



**Monitoring report form for CDM programme of activities**  
(version 01.0)

Complete this form in accordance with the Attachment "Instructions for filling out the monitoring report form for CDM programme of activities" at the end of this form.

**MONITORING REPORT**

<b>Title of the programme of activities (PoA)</b>	SimGas Biogas Programme of Activities	
<b>UNFCCC reference number of the PoA</b>	PoA 7734	
<b>Version number(s) of the PoA-DD(s) applicable to this monitoring report</b>	7.0	
<b>Coordinating/managing entity (CME)</b>	SimGas IP BV	
<b>Version number of this monitoring report</b>	3. <del>43</del>	
<b>Completion date of this monitoring report</b>	<del>30/28/03/14</del> /201 <del>87</del>	
<b>Monitoring period number and dates covered by this monitoring report</b>	First Monitoring Period Duration: 20/01/2013 to 31/12/2015 (both days inclusive)	
<b>Monitoring report number for this monitoring period</b>	1	
<b>Host Party(ies)</b>	Host Party(ies) of the PoA	Is this a host Party to a specific-case CPA covered in this monitoring report?(yes/no)
	Kenya	Yes
<b>Sectoral scope(s)</b>	1 : Energy industries (renewable - / non-renewable sources) 15 : Agriculture	
<b>Selected methodology(ies)</b>	<a href="#">AMS-III.R. ver. 2</a> - Methane recovery in agricultural activities at household/small farm level <a href="#">AMS-I.E. ver. 4</a> - Switch from Non-Renewable Biomass for Thermal Applications by the User <a href="#">AMS-I.I. ver. 4</a> - Biogas/biomass thermal applications for households/small users	
<b>Selected standardized baseline(s)</b>	Not applicable	
<b>Total amount of GHG emission reductions or net GHG removals by sinks for all specific-case CPAs in the PoA covered in this monitoring report</b>	GHG emission reductions or net GHG removals by sinks reported up to 31 December 2012	GHG emission reductions or net GHG removals by sinks reported from 1 January 2013 onwards
	0 tCO <sub>2</sub> e	<del>2,5193,513</del> tCO <sub>2</sub> e

## PART I - Programme of activities

### SECTION A. Description of PoA

#### A.1. Brief description of the PoA

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This programme aims to install biogas digesters with stoves in households/SMEs/communities typically using non-renewable biomass and fossil fuels as their main source of cooking fuel. The biogas systems are fed with a feedstock of manure and/or organic waste, which is anaerobically digested to produce biogas. The biogas produced will be used to replace the combustion of non-renewable biomass and fossil fuels, thereby reducing CO<sub>2</sub> emissions. The biogas systems that use manure as a feedstock can also reduce CH<sub>4</sub> emissions by diverting manure that would otherwise decompose without the capture and use of the methane.

The Coordinating/Managing Entity of the SSC-PoA is SimGas IP BV. Upon sale of the biogas system, users sign a sales contract, transferring the rights to the CERs generated to SimGas IP BV. The revenue generated from the sale of CERs is used to subsidise the investment costs of the biogas digesters, making them more affordable.

The PoA is registered under both the Clean Development Mechanism (CDM) and The Gold Standard (GS). The PoA was registered with the CDM on 21 December 2012, and with the GS on 10/11/2015 with the GS IDs GS2667/GS2738. ~~Since the GS registration was pursued at a later date than CDM registration, the GS required that the latest versions of all methodologies be applied to calculate the GS emission reductions.<sup>1</sup> A separate monitoring report has therefore been prepared to present the emission reduction calculations under the Gold Standard.~~

#### A.1.1. Generic CPA(s)

Title, identification/reference number and/or version number of the generic CPA(s) of the PoA	Sectoral scope(s)	Applied methodology(ies) or combination of methodologies and/or standardized baseline(s) for CDM calculations
<b>SimGas Biogas Programme of Activities, [country] (CPA [number])</b>	1 : Energy industries (renewable - / non-renewable sources) 15 : Agriculture	<a href="#">AMS-III.R. ver. 2</a> - Methane recovery in agricultural activities at household/small farm level <a href="#">AMS-I.E. ver. 4</a> - Switch from Non-Renewable Biomass for Thermal Applications by the User <a href="#">AMS-I.I. ver. 4</a> - Biogas/biomass thermal applications for households/small users

#### A.1.2. Specific-case CPA(s) covered in this monitoring report

Reference number of the specific-case	Title, identification/reference number	Crediting period dates of the specific-	Is this specific-case CPA covered in this
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<sup>1</sup> ~~See file 'Subject: Amendment to PoA-DD and CPA1-DD for SimGas Biogas PoA 7734 (GS 2738) based on revised methodologies'.~~

CPA included in the PoA as of the end of this monitoring period	and version number of the generic CPA to which the specific-case CPA applies	case CPA	monitoring report? (yes/no)
CPA 7734-0001	SimGas Biogas Programme of Activities, [country] (CPA [number])	20/01/2013 – 19/01/2020	Yes

## A.2. Contact information of the coordinating/managing entity (CME) and/or responsible persons(s)/entity(ies)

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### Contact details of CME:

Sanne Castro  
CEO  
SimGas IP BV  
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The Hague, 2516 BE  
The Netherlands  
Email: [sannecastro@simgas.org](mailto:sannecastro@simgas.org)  
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### Contact details of entity responsible for CDM-PoA-MR-FORM:

Hilda Galt  
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## SECTION B. Implementation of PoA

### B.1. Implementation of the management system of the PoA

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The management system was implemented as per Section C of the registered PoA-DD. Accordance with this management system is outlined below.

The operation of the SimGas Biogas Programme of Activities, including installation and commissioning of the biogas digesters was carried out as per the procedure outlined below:

1. **Complete Sales Contract:** the Supplier signs a Sales Contract with the user. The sales contract contains at least the following data, in addition to specific sales and financing arrangements:
  - A unique sales contract number;
  - Date of installation (provisional);
  - Name of the user;
  - Address of the user (if available);
  - Mobile phone number of the user;
  - Type (manure/organic waste)<sup>2</sup> and size (m<sup>3</sup> and kW<sub>th</sub>) of the biogas system purchased;

<sup>2</sup> All GesiShamba digester models are manure-fed, they cannot be used for food waste.

- Typology of the user: household, community, SME;
  - Acknowledgement that the user is aware that the installation is operating as part of a PoA, and confirmation that they are not taking part in another registered PoA.
  - A confirmation that the user assigns the right and title to the CERs to SimGas IP BV;
  - Name and signature of the user;
  - Name and signature of the Supplier;
2. **Installation:** next, the Supplier installs the biogas digester at the user's, or has a specialised installation company do so. The installation is finalised by filling and inoculating the biogas digester.
3. **Commissioning:** three to 14 days after the installation, the Supplier commissions the biogas digester by:
- handing over the biogas appliances (biogas stove);
  - checking sufficient flow of gas;
  - instructing the user to contact the Supplier should any maintenance be needed. Contact details of the Supplier are provided.
  - instructing the user to contact the Supplier should the biogas digester be moved to a different address. Contact details of the Supplier are provided.
  - filling out the **Commissioning Protocol**, which contains at least the following data:
    - A reference to the sales contract number;
    - A unique GPS location of the biogas system;
    - A baseline survey on previous fuel use and, in case of manure-fed systems, previous manure management practices;
    - Date of completion, which will be equal to the start date of CER generation;
    - Name and signature of user;
    - Name and signature of commissioner.
- For manure-fed biogas digesters the Supplier additionally provides user training on:
- the proper application of slurry to agricultural land
  - the optimal quantity of manure and water fed into the biodigester
4. **Data entry:** The Supplier provides hard copies of the Sales Contract and the Commissioning Protocol to SimGas Kenya. The data is transferred to SimGas IP BV (the CME), who is responsible for cross-checking and entering data into the centralised record-keeping database. It is the CME's responsibility to ensure that data is entered correctly and to follow-up with the Supplier if there are errors or missing data. The database does not allow double-entries of data such as the GPS coordinates.
5. **Operation of biogas system:** the user is provided with the contact details of the Supplier should the system need maintenance at any time during the project. It is the user's responsibility to use the biogas system as instructed during commissioning.

#### **Record keeping system for each CPA under the PoA**

The CME maintains a digital database with all biogas systems in the PoA, with a clear division between the different CPAs. For each biogas digester installed the CME also keeps a paper copy of the Sales Contract and the Commissioning Protocol that is provided by the suppliers.

#### **A system/procedure to avoid double accounting e.g. to avoid the case of including a new CPA that has been already registered either as a CDM project activity or as a CPA of another PoA**

Double counting is avoided by keeping a record of the unique GPS location of each biogas digester in the centralised digital database operated and maintained by the CME, clearly divided per CPA. A programme logo is also physically attached to each biogas digester. These data can be used by the CME and DOE to identify and locate each individual biogas digester installed.

The CME may annually check the systems to ensure that:

- The recorded address at which the biogas digesters are installed is still correct;
- The biogas digesters are still operational (as part of the monitoring procedure);
- GPS coordinates are unique and correspond with the digester location.

If systems are no longer in operation the system is listed as no longer operational in the project database, and the reason recorded in the database. If the address is found to no longer comply with the database *and* the user is found to be different to that listed in the sales contract, the new user is asked to sign and complete the sales contract (detailed below) and, if willing to do so, undergo commissioning. All new details are recorded in the database. Where the new user does not wish to sign a sales contract, the system is listed as no longer operational in the database.

There are two situations in which the address of the biodigester may change:

- A biodigester is replaced. During commissioning, the user has been directed to contact the Supplier should a biodigester need replacing. The owner therefore has contact with the Supplier, who will record these cases in the database, or inform the CME that this needs to be done.
- A biodigester is moved to a different location. During commissioning, the user has been directed to contact the Supplier should a biodigester be moved. If the user is found to differ from that registered in the database the new address will be recorded in the database and a new Sales Contract and Commissioning Protocol completed.

A record of old data is kept alongside a description of the circumstances under which changes were made.

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

Each SSC-CPA under the proposed PoA is exempt from a de-bundling check since each of the independent subsystems (biogas digesters) do not exceed 1% of the small-scale of methodologies AMS-I.E (450 kW<sub>th</sub>) and AMS-III.R (600tCO<sub>2</sub>e) methodologies applied. Compliance is demonstrated at CPA level, as follows:

*Demonstration of each individual sub-system not exceeding 450 kW<sub>th</sub>*

The largest digester included in the CPA is 24 m<sup>3</sup>. A digester of this size produces only ~~7.009.06~~ kW<sub>th</sub>, which is far below 1% of the small-scale methodologies limit of 450 kW<sub>th</sub>. Please see the emission reduction calculation spreadsheet, tab 'Capacity limit for the calculation.

*Demonstration of each individual sub-system not exceeding 600 tCO<sub>2</sub>e*

Each individual subsystem (biogas digester) achieves a maximum emission reduction of ~~2.001.48~~ tCO<sub>2</sub>e/year (where AMS-I.I and AMS-III.R apply), or 8.5894 tCO<sub>2</sub>e/year (where AMS-I.E and AMS-III.R apply). This is far below the 1% of the limit of the small-scale methodologies applied (ie. 600 tCO<sub>2</sub>e)

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

SimGas IP BV is the CME for the PoA and responsible for operating each of the SSC-CPAs. The contracts of all contracted entities state the involvement of their activities as part of a PoA. All users also acknowledge they are aware of this as part of the Sales Contract outlined above.

## **B.2. Implementation of single sampling plan(s)**

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The sampling plan is implemented for a single CPA, as referenced in A.1.2 above.

### **a) List of CPAs to which the single sampling was applied**

The sampling plan was applied to the single CPA 7734-0001.

## b) Description of implemented single sampling design

### *Sampling Design*

#### *(i) Objectives and Reliability Requirements*

The objective of the sampling effort was to meet the monitoring requirements set forth in the methodologies AMS-III.R (version 2), AMS-I.I (version 4), and AMS-I.E (version 4), as well as the requirements of the Gold Standard for the parameters that are monitored under this standard. In accordance with the requirements set forth in the respective methodologies, the sample size was selected following a 90% confidence interval and a 10% margin of error (90/10) where applicable. All monitoring was coordinated by the CME, SimGas IP BV.

