This biomass also accounts for more than 70% of all primary energy needs in East Africa[42]. The wood collected or harvested to be used in meeting energy needs or converted into charcoal for the same purpose, consists of a high

[41] Page 4, Strategy on scaling up access to modern energy services. East African Community. http://www.eac.int/energy/index.php?option=com_docman&task=doc_download&gid=14&Itemid=70

[42] Page 19, Strategy on scaling up access to modern energy services. East African Community. http://energy.eac.int/index.php?option=com_docman&task=doc_download&gid=15&Itemid=70

percentage of non-renewable biomass in East African countries as previously demonstrated. The primary use of NRB for most households is cooking, the technology for charcoal users is the traditional metal charcoal stove, while the "three-stone" fire is the most frequently used technology by wood users.[43] Institutions in East Africa also primarily use wood fuel for cooking purposes and in some case for industrial processes. The substitution of traditional technologies with biogas systems is a switch from a non-renewable fuel to a renewable one. By switching from wood fuel consumption, the PoA is reducing anthropogenic GHG emissions.

Use of non-renewable biomass for thermal energy generation since 1989[44] can be demonstrated when there is a depletion of biomass stock in forests or a reduction of forest coverage. This indicates that there has been an unsustainable use of the biomass resources but additional evidence is also required to show that this NRB has been used in the generation of thermal energy in both households and institutions. The fraction of woodfuel that is NRB (fNRB) will be determined on CPA-level however below is a description of the baseline scenario in the host countries:

Ethiopia

Around 79% of primary energy supply comes from woody biomass as shown in Table 1 nearly 90% of the total energy consumption is for residential use with the main purpose being cooking and baking. Fuelwood burning contributes to deforestation with biomass fuels supplying nearly 95% of the country's energy market. The countries forest cover has been linearly reducing over the past 15 years.[45]

Table 1 Energy consumption in Ethiopia by source and sector (TJ)[46]

	Fuelwood	Crop residues	Dung	Charcoal	Electricity	Petroleum	Total	%
Urban households	34,969	2,824	3,263	5,856	1,832	4,161	52,905	7.1
Rural households	507,172	49,186	50,629	2,709		2,171	612,867	82.1
Agriculture						1,497	1,497	0.2
Transport						26,743	26,743	3.6
Industries	17,101	1,409	1,396	112	1,864	4,573	26,455	3.5
Services	22,110	1,031	1,046	109	1,145	331	25,772	3.5
Total	581,352	54,450	56,334	8,786	4,841	40,476	746,239	

[43] Page 18, Eshete, G et al., Report on the feasibility study of a national programme for domestic biogas in Ethiopia, 2006
Page 22, Winrock International, Report on the Feasibility for a National Household Biogas Commercialization Program in Uganda, 2007
Page 18, SNV, Report on the Feasibility Study for a Biogas Support Programme in the Republic of Rwanda, Guy Dekelver, Silas Ruzigana & Jan Lam, 2005
Page 7, Mugo, F. and Gathui, T. (2010) Biomass energy use in Kenya. A background paper prepared for the International Institute for Environment and Development (IIED) for an international ESPA workshop on biomass energy, 19-21 October 2010, Parliament House Hotel, Edinburgh. Practical Action, Nairobi, Kenya.

[44] As required under AMS-I.E v05 paragraph 2

[45] Page 13 +14,Eshete, G et al., Report on the feasibility study of a national programme for domestic biogas in Ethiopia, 2006

[46] Page 13,Eshete, G et al., Report on the feasibility study of a national programme for domestic biogas in Ethiopia, 2006

%	77.9	7.3	7.5	1.2	0.6	5.4		

In Ethiopia, according to Global Forest Resource Assessment 2010, biomass stock from forests (above-ground biomass) decreased from 484 million tonnes in 1990 to only 367 million tonnes in 2010 (Ethiopia Country Report. Page 25). The same report on page 31 indicates there are two main uses of wood, as industrial roundwood (used in the production of goods and services) and woodfuel. The report indicates woodfuel removals have increased from 100,376,000m^3 in 2000 to 108,548,000m^3 in 2005. The quantity of woodfuel removals is just over thirty times larger than industrial roundwood removals. These figures along with the decrease in forest biomass clearly indicate that NRB is being used by households and institutions for the generation of thermal energy.

Kenya

Biomass fuels are the most important source of primary energy in Kenya with fuelwood and charcoal accounting for over 68% of the total primary energy consumption. Studies on biomass energy point to a widening gap between supply and demand for wood-fuel.[47]

The Kenya Bureau of Statistics led the Kenya Household Budget Survey that indicates woody biomass is the main fuel source and most households use unimproved cooking appliances as indicated in Tables 2 and 3. Small industries and institutions generally use a similar fuel mix to households.[48]

Table 2 Percentage of main source of cooking fuel used in Kenya[49]

Region	Firewood	Grass	Paraffin	Electricity	LPG	Charcoal	Biomass residue	Biogas	Other
National	68.3	0.1	13.2	0.6	3.5	13.3	0.3	0.0	0.6
Rural	87.7	0.1	2.7	0.2	0.7	7.7	0.4	0.0	0.4
Urban	10.0	0.2	44.6	1.8	11.9	30.2	0.1	0.1	1.1

Table 3 Percentage of primary cooking appliance used in Kenya[50]

Region	Stone Fire	Ordinary Jiko	Improved Jiko	Kerosene Stove	Gas Cooker	Electric Cooker	Other
National	69.2	7.1	6.5	12.8	3.4	0.4	0.6
Rural	88.9	4.9	3.9	2.3	0.6	0.3	0.3
Urban	10.1	16.6	14.3	44.7	11.7	1.2	1.3

In Kenya, according to Global Forest Resource Assessment 2010, biomass stock from forests (above-ground biomass) decreased from 901.3 million tonnes in 1990 to only 817.1 million tonnes in 2010 (Kenya Country Report. Page 27). The same report on page 36 indicates there are two main uses of wood, as industrial roundwood (used in the production of goods and services) and woodfuel. The report indicates woodfuel removals have increased from 19,380,900m^3 in 1990 to 27,359,000m^3

[47] Kenya National Energy Policy, Third Draft, 2012, pages 48 and 49, available from: http://www.energy.go.ke/wp-content/uploads/2010/08/National%20Energy%20Policy%20-%20Third%20Draft%20%20May%2011%202012.pdf

[48] Page 14, Study on Kenya's Energy Demand, Supply and Policy Strategy for Households, Small Scale Industries and Service Establishments, Ministry of Energy, 2002

[49] Page 217, Kenya Integrated Household Budget Survey (KIHBS), Kenya National Bureau of Statistics, 2005/6

[50] Page 230, Kenya Integrated Household Budget Survey (KIHBS), Kenya National Bureau of Statistics, 2005/6

in 2005. The quantity of woodfuel removals is more than ten times larger than industrial roundwood removals.

