

TEMPLATE

MONITORING REPORT

PUBLICATION DATE 14.10.2020

VERSION v. 1.1

RELATED SUPPORT - TEMPLATE GUIDE Monitoring Report v. 1.1

This document contains the following Sections

Key Project Information

0 - Description of project

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0 - Data and parameters

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KEY PROJECT INFORMATION

Programme of Activity Information

GS ID of Programme	GS12063
Title of Programme	HomeBiogas Programme in Kenya
Version of POA-DD applicable to this monitoring report	02
Name and GS ID of fully Validated CPA/VPAs (i.e. non compliance check)	HomeBiogas Programme in Kenya – VPA1 (12064)

Key Project Information

GS ID (s) of Project (s)	12064
Title of the project (s) covered by monitoring report	GS12063 HomeBiogas Programme in Kenya – VPA1
Version number of the PDD/VPA-DD (s) applicable to this monitoring report	5
Version number of the monitoring report	5
Completion date of the monitoring report	13/02/2024
Date of project design certification	20/12/2023
Date of Last Annual Report	NA
Monitoring period number	1 st Monitoring Period
Duration of this monitoring period	01/03/2022 to 30/06/2023 (both dates included)
Project Representative	HomeBiogas LTD
Host Country	Kenya
Activity Requirements applied	☒ Community Services Activities ☐ Renewable Energy Activities ☐ Land Use and Forestry Activities/Risks & Capacities ☐ N/A

Methodology (ies) applied and version number	GS Methodology: Methodology for Animal Manure Management and Biogas Use for Thermal Energy Generation V.1.1
Product Requirements applied	☒ GHG Emissions Reduction & Sequestration ☐ Renewable Energy Label ☐ N/A

Table 1 - Sustainable Development Contributions Achieved

Sustainable Development Goals Targeted	SDG Impact	Amount Achieved	Units/ Products
13Climate Action (mandatory)	Amount of GHG Emission reduction	7,692	tCO2e/y
1: No Poverty	Proportion of population living in households with access to basic services	100%	-
2. Zero Hunger	Number of farmers adopted practices promoted by the project	1,355	Nos
3: Good health and well being	Percentage of project population using polluting fuels (reduction)	5.98% (81.6% reduction)	-
5: Gender Equality	Average time saving associated with cooking time and fuel collection	3.18	Hours
7: Affordable and Clean energy	Number of beneficiaries: Households	1,355	Nos
8: Decent work and economic growth	Total Number of Jobs	56	Nos
15: Life on Land	Total non-renewable wood fuel saved	1,922	Tonnes

Table 2 – Product Vintages

		Amount Achieved
Start Dates	End Dates	GS VERs
01/03/2022	31/12/2022	2,898
01/01/2024	30/06/2923	4,794

SECTION A. DESCRIPTION OF PROJECT

A.1. General description of project

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The proposed project activity involves installation of biogas units (clean and sustainable source of renewable energy for cooking) at the target households in Kenya. HomeBiogas distributes 2.5 m³ biogas systems to rural households at subsidized price. The biogas system will replace traditional wood stove and thereby avoid CO₂ emission associated with wood burning. The biogas systems use the animal manure as feedstock which was dumped in a pit in the baseline scenario. Hence, the biogas systems also avoid CH₄ emission from the animal manure dumped in pits.

The project activity aims to provide around 50,000 households with a biogas unit. The capacity of the biodigester will be 8m³ (2.5 m³ gas tank volume) depending on the need of the family. The gas production capacity and digester capacity are given below:

Type	Balloon type
Manufacture	HomeBiogas
Gas tank Volume	2.5 m ³
Digester Volume (excluding gas storage)	5.5 m ³
Total System Volume	8 m ³

The implementation of the biogas units is started on 1st February 2022. The biogas units are expected to start generating biogas for consumption in about 20-25 days from its installation. The installation of the biogas units will be carried out progressively throughout the year. A project database will be maintained to keep track of the date of commissioning of each unit constructed. Each biogas unit constructed has been given a unique identification number so that they can be easily identified during the monitoring surveys and to avoid double counting of the total installed units.

As on 30th June 2023, about 1,355 number of digesters are implemented. During the reported monitoring period (01/03/2022 to 30/06/2023), the total emission reduction achieved is 7,692 tCO₂.

A.2. Location of project

The project is being implemented in rural households in Kenya.