#### *(ii) Target Population*

The target population for the application of monitoring procedure was the households in which biogas systems have been installed, as identified through the centralised record-keeping database managed by the CME.

#### *(iii) Sampling method*

Multi-stage sampling was applied in the CPA in line with the Guidelines for Sampling and Surveys for CDM Project Activities and Programme of Activities (EB 69, Annex 5). Multistage sampling involves sampling from a number of groups (known as primary sampling units), and then going on to sample units within each group (known as secondary sampling units). In contrast to cluster sampling where all of the secondary units are measured, in multi-stage sampling data are collected for only a sample of the secondary units. This is useful for this CPA as measuring all the elements in the selected clusters is prohibitively expensive.

## c) Collected data

A detailed survey was conducted during the period 29/02/2016 to 15/03/2016. A full copy of the survey carried out is available in the results spreadsheet.<sup>3</sup>

The survey was completed using face to face household interviews conducted by members of staff of Simgas Kenya Ltd. The survey was completed on a customised mobile phone application<sup>4</sup> designed and built by the CME. The results of the survey were automatically uploaded to the server of the CME and were checked for consistency and accuracy and then downloaded for analysis in Excel.

All downloaded data was transferred to an Excel spreadsheet<sup>5</sup> and checked to remove any errors or inconsistencies. In case any such cases were found, the customer was re-contacted to clear up the inconsistency.

## d) Analysis of collected data

Analysis was performed on the monitoring survey's results in order to establish the required monitored parameters (see spreadsheet "~~Monitoring Results-16033020180330 Monitoring Results KE MP1 + ANALYSIS~~"). The collected data consists of answers provided by 54 respondents randomly selected from the project's database. A worksheet called "Analysis" was created within the spreadsheet "~~Monitoring Results-16033020180330 Monitoring Results KE MP1 + ANALYSIS~~" to provide ground for calculations. Further explanation of the analysis conducted is provided below. ~~For detailed explanations regarding parameter calculations, please refer to section G.2 below or to column F ("Comment") from the "Analysis" worksheet.~~

<sup>3</sup> See file '~~Monitoring Results-16033020180330 Monitoring Results KE MP1 + ANALYSIS~~', sheet '160330\_ke-carbon', row 4

<sup>4</sup> As permitted via the Guidelines for 'Sampling and surveys for CDM project activities and programmes of activities (version 4.0), Section 9.1.1

<sup>5</sup> See file '~~Monitoring Results-16033020180330 Monitoring Results KE MP1 + ANALYSIS~~'

**e) Demonstration of whether the required confidence/precision has been met**

In order to demonstrate whether the required confidence/precision has been met for each parameter monitored, An outlier analysis was first carried out on all mean (ie. non-proportional) data. An interquartile analysis was carried out, both to identify the 'inner fence' outliers via the most commonly applied method of analysis data points that are 1.5 times above or below the interquartile range. In order to identify true outliers, an 'outer fence' outlier analysis was also conducted to identify data points that are 3 times above or below the interquartile range. Only data points that were identified as 'outer fence' outliers were carefully scrutinized to determine whether they should be excluded from the data analysis or not. The verdict for each data point identified as a possible outlier, and rational, is provided in the sheet 'Outlier analysis'.

Once the outlier analysis was completed, compliance with the 90/10 confidence level was evaluated for each monitored parameter. Please refer to the sheet 'Analysis' columns F to Q of the monitored data sheet.

This analysis revealed that all monitored data meet the 90/10 confidence level, apart from four values for which discount factors following the Standard for Sampling & Surveys (v07) paragraph 17 (b) therefore needed to be applied. All calculations are clearly demonstrated for each parameter in the sheet '20180330 Monitoring Results KE MP1 + ANALYSIS'

The required 90% confidence interval and 10% margin of error has been met. Please see below for a demonstration of how sample size was calculated in accordance with the 90/10 requirements.

**f) Demonstration of whether the samples were randomly selected and are representative of the population**

Clusters were defined as the geographical areas of Kenya in which bioogas digesters are installed in the CPA. This includes the counties: Nairobi, Nyeri (Karatine), Eldoret, Nakuru (Gilgil), Meru (Meruwest) and Kiambu (Githunguri). In line with the PoA-DD and in order to account that not all the geographical clusters are the same size, sampling was employed proportionate to cluster size.<sup>6</sup> Clusters were selected with a probability proportionate to the size of the target population within each cluster such that larger clusters have a greater probability of selection, and smaller clusters a lower probability. Therefore, to select the sample sizes and households to visit, the following steps were followed:

- 1) To determine the number of groups that should be sampled, the following formula as specified in the registered CPA-DD was used:

$$c \geq \frac{\frac{SD_B^2}{\bar{p}^2} \times \frac{M}{M-1} + \frac{1}{u} \times \frac{SD_w^2}{\bar{p}^2} \times \frac{(\bar{N} - u)}{(\bar{N} - 1)}}{\frac{0.1^2}{1.645^2} + \frac{1}{M-1} \times \frac{SD_B^2}{\bar{p}^2}}$$

Where:

Parameter	Explanation	Value applied	Source
<b>c</b>	Number of groups that should be sampled	2.24	Calculated
<b>M</b>	Total number of groups in the population	6	Ke - Central GesiShamba Database 15Feb2016, Sheet 'OpsSummary'
<b><u>u</u></b>	Number of units to be sampling within each group	10	n/a

<sup>6</sup> See emission reduction calculation spreadsheet, tab 'Multistage sampling'

Parameter	Explanation	Value applied	Source
$\bar{N}$	Average units per group	46	Emission reduction calculations, sheet 'Installation Summary'
$SD_B^2$	Unit variance	0.0023	Emission reduction calculations, sheet 'Multistage sampling'
$SD_W^2$	Average of the group variances	0.0689	Emission reduction calculations, sheet 'Multistage sampling'
$p$	Overall proportion	0.94	Emission reduction calculations, sheet 'Multistage sampling'
1.645	Represents the 90% confidence required	n/a	n/a
0.1	Represents the 10% relative precision	n/a	n/a

The above equation resulted in 2.24 clusters needing to be sampled. Three clusters were therefore randomly selected from the total sample group using the excel function RAND() and selecting three groups with the lowest numbers assigned via the 'RAND' function. This resulted in the selection of Nairobi, Nakuru (Gilgil) and Eldoret.

- 2) To determine the total sample size the number of groups to be sampled (2.24) was multiplied by the units per group to be sampled (10), resulting in a minimum required sample size of 22. To account for invalid responses an additional 30 households were sampled, resulting in a total sample size of 52 households.<sup>7</sup>
- 3) To distribute the sample sizes proportionately across the three selected groups, the total sample size was multiplied by the proportion of digesters located in each state.<sup>8</sup>

## SECTION C. Post-registration changes to the PoA (including the generic CPA(s))

### C.1. Corrections

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#### Removal of serial numbers

The PoA-DD, CPA-DD and Generic CPA-DD have been corrected to remove the requirement for serial numbers physically attached to the biogas digesters. This requirement had been included at registration of the PoA to avoid double counting. However, double counting is still avoided through:

- Recording the unique GPS coordinates of each biogas digester
- A programme logo physically attached to the biogas digester
- The CME has an agreement in place with the owner of each individual biogas digester in which the owner transfers the rights to the emission reductions to SimGas IP BV.

According to the CDM Project Standard (Version 9.0) "Changes to the project design of a registered CDM project activity that do not adversely impact any of the following do not require prior approval by the Board: (a) The applicability... of the applied methodology... (b) The additionality... (c) the

<sup>7</sup> See cell K12 of the Emission Reduction calculation spreadsheet, sheet 'multistage sampling'

<sup>8</sup> See cells L27, L28 and L29 of the Emission Reduction calculation spreadsheet, sheet 'multistage sampling'

scale of the project activity". The proposed change would not have an impact on any of these aspects.

#### Removal of tracking quantity of manure fed into digester

The PoA-DD, CPA-DD and Generic CPA-DD have been corrected to remove the requirement for customers to record the quantity of manure fed into the biodigester everytime they feed it to establish parameter  $WST_{fed}$ . Given the farmer's circumstances in Kenya, it is practically unreasonable to expect them to tally this information everytime they feed their digester. The parameter can therefore equally be established through a monitoring survey in which customers are asked what percentage of their animal's manure is fed into the biogas digester, as has been carried out during this monitoring period.

The revised documentation references are outlined in Table 1 below.

**Table 1: Revised documentation references**

Document	Registered document reference	Corrected document reference
PoA-DD	Version number: 4.1 Date: 27/02/2013	Version number: 7.0 Date: 13/10/2016
Generic CPA-DD	Version number: No number Date: No date	Version number: No number Date: No date
CPA1-DD (Kenya)	Version number: 4 Date: 14/12/2012	Version number: 7.0 Date: 13/10/2016

#### **C.2. Inclusion of a monitoring plan to the registered PoA-DD (including its generic CPA-DD(s)), if a monitoring plan was not included at the time of registration**

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Not applicable

#### **C.3. Permanent changes to the monitoring plan as described in the registered PoA-DD, applied methodology, or applied standardized baseline**

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##### Update version of AMS-I.I from version 3.0 to 4.0

A permanent change to the monitoring is proposed for the PoA in regards to the version of the methodology AMS-I.I. At the time of PoA registration version 3.0 of the methodology was applied. This has been updated to apply the latest version 4.0 of the methodology. The only difference between the two versions is the ability to apply a default value for the parameter  $BS_{k,y}$  'The net quantity of renewable biomass or biogas consumed by the thermal application'. Version 4.0 of the methodology allows the application of a default biogas generation rate of  $0.13 \text{ Nm}^3 \cdot \text{m}^3 \cdot \text{day}^{-1}$  to be applied in regions where the annual average ambient temperature is higher than 20C. This option has been included in the PoA-DD for those CPAs that wish to apply it.

The revised documentation references are outlined in Table 2 below.

**Table 2: Revised documentation references**

Document	Registered document reference	Corrected document reference
PoA-DD	Version number: 4.1 Date: 27/02/2013	Version number: 7.0 Date: 13/10/2016
Generic CPA-DD	Version number: No number Date: No date	Version number: No number Date: No date
CPA1-DD (Kenya)	Version number: 4 Date: 14/12/2012	Version number: 7.0 Date: 13/10/2016

**C.4. Changes to the programme design of the registered PoA-DD (including corresponding changes to project design of the generic CPA-DD(s)) and updates to the eligibility criteria for inclusion of specific-case CPAs in the PoA**

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In line with the above proposed correction in C.1 above, a change to the eligibility criteria for inclusion of specific-case CPAs in the PoA-DD is submitted with this monitoring report. Reference to the requirement for serial numbers has been removed from the eligibility criteria table.

The revised documentation references are outlined in Table 2 below.

**Table 3: Revised documentation references**

<b>Document</b>	<b>Registered document reference</b>	<b>Corrected document reference</b>
PoA-DD	Version number: 4.1 Date: 27/02/2013	Version number: 7.0 Date: 13/10/2016
Generic CPA-DD	Version number: No number Date: No date	Version number: No number Date: No date
CPA1-DD (Kenya)	Version number: 4 Date: 14/12/2012	Version number: 7.0 Date: 13/10/2016

**C.5. Types of changes specific to afforestation and reforestation activities**

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Not applicable

**PART II - Specific-case component project activity(ies)**

**SECTION D. Description of specific-case CPA(s)**

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**D.1. Brief description of implemented specific-case CPA(s)**

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The specific case CPA for which this monitoring report is elaborated is located in Kenya. The CPA supports the implementation of plastic household biogas digesters for farmers located in rural areas.

The start date of the CPA and the crediting period is 20/01/2013, which was the expected commissioning date of the first digester to be included under the CPA. In reality, one digester was installed before this date and is therefore excluded from the emission reduction calculations.<sup>9</sup> This onedigester is detailed below, and has been excluded from the emission reduction calculations as evidenced in column AM1 of the Database (sheet 'Carbon').