These figures along with the decrease in forest biomass clearly indicate that NRB is being used by households and institutions for the generation of thermal energy.

Rwanda
Approximately 86% of primary energy comes from biomass, in the form of wood that is used directly as a fuel (57%) or is converted into charcoal (23%), together with smaller amounts of crop residues and peat (6%). Of the 14% of non-biomass primary energy, petroleum products account for 11% (used mainly in the transport sector) and electricity for approximately 3%. The use of biomass energy has potentially serious environmental implications and will not be sustainable unless managed properly. Biomass energy will remain dominant for cooking and other household uses and in this regard it is imperative that forests and woodlots be more productively managed and charcoal more efficiently produced.[51]

In Rwanda, according to Global Forest Resource Assessment 2010, forest area decreased from 698,660ha in 1990 to only 545,000ha in 2005 (Rwanda Country Report. Page 9). The same report on page 51 indicates there are two main uses of wood, as industrial roundwood (used in the production of goods and services) and woodfuel. The report, on page 51, indicates woodfuel removals have increased from 4,823,000m^3 in 1990 to 7,801,000m^3 in 2005. The quantity of woodfuel removals is just over ten times larger than industrial roundwood removals.

These figures along with the decrease in forest area clearly indicate that NRB is being used by households and institutions for the generation of thermal energy.

Uganda
In Uganda the majority of the households (72.7%) use the three-stone method for cooking. The open charcoal stove is used by 14.8% of the households. Only 8.7% of households use improved stoves.[52]

Biomass contributes over 90% of the total energy consumed in the country and provides almost all the energy used to meet basic energy needs for cooking and water heating in rural areas, most urban households, institutions, and commercial buildings. Biomass is the main source of energy for rural industries. Fuel wood requirements have contributed to the degradation of forests as wood reserves are depleted at a rapid rate in many regions. Charcoal consumption increases at a rate close to the urban growth rate of 6% per annum. Most of the traditional biomass energy technologies; which include wood and charcoal stoves, ovens and kilns used in Uganda are inefficient. The per capita annual consumption is 680kg and 240kg for firewood and 4kg and 120 kg for charcoal for rural and urban areas respectively. Total biomass demand for households in 2006 was 22.2 million tonnes and cottage industries account for about 20% of total biomass use, adding a further 5.5 million tonnes.[53]

According to Global Forest Resource Assessment 2010, biomass stock from forests (above-ground biomass) decreased from 287 million tonnes in 1990 to only 182.2 million tonnes in 2010 (Uganda Country Report, Page 28). On page 33, of the same report it is indicated that there are two main uses

[51] Pages 2 and 3, Rwanda National Energy Policy and National Energy Strategy 2008-2012

[52] Page 2, EAC strategy to scale-up access to modern energy services. Uganda country report, EAC 2008

[53] Pages 34 and 37, Uganda Renewable Energy Policy, 2007

of wood, as industrial round wood (used in the production of goods and services) and woodfuel. The report indicates woodfuel removals have increased from 33,865,000m^3 in 1990 to 42,310,000m^3 in 2005. The quantity of woodfuel removals is over ten times larger than industrial roundwood removals. These figures along with the decrease in forest biomass clearly indicate that NRB is being used by households and institutions for the generation of thermal energy.

Households and institutions in East Africa are a large potential market for small-scale biogas systems. Organisations to date have generally focused on zero grazing or semi zero grazing cattle or other livestock owners for biogas system dissemination. Households with at least two cows or seven pigs (or a flock of 170 poultry)[54] can generate sufficient gas to meet their daily basic cooking needs as long as they have access to a reliable supply of water. The estimated potential of this market is seen in Table 4.

Country	Potential livestock owning market for domestic biogas (number of households)
Ethiopia	1,131,324[55]
Kenya	172,312[56]
Rwanda	110,000[57]
Uganda	216,000[58]

Table 4. Potential domestic market for biogas systems

According to the approved methodology, it is assumed that in the absence of the project activity, the baseline scenario would be the use of fossil fuels for meeting similar thermal energy needs. Therefore the emission reductions are calculated based on the annual savings of non-renewable biomass multiplied by an emission factor to establish equivalence to such fossil fuel use.

E.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the SSC-CPA being included as registered PoA (assessment and demonstration of additionality of SSC-CPA):

E.5.1. Assessment and demonstration of additionality for a typical SSC-CPA:

Additionality is demonstrated at the PoA level and re-examined on CPA-level. The typical CPA has to fulfil the key criteria of additionality as stipulated in chapter E.5.2. of this PoA-DD. The first and second additionality approaches follow the "Guidelines on the Demonstration of Additionality of Small-Scale Project Activities" Version 09, EB68 Annex 27. The third additionality approach follows the "Guidelines for demonstrating additionality of microscale project activities (Version 04)"[59] The first approach will be

[54] Page 9, SNV & HIVOS, Africa Biogas Partnership Programme Proposal, 2008

[55] Page 56, Eshete, G et al., Report on the feasibility study of a national programme for domestic biogas in Ethiopia, 2006

[56] Page 24, ETC Group, Promoting Biogas Systems in Kenya, A feasibility study, Final Draft, 20 August 2007

[57] Page 10, SNV, Investigation on the National Domestic Biogas Programme in Rwanda, 2007

[58] Page 54, Winrock International, Report on the Feasibility for a National Household Biogas Commercialization Program in Uganda, 2007

[59] EB 68 Report, Annex 26

used by CPAs supplying biogas systems to households, communities or SMEs. Either the second or third approach will be used for CPAs supplying biogas system to large enterprises or institutions.

First Approach
As per paragraph 2 (c) of the Guidelines on the Demonstration of Additionality of Small-Scale Project Activities, version 09. *Project activities solely composed of isolated units where the users of the technology/measure are households or communities or Small and Medium Enterprises (SMEs) and where the size[1] of each unit is no larger than 5% of the small-scale CDM thresholds* are part of the positive list of technologies that are defined as automatically additional. Biogas systems for thermal energy generation are isolated systems and most will be well below the 5% small-scale threshold (2.25MW thermal).

Second Approach
There are realistic and credible barriers that would prevent the implementation of the proposed project activity from being carried out if the project activity is not registered as a CDM activity. Barriers are described in detail in section A.4.3. of the SSC-PoA-DD and the investment barrier is used in this approach:

Investment barrier
A financially more viable alternative to the project activity would have led to higher emissions.[60]

As has been demonstrated in the host countries woody biomass is the typical fuel used to provide thermal energy and this fuel in the host countries is typically non-renewable. Biogas systems cost significantly more to install than the baseline technology which is typically a three stone fire or unimproved charcoal stove. The baseline technology would therefore lead to higher emissions as biogas systems produce no GHG emissions.