The geographical coordinates of the project districts are provided below:

Country	Latitude	Longitude
Kenya	0° 1' 24.96" N (0.0236°)	37° 54' 22.32" E (37.9062°)

The project location is highlighted in the below map:



A.3. Reference of applied methodology

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Gold Standard Methodology: Methodology for Animal Manure Management and Biogas Use for Thermal Energy generation v1.1

Additional Guidelines Referred:

Cookstove Usage Rate Guidelines, version 2.0

A.4. Crediting period of project

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Start date of crediting period: 01/03/2022

End date of crediting period: 28/02/2027

Length of crediting period: 5 years

Type: Renewable

SECTION B. IMPLEMENTATION OF PROJECT

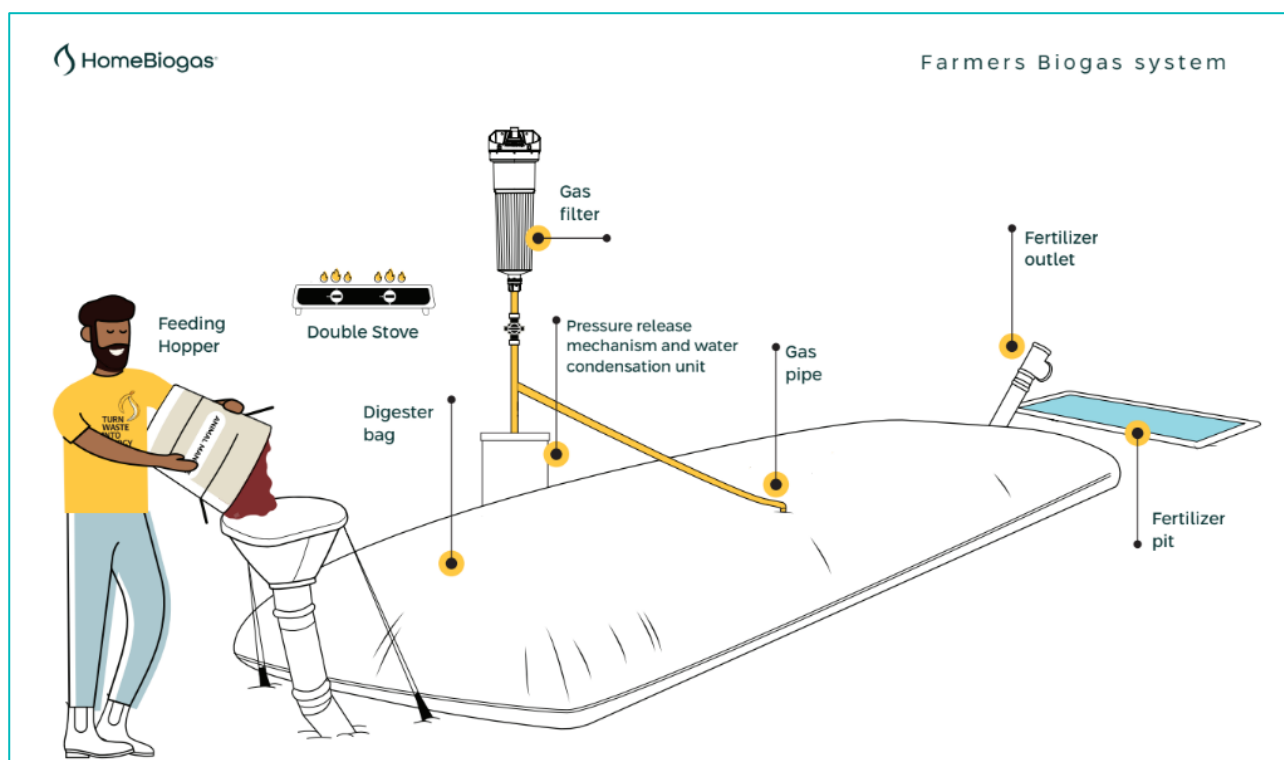
B.1. Description of implemented project

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The balloon type biodigesters technology is used in the current VPA. This type digesters are pre-fabricated modular semi-continuous flow type hybrid reactors that are made of UV protected polypropylene. The accessories and pipes are made of hydraulic PVC and HDPE (High-density polyethylene) material. In addition to the basic connections, H₂S filter, pressure release valves and the water condensate trap are provided to ensure safe functioning of the system. An additional geotextile lining is provided which is placed below the reactor to protect the unit from rodents and other such issues. The technical specification of the 2.5 m³ digesters are given below:

Type of digester	Balloon
Manufacturer	HomeBiogas
Model	Farmers Biogas System
Gas output (design capacity)	2.5 m ³
Digester Volume	5.5 m ³
Gas Storage Volume	2.5 m ³
Bio-fertilizer daily Production (LPD)	150 Liters
Dung to water ratio	For Cow dung: 1:2 For swine dung: 1:4
Digester material	UV protected Polypropylene
Stove type	2 burner stove
Ancillaries	Pipes, Stove, Connectors, Nylon sheet, feeding hopper, bucket and parts bag.
Lifetime	15 years

Parts of the digesters



The details of month wise installed digesters are given below:

Month	No of unit Commission
Feb-22	20
Mar-22	41
Apr-22	54
May-22	52
Jun-22	84
Jul-22	124
Aug-22	89
Sep-22	70
Oct-22	142
Nov-22	110
Dec-22	89
Jan-23	44
Feb-23	79
Mar-23	70
Apr-23	101
May-23	74
Jun-23	112
Total	1,355

As on 30/06/2023, total of 1,355 digesters were installed.