<sup>9</sup> Evidenced in the Project Database, tab 'Carbon', column AQ

Table 4: Digesters commissioned before the start date of the CPA

Customer number	reference	Customer name	Commissioning date	Source
E00010		Charles Mackens	08/01/2013	Ke – central GesiShamba Database, tab 'OpsStatus', column K

## D.2. Geographical references or other means of identification of the location of the specific-case CPA(s)

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The geographic boundary for the CPA is the Republic of Kenya.

**Figure 1:** Map of the Republic of Kenya



All of the biogas systems implemented under this CPA detail unique GPS coordinates that are recorded in the CME's database. These enable the DOE to identify systems listed in the database and verify their location within the boundaries of the Republic of Kenya. The database further includes information regarding the owner and the digesters operational status.

## SECTION E. Post-registration changes to specific-case CPA(s)

### E.1. Temporary deviations from registered monitoring plan, applied methodology or applied standardized baseline

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#### Confidence/precision compliance

**Nature of deviation:** The analysis to determine whether each parameter monitored met the 90/10 confidence level revealed that all monitored data meet the 90/10 confidence level, apart from the parameters listed below.

**Extent of deviation:** For those parameters that were not able to meet the 90/10 confidence level, conservative discount factors following the Standard for Sampling & Surveys (v07) paragraph 17 (b) needed to be applied. Paragraph 17 (c) states that the option to apply a discount factor is permitted if 1) the survey is undertaken within the first two years of the crediting period and 2) when the attained confidence/precision from the actual samples is equal to or better than 90/15 for small-scale CDM project activities. Regarding the first requirement, a call with the UNFCCC Secretariat on 19 March 2018 confirmed that the first requirement is in place to ensure that Project Participants do not apply the discount factor repeatedly, and that in some occasions it happens that Project Participants must apply the discount factor. Further, the methodology AMS-I.E states that "In cases where survey results indicate that 90/10 precision... is not achieved, the lower bound of a 90 per cent... confidence interval of the parameter value may be chosen as an alternative to repeating the survey efforts to achieve the 90/10... precision" without any further time boundary stated. This is the Project Participant's first ever monitoring effort. It was not possible to conduct monitoring at an earlier date due to the exceptionally low CER prices and low project implementation numbers, as explain further below. Regarding the second requirement, the attained confidence/precision from the actual samples is equal to or better than 90/15 for all parameters listed below.<sup>10</sup>

**Duration of deviation:** 20/01/2013 to 31/12/2015 (both days inclusive)

#### Proposed alternative:

- Operational rate of thermal application installed. The achieved precision was 11%, 1.3% higher than the 10 % target. Therefore the emission reductions are discounted by no less than three times the percentage precision points missed, inline with the Standard for Sampling & Surveys (V07), paragraph 17 (b) (i) (b). See the emission reduction calculation spreadsheet, sheet 'CDM CPA 1 Total ERs', rows 84 – 88. The operational rate applied in the ER calculations is 75.93%. For comparison and to demonstrate conservativeness, the more recent 2017 monitoring survey yielded a value of 86.57%.
- Average annual hours of operation of a system. The achieved precision was 12%, 2% higher than the 10% target. Therefore, the lower bound of the confidence interval was applied as per Standard for Sampling & Surveys (V07), para 17, (b) (i) (a), and AMS-I.E (V 04), paragraph 17.
- Average number of cows produced annually. The achieved precision was 15%, 5% higher than the 10% target. Therefore, the lower bound of the confidence interval was applied as per Standard for Sampling & Surveys (V07), para 17, (b) (i) (a) to derive a value of 4.78 cows produced annually. This is a conservative approach. For comparison and to demonstrate conservativeness, a more recent 2017 monitoring survey yielded a value of 5.65 cows.
- Average number of pigs produced annually. The survey revealed that only 3 customers owned pigs, with significant variation in the number owned (from 0- 300). It is prohibitively expensive to carry out additional monitoring in order to meet the 90/10 confidence level for this parameter due to the large sample size that would be needed. The Project Participant

<sup>10</sup> See file '20180330 Monitoring Results KE MP1 + ANALYSIS', sheet 'Analysis', columns M and N

has therefore chosen to report this parameter as zero, in line with the Project Standard for Programmes of Activities, paragraph 229 (b) and Annex 1 quoted below, which allows the application of the most conservative values approach. This approach was also confirmed with the UNFCCC Secretariat during a call on 19 March 2018.

- % pig manure fed into the digester. The survey revealed that only 3 customers owned pigs, with significant variation in the number owned (from 0- 300). It is prohibitively expensive to carry out additional monitoring in order to meet the 90/10 confidence level for this parameter due to the large sample size that would be needed. The Project Participant has therefore chosen to report this parameter as zero, in line with the CDM Project Standard (v09.0, Appendix 1, paragraph 2), which allows the application of the most conservative values approach. This approach was also confirmed with the UNFCCC Secretariat during a call on 19 March 2018.

### **Annual monitoring**

The PoA, and respective CPA1, achieved registration with the CDM in December 2012, and started implementation of biogas digesters in February 2013. At time that the first annual monitoring would have taken place (from February 2014), less than 100 project technologies had been installed under the CPA. At the time that the second annual monitoring would have taken place (from February 2015), the implementation rate was still much lower than expected and prices for Certified Emission Reductions were exceptionally low. It therefore made little financial sense to go through a monitoring and verification round. The nature of this domestic biogas program means that monitoring can only occur via targeted surveys of SimGas' customers, which involves costs incurred in survey design, training, data analysis and logistics. Monitoring was, however, planned and took place in early 2016. This means that a temporary deviation from the monitoring plan for those parameters that must be monitored annually is sought.

The temporary deviation is in accordance with paragraph 272 – 274 of the Project Standard (version 9), which states that “If project participants or the coordinating/managing entity are temporarily unable to monitor the registered CDM project activity of PoA in accordance with the registered monitoring plan, the applied methodology... [they] shall describe the nature, extent and duration of the non-conforming monitoring and the proposed alternative... Project participants or the coordinating/managing entity shall apply conservative assumptions or discount factors to the calculations to the extent required to ensure that GHG emission reductions will not be over-estimated as a result of the deviation”.

Annex 1 of the Project Standard (version 9) further states “If project participants or the coordinating/managing entity have temporarily not monitored parameters related to baseline greenhouse gas (GHG) emissions or are unable to produce evidence related to such monitoring, prior approval by the Board is not required if project participants or the coordinating/managing entity report these parameters as zero.

If project participants or the coordinating/managing entity have temporarily not monitored parameters related to project GHG emissions or are unable to produce evidence related to such monitoring, prior approval by the Board is not required if project participants or the coordinating/managing entity estimate these parameters assuming that the source of the GHG emissions operated at maximum capacity for the full period of the missing data.”

Therefore, compliance with the Project Standard is hereby demonstrated as follows:

- **Nature of deviation:** monitoring was not carried during the first and second annual monitoring rounds for those parameters that require annual monitoring as per the registered CPA-DD.
- **Extent of deviation:** annual monitoring was not carried out for the following input parameters used in the emission reduction calculations under AMS-III.R:
  - $n_{k,y}$  Operational rate of thermal applications installed
  - $N_{da,y}$  Number of days animal is alive on the farm;
  - $N_{p,y}$  Number of animals produced annually of type LT for year y;

- $N_{LT,y}$  Average number of animals of type LT in year y (population)

All other monitored parameters that are inputs in the emission reduction calculations were monitored on an ongoing basis as when new customers were added to the programme, including:

- Number of biogas systems commissioned
- Methane conversion factor for each manure management system j
- Fraction of manure handled in the baseline animal manure management system j
- Global Warming Potential of methane

Other monitored parameters not mentioned above do not impact the calculation of emission reductions.

- **Duration of deviation:** the above four parameters were not monitored during the first and second annual monitoring rounds. The results of the monitoring carried out in early 2016 can be applied for the year 2015.
- **Proposed alternative:** conservative values are applied for the monitored parameters as follows:
  - $n_{k,y}$  operational Rate: the 2016 monitoring resulted in an operational rate of 75.9387.9304%. In order to maintain conservativeness in the emission reduction estimates, this value is applied equally across all years of the Monitoring Period. Applying the 75.9387.04% operational rate over the years 2013, 2014 and 2015 is a conservative approach since it assumes that the operation rate of digesters is likely lower than in reality: a digester installed in 2013 that was not operational in 2016 is likely to have been operational when it was newly installed in 2013. Since this is the lowest possible operational rate encountered over the three years (due to having the oldest digesters installed), applying 75.93-87.04% across all years is equivalent to assuming the operational rate is at “maximum capacity” for the duration of the period of missing data and is therefore inline with the Project Standard.
  - $N_{da,y}$  Number of days animal is alive on the farm: there is no reason for the number of days an animal is alive on the farm to change significantly from one year to another. Hence, applying the monitored values of 343 days for cows is reasonable. However, in order to meet the requirements of the Project Standard quoted above, the values are reported as 0 for the years 2013 and 2014. The sample size for market swine is below the 90/10 sample size requirements, and a value of zero is therefore applied, and 336 for market swine is reasonable. This is in line with the CDM Project Standard (V09.0) quoted above, which allows the application of the most conservative values approach. However, in order to meet the requirements of the Project Standard quoted above, the values are reported as 0 for the years 2013 and 2014.
  - $N_{p,y}$  Number of animals produced annually of type LT for year: there is no reason for the number of animals produced annually to change significantly from one year to another. Hence, applying the monitored values of 7.22-4.78days for cows is reasonable, and 6.26 for market swine is reasonable. However, in order to meet the requirements of the Project Standard quoted above, the values are reported as 0 for the years 2013 and 2014. The sample size for market swine is below the 90/10 sample size requirements, and a value of zero is therefore applied. This is in line with the CDM Project Standard (V09.0) quoted above, which allows the application of the most conservative values approach.
  - $N_{LT,y}$  Average number of animals of type LT in year y (population): this value is derived from the above two quoted values, hence is also reported at zero for the years 2013 and 2014 (and beyond for market swine).

The emission reduction calculation spreadsheet reflects the above changes.

## E.2. Corrections

>>

Removal of serial numbers

As above in Section C.1.

Removal of tracking quantity of manure fed into digester

As above in Section C.1.

Capacity limit

Section A.2 of the specific registered CPA-DD has a statement that the CPA would “include biodigesters with capacities ranging from 0.5 m<sup>3</sup> to 16 m<sup>3</sup>”. However, there is no need for such a size boundary as long as each individual system remains below the micro-scale limit. This statement have therefore been removed. The eligibility criteria table in Section B.2, criteria 6 on de-bundling has been updated to remove the demonstration of the thermal capacity and emission reductions under AMS-III.R since this is already demonstrated above and in section A.4.6.

The eligibility criteria table in Section B.2 of the specific registered CPA-DD already include clear statements on the size limits of each individual biogas system, as follows:

- 7(b): “Where AMS-I.E or AMS-I.I apply, an individual household biogas system in the CPA has a maximum thermal capacity of 450 kWth”
- 7(c): “Where AMS-III.R applies, each of the independent biogas systems in the project activity achieves an estimated annual emissions reduction equal to or less than 600 tCO<sub>2</sub>e per year”

The maximum size of the digesters included in the CPA and now installed is 24 m<sup>3</sup>.<sup>11</sup>

Regarding 7(b), *Demonstration of each individual sub-system not exceeding 450 kWth*

The largest digester included in the CPA is 24 m<sup>3</sup>. A digester of this size produces only ~~7.009.06~~ kWth, which is far below the limit of 450 kWth. Please see the emission reduction calculation spreadsheet, tab ‘Capacity limit’ for the calculation.

Regarding 7(c), the average emission reduction achieved for each independent biogas system under AMS-III.R for this monitoring period is ~~0.3768~~ tCO<sub>2</sub>e. This is nowhere near being at the capacity limit, and therefore is well within the scale limit of AMS-III.R.

Time induced boundary

The CPA-DD has been corrected to remove the requirement for only digesters implemented between 20/01/2013 to 20/01/2014 being eligible for inclusion in the CPA. The geographical boundary of the CPA is met through recording the address of all customers’ at which the digester is installed, as well as the GPS coordinates. An additional time-induced boundary is not necessary.