The criteria to assess if the investment barrier exists for a proposed CPA are described in E.5.2.

Third Approach
As per the 'Guidelines for demonstrating additionality of microscale project activities (Version 04): [61]
CPAs that aim to achieve energy savings of no more than 15MW of thermal energy equivalent per year are additional if the geographic location of the CPA is in one of the LDCs of, Ethiopia, Rwanda or Uganda, or in a special underdeveloped zone (SUZ) of Kenya.[62]

E.5.2. Key criteria and data for assessing additionality of a SSC-CPA:

Referring to the assessment and demonstration of additionality in section E.5.1, any one of the following criteria will be applied in order to assess the additionality of a CPA that is proposed to be included in the registered PoA:

First Approach

[60] Guidelines on the Demonstration of Additionality of Small-Scale Project Activities, Version 09, EB68 Annex 27

[61] EB 68 Report, Annex 26

[62] http://www.unohrlls.org/en/ldc/25/ demonstrates Ethiopia, Rwanda and Uganda are LDCs, SUZs in Kenya will be determined on CPA level if necessary as per the "Guidelines for demonstrating additionality of microscale project activities (Version 04)"

CPAs disseminate biogas systems of a rated capacity of less than 2.25MW to households or communities or Small and Medium Enterprises (SMEs).

Second Approach
CPAs demonstrate that their biogas system(s) cost significantly more than the baseline alternative technology (e.g. three stone fire or charcoal stove) to install which would have resulted in higher emissions.

Third Approach
CPAs that aim to achieve energy savings at a scale of no more than 15MW of thermal energy equivalent per year and the geographic location of the CPA is in one of the LDCs of Ethiopia, Rwanda or Uganda[63], or in a SUZ(s) of Kenya.

E.6. Estimation of Emission reductions of a CPA:

E.6.1. Explanation of methodological choices, provided in the approved baseline and monitoring methodology applied, selected for a typical SSC-CPA:

A typical CPA includes the switching of fuel from NRB to biogas. Each CPA implementer will be involved with the dissemination of biogas systems. It is assumed that in the absence of the project activity, the baseline scenario would be the use of fossil fuels for meeting similar thermal energy needs. Each CPA will apply the small-scale baseline and monitoring methodology AMS I.E, Version 05, entitled "Switch from non-renewable biomass for thermal applications by the user".[64]

E.6.2. Equations, including fixed parametric values, to be used for calculation of emission reductions of a SSC-CPA:

According to the applied methodology, emission reductions will be calculated as follows:

$$ER_y = B_y \cdot f_{NRB,y} \cdot NCV_{biomass} \cdot EF_{projected\text{-}fossilfuel} \quad \textbf{(1)}$$

Where:

ER_y	Emission reductions during the year y in tCO_2e
B_y	Quantity of woody biomass that is substituted or displaced in tonnes
$f_{NRB,y}$	Fraction of woody biomass used in the absence of the project activity in year y that can be established as non-renewable biomass using survey methods or government data or approved default country specific fraction of non-renewable woody biomass (fNRB) values available on the CDM website
$NCV_{biomass}$	Net calorific value of the non-renewable woody biomass that is substituted. The IPCC default for wood fuel, 0.015 TJ/tonne is applied
$EF_{projected\text{-}fossilfuel}$	Emission factor for the substitution of non-renewable woody biomass by similar consumers. As per methodology, a value of 81.6 tCO_2/TJ is employed.

[63] http://www.unohrlls.org/en/ldc/25/ demonstrates Ethiopia, Rwanda and Uganda are LDCs, SUZs in Kenya will be determined on CPA level if necessary as per the "Guidelines for demonstrating additionality of microscale project activities (Version 04)"

[64] http://cdm.unfccc.int/methodologies/DB/WHTQUFLWCVNB9CIUZC198A712WGQR4, EB68 Annex 22

B_y will be determined by using one of the following options[65].

(a) Calculated as the product of the number of appliances multiplied by the estimate of average annual consumption of woody biomass per appliance (tonnes/year); This can be derived from historical data or estimated using survey methods; or

(b) Calculated from the thermal energy generated in the project activity as:

$$B_y = HG_{p,y} / (NCV_{biomass} * \eta_{old}) \quad \textbf{(2)}$$

Where:

$HG_{p,y}$	Quantity of thermal energy generated by the new renewable energy technology in the project in year *y* (TJ) For a biogas digester, it shall be monitored as per the requirements stipulated in the Table 1 of AMS-I.I "Biogas/biomass thermal applications for households/small users". Alternatively project proponents may use a default biogas generation value of 0.13 $Nm^3.m^{-3}.day^{-1}$ (i.e. volume of biogas generated in normal conditions of temperature and pressure per unit useful volume of the digester per day) for regions/countries where annual average ambient temperature is higher than 20°C
η_{old}	1. Efficiency of the system being replaced, measured using representative sampling methods or based on referenced literature values (fraction), use weighted average values if more than one type of system is being replaced; 2. A default value of 0.10 may be optionally used if the replaced system is a three stone fire, or a conventional system with no improved combustion air supply or flue gas ventilation system, i.e. without a grate or a chimney; for other types of systems a default value of 0.2 may be optionally used

If option (a) will be used to determine B_y the following calculation applies:

$B_y = X \times C_y \times L$

Where:

X	Number of biogas systems (appliances) operational
C_y	Estimate of average annual woody biomass replacement per biogas system (tonnes/year)
L	The fraction by which emission reductions are multiplied to obtain an assessment adjusted for leakage risks. As per methodology, a value of 0.95 is employed.

X is the number of biogas systems (appliances) operational and complies with "the number of appliances" as in AMS I.E. Version 05 paragraph 6 (a) and C_y, and L comply with "the estimate of average annual

[65] Option (c) of paragraph 6, AMS-I.E. v05 has been excluded from consideration as it is for 'renewable energy based water treatment technologies' and is therefore not applicable to biogas systems.

consumption of woody biomass per appliance (tonnes/year)" that will be replaced by the biogas system as in AMS I.E. Version 05 paragraph 6 (a).