Also, there is no change occurred to the project design during the monitoring period.

B.1.1 Forward Action Requests

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The FARs raised during the Preliminary Request Form for the POA are as follows:

FAR	FARs raised during the Preliminary Review	Response
FAR 1	PD shall provide start date evidence of the PoA to the validating VVB	The project database with the implementation date of all the biodigesters are provided. As per the database, the implementation date of the first digester is considered to be the start date of the PoA.
FAR 2	The programme is implemented within a region where another biogas project is in existence. PD shall document in the PoA-DD how the PoA will ensure that there is no double counting.	PD signed an agreement with all the end-users which confirms that only PD owns the rights to the carbon credits (VERs). Each digesters have a unique ID number to avoid the double counting. Moreover the project type digester itself is unique and manufactured by Homebiogas which is entirely different from biogas installed in the existing project Also, the double counting declaration has been provided by the PD.

The FARs raised during the Preliminary Request Form for the VPA are as follows:

FAR	FARs raised during the Preliminary Review	Response
FAR 1	PD shall upload signed Terms of Use to the SC App.	The Terms of Use has been now uploaded to the SC App
FAR 2	The title of the project in stakeholders consultation report is	The stakeholder consultation is conducted at the PoA level and hence the title of stakeholder

	not consistent with the title in the SC App	consultation matches with the PoA title and not the VPA title in the SC App
FAR 3	There is to evidence in section B.1 of LSC report to show that Gold Standard invitation was sent out.	Gold Standard invitation proof is now added in the section B.1 of the LSC report.
FAR 4	PD shall confirm if carbon rights transfer was discussed during the consultations.	PD has conveyed the carbon rights ownership with the end-users and the same has been mentioned in the minutes of meetings of the LSC. Also, an agreement has been signed with all the end-users.
FAR 5	In section A.2 of the LSC report, under timelines, it is stated that the first biodigester was installed in August 2022, however, in meeting minutes in C.2, par 6 on sharing experience, Joseph said he has been using the biodigester since January, while in the preliminary revied form, the start date is February 2022. PD shall confirm the exact start date of the project and provide evidence.	The 1 st installation of the biodigester was done in February 2022 and is now consistent with LSC, MOM and start date of the VPA. The database with the implementation dates of the project activity is provided as the evidence for the start date.
FAR 6	PD shall carry out Stakeholders Feedback Round (SFR) as per the stakeholders consultation requirement and update section E of the final LSC report afterwards.	The Stakeholders Feedback Round (SFR) has been conducted by PD from 25/07/2023 to 24/08/2023 and it has been updated in section E of the LSC report.

B.2. Post-Design Certification changes

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B.2.1. Temporary deviations from the approved Monitoring & Reporting Plan, methodology or standardized baseline

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No temporary deviation applied.

B.2.2. Corrections

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No correction in the registered PDD is applied.

B.2.3. Changes to start date of crediting period

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No change in start date is applied.

B.2.4. Permanent changes from the Design Certified monitoring plan, applied methodology or applied standardized baseline

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No permanent changes applied.

B.2.5. Changes to project design of approved project

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No change in the project design applied.

SECTION C. DESCRIPTION OF MONITORING SYSTEM APPLIED BY THE PROJECT

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The monitoring data collected is specific to the characteristics of the project scenario, and the following information will be collected during each monitoring survey:

- User follow up
 - Address or location
 - Mobile telephone number and/or landline telephone number (if possible)
- End user characteristics
 - Number of people served by the biogas technology
 - Number of biogas hours used per day per household
 - Number of animals (per category) per household
 - Amount of dung collected from the shed etc.
- Biogas and other fuels used for cooking
 - Types of project technologies used and estimated frequency
 - Types of fuels used and quantities
 - Seasonal variations
 - Sources of fuels other than biogas; (purchased or hand-collected, etc.) and prices paid or effort made (e.g. walking distances, persons collecting, opportunity cost)
- SDG's impact
 - If had any technical problems with the biodigester (cracks) pipe damaged, stove damaged etc.)
 - If received training by the project supervisors on the maintenance of the unit
 - Use of the biogas slurry
 - Reduction in the use of firewood for cooking and heating water

Data Management:

The complete project data including the digester installation database, baseline data, monitoring data, repair & maintenance data etc., will be recorded in a CRM database of CME. The field staff will update the project data in this excel sheet from the field itself as and when the data is collected. To ensure the accuracy of the data the coordinators regularly cross-verify the data collected by the field staff.