MCF and temperature

The MCFs differ depending on the national temperature. The registered CPA-DD listed the temperatures per regions. For simplicity, this has been modified to use the MCF based on the national average temperature of 25.10C<sup>12</sup>. This results in a higher ex-ante emission reduction calculation under AMS-III.R, but a lower ex-post emission reduction under AMS-III.R due to the actual observed baseline manure handling ratio techniques being different from those assumed ex-ante in the CPA-DD. The corrected (i.e. applying 25.1C) ex-ante MCF is 44.9%, whilst the ex-post MCF 6.14%. If regional values were applied as in the non-corrected registered CPA-DD, the ex-post MCF would be 6.52%. This is therefore a conservative correction and results in slightly lower

<sup>11</sup> See Project Database, tab ‘Carbon’, column AO.

<sup>12</sup> As evidenced by World Bank, *Climate Change Knowledge Portal*, Average Monthly Temperature for Kenya from 1990 – 2012 [online] Available from: [http://sdwebx.worldbank.org/climateportal/index.cfm?page=country\\_historical\\_climate&ThisCCCode=KEN](http://sdwebx.worldbank.org/climateportal/index.cfm?page=country_historical_climate&ThisCCCode=KEN) . See also temperature analysis file ‘World Bank Temp Data 10 year’, cell A220

emission reductions from AMS-III.R. The CME wishes to forego these emissions in favour of the specified correction. The respective ex-ante emission reductions specified in the CPA-DD have been updated to reflect the corrected MCF.

In addition, it was noticed that some manure management techniques were missing from the MCF table in Table 4 of the CPA-DD. The relevant manure management techniques and respective MCFs have therefore been copied into Table from the IPCC's Table 10.17 2006 IPCC Guidelines for National Greenhouse Gas Inventories based on the national average temperature of Kenya.

The CPA-1 ER calculation spreadsheet details the full calculation. ~~-(see cells D35 to D51).~~

The revised documentation references are outlined in Table 1 below.

**Table 54: Revised documentation references**

Document	Registered document reference	Corrected document reference
PoA-DD	Version number: 4.1 Date: 27/02/2013	Version number: 7.0 Date: 13/10/2016
Generic CPA-DD	Version number: No number Date: No date	Version number: No number Date: No date
CPA1-DD (Kenya)	Version number: 4 Date: 14/12/2012	Version number: 7.0 Date: 13/10/2016

### **E.3. Changes to the start date of the crediting period of the specific-case CPA(s)**

>>

Not applicable

### **E.4. Inclusion of a monitoring plan into the specific-case CPA(s) that was not included at registration**

>>

Not applicable

### **E.5. Permanent changes to the monitoring plan as described in the registered specific-case CPA-DD(s), applied methodology or standardized baseline**

>>

As per Section C.3 above.

### **E.6. Changes to project design of the specific-case CPA(s)**

>>

As per Section C.4 above.

### **E.7. Types of changes specific to afforestation and reforestation specific-case CPA(s)**

>>

Not applicable

## **SECTION F. Description of the monitoring system of specific-case CPA(s)**

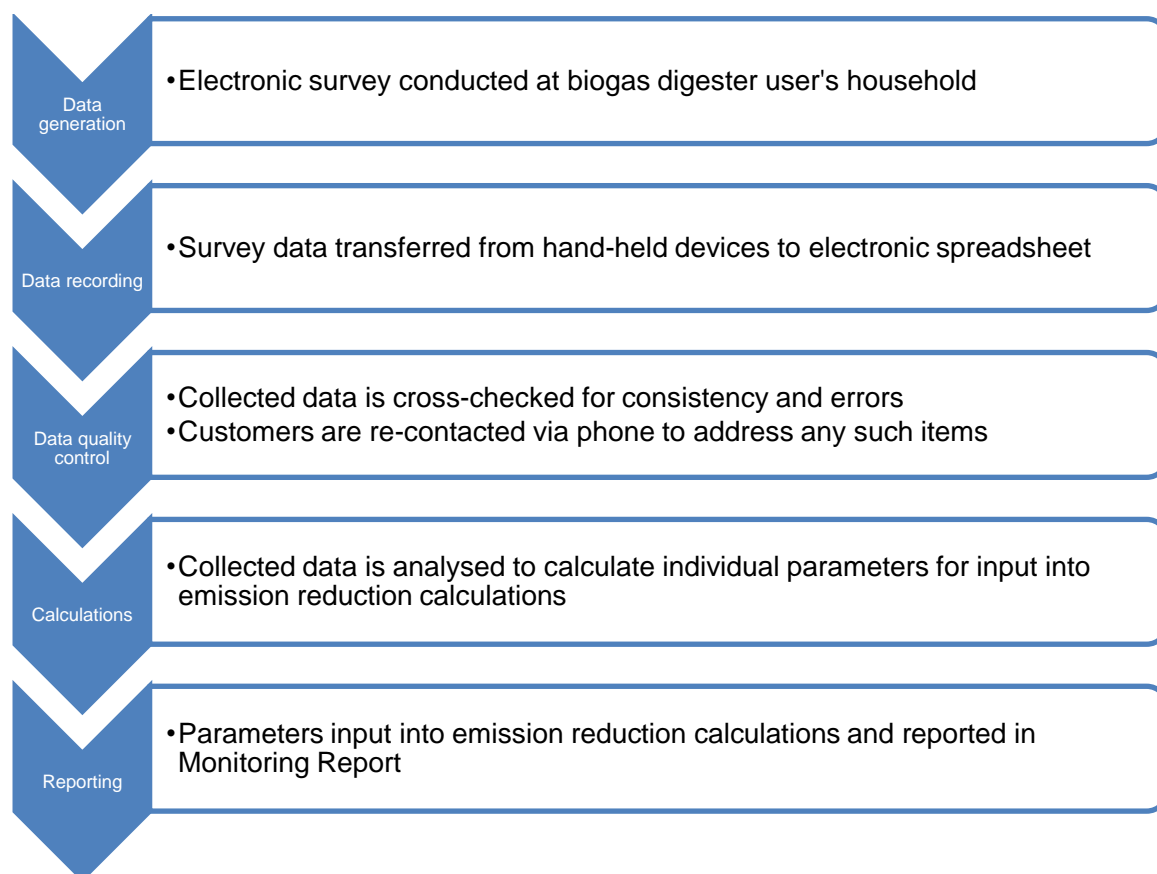
>>

### **Description of the monitoring system**

The monitoring system implemented involved a survey team of SimGas staff, who were supported by Climate Focus. Following selection of the minimum sample size and random allocation of this sample across the project population (methodology described in Section B.2 above), a survey was developed in order to establish the monitored parameters listed in the CPA-DD.

## Data flow

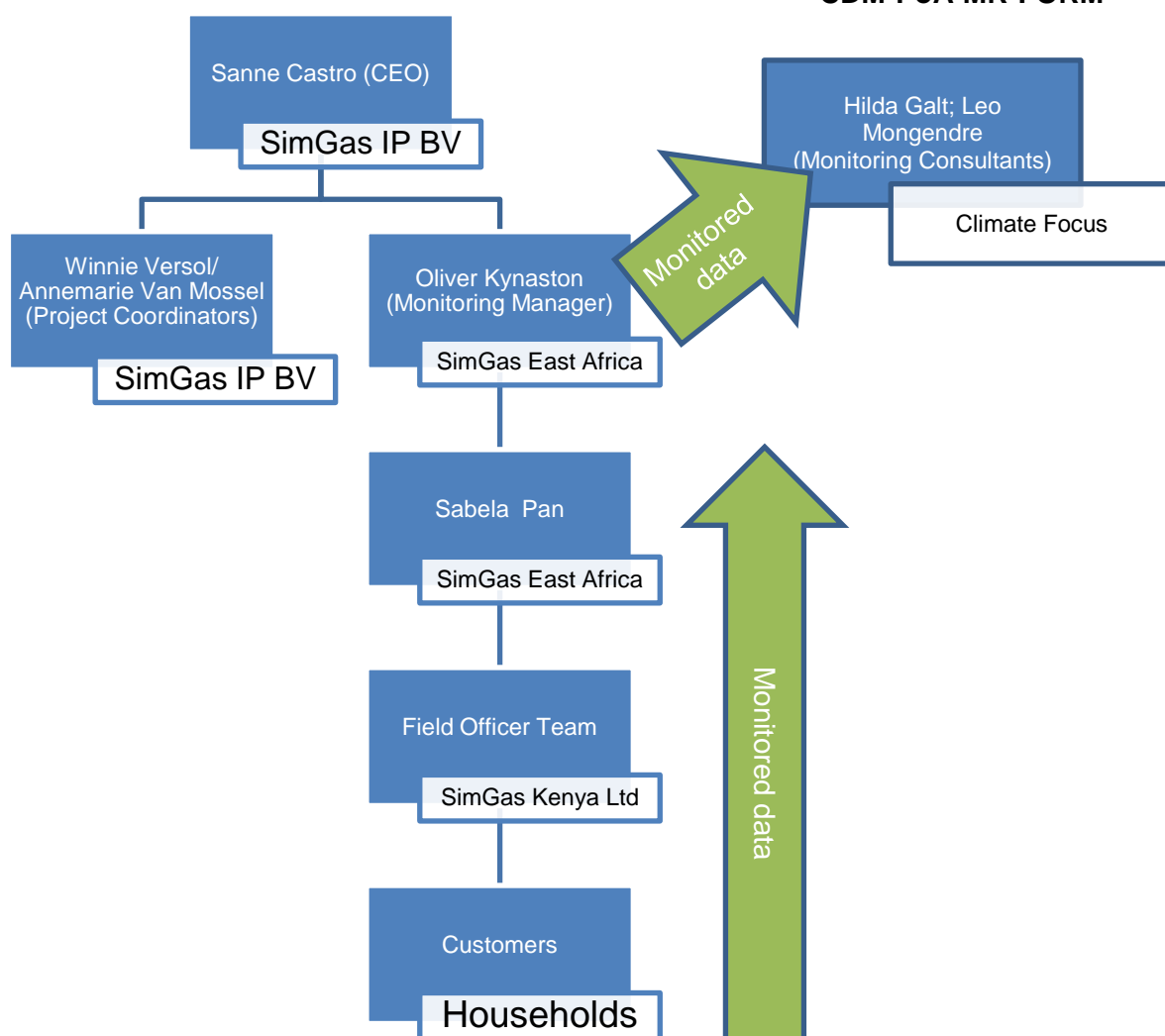
**Figure 1: Diagrammatic representation of monitoring data flow**



## Organizational structure of the monitoring system

All surveys and monitoring were carried out by SimGas staff. Climate Focus assisted SimGas in ensuring that the requirements of the CDM and applied methodologies were adhered to throughout this process. The teams collaborated in determining the sample size, selection of the customers to be surveyed and development of the survey questionnaire. SimGas carried out the surveys and ensured quality of the data, after which point Climate Focus carried out the analysis of data for input into the emission reduction calculations. The organizational structure of the monitoring team is presented in [Figure 2](#) below.