The number of biogas systems operational (X) is determined as the fraction of days in a year for each installed system ($t_{fraction,y}$) multiplied by the fraction of these systems to be still in use.

$$X = U \times \sum_{1}^{x} t_{fraction,\,y}$$

Where:

U	Usage, the fraction to adjust for drop off of biogas systems
$t_{fraction,y}$	Fraction of days in a year for each installed biogas system
x	Number of biogas systems in the records

If option (b) is chosen and the default value of biogas production will be used then the following calculation will be used to determine $HG_{p,y}$ applies:

$$HG_{p.y} = DV \times 365 \times S_y \times NCV_{biogas} \times \eta_{new}$$

Where:

DV	Default Value of biogas produced ($0.13 Nm^3 m^{-3} day^{-1}$)
365	Number of days in year y (days/year)
S_y	Total volume of biogas systems in year y (m^3)
NCV_{biogas}	Energy content of biogas (TJ/m^3)
η_{new}	Efficiency of biogas stove

The total volume of biogas systems (S) is determined as the fraction of days in a year for each installed system ($t_{fraction,y}$) multiplied by the fraction of these systems to be still in use.

$$S = U \times \sum_{1}^{x} (t_{fraction} \times s)_{,\,y}$$

Where:

U	Usage, the fraction to adjust for drop off of biogas systems
$t_{fraction,y}$	Fraction of days in a year for each installed biogas system
x	Number of biogas systems in the records
s	Installed capacity of each biogas system

If option (b) is chosen but the default value of biogas production will not be used the appropriate calculations will be made on CPA level based on the chosen method of determining and monitoring $HG_{p,y}$.

For option (b) the final value of B_y will be multiplied by 0.95, the fraction to obtain an assessment adjusted for leakage risks, as per the methodology.

When a CPA is included in this PoA the variables have to be determined or measured for the region included in the PoA and/or each model of biogas system used as applicable.

Leakage Emissions

The following leakages must be estimated and accounted for, if required, on a sample basis using a 90/30 precision for the selection of samples, and accounted for:

(a) Use of non-renewable woody biomass saved under the project activity to justify the baseline of other CDM project activities. If this leakage assessment quantifies a portion of non-renewable woody biomass saved under the project activity that is then used as the baseline of other CDM project activities then B_y is adjusted to account for the quantified leakage;
(b) Increase in the use of non-renewable woody biomass outside the project boundary to create non-renewable woody biomass baselines can also be a potential source of leakage. If this leakage assessment quantifies an increase in the use of non-renewable woody biomass outside the project boundary, then B_y is adjusted to account for the quantified leakage;
(c) As an alternative to subparagraphs (a) and (b), B_y can be multiplied by a net to gross adjustment factor of 0.95 to account for leakages, in which case surveys are not required.

It has been decided to use 0.95 as a standard figure to account for leakages as per (c) to simplify the management of the PoA and eliminate the cost of monitoring leakages.

E.6.3. Data and parameters that are to be reported in CDM-SSC-CPA-DD form:

Data / Parameter:	**$NCV_{biomass}$**
Data unit:	TJ/tonne
Description:	Net calorific value of the non-renewable woody biomass that is substituted
Source of data used:	IPCC as quoted in AMS I.E. v05
Value applied:	0.015
Justification of the choice of data or description of measurement methods and procedures actually applied:	Default value that is provided in AMS I.E.
Any comment:	

Data / Parameter:	**$EF_{projected\_fossilfuel}$**
Data unit:	tCO_2/TJ
Description:	Emission factor for the substitution of non-renewable woody biomass by similar Consumers
Source of data used:	AMS I.E. v05
Value applied:	81.6
Justification of the choice of data or description of measurement methods and procedures actually applied:	Stipulated in AMS I.E: This value represents the emission factor of the substitution fuels likely to be used by similar users, on a weighted average basis.
Any comment:	

Data / Parameter:	**$f_{NRB,y}$**
Data unit:	Fraction
Description:	Fraction of woody biomass used in the absence of the project activity in year *y*

	that can be established as non renewable biomass using survey methods or government data or approved default country specific fraction of non-renewable woody biomass (fNRB) values available on the CDM website
Source of data used:	FAO, national forestry agencies and environmental authorities or approved default country specific fraction of non-renewable woody biomass (fNRB) values available on the CDM website
Value applied:	Variable for each region or country
Justification of the choice of data or description of measurement methods and procedures actually applied:	The $f_{NRB,y}$ will be determined for each CPA based on the most recent national approved studies or African studies. Where available, a regional approach will be used to determine $f_{NRB,y}$.
Any comment:	

Data / Parameter:	**L**
Data unit:	Fraction
Description:	Net to gross adjustment factor to account for leakages
Source of data used:	AMS I.E. v05
Value applied:	0.95
Justification of the choice of data or description of measurement methods and procedures actually applied:	B_y is multiplied by a net to gross adjustment factor of 0.95 to account for leakages, in which case surveys are not required
Any comment:	

If option (a) will be used to determine B_y

Data / Parameter:	C_y
Data unit:	Tonnes/year/biogas system
Description:	Estimate of average annual woody biomass replacement per biogas system
Source of data used:	Surveys or studies
Value applied:	Variable depending on each CPA
Justification of the choice of data or description of measurement methods and procedures actually applied:	The data used will depend on the available studies or surveys on national or regional level.
Any comment:	The survey follows the representative sampling methods as described in paragraph 17 of AMS I.E. v05. This parameter may or may not be reported according to the option selected at CPA level for the estimate of emission reductions.

If option (b) will be used to determine B_y

Data / Parameter:	$\eta_{old,i}$
Data unit:	Fraction
Description:	Efficiency of the system being replaced

Source of data used:	AMS I.E. v05
Value applied:	0.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value according to the methodology will apply as appliances replaced are without improved combustion air supply or flue gas ventilation systems
Any comment:	This parameter may or may not be reported according to the option selected at CPA level for the estimate of emission reductions.

Data / Parameter:	**NCV_{biogas}**
Data unit:	TJ/m^3
Description:	Energy content of biogas
Source of data used:	AMS-I.I v03[66]
Value applied:	0.0000215
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value
Any comment:	This parameter may or may not be reported according to the option selected at CPA level for the estimate of emission reductions.

Data / Parameter:	**η_{new}**
Data unit:	Fraction
Description:	Efficiency of biogas stove
Source of data used:	Manufacturers specification or Water Boiling Test result
Value applied:	Variable for each CPA
Justification of the choice of data or description of measurement methods and procedures actually applied :	Determined from a manufacturers specification or as part of a Water Boiling Test conducted by an authorised tester.
Any comment:	This parameter may or may not be reported according to the option selected at CPA level for the estimate of emission reductions.

If option (b) and default value is used:

Data / Parameter:	**DV**
Data unit:	$Nm^3/m^3/day$
Description:	Volume of biogas generated in normal conditions of temperature and pressure per unit useful volume of the digester per day
Source of data used:	AMS-I.E v05

[66] EB66 Annex 61

Value applied:	0.13
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value is applicable for regions/countries where annual average ambient temperature is higher than 20°C.[67]
Any comment:	This parameter may or may not be reported according to the option selected at CPA level for the estimate of emission reductions.