**Figure 2: Organizational structure of the monitoring team**



## SECTION G. Data and parameters

### G.1. Data and parameters fixed ex ante, at registration, inclusion or renewal of crediting period

<b>Data/parameter</b>	$B_{y \text{ rural}}$
Unit	Tonnes/year
Description	Biomass substituted in rural areas
Source of data	Kituyi et al.: Biofuel consumption rates and patterns in Kenya, Biomass and Bioenergy 20, 83-99 (2001)
Value(s) applied	7.42
Choice of data or measurement methods and procedures	National data are used as the CPA is implemented nationwide.
Purpose of data	Calculation of baseline emissions
Additional comments	Only applicable to AMS-I.E

<b>Data/parameter</b>	$B_{y \text{ urban}}$
Unit	Tonnes/year
Description	Biomass substituted in urban areas

Source of data	Kituyi et al.: Biofuel consumption rates and patterns in Kenya, Biomass and Bioenergy 20, 83-99 (2001)
Value(s) applied	4.72
Choice of data or measurement methods and procedures	National data are used as the CPA is implemented nationwide.
Purpose of data	Calculation of baseline emissions
Additional comments	Only applicable to AMS-I.E

<b>Data/parameter</b>	$F_{NRB,y}$
Unit	%
Description	Fraction of biomass used in the absence of the project activity in year y that can be established as non-renewable biomass using nationally approved methods
Source of data	FAO: Global Forest Resources Assessment 2010: Kenya (2010); and Kituyi et al.: Biofuel consumption rates and patterns in Kenya, Biomass and Bioenergy 20, 83-99 (2001)
Value(s) applied	95.1
Choice of data or measurement methods and procedures	National data are used as the CPA is implemented nationwide. The FAO Assessment provides insight into Kenya's forestry sectors, indicating total forest cover and growing stock figures.  NRB can be calculated by subtracting the DRB of 4,040,000 m <sup>3</sup> from B <sub>y</sub> of 82,618,338 m <sup>3</sup> . The fraction of NRB equals to 78,578,338 / 82,618,338, which is 95.1% (see section D.6.3)
Purpose of data	Calculation of baseline emissions;
Additional comments	Only applicable to AMS-I.E

<b>Data/parameter</b>	NRB
Unit	M <sup>3</sup>
Description	Non-renewable woody biomass
Source of data	FAO: Global Forest Resources Assessment 2010: Kenya (2010); and Kituyi et al.: Biofuel consumption rates and patterns in Kenya, Biomass and Bioenergy 20, 83-99 (2001)
Value(s) applied	78,578,338
Choice of data or measurement methods and procedures	NRB can be calculated by subtracting the DRB of 4,040,000 m <sup>3</sup> from B <sub>y</sub> of 78,578,338 m <sup>3</sup> .
Purpose of data	Calculation of baseline emissions;
Additional comments	Only applicable to AMS-I.E

<b>Data/parameter</b>	DRB
Unit	M <sup>3</sup>
Description	Demonstrably renewable woody biomass
Source of data	FAO: Global Forest Resources Assessment 2010: Kenya (2010); and Montagnini, F. and Jordan, C. F. Tropical forest ecology: the basis for conservation and management p.167 (2005)
Value(s) applied	4,040,000

Choice of data or measurement methods and procedures	Literature indicates that sustainable yields in managed plantations is 20 m <sup>3</sup> per ha. Given the total plantation cover referred to by FAO of 202,000 ha, the annual sustainable yield from the plantations is determined to be 4,040,000 m <sup>3</sup> . This is the demonstrably renewable biomass (DRB).
Purpose of data	Calculation of baseline emissions;
Additional comments	Only applicable to AMS-I.E

<b>Data/parameter</b>	SNU <sub>NRB switch</sub>
Unit	%
Description	Share of non-users that started using non-renewable biomass that was replaced by biogas from a digester user
Source of data	AMS-I.E. (version 4) paragraph 10.a
Value(s) applied	5 (adjustment factor of 0.95 applicable to By)
Choice of data or measurement methods and procedures	By is multiplied by a net to gross adjustment factor of 0.95 to account for leakages, in which case surveys are not required.
Purpose of data	Calculation of leakage emissions
Additional comments	Only applicable to AMS-I.E

<b>Data/parameter</b>	Capacity
Unit	kWth
Description	Capacity of biodigester system
Source of data	Section A.12 of CPA-DD
Value(s) applied	1.44
Choice of data or measurement methods and procedures	Calculated using the formula presented in Section A.4.6. The 16m3 capacity biodigester produces 6m3 of biogas per day. If the 6m3 capacity is used, 2,25 m3 applies. This gives a maximum output of 1.44 kWth.
Purpose of data	Calculation of project emissions
Additional comments	Applied in AMS-III.R

<b>Data/parameter</b>	EF <sub>projected_fossilfuel</sub>
Unit	tCO <sub>2</sub> /TJ
Description	Emission factor for the substitution of non-renewable woody biomass
Source of data	AMS-I.E. version 4
Value(s) applied	81.6
Choice of data or measurement methods and procedures	As per requirement of the methodology
Purpose of data	Calculation of baseline emissions and project emissions
Additional comments	Only applicable to AMS-I.E

<b>Data/parameter</b>	NCV <sub>biomass</sub>
Unit	TJ/tonne
Description	Net calorific value of the non-renewable biomass that is substituted
Source of data	IPCC default

Value(s) applied	0.015
Choice of data or measurement methods and procedures	As per requirement of the methodology AMS-I.E
Purpose of data	Calculation of baseline emissions; calculation of project emissions
Additional comments	Only applicable to AMS-I.E

<b>Data/parameter</b>	NCV <sub>biogas</sub>
Unit	TJ/tonne
Description	Net calorific value of the biogas
Source of data	AMS-I.I. version 4, Werner U., Stohr U., and Hees, N. Biogas plants in animal husbandry. GTZ, Germany (1989)
Value(s) applied	0.0182
Choice of data or measurement methods and procedures	AMS-I.I. states that the NCV of biogas to be applied is 0.0215 GJ/m <sup>3</sup> . To convert this figure to TJ/tonne, a density factor of 1.18 kg/m <sup>3</sup> is applied (Werner et al, 1989 – p.66). This results in a NCV of biogas of 0.0182 TJ/tonne.
Purpose of data	Calculation of baseline emissions; calculation of project emissions
Additional comments	Only applicable to AMS-I.I

<b>Data/parameter</b>	EF <sub>fossil fuel</sub>
Unit	tCO <sub>2</sub> /TJ
Description	Emission factor of kerosene consumed in the baseline scenario
Source of data	IPCC default
Value(s) applied	71.9
Choice of data or measurement methods and procedures	Literature indicates that kerosene is used for cooking purposes, and is prevalent in urban regions.  As per Table 2.3, Chapter 2, Volume 2 of the 2006 IPCC Guidelines.
Purpose of data	Calculation of baseline emissions and project emissions
Additional comments	Only applicable to AMS-I.I

<b>Data/parameter</b>	EF <sub>fossil fuel</sub>
Unit	tCO <sub>2</sub> /TJ
Description	Emission factor of LPG consumed in the baseline scenario
Source of data	IPCC default
Value(s) applied	63.1
Choice of data or measurement methods and procedures	Literature indicates that LPG is used for cooking purposes, and is prevalent in urban regions.  As per Table 2.3, Chapter 2, Volume 2 of the 2006 IPCC Guidelines.
Purpose of data	Calculation of baseline emissions
Additional comments	Only applicable to AMS-I.I

<b>Data/parameter</b>	$\eta$ BL
Unit	%
Description	Efficiency of the baseline equipment being replaced
Source of data	Laboratory test
Value(s) applied	15
Choice of data or measurement methods and procedures	Not applicable
Purpose of data	Calculation of baseline emissions;
Additional comments	Only applicable to AMS-I.I

<b>Data/parameter</b>	$\eta$ PJ
Unit	%
Description	Efficiency of the new equipment being implemented
Source of data	Stove Report SimGas –average efficiency value from nine tested cook stoves
Value(s) applied	55
Choice of data or measurement methods and procedures	Not applicable
Purpose of data	Calculation of baseline emissions;
Additional comments	Only applicable to AMS-I.I

<b>Data/parameter</b>	VS <sub>dairy cow</sub>
Unit	kg/hd/day
Description	Daily volatile solid excreted for dairy cows
Source of data	IPCC default
Value(s) applied	1.9
Choice of data or measurement methods and procedures	As per Table 10.A. 4, Chapter 10, Volume 4 of the 2006 IPCC Guidelines
Purpose of data	Calculation of baseline emissions;
Additional comments	Only applicable to AMS-III.R

<b>Data/parameter</b>	VS <sub>market swine</sub>
Unit	kg/hd/day
Description	Daily volatile solid excreted for market swine
Source of data	IPCC default
Value(s) applied	0.3
Choice of data or measurement methods and procedures	As per Table 10.A. 7, Chapter 10, Volume 4 of the 2006 IPCC Guidelines
Purpose of data	Calculation of baseline emissions;
Additional comments	Only applicable to AMS-III.R

<b>Data/parameter</b>	VS <sub>goat</sub>
Unit	kg/hd/day
Description	Daily volatile solid excreted for goat
Source of data	IPCC default
Value(s) applied	0.35
Choice of data or measurement methods and procedures	As per Table 10.A. 9, Chapter 10, Volume 4 of the 2006 IPCC Guidelines
Purpose of data	Calculation of baseline emissions;
Additional comments	Only applicable to AMS-III.R

<b>Data/parameter</b>	VS <sub>sheep</sub>
Unit	kg/hd/day
Description	Daily volatile solid excreted for sheep
Source of data	IPCC default
Value(s) applied	0.32
Choice of data or measurement methods and procedures	As per Table 10.A. 9, Chapter 10, Volume 4 of the 2006 IPCC Guidelines
Purpose of data	Calculation of baseline emissions;
Additional comments	Only applicable to AMS-III.R

<b>Data/parameter</b>	B <sub>0dairy cow</sub>
Unit	m <sup>3</sup> CH <sub>4</sub> /kg
Description	Maximum methane producing capacity for manure produced by dairy cows
Source of data	IPCC default
Value(s) applied	0.13
Choice of data or measurement methods and procedures	As per Table 10.A. 4, Chapter 10, Volume 4 of the 2006 IPCC Guidelines
Purpose of data	Calculation of baseline emissions;
Additional comments	Only applicable to AMS-III.R

<b>Data/parameter</b>	B <sub>0market swine</sub>
Unit	m <sup>3</sup> CH <sub>4</sub> /kg
Description	Maximum methane producing capacity for manure produced by dairy cows
Source of data	IPCC default
Value(s) applied	0.29
Choice of data or measurement methods and procedures	As per Table 10.A. 4, Chapter 10, Volume 4 of the 2006 IPCC Guidelines
Purpose of data	Calculation of baseline emissions;
Additional comments	Only applicable to AMS-III.R

<b>Data/parameter</b>	$B_{0goat}$
Unit	$m^3 CH_4/kg$
Description	Maximum methane producing capacity for manure produced by dairy cows
Source of data	IPCC default
Value(s) applied	0.13
Choice of data or measurement methods and procedures	As per Table 10.A. 4, Chapter 10, Volume 4 of the 2006 IPCC Guidelines
Purpose of data	Calculation of baseline emissions;
Additional comments	Only applicable to AMS-III.R

<b>Data/parameter</b>	$B_{0sheep}$
Unit	$m^3 CH_4/kg$
Description	Maximum methane producing capacity for manure produced by dairy cows
Source of data	IPCC default
Value(s) applied	0.13
Choice of data or measurement methods and procedures	As per Table 10.A. 4, Chapter 10, Volume 4 of the 2006 IPCC Guidelines
Purpose of data	Calculation of baseline emissions;
Additional comments	Only applicable to AMS-III.R

<b>Data/parameter</b>	$UF_b$
Unit	Number
Description	Model correction factor
Source of data	AMS-III.R, Version 2
Value(s) applied	0.94
Choice of data or measurement methods and procedures	Not applicable
Purpose of data	Calculation of baseline emissions;
Additional comments	Only applicable to AMS-III.R

<b>Data/parameter</b>	$PE_{leakage}$
Unit	tCO <sub>2</sub> e/year
Description	Project emissions due to physical leakage of biogas from the animal manure management system
Source of data	AMS-III.D. version 18; calculated in ER calculation spreadsheet sheet 'CDM CPA1 AMS-III.R ERs', cell D42.
Value(s) applied	0.01968
Choice of data or measurement methods and procedures	A default value of 0.05 m <sup>3</sup> biogas leaked/m <sup>3</sup> biogas produced may be used in accordance with paragraph 13.b of AMS-III.D. version 18
Purpose of data	Calculation of project emissions
Additional comments	Only applicable to AMS-III.R

<b>Data/parameter</b>	$N_s$																												
Unit	Number																												
Description	Number of biogas systems in each size category ( $m^3$ ) installed under the CPA																												
Source of data	SimGas Project Database 'Ke – Central GesiShamba Database', Tab 'Analysis'																												
Value(s) applied	<table> <tr> <th>Digester size (<math>m^3</math>)</th><th>Number of digesters installed within MP1</th></tr> <tr><td>3</td><td>1</td></tr> <tr><td>4</td><td>22</td></tr> <tr><td>5</td><td>26</td></tr> <tr><td>6</td><td>144</td></tr> <tr><td>7</td><td>7</td></tr> <tr><td>8</td><td>46</td></tr> <tr><td>9</td><td>6</td></tr> <tr><td>10</td><td>11</td></tr> <tr><td>12</td><td>8</td></tr> <tr><td>14</td><td>3</td></tr> <tr><td>16</td><td>1</td></tr> <tr><td>24</td><td>1</td></tr> <tr><td>Total</td><td>276</td></tr> </table>	Digester size ( $m^3$ )	Number of digesters installed within MP1	3	1	4	22	5	26	6	144	7	7	8	46	9	6	10	11	12	8	14	3	16	1	24	1	Total	276
Digester size ( $m^3$ )	Number of digesters installed within MP1																												
3	1																												
4	22																												
5	26																												
6	144																												
7	7																												
8	46																												
9	6																												
10	11																												
12	8																												
14	3																												
16	1																												
24	1																												
Total	276																												
Choice of data or measurement methods and procedures	Not applicable																												
Purpose of data	Calculation of baseline emissions, project emissions and leakage																												
Additional comments	As the CPA collects baseline data from each participating customer.																												