E.7. Application of the monitoring methodology and description of the monitoring plan:

E.7.1. Data and parameters to be monitored by each SSC-CPA:

Data / Parameter:	$t_{fraction,}$
Data unit:	Fraction of 365
Description:	Fraction of days in a year each system is installed, for example a biogas system is installed on 1st July (approximately representing the middle of the year) the corresponding $t_{fraction}$ equals 184/365=0.5 (Number of days 1st July to 31st December / Number of days in year)
Source of data to be used:	Derived from records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.5 for the year of installation and 1 for the following years
Description of measurement methods and procedures to be applied:	The CPA implementer keeps a paper and electronic record of the installation date, and the system is considered to be in use from the day of installation. This factor will be calculated daily through the database by using the following formula: (Number of days between installation date and 31st December / Total number of days in year). The $t_{fraction}$ will therefore be calculated for each biogas system
QA/QC procedures to be applied:	Records will be scrutinised by the CPA implementer to avoid double-counting and the CME will also conduct spot-checks to verify the legitimacy of such records. This will be undertaken by telephone on receipt of new records by the CME and annually with site visits.
Any comment:	

Data / Parameter:	*X*
Data unit:	Number
Description:	Number of installed systems in the records per year
Source of data to be used:	Derived from records

[67] To be established on CPA level.

Value of data applied for the purpose of calculating expected emission reductions in section B.5	Variable for each CPA
Description of measurement methods and procedures to be applied:	The CPA implementer keeps a paper and electronic record of the installed systems.
QA/QC procedures to be applied:	Records will be scrutinised by the CPA implementer to avoid double-counting and the CME will also conduct spot-checks to verify the legitimacy of such records. This will be undertaken by telephone on receipt of new records by the CME and annually with site visits.
Any comment:	

Data / Parameter:	**U**
Data unit:	Fraction
Description:	Check of all appliances or a representative sample thereof, at least once every two years (biennial) to ensure that they are still operating or are replaced by an equivalent in service appliance.
Source of data to be used:	Survey of biogas system users using sampling methods or a census of biogas systems covering all systems.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Variable for each CPA
Description of measurement methods and procedures to be applied:	The CPA implementer keeps a paper and electronic record and a survey is done at least every two years in order to assess the biogas systems in operation.
QA/QC procedures to be applied:	Usage monitoring will be performed by the CME and/or by an authorised organisation designated by the CME following the sampling plan. This will be carried out annually or biennially. When the CME conducts spot-checks to verify the legitimacy of records for X and $t_{fraction}$ data on drop off rate will also be noted. This will help to provide an estimate for the annual or biennial surveys. If the CPA opts for a census of biogas systems then the CME will also conduct spot-checks to verify the legitimacy of such records. This will be undertaken by telephone on receipt of new records by the CME and annually with site visits.
Any comment:	For most CPAs it will not be possible to replace a biogas system with an equivalent in service appliance as they are often in the case of fixed dome models constructed from bricks and concrete. CPAs will be encouraged to run maintenance services to ensure biogas systems are operational. There are a number of reasons for a biogas system being found non-operational that are outside the control of the CPA implementer such as users moving away from the project boundary.

If option (b) will be used to determine B_y but no default value

Data / Parameter:	$HG_{p,y}$

Data unit:	TJ
Description:	Quantity of thermal energy generated by the new renewable energy technology in the project in year *y*
Source of data to be used:	Survey of users
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Variable according to CPA and type of biogas appliances to be used.
Description of measurement methods and procedures to be applied:	Gas meters will be used to monitor accumulated biogas supplied to thermal energy equipment; Measurement campaigns shall be undertaken at selected sites. At least five campaigns per digester type (e.g. 6 cubic metre or 8 cubic metre capacity, fixed dome or floating dome, region with high average ambient temperature or low average annual temperature) shall be carried out in each year of the crediting period. Continuous measurement made for at least one month at a single digester is considered as a campaign. Monthly average value is annualised taking into account seasonal variation in gas production which is mainly a function of ambient temperature.
QA/QC procedures to be applied:	As per AMS-I.E. paragraph 6 (b) monitoring requirements shall follow the relevant parameter under Table 1 of AMS-I.I v03 "Biogas/biomass thermal applications for households/small users". Gas meters will be required to be calibrated to appropriate national standards.
Any comment:	

If the default value is used from option (b)

Data / Parameter:	S
Data unit:	m^3
Description:	Volume of each installed biogas system
Source of data to be used:	CME database
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Variable for each CPA
Description of measurement methods and procedures to be applied:	The CPA implementer keeps a paper and electronic record of the installed capacity, The CME database will store all these records.
QA/QC procedures to be applied:	Records will be scrutinised by the CPA implementer to avoid double-counting and the CME will also conduct spot-checks to verify the legitimacy of such records. This will be undertaken by telephone on receipt of new records by the CME Implementer and annually with site visits.
Any comment:	

E.7.2. Description of the monitoring plan for a SSC-CPA:

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 the Monitoring Report. The data collection will follow the "Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities (Version 02)"[68], will comply with the requirements for the verification stated in A.4.4.2 of transparency and double-counting avoidance, and will check the required parameters in the methodology AMS I.E v05 in an unbiased and reliable way.

The monitoring plan consists of:

- Monitoring concept
- Requirements for replacement of NRB
- Data collection
- Data archiving
- Training
- Quality Assurance/Quality Control Procedures
- Monitoring Report
- Monitoring responsibilities

Monitoring concept

The CME will be responsible for the collection of all Sales Agreement and commissioning date[69] data, for internally verifying the information in the Sales Agreements and if applicable the commissioning date, and creation of the Monitoring Report at the end of each Monitoring Period. The CPA implementer will be responsible for data entry into an electronic database and for ensuring that the information in the Sales Agreements is complete and correct and if applicable the commissioning date is provided. The total amount of Sales Agreements will reveal the quantity of biogas systems sold at the end of a Monitoring Period. The electronic 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 CPA, preventing any occurrences of double-counting. Hence, the project database will keep records to determine the current status of each CPA, the duration of previous Monitoring Periods, the household surveys, and verification activities. The monitoring sampling will be tracked through the electronic database that consolidates the sales records from all CPAs.

To account for drop-off in use (U), the biogas systems deployed by the CPA implementer will be monitored in the usage survey or alternatively via a census of all systems, depending on the CPA implementer. A representative sampling will be applied to account for drop-off of biogas systems for every CPA. Sampling size will be chosen to achieve a 90/10 precision when annual sampling is chosen or 95/10 precision if it is biennial across a single CPA[70], if parameters are monitored across CPAs they will be required to achieve 95/10 confidence precision[71]. In cases where survey results indicate that the

[68] EB 65, Annex 2

[69] Only applicable for CPAs where commissioning date is not available on Sales Agreement e.g. when construction period is required.