<b>Data/parameter</b>	$D_{CH_4}$
Unit	$t/m^3$
Description	Methane density
Source of data	IPCC: <a href="http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1ref7.pdf">http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1ref7.pdf</a>
Value(s) applied	0.00067
Choice of data or measurement methods and procedures	Not applicable
Purpose of data	Calculation of baseline emissions; calculation of project emissions; calculation of leakage
Additional comments	Applied in AMS-III.R

<b>Data / Parameter:</b>	$B_{sk,y}$
Unit	$Nm^3 \cdot m^{-3} \cdot day^{-1}$
Description	The net quantity of renewable biogas consumed by the thermal application k in year y
Source of data	AMS-I.I (versión 4)
Value(s) applied	0.13
Choice of data	As per the applied methodology, paragraph 14.

or measurement methods and procedures	This is permitted to be applied for countries where annual average ambient temperature is higher than 20C. The annual average ambient temperature in Kenya is 25.10 C. <sup>13</sup>
Purpose of data	Calculation of baseline emissions; calculation of project emissions
Additional comments	Not applicable

## G.2. Data and parameters monitored

Data/parameter	N								
Unit	Number								
Description	Number of biogas systems commissioned								
Measured/calculated/ default	Measured								
Source of data	SimGas Project Database 'Ke – Central GesiShamba Database' , Tab 'Analysis'								
Value(s) of monitored parameter	<table> <tr> <th>Dates</th><th>Number of biogas digesters commissioned</th></tr> <tr> <td>20/01/2013 – 31/12/2013</td><td>70</td></tr> <tr> <td>01/01/2014 – 31/12/2014</td><td>158</td></tr> <tr> <td>01/01/2015 – 31/12/2015</td><td>48</td></tr> </table>	Dates	Number of biogas digesters commissioned	20/01/2013 – 31/12/2013	70	01/01/2014 – 31/12/2014	158	01/01/2015 – 31/12/2015	48
Dates	Number of biogas digesters commissioned								
20/01/2013 – 31/12/2013	70								
01/01/2014 – 31/12/2014	158								
01/01/2015 – 31/12/2015	48								
Monitoring equipment	Not applicable								
Measuring/reading/ recording frequency	Annual/ongoing								
Calculation method (if applicable)	Not applicable								
QA/QC procedures	On commissioning of the biogas system a unique GPS coordinate of each digester will be recorded, and entered into the electronic database, with clear divisions between CPAs.								
Purpose of data	Calculation of baseline emissions; calculation of project emissions; calculation of leakage								
Additional comments	Completed as part of the Commissioning Protocol on a continual basis as and when new biogas digesters are added to the programme. Annual record checks are carried out.								

Data/parameter	n <sub>k,y</sub>
Unit	%
Description	Operational rate of the thermal applications installed
Measured/calculated/ default	Calculated
Source of data	SimGas Monitoring Survey   Spreadsheet " <del>Monitoring Results</del> 46033020180330 Monitoring Results KE MP1 + ANALYSIS _KE" / Sheet "Analysis" / Cell Q6A2
Value(s) of monitored parameter	<del>87.0475.93</del> %
Monitoring equipment	Not applicable
Measuring/reading/ recording frequency	Annually

<sup>13</sup> As evidenced by World Bank, *Climate Change Knowledge Portal*, Average Monthly Temperature for Kenya from 1990 – 2012 [online] Available from: [http://sdwebx.worldbank.org/climateportal/index.cfm?page=country\\_historical\\_climate&ThisCCCode=KEN](http://sdwebx.worldbank.org/climateportal/index.cfm?page=country_historical_climate&ThisCCCode=KEN)

Calculation method (if applicable)	Percentage value of operational units within a randomly selected and statistically representative sample of biogas users. <u>The achieved precision of the sampled results was 11%, 1% higher than the 10% target. Therefore the emission reductions were discounted by no less than three times the percentage precision points missed, inline with the Standard for Sampling &amp; Surveys (V07), paragraph 17 (b) (i) (b). See the emission reduction calculation spreadsheet, sheet 'CDM CPA 1 Total ERs', rows 84 – 88.</u>
QA/QC procedures	The operational rate of thermal applications is monitored annually using sampling methods to satisfy a 90/10 precision/confidence, following the <i>Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities</i> (EB 69, Annex 4).
Purpose of data	Calculation of project emissions
Additional comments	AMS-I.I parameter

<b>Data/parameter</b>	<b>Displacement<sub>NRB</sub></b>
Unit	Not applicable
Description	Confirmation of the displacement or substitution of the non-renewable woody biomass at each location.
Measured/calculated/ default	Calculated
Source of data	SimGas Monitoring Survey   Spreadsheet " <u>Monitoring Results 46033020180330 Monitoring Results KE MP1 + ANALYSIS</u> "_KE" / Sheet "Analysis" / Cell <u>Q7A3</u>
Value(s) of monitored parameter	<u>94.44% of respondents confirmed the displacement/substitution of non-renewable woody biomass is confirmed. Over 80% of respondents (44 out of a total of 54) have stated a reduction of their consumption (in average by 57.61%). Only 2 respondents have stated an increase in their consumption of fuelwood or charcoal (in average by 75%) and 3 respondents were not using woody biomass prior to the installation of their digesters.</u>
Monitoring equipment	Not applicable
Measuring/reading/ recording frequency	Annual survey based on sample
Calculation method (if applicable)	Basic statistics were performed on respondents' answers <u>to ensure they meet the 90/10 requirements.</u> <del>Results were segregated to assess the impact of installing biogas digesters on users' woody biomass consumption</del>
QA/QC procedures	This parameter is monitored annually using sampling methods to satisfy a 90/10 precision/confidence, following the <i>Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities</i> (EB 69, Annex 4).
Purpose of data	Confirming the displacement of woody biomass
Additional comments	AMS-I.E parameter

<b>Data/parameter</b>	<b>HG<sub>p,y</sub></b>
Unit	Number
Description	Quantity of thermal energy generated by the new renewable energy technology in the project in year y (TJ)
Measured/calculated/ default	Calculated
Source of data	Not applicable
Value(s) of monitored parameter	Not applicable
Monitoring equipment	Not applicable
Measuring/reading/ recording frequency	Annual survey based on sample only in CPAs where B <sub>y</sub> is determined from the thermal energy generated in the project activity.

Calculation method (if applicable)	Not applicable
QA/QC procedures	Not applicable
Purpose of data	Calculation of baseline emissions
Additional comments	This monitored parameter is not applicable since this parameter only needs to be monitored in CPAs where $B_y$ is determined from the thermal energy generated in the project activity under AMS-I.E.

<b>Data/parameter</b>	<b><math>BS_{k,y}</math></b>
Unit	Tonne
Description	The net quantity of renewable biogas consumed by the thermal application $k$ in year $y$
Measured/calculated/ default	Calculated
Source of data	Not applicable
Value(s) of monitored parameter	Not applicable
Monitoring equipment	Not applicable
Measuring/reading/ recording frequency	Annual
Calculation method (if applicable)	Not applicable
QA/QC procedures	Shall be monitored in accordance with AMS-I.I (version 4.0)
Purpose of data	Calculation of baseline emissions
Additional comments	Not applicable to this CPA: Only applicable to CPAs that choose <b>not</b> to apply a default value for $BS_{k,y}$ , following paragraph 14 of AMS-I.I (version 4.0).

<b>Data/parameter</b>	<b><math>MCF_j</math></b>
Unit	%
Description	Methane conversion factor for each manure management system $j$
Measured/calculated/ default	Calculated
Source of data	Baseline survey completed on commissioning of installations; Emission reduction calculations, cell D12, Project database, Tab 'Carbon', column AC and IPCC Guidelines for National Greenhouse Gas Inventories Chapter 10: Emissions from Livestock and Manure Management, Table 10.17 (2006)
Value(s) of monitored parameter	44.9 %
Monitoring equipment	Not applicable
Measuring/reading/ recording frequency	Ongoing as and when a new customer is added to the project.
Calculation method (if applicable)	To derive the MCF, the following calculations took place: 1) MCF of Kenya's average temperature of 25.10 C taken from IPCC default values. 2) The proportions of each baseline IPCC manure handling technique was established from the Project Database 3) Each MCF was multiplied by the respective proportion of the baseline manure handling technique.
QA/QC procedures	Recorded by Simgas staff on site who are able to physically verify the manure management strategy.
Purpose of data	Calculation of baseline emissions
Additional comments	AMS-III.R parameter

<b>Data/parameter</b>	<b>MS<sub>%BI,i</sub></b>
Unit	Number
Description	Fraction of manure handled in the baseline animal manure management system j
Measured/calculated/ default	Measured
Source of data	Baseline survey completed on commissioning of installations; Project database, Tab 'Carbon' columns S, W and AA
Value(s) of monitored parameter	100%
Monitoring equipment	Not applicable
Measuring/reading/ recording frequency	Ongoing as and when new digesters are added to the project.
Calculation method (if applicable)	Not applicable
QA/QC procedures	When new customers are added to the project they are asked how they handle the manure of each type of livestock owned before receiving a biogas digester. Respondents provide a response for each type of animal owned whose manure would be used in the digester.
Purpose of data	Calculation of baseline emissions
Additional comments	AMS-III.R parameter

<b>Data/parameter</b>	<b>OP<sub>hours</sub></b>
Unit	Number (hours)
Description	Average annual hours of operation of a system using survey methods
Measured/calculated/ default	Calculated
Source of data	SimGas Monitoring Survey   Spreadsheet " <del>Monitoring Results 46033920180330</del> Monitoring Results KE MP1 + ANALYSIS KE" / Sheet "Analysis" / Cell <u>Q8A8</u>
Value(s) of monitored parameter	<u>4,034,795.95</u>
Monitoring equipment	Not applicable
Measuring/reading/ recording frequency	Annual survey based on sample
Calculation method (if applicable)	Average daily hours of biodigesters' usage from a randomly selected and statistically representative sample, multiplied by 365 and rounded to the nearest integer to obtain an annual average. <u>The achieved precision was 12%, 2% higher than the 10% target. Therefore, the lower bound of the confidence interval was applied as per Standard for Sampling &amp; Surveys (V07), para 17, (b) (i) (a), and AMS-I.E (V 04), paragraph 17.</u>
QA/QC procedures	This parameter is monitored annually using sampling methods to satisfy a 90/10 precision/confidence, following the <i>Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities</i> (EB 69, Annex 4).
Purpose of data	Not applicable to the calculation of baseline emissions, project emissions or leakage
Additional comments	Not applicable

<b>Data/parameter</b>	<b>N<sub>da,y</sub></b>
Unit	Number (days)
Description	Number of days animal is alive in farm in year y
Measured/calculated/ default	Calculated

Source of data	SimGas Monitoring Survey   Spreadsheet " <del>Monitoring Results 46033020180330</del> Monitoring Results KE MP1 + ANALYSIS_KE" / Sheet "Analysis" / Cells <u>QA9</u> and <u>QA10</u>
Value(s) of monitored parameter	2013 : 0 (see Section E.1) 2014 : 0 (See Section E.1) 2015 : 343 ( $N_{da,y,cow}$ ), <del>0-336</del> ( $N_{da,y,pig}$ )
Monitoring equipment	Not applicable
Measuring/reading/recording frequency	Annual survey based on sample
Calculation method (if applicable)	<p>This parameter is determined from the monitoring survey's answers regarding duration of presence of animals on their farm, i.e. based on the number of days an animal is alive on the farm to yield the percentage of time within 365 days that an animal is alive on the farm. This percentage value is multiplied by 365 days to yield <math>N_{da,y}</math>.</p> <p><u>The achieved precision for pigs was above 15%. The PP has therefore chosen to report this parameter as zero, in line with the CDM Project Standard (V09.0), which allows the application of the most conservative values approach.</u></p> <p><del><math>N_{da,y}</math> is a parameter required to calculate the annual average number of animals (<math>N_{LT,y}</math>) under AMS-III.D which would in turn be used to estimate baseline emissions from manure handling under AMS-III.R.</del></p>
QA/QC procedures	This parameter is monitored annually using sampling methods to satisfy a 90/10 precision/confidence, following the <i>Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities</i> (EB 69, Annex 4).
Purpose of data	Calculation of baseline emissions; calculation of project emissions
Additional comments	AMS-III.R parameter (which refers to AMS-III.D)

<b>Data/parameter</b>	<b><math>N_{p,y}</math></b>
Unit	Number
Description	Number of animals produced annually of type LT for the year $y$
Measured/calculated/ default	Calculated
Source of data	SimGas Monitoring Survey   Spreadsheet " <del>Monitoring Results 46033020180330</del> Monitoring Results KE MP1 + ANALYSIS_KE" / Sheet "Analysis" / Cells <u>Q11A11</u> and <u>Q12A12</u>
Value(s) of monitored parameter	2013 : 0 (see Section E.1) 2014 : 0 (see Section E.1) 2015 : <u>4.787.22</u> ( $N_{p,y,cow}$ ), <u>06.26</u> ( $N_{p,y,pig}$ )
Monitoring equipment	Not applicable
Measuring/reading/recording frequency	Annually
Calculation method (if applicable)	<p>Average value of animal ownership per animal index, per year of a randomly selected and statistically representative sample.</p> <p><u>The achieved precision for cows was 15%, 5% higher than the 10% target. Therefore, the lower bound of the confidence interval was applied as per Standard for Sampling &amp; Surveys (V07), para 17, (b) (i) (a). This is a conservative approach.</u></p> <p><u>The achieved precision for pigs was above 15%. The PP has therefore chosen to report this parameter as zero, in line with the CDM Project Standard (V09.0), which allows the application of the most conservative values approach.</u></p>

QA/QC procedures	This parameter is monitored annually using sampling methods to satisfy a 90/10 precision/confidence, following the <i>Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities</i> (EB 69, Annex 4).
Purpose of data	Calculation of baseline emissions; calculation of project emissions
Additional comments	AMS-III.R parameter (which refers to AMS-III.D)

<b>Data/parameter</b>	<b>N<sub>LT,y</sub></b>
Unit	Number
Description	Average number of animals of type LT in year y (population)
Measured/calculated/ default	Calculated
Source of data	SimGas Monitoring Survey   Spreadsheet " <del>Monitoring Results 16033020180330 Monitoring Results KE MP1 + ANALYSIS</del> _KE" / Sheet "Analysis" / Cells <del>Q13A13</del> and <del>QA14</del>
Value(s) of monitored parameter	2013: 0 2014: 0 2015: <del>4.496.78</del> (N <sub>cow</sub> ), <del>05.76</del> (N <sub>pig</sub> )
Monitoring equipment	Not applicable
Measuring/reading/ recording frequency	Annually
Calculation method (if applicable)	Based on <i>AMS-III.D</i> (v.18), this parameter is obtained through the product of the previous two parameters N <sub>da,y</sub> and N <sub>p,y</sub> divided by 365.
QA/QC procedures	This parameter is monitored annually using sampling methods to satisfy a 90/10 precision/confidence, following the <i>Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities</i> (EB 69, Annex 4).
Purpose of data	Calculation of baseline emissions; calculation of project emissions
Additional comments	AMS-III.R parameter

<b>Data/parameter</b>	<b>WST<sub>generation,y</sub></b>
Unit	Number (tonne)
Description	Amount of waste/animal manure generated on the farm in year y
Measured/calculated/ default	Calculated
Source of data	SimGas Monitoring Survey   Spreadsheet " <del>Monitoring Results 16033020180330 Monitoring Results KE MP1 + ANALYSIS</del> _KE" / Sheet "Analysis" / Cells <del>QA15</del> and <del>QA16</del>
Value(s) of monitored parameter	<del>3.3175.007</del> (WST <sub>generation,cow</sub> ) <del>685-0</del> (WST <sub>generation,pig</sub> )
Monitoring equipment	Not applicable
Measuring/reading/ recording frequency	Annually
Calculation method (if applicable)	The amount of animal waste generated by livestock is calculated as the product of the average number of animals on the farm and the default VS values as per the IPCC 2006 Guidelines for National Greenhouse Gas Inventories
QA/QC procedures	This parameter is monitored annually using sampling methods to satisfy a 90/10 precision/confidence, following the <i>Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities</i> (EB 69, Annex 4).
Purpose of data	Not applicable for the calculation of baseline emissions, project emissions or leakage
Additional comments	Not applicable

Data/parameter	WST <sub>fed,y</sub>
Unit	Number (tonne)
Description	Amount of waste/animal manure fed into the system
Measured/calculated/ default	Calculated
Source of data	SimGas Monitoring Survey   Spreadsheet " <del>Monitoring Results 16033020180330 Monitoring Results KE MP1 + ANALYSIS</del> _KE" / Sheet "Analysis" / Cells <u>QA177</u> and <u>QA1848</u>
Value(s) of monitored parameter	<u>2,8044,233</u> (WST <sub>fed,cow</sub> ) <del>388-0</del> (WST <sub>fed,pig</sub> )
Monitoring equipment	Not applicable
Measuring/reading/ recording frequency	Annually
Calculation method (if applicable)	Monitoring survey's respondents are asked about the share of their animals' manure being fed into the project's digester (and whether they only feed SimGas' digester). This factor is multiplied by previous parameter WST <sub>generation</sub> to establish the amount of animal manure fed into the system
QA/QC procedures	This parameter is monitored annually using sampling methods to satisfy a 90/10 precision/confidence, following the <i>Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities</i> (EB 69, Annex 4).
Purpose of data	Not applicable for the calculation of baseline emissions, project emissions or leakage
Additional comments	Not applicable

Data/parameter	Soil application
Unit	Not applicable
Description	Confirmation that the final sludge is being handled aerobically to ensure no further methane emissions
Measured/calculated/ default	Calculated
Source of data	SimGas Monitoring Survey   Spreadsheet " <del>Monitoring Results 16033020180330 Monitoring Results KE MP1 + ANALYSIS</del> _KE" / Sheet "Analysis" / Cells <u>QA2149</u>
Value(s) of monitored parameter	Aerobic handling of the final sludge is confirmed. Over 90% of respondents (49 out of a total of 54) have stated they're using the final sludge as a fertilizer on their crops, thereby aerobically applying the sludge.
Monitoring equipment	Not applicable
Measuring/reading/ recording frequency	Annual survey based on sample
Calculation method (if applicable)	Basic statistics were performed on respondents' answers. <del>Results are showing that over 90% of respondents use the final sludge as fertilizer</del>
QA/QC procedures	This parameter is monitored annually using sampling methods to satisfy a 90/10 precision/confidence, following the <i>Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities</i> (EB 69, Annex 4).
Purpose of data	Not applicable for the calculation of baseline emissions, project emissions or leakage
Additional comments	Not applicable

Data/parameter	GWP <sub>CH4</sub>
Unit	Number
Description	Global Warming Potential of methane
Measured/calculated/ default	Default

Source of data	IPCC
Value(s) of monitored parameter	25
Monitoring equipment	Not applicable
Measuring/reading/recording frequency	Annual
Calculation method (if applicable)	Not applicable
QA/QC procedures	Not applicable
Purpose of data	Calculation of baseline emissions, project emissions and leakage
Additional comments	All future emission reductions and removals shall be calculated using the global warming potentials (GWPs) adopted by the Conference of the Parties serving as the meeting of the Parties at its seventh session, in accordance with decision 4/CMP.7 and EB 69, Annex 3. This decision references the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) as the source to be used for GWPs during the second commitment period of the Kyoto Protocol.

### G.3. Implementation of specific-case CPA level sampling plan

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The single sampling plan described in section B.2 of Part I was applied to the specific-case registered CPA.

## SECTION H. Calculation of GHG emission reductions or net GHG removals by sinks

### H.1. Calculation of baseline emissions or baseline net GHG removals by sinks

>>

As stated in section E.6.2 of the registered PoA-DD, the baseline emissions are calculated by applying a combination of AMS-I.E or AMS-I.I and AMS-III.R (applicable for manure-fed digesters). All digesters installed to date are manure-fed digesters, as evidenced by specifying that the digesters are GesiShamba models, which can only be fed with manure. SimGas does not sell digesters to customers that do not own sufficient animals to feed the digester.

#### Determining whether AMS-I.E or AMS-I.I applies

In order to determine whether AMS-I.E or AMS-I.I applies to an individual digester, the results of the baseline survey conducted for each customer were used. At installation of a biogas digester, a customer is asked about the type of fuel they used for cooking before receiving a biogas digester, the amount used and the cost per month (see Tab 'Carbon'). The first step is to determine whether biomass or fossil fuels are the most dominant fuels used in the household. This is necessary since different fuels are reported in different units. For example, firewood is reported in kg/month, whilst kerosene is reported in liters/month. Equally, 1 kg of charcoal does not supply the same quantity of energy as 1 kg of firewood and must therefore be converted into energy equivalents. In order to ensure comparable values, all cooking fuels were therefore converted into TJ/tonne by applying default Net Calorific Values from the IPCC (Project Database, rows AD to AG). The total biomass and total fossil fuels used were then derived for each customer. Whilst most use a mix of fuels, an individual customer may only account for emission reductions using AMS-I.E or AMS-I.I. and are therefore allocated to a specific methodology.

To determine which methodology applies, the most dominant fuel type (biomass or fossil fuel) was used (see Project Database, column AJ). The emission reductions were then calculated separately

for AMS-I.E or AMS-I.I depending on the number of digesters installed per month falling into each methodology type.<sup>14</sup>

### Calculation of baseline emissions under AMS-I.E (version 4.0)

Emission reductions under AMS-I.E are calculated using the following formula:

$$ER_y = B_y * f_{NRB,y} * NCV_{biomass} * EF_{projected\_fossilfuel} \quad (1)$$

Where:

$ER_y$  Emission reductions from non-renewable biomass use during the year  $y$  in tCO<sub>2</sub>e

$B_y$  Quantity of woody biomass that is substituted or displaced in tonnes

$f_{NRB,y}$  can Fraction of woody biomass used in the absence of the project activity in year  $y$  that be established as non-renewable biomass using survey methods (percentage)

$NCV_{biomass}$  Net calorific value of the non-renewable woody biomass that is substituted (IPCC default for firewood, 0.015 TJ/tonne)

$EF_{projected\_fossilfuel}$  Emission factor for the substitution of non-renewable woody biomass by similar consumers. Use a value of 81.6 tCO<sub>2</sub>/TJ

The baseline emissions per biogas digester were therefore:

$$BE_y = 7.42 * 95.1\% * 0.015 * 81.6 = 8.64 \text{ tCO}_2\text{e/year}$$

Please refer to the emission reduction calculation spreadsheet for the full calculations.