[70] As per AMS-I.E v05 paragraph 17

[71] As per EB 69 Annex 4, Clause 20

precision level is not achieved the lower bound of the confidence interval may be chosen instead of repeating the survey effort. To avoid this situation, oversampling will be encouraged.

Requirements for replacement of NRB
Monitoring shall confirm the displacement or substitution of NRB.[72] The fNRB as per equation 4 in AMS-I.E v05 will be determined at CPA level and fixed ex ante for the crediting period. The continued replacement of NRB will be monitored through the parameter U (as above) that will confirm displacement of woody biomass and through monitoring at least two of the four indicators of NRB on CPA level as in paragraph 7 of AMS-I.E v05. These indicators can be monitored as part of the biogas drop-off survey or through appropriate studies or reports.

Data collection
The CME will collect the data necessary for the monitoring and for the emission reductions calculation. Data will be managed through an electronic database that can directly attribute the data to the CPA, thereby allowing unambiguous determination of the emission reductions attributable to each CPA.

Data archiving and Procedures for Emergency Breakdown of Monitoring System
Sales Agreements will be stored by the CPA with copies sent to the CME. 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 two years after the end of the crediting period or the last issuance of CERs for the project activity, whichever is later.

The primary source of information for monitoring will be the electronic database stored by the CME. In case of emergency breakdown of the server or CME database the CME will store a back up of the database off site. In addition if the off-site copy of the database is broken down then the CME will retrieve the electronic database from the CPA implementer, if this fails then the CME will be able to recreate the information from the copies of the Sales Agreements stored by the CME or CPA.

Training
The CME will provide the necessary training to the CPA implementers and the parties involved in the monitoring to ensure that the data recorded is complete and accurate. This monitoring training will be provided by the CME to the CPA implementers before the inclusion of their CPAs..

Quality Assurance/Quality Control Procedures
Different quality control and quality assurance measures will be put in place by the CME to ensure that all emission reductions are real. Surveys will be carried out and the CME will check the consistency of the results. The CME will ensure that the studies are accurate and that a conservative approach has been taken.

Sales records will be scrutinised by the CPA implementer to avoid double-counting and the CME will also conduct spot-checks to verify the legitimacy of such records. These checks will be undertaken by telephone on receipt of new records by the CME and annually with site visits. Sales Agreements will be checked at three levels, by the vendor, the CPA implementer and the CME, and missing or wrong data will be corrected wherever possible. In cases where it is not possible, any mandatory missing data will automatically invalidate that biogas system and the $t_{fraction}$ will be counted as zero resulting in no emission reductions being generated by that appliance. Wrong data entered in the Sales Agreement that lead to an

[72] Required by paragraph 14 of AMS-I.E. v05

inability to track biogas systems during monitoring will result in a lower usage rate. However in cases where the biogas systems can be traced, and missing information can be corrected, the new data will be updated in the Sales Agreement and the electronic record.

Monitoring Report

The CME will assess all monitoring data and produce a Monitoring Report corresponding to the preceding Monitoring Period of the required sample of CPAs for the DOE to verify. This report will present the data relating to the emission reductions generated by CPAs during the Monitoring Period. The Monitoring Report will also include, as required by the sampling plan:

1. Unbiased and reliable estimates of the mean value of parameters used in the calculation of greenhouse gas emission reductions.
2. Necessary precision of estimated parameters if required, or the lower bound of the confidence interval and the necessary sampling requirements.
3. Formulas used in calculating and reporting parameters.

Generally, the Monitoring Report will use the current CDM Monitoring Report Form and follow the current "Guidelines for completing the Monitoring Report Form (CDM-MR)"[73].

Monitoring Responsibilities

The CME is in charge of supervising all the monitoring activities, including data collection, data monitoring, and writing the Monitoring Report. The CPA implementers and their CPAs will support the CME in all the monitoring activities by collecting the Sales Agreements and facilitating the tracking of the biogas systems. The final responsibility for the data contained in the Monitoring Report belongs to the CME.

[73] EB 54 Report, Annex 34

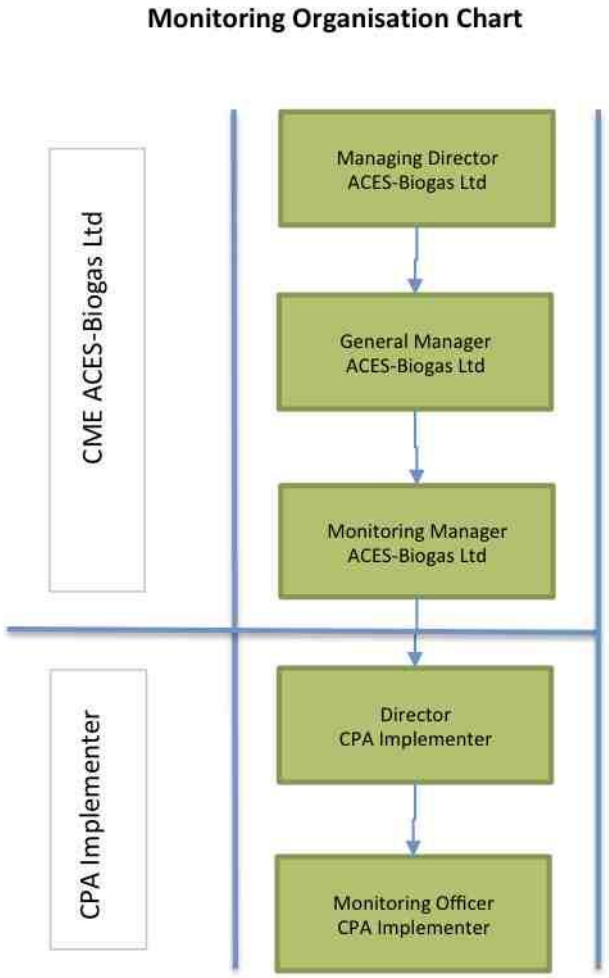

Figure 7. Monitoring organisation chart

E.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)

Date of completion:
28/10/2011

Name of the responsible persons and entity:
Stuart Leckie
Georg Zenk
Uganda Carbon Bureau Limited
E-Mail: mail@ugandacarbon.org

The persons and entity responsible for the baseline study are not Project Participants in the PoA-DD.