### Calculation of baseline emissions under AMS-I.I (version 4.0)

The baseline emissions are calculated following 'Option 2: Based on thermal energy generate' of the methodology. The emission reductions are calculated using the following formula:

$$ER_y = \sum_k N_{k,0} * n_{k,y} * BS_{k,y} * EF * \eta_{PJ/BL} * NCV_{biogas} - LE_y \quad (2)$$

Where:

$ER_y$  Emission reductions from fossil fuel use during the year  $y$  in tCO<sub>2</sub>e

$N_{k,0}$  Number of thermal applications  $k$  commissioned

$n_{k,y}$  Proportion of  $k,0 N$  that remain operating in year  $y$  (fraction)

$BS_{k,y}$  The net quantity of renewable biogas consumed by the thermal application  $k$  in year  $y$ . A default biogas generation rate of 0.13 Nm<sup>3</sup>.m<sup>-3</sup>.day<sup>-1</sup> is applied. This is equivalent to 0.3080 tonnes per year.

$EF$  Mean CO<sub>2</sub> emission factor, in tonnes/TJ (calculated as the mean of  $EF_{fossil\ fuel}$ )

$\eta_{PJ/BL}$  Ratio of efficiencies of project equipment and baseline equipment

<sup>14</sup> See Project Database, Tab 'Analysis', rows 4 and 5.

NCV<sub>biogas</sub> Net calorific value of the biogas, use default value: 0.0215 GJ/m<sup>3</sup> biogas. This is equivalent to 0.0182 TJ/tonne

The baseline emissions per biogas digester were therefore:

$$BE_y = 75.9387\% * 0.3080 * 70.8 * 3.67 * 0.0182 = 1.1127 \text{ tCO}_2\text{e/year}$$

Please refer to the emission reduction calculation spreadsheet for the full calculations.

### Calculation of baseline emissions under AMS-III.R (version 2.0)

Emission reductions under AMS-III.R are calculated using the following formula:

$$BE_y = GWP_{CH_4} * D_{CH_4} * UF_b * \sum_{j,LT} MCF_j * B_{O,LT} * N_{LT,y} * VS_{LT,y} * 365 * MS\%_{Bl,j} \quad (3)$$

Where:

BE<sub>y</sub> Baseline emissions from manure handling during the year y in tCO<sub>2</sub>e

GWP<sub>CH<sub>4</sub></sub> Global Warming Potential of methane

D<sub>CH<sub>4</sub></sub> CH<sub>4</sub> density (0.00067 t/m<sup>3</sup>)

UF<sub>b</sub> Model correction factor to account for model uncertainties (0.94)

LT Index for all types of livestock

J Index for animal manure management system

MCF<sub>j</sub> Annual methane conversion factor (MCF) for the baseline manure management system j

B<sub>O,LT</sub> Maximum methane producing capacity for manure produced by livestock category LT in m<sup>3</sup> CH<sub>4</sub>/kg dm

N<sub>LT,y</sub> Annual average number of animals of type LT in year y (numbers)

VS<sub>LT</sub> Daily volatile solid excreted for livestock category LT in kg/day

MS%<sub>Bl,j</sub> Fraction of manure handled in the baseline animal manure management system j

Calculation of N<sub>LT,y</sub>

N<sub>LT,y</sub> was calculated using the following formula:

$$N_{LT,y} = N_{da,y} * \left( \frac{N_{p,y}}{365} \right) \quad (4)$$

Where:

N<sub>da,y</sub> Number of days animal is alive in the farm in year y

N<sub>p,y</sub> Number of animals produced annually of type LT for year y

N<sub>LT,y</sub> for cows is therefore:

$$N_{cow,y} = 343 * (4.787.22/365) = 4.496.78$$

N<sub>LT,y</sub> for market swine is therefore:

$$N_{\text{marketswine},y} = 336 * (6.26/365) = 5.76$$

The baseline emissions per biogas digester were therefore:

$$BE_y = (25 * 0.00067 * 0.94 * 6.14\% * ((0.13 * 4.49678 * 1.9) + (0.29 * 05.76 * 0.3)) * 365 * 100\%) = 0.397687 \text{ tCO}_2\text{e/year}$$

Please refer to the emission reduction calculation spreadsheet for the full calculations.

## H.2. Calculation of project emissions or actual net GHG removals by sinks

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### Calculation of project emissions under AMS-I.E (version 4.0)

No project emissions are accounted for under the methodology

### Calculation of project emissions under AMS-I.I (version 4.0)

As Option 2 is chosen to calculate the baseline emissions, no project emissions are accounted for.

### Calculation of project emissions under AMS-III.R (version 2.0)

Project emissions due to physical leakage of biogas from the animal manure management are accounted for in accordance with option (b) listed in paragraph 13 from AMS-III.D. version 18, where a default factor of 0.05m<sup>3</sup> per 1m<sup>3</sup> of produced biogas.

$$PE_y = X * GWP_{CH_4} * D_{CH_4} * UF_b * \sum_{j,LT} MCF_j * B_{O,LT} * N_{LT,y} * VS_{LT,y} * 365 * MS\%_{Bl,j}$$

Where:

X	Physical leakage of biogas, where a default factor of 0.05 m <sup>3</sup> per 1 m <sup>3</sup> of produced biogas.
BE <sub>y</sub>	Baseline emissions from manure handling during the year y in tCO <sub>2</sub> e
GWP <sub>CH<sub>4</sub></sub>	Global Warming Potential of methane
D <sub>CH<sub>4</sub></sub>	CH <sub>4</sub> density (0.00067 t/m <sup>3</sup> )
UF <sub>b</sub>	Model correction factor to account for model uncertainties (0.94)
LT	Index for all types of livestock
J	Index for animal manure management system
MCF <sub>j</sub>	Annual methane conversion factor (MCF) for the baseline manure management system j
B <sub>O,LT</sub>	Maximum methane producing capacity for manure produced by livestock category LT in m <sup>3</sup> CH <sub>4</sub> /kg dm
N <sub>LT,y</sub>	Annual average number of animals of type LT in year y (numbers)
VS <sub>LT</sub>	Daily volatile solid excreted for livestock category LT in kg/day
MS% <sub>Bl,j</sub>	Fraction of manure handled in the baseline animal manure management system j

The project emissions are therefore:

$$PE = 0.05 * (25 * 0.00067 * 0.94 * 6.14\% * ((0.13 * 4.496.78 * 1.9) + (0.29 * 05.76 * 0.3)) * 365 * 100\%) = 0.0196384 \text{ tCO}_2\text{e/year}$$

Please refer to the emission reduction calculation spreadsheet for the full calculations.

### H.3. Calculation of leakage

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#### Calculation of leakage under AMS-I.E (version 4.0)

In accordance with the methodology (paragraph 10), leakage is accounted for by multiplying emission reductions by a net to gross adjustment factor of 0.95 to account for leakages.

#### Calculation of leakage under AMS-I.I (version 4.0)

In accordance with the methodology (paragraph 16), leakage is not considered if the biogas digesters are part of a Type III CDM project activity. Leakage is therefore accounted for under AMS-III.R since all biogas digesters under the project apply this methodology.

#### Calculation of leakage under AMS-I.I (version 4.0)

In accordance with the methodology (paragraph 11) no leakage is considered as the biogas digesters are not transferred from another activity.

### H.4. Summary of calculation of GHG emission reductions or net GHG removals by sinks

Specific-case CPA reference number	Baseline emissions or baseline net GHG removals by sinks (tCO <sub>2</sub> e)	Project emissions or actual net GHG removals by sinks (tCO <sub>2</sub> e)	Leakage (tCO <sub>2</sub> e)	GHG emission reductions or net GHG removals by sinks (tCO <sub>2</sub> e) achieved in the monitoring period		
				Up to 31/12/2012	From 01/01/2013	Total amount
CPA 7734-0001	3,696.792,758.03	8.463.76	174.49132.49	0.00	3,513.842,621.78	3,513.842,621.78
....				Discounting by 3x the % precision points missed for Nk,y (Operational rate) <sup>15</sup>		-102.25
<b>Total</b>	2,758.033,696.79	3.768.46	132.49174.49	0.00	2,621.783,513.43	2,5193,513

### H.5. Comparison of GHG emission reductions or net GHG removals by sinks with estimates in the included CPA-DD(s)

Specific-case CPA reference number	Value estimated in ex ante calculation in the included CPA-DD(s)	Actual values achieved by the specific-case CPA(s) during this monitoring period
CPA 7734-0001	126,322	3,5132,519
....		
<b>Total</b>	126,322	2,5193,513

<sup>15</sup> See emission reduction calculation spreadsheet, sheet 'CDM CPA1 Total ERs', cells G84 – G88 and Section E.1 of this monitoring report.

**H.6. Remarks on difference from the estimated value in the included CPA-DD(s)**

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The emission reductions in this first monitoring period are significantly lower than those expected in the ex-ante calculation in the CPA-DD over the same time period (20/01/2013 – 31/12/2015). This is due to the following main reasons:

- **Implementation schedule:** the CPA-DD assumed the implementation of 4,000 manure-fed and 6,000 organic-waste fed digesters in 2013. The pace of implementation has in fact been slower, and no organic-waste fed digesters are installed. Up until 31/12/2015 276 digesters were included in the CPA.
- **Methane conversion factor (MCF) (AMS-III.R):** the ex-ante emission reduction calculations assumed that the baseline manure management practices would result in a Methane Conversion Factor of 41.52%. This was based on a survey conducted by the Kenya Agricultural Research Institute<sup>16</sup> amongst 300 rural households in Central Kenya, which indicated that 67% of the farmers store their manure in uncovered pits, and 33% through solid storage. The outcome of the baseline manure management survey, carried out for 100% of the project population, revealed that a much lower percentage of the population handles their manure anaerobically. The most common manure management practices before receiving a biogas digester were pit storage for less than 1 month (39.3%), dry lot (22.1%), solid storage (11.8%) and daily spread (11.4%). The ex-post MCF is therefore 6.14%.
- **Number of days animal is alive on farm (AMS-III.R):** the ex-ante emission reduction calculations assumed all animals were alive for 365 days of the year. The monitoring results revealed that on average cows were alive for only 343 days per year, and market swine for 336.0 days per year.
- **Number of animals produced annually (Np,y) (AMS-III.R):** the ex-ante emission reduction calculations assumed customers owned 3 cows each. The monitoring results revealed that on average customers own 4.787.22 cows and 06.26 market swine each.
- **Update to AMS-I.I version 4.0:** this version of the methodology allowed the application of a default factor for the calculation of the parameter BSk,y. This resulted in the application of a 0.308 tonnes/year of biogas rather than the ex-ante value of 0.27 tonnes/year.
- **Update of the GWP of methane** to 25, rather than a value of 21 applied at registration of the programme.
- **Temporary deviation from registered monitoring plan:** the project was not able to conduct monitoring until early 2016. Hence, to maintain compliance with the Project Standard (version 9), conservative values needed to be applied for the years 2013 and 2014 within the monitoring period. Please refer to section E.1 of this monitoring report for more details.

<sup>16</sup> Cattle manure quality in Maragua District, Central Kenya: Effect of management practices and development of simple methods of assessment (2002)

# Appendix 1. Contact information of coordinating/managing entity and/or responsible persons/entities

<b>Coordinating/managing entity and/or responsible person/entity</b>	<input checked="" type="checkbox"/> Coordinating/managing entity <input type="checkbox"/> Person/entity responsible for completing the CDM-MR-FORM
<b>Organization name</b>	SimGas IP BV
<b>Street/P.O. Box</b>	Binckhorstlaan
<b>Building</b>	36
<b>City</b>	The Hague
<b>State/Region</b>	South Holland
<b>Postcode</b>	2516 BE
<b>Country</b>	The Netherlands
<b>Telephone</b>	+31 645 406 419
<b>Fax</b>	Not applicable
<b>E-mail</b>	<a href="mailto:Sannecastro@simgas.org">Sannecastro@simgas.org</a>
<b>Website</b>	<a href="http://www.simgas.nl">www.simgas.nl</a>
<b>Contact person</b>	Sanne Castro
<b>Title</b>	CEO
<b>Salutation</b>	Mr.
<b>Last name</b>	Castro
<b>Middle name</b>	-
<b>First name</b>	Sanne
<b>Department</b>	-
<b>Mobile</b>	-
<b>Direct fax</b>	-
<b>Direct tel.</b>	+31 645 406 419
<b>Personal e-mail</b>	<a href="mailto:Sannecastro@simgas.org">Sannecastro@simgas.org</a>