Annex 1

CONTACT INFORMATION ON COORDINATING/MANAGING ENTITY and PARTICIPANTS IN THE PROGRAMME of ACTIVITIES

Organisation:	African Clean Energy Switch - Biogas (ACES-Biogas) Limited
Street/P.O.Box:	P.O. Box 70480
Building:	Plot 47
City:	Kampala
State/Region:	
Postfix/ZIP:	
Country:	Uganda
Telephone:	+256 414200988
FAX:	+256 414200988
E-Mail:	billfarmer@ugandacarbon.org
URL:	www.ugandacarbon.org
Represented by:	William Farmer
Title:	Chairman
Salutation:	Mr
Last Name:	Farmer
Middle Name:	
First Name:	William
Department:	-
Mobile:	+256 752644611
Direct FAX:	+256 414200988
Direct tel:	-
Personal E-Mail:	billfarmer@ugandacarbon.org

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Annex 3

BASELINE INFORMATION

Annex 4

MONITORING INFORMATION

SAMPLING PLAN[74]

[74] The sampling plan follows clause 17 of AMS-I.E version 5 and the Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities (Version 03.0), EB 69 Report, Annex 4. Sampling methods and equations were obtained from "Guidelines for sampling and surveys for CDM project activities and programme of activities" Version 02.0 EB69 Annex 5.

SAMPLING DESIGN

Any one of the following two approaches may be used based on an analysis of the estimated monitoring costs and benefits associated with each approach-monitoring costs for the two approaches are expected to vary depending on the geographical coverage of the CPA and the comprehensiveness of the CPA's existing monitoring/tracking system.

Approach 1: Census

A census of all biogas systems in use can be obtained through the monitoring of records in the CPA's database. The database will be continually updated with the following events:
(a) an annual maintenance/repair event
(b) customer inspections resulting from loan or hire purchase agreements
(c) double verified records of community-based biogas system monitoring staff
(d) independent monitoring verification exercises organised by the CME.

Approach 2: Sampling

Since this is a multi-country PoA, the CPAs admitted to the PoA may choose a suitable sampling plan from one of the following three options. Option 1 and 3 are for annual or biennial inspections per CPA the choice between these two options may be because of sales performance that may fluctuate. Option 2 can only be used if the CPA implementer has multiple CPAs and therefore CPAs may chose to use this methodology after a number of years:

OPTION 1: ANNUAL INSPECTION PER CPA

Objectives and reliability requirements

The objectives are:

1. To check a representative sample of appliances, at least once every two years (biennial) to ensure that they are still operating or are replaced by an equivalent in service appliance. (U)

AMS-I.E. Version 05 will be applied. The overall objective is to estimate the annual emission reductions during the year y in tCO_2e during the crediting period, and with 90/10 confidence/precision.

Target population

The target population is the total number of biogas systems installed by the CPA at the end of the year. The primary means to uniquely identify the activities under the CPA is by means of buyer information collected through Sales Agreements, unique numbering of each biogas system and GPS co-ordinates where available. The sales data will be stored in the CPA's records in the PoA's electronic database.

The data to be collected on each sampling unit (biogas system) is whether or not it has been operational and in use over the course of the monitoring period.

Sampling method

Simple random sampling will be used. A number of biogas systems will be sampled using simple random sampling with the aid of a computerised randomiser. The PoA database of biogas system and user

information established through the Sales Agreements and subsequently updated on a continuous basis will be used as the sampling frame.

Sample size

The required sample size will be determined using simple random sampling.

The equation for estimating the sample size is[75]:

$$n \geq \frac{1.645^2 N * p(1-p)}{(N-1) * 0.1^2 * p^2 + 1.645^2 p(1-p)} \quad \textbf{(1)}$$

n Sample size
N Total population (total number of biogas systems installed, represented earlier by *x*)
p The expected proportion
1.645 Represents the 90% confidence required
0.1 Represents the 10% relative precision

Using either existing data or a small pilot survey, the expected proportion can be estimated for purposes of determining the minimum sample size.

The minimum sample sizes for the different scenarios required to meet the confidence and precision requirements are calculated in a sample size computation spreadsheet.[76]

Summary results for different populations are found in Table 7 for an assumed 90% of biogas systems still in use[77]:

Population size	Calculated minimum sample size	Adjusted sample size according to response rate of 80%
2,000	30	38
4,000	30	38
6,000	30	38
8,000	30	38
10,000	30	38
12,000	30	38
14,000	31	39
16,000	31	39
18,000	31	39
20,000	31	39

[75] Page 16, Guidelines for sampling and surveys for CDM project activities and programme of activities" Version 02.0 EB69 Annex 5

[76] Sample size calculation spreadsheet provided to the DOE

[77] The percentage of biogas systems expected in use will be altered for each CPA depending on their performance

22,000	31	39
24,000	31	39

Table 7. Example of potential sample sizes depending on population

Sampling frame

The PoA database of biogas system and user information established through the Sales Agreements and subsequently updated on a continuous basis will be used as the sampling frame.

OPTION 2: ANNUAL INSPECTION OF A RANDOM SAMPLE OF CPAS FROM EACH CPA IMPLEMENTER

Objectives and reliability requirements

The objective is:

1. To determine the proportion of biogas systems that are still in operation/use over the monitoring period.

AMS-I.E. Version 05 will be applied. The overall objective is to estimate the annual emission reductions during the year y in tCO_2e during the crediting period, and with 95/10 confidence/precision.

Target population

The target population is the total number of biogas system installed by the CPAs classified by CPA Implementer at the end of the year. The primary means to uniquely identify the activities under the CPA is by means of buyer information collected through Sales Agreements, the unique numbering of each biogas system and GPS co-ordinates where available. The sales data will be stored in the CPA's records in the PoA's electronic database.

The data to be collected on each sampling unit (biogas system) is the number of burner hours used in each day and whether or not it is operational.

Sampling method

Multistage sampling will be used. A number of biogas system within the selected CPAs belonging to each CPA Implementer will be sampled using stratified sampling depending on the number of sizes/types of biogas systems in the CPAs. The PoA database of biogas system and user information established through the Sales Agreements and subsequently updated on a continuous basis will be used as the sampling frame.

Sample size

The required sample size will be determined using multistage sampling.

The total sample size of biogas systems is represented by the following equation[78]:

$$C \geq \frac{\frac{SD_B^2}{\bar{p}^2} * \frac{M}{M-1} + \frac{1}{u} * \frac{SD_W^2}{\bar{p}^2} * \frac{(\bar{N}-u)}{(\bar{N}-1)}}{\frac{0.1^2}{1.96^2} + \frac{1}{M-1} * \frac{SD_B^2}{\bar{p}^2}} \quad \textbf{(55)}$$

Where:

C	Number of CPAs that should be sampled
M	Total number of CPAs in the population
u	Number of biogas systems to be sampled within each CPA
$\bar{N}$	Average number of biogas systems per CPA
2	
SD_B^2	Variance between CPAs
SD_W^2	Average within CPA variation
$\bar{p}$	Overall proportion of biogas system operational
1.96	Represents the 95% confidence required
0.1	Represents the 10% absolute precision

Using either existing data or a small pilot survey, the expected proportion can be estimated for purposes of determining the minimum sample size.

The minimum sample sizes -for the different scenarios- required to meet the confidence and precision requirements are given in a computation spreadsheet.[79]

Summary results for different possible numbers of biogas systems to be samples in each CPA, assuming a total of 5 CPAs, are found in Table 8 for an assumed 90% of biogas systems in use:[80]

u (Number of biogas systems to be sampled in each CPA)	C (Number of CPAs to Sample)	Total Sample Size
10	5	50
15	4	60
20	3	60
25	3	75
30	2	60
35	2	70

[78] Page 40-41, Guidelines for sampling and surveys for CDM project activities and programme of activities Version 02.0 EB69 Annex 5.

[79] provided to the DOE

[80] The percentage of cook stoves expected in use will be altered for each CPA depending on their performance

40	2	80

Table 8. Example of potential sample sizes depending number of samples in a CPA

Sampling frame

The PoA database of biogas systems and user information and their corresponding CPAs classified by CPA Implementer established through the Sales Agreements and subsequently updated on a continuous basis will be used as the sampling frame. The biogas systems in the PoA database will be classified by CPA Implementer by CPA for sampling purposes.

OPTION 3: BIENNIAL INSPECTION PER CPA

Objectives and reliability requirements

The objective is:

1. To determine the proportion of biogas systems that are still in operation/use over the monitoring period.

AMS-I.E. Version 05 will be applied. The overall objective is to estimate the annual emission reductions during the year y in tCO_2e during the crediting period, and with 95/10 confidence/precision.

Target population

The target population is the total number of biogas systems installed by the CPA at the end of the year. The primary means to uniquely identify the activities under the CPA is by means of buyer information collected through Sales Agreements, unique numbering of each biogas system and GPS co-ordinates where available. The sales data will be stored in the CPA's records in the PoA's electronic database.

The data to be collected on each sampling unit (biogas system) is the number of burner hours used in each day and whether or not it is operational.

Sampling method

Simple random sampling will be used. A number of biogas systems will be sampled using simple random sampling with the aid of a computerised randomiser. The PoA database of biogas system and user information established through the Sales Agreements and subsequently updated on a continuous basis will be used as the sampling frame.

Sample size

The required sample size will be determined using simple random sampling.

The equation for estimating the sample size is[81]:

$$n \geq \frac{1.96^2 * v * N}{(N - 1) * 0.1^2 + 1.96^2 * v} \quad \textbf{(40)}$$

Where:

$$v = \frac{p(1 - p)}{p^2}$$

n Sample size
N Total population (total number of biogas systems installed)
p The expected proportion
1.96 Represents the 95% confidence required
0.1 Represents the 10% relative precision

Using either existing data or a small pilot survey, the overall proportion can be estimated for purposes of determining the minimum sample size.

The minimum sample sizes-for the different scenarios-required to the meet the confidence and precision requirements are calculated in a computation spreadsheet[82].

Summary results for different populations are found in Table 9 for an assumed 90% of biogas systems still in use[83]:

Population size	Calculated minimum sample size	Adjusted sample size according to response rate of 80%
2,000	42	53
4,000	43	54
6,000	43	54
8,000	43	54
10,000	43	54
12,000	43	54
14,000	43	54
16,000	43	54
18,000	43	54
20,000	43	54
22,000	43	54
24,000	43	54

[81] Page 35-36, Guidelines for sampling and surveys for CDM project activities and programme of activitiesVersion 02.0 EB69 Annex 5. Parameters labels have been changed to avoid confusion with parameters earlier in the document

[82] Sample size calculation spreadsheet provided to the DOE

[83] The percentage of cook stoves expected in use will be altered for each CPA depending on their performance

Table 9. Example of potential sample sizes depending on population

Sampling frame

The PoA database of biogas system and user information established through the Sales Agreements and subsequently updated on a continuous basis will be used as the sampling frame.

DATA

Field measurements

The main variable that will be measured by the monitoring survey is the proportion of biogas systems that have been operational and in use over the monitoring period.

Quality assurance/quality control

A team of research assistants and supervisors for the usage survey will be recruited and trained in all aspects of sampling, data collection and interviewing by the CME or a CME-appointed agent. The training will involve both theoretical and practical aspects to ensure that all the research assistants are competent to collect the desired data. Data collection protocols will be prepared and given to the research assistants and supervisors to guide them during the data collection exercise. In addition, there will be a supervisor from the CME head office. The updating of the PoA's central database will be strictly monitored with several permission levels and passwords. In cases where the use of mobile devices is impossible, paper copies of questionnaires will be used to collect data about the usage of biogas system from the selected sample.

The data collection protocols prepared for the research assistants will include the procedures for handling cases of non-response (refusals, not-at-home, out-of-population cases and related cases). A variable will be included to capture the results of interviews with the following four options: responded, out-of-population, refused, not-at-home. The protocols will also include the roles and responsibilities of the research assistants and supervisor. In addition, the definition of each of the study variables, mode of data collection and recording will be highlighted in the data collection protocol.

In case of non-response as a result of respondents not being at home, there will be at least three callbacks. Oversampling will also be undertaken to take care of non-response.

In addition, CPA Implementers will be trained in all aspects of data collection and recording, especially using mobile devices and other relevant technologies, for the continuous updating and monitoring of data in the PoA's central database.

The main parameter in the usage survey is the operational status of the biogas system over the monitoring period. Outliers are expected to be rare. For the parameter of the proportion of biogas system operational/in use, no outlier data/measurements are expected. Check programmes will be prepared to automatically reject data that is defective and will automatically notify the research assistant that the data is defective for immediate verification, rectification or callback.

Analysis

The data obtained from the selected households/institutions owning the biogas system will be further cleaned and validated for accuracy and analysed by the CME's Monitoring Manager. All the sales data and the survey data will be captured in a computerised database. The analysis will include computation of the proportion of biogas system in use, frequencies of the other study variables and the computation of variables necessary for the estimation of emission reductions according to AMS-I.E Version 05. The results will be summarised using the pre-specified level of confidence. The precision of the estimates will be checked to ensure that the estimate is within the pre-specified reliability precision. The reliability of the estimates will be checked by computing and evaluating the standard error of the proportion to establish whether it is within the permissible limits.

IMPLEMENTATION

Implementation Plan

The Monitoring Manager will be responsible for data collection and data analysis. The Monitoring Manager has experience in sampling and surveys.

The schedule for implementing the sampling will be set out by the Monitoring Manager.