SECTION D. DATA AND PARAMETERS

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

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BGTA 1

Data/parameter	Avoidance of double counting or double claiming among project participants.
Unit	NA
Description	Evidence of avoidance of double counting or double claiming with other parties directly involved with the project or programme.
Source of data	Written assertions with the project developer of the ownership rights and intention of selling the emission reductions resulting from the project activity directed at or signed with all end users
Value(s) applied	No double counting involved
Choice of data or Measurement methods and procedures	NA
Purpose of data	To avoid double counting
Additional comment	As Home Biogas is the manufacture of biogas system as well as project and distributing directly to the households, there is no other project participant or retailers are involved in this project. The agreement signed with all end users will be provided to VVB at the time of verification.

BGTA 2

Data/parameter	Avoidance of double counting or double claiming with other mitigation actions
Unit	NA
Description	Review and analysis of mitigation actions in other voluntary market or UNFCCC/compliance mechanism
Source of data	Using publicly available information from Gold Standard and other voluntary standards, at a minimum Verra and any recognised national or regional standards in the

	project location, and UNFCCC CDM project & PoA database: - identify and list any mitigation actions of similar technology, i.e., that provide the same kind of output and use the same kind of equipment or conversion process, operating in overlapping spatial boundaries. If one or more are identified: - describe the practices that will be implemented to ensure that the programme or project activity quantifies emission reductions only from technology it has implemented, - describe the practices to avoid that the programme or project activity implementation displaces technology of other mitigation actions, and - design a method to discount emission reductions in case the programme or project activity is found to displace or operate alongside another mitigation action
Value(s) applied	The digesters are manufactured by Home Biogas and all end users signed agreement with Home Biogas hence not part of in any other registered project. Hence, no double counting involved.
Choice of data or Measurement methods and procedures	NA
Purpose of data	To avoid double counting
Additional comment	-

BGTA 3

Data/parameter	Regulatory framework for provision of animal waste management and thermal energy services.
Unit	NA
Description	Evidence that the project does not undermine or conflict with any national, sub-national or local regulations or guidance for thermal energy supply/devices or fuel supply or use
Source of data	Online research

Value(s) applied	No regulatory framework for provision of animal waste management and thermal energy services are available in Kenya
Choice of data or Measurement methods and procedures	NA
Purpose of data	NA
Additional comment	This check will be undertaken at the start of each crediting period

BGTA 4

Data/parameter	Project technology description
Unit	NA
Description	The detailed description of the project technology (including both biodigester and biogas stove) shall include as a minimum: - manufacturer name (if applicable), - product name (if applicable), - technology type, - capacity characteristics (e.g., volume of digester), - continuous useful energy output demonstration, - rated thermal efficiency of biogas stove, - any performance certifications from national standards body or certification body recognized by national standards body also shall be provided.
Source of data	Manufacturer specifications
Value(s) applied	Refer section A.3 above
Choice of data or Measurement methods and procedures	NA
Purpose of data	NA
Additional comment	NA

BGTA 5

Data/parameter	Expected technical life of project technology
Unit	Years
Description	The expected technical life of an individual project technology shall be defined in the PDD.
Source of data	Manufacturer specifications
Value(s) applied	15 years
Choice of data or Measurement methods and procedures	NA
Purpose of data	NA
Additional comment	The lifetime is higher than the crediting period.

BGTA 6

Data/parameter	Baseline scenario survey results.
Unit	NA
Description	Report of the results of the baseline scenario survey.
Source of data	Baseline Survey Sheet
Value(s) applied	Refer section E below
Choice of data or Measurement methods and procedures	NA
Purpose of data	To Calculate the baseline emission
Additional comment	NA

BGTA 7

Data/parameter	GWP _{CH4}
Unit	tCO ₂ e per tCH ₄

Description	Global Warming Potential (GWP) of methane applicable to the crediting period
Source of data	IPCC ¹
Value(s) applied	28
Choice of data or Measurement methods and procedures	As the crediting period starts after 31st December 2020, the result of GWP value IPCC AR5 report is applicable.
Purpose of data	To Calculate the baseline & project emission
Additional comment	The value shall be updated according to any future COP/MOP decisions.

BGTA 8

Data/parameter	$MS\%_{BL,j}$											
Unit	%											
Description	Fraction of manure handled in baseline animal manure management system j											
Source of data	Baseline Survey											
Value(s) applied	<table><tr><th>Parameter</th><th>Dairy_cow</th><th>Market_Swine</th></tr><tr><td>MS%BI,liquid/slurry/ Pit-storage</td><td>99.11%</td><td>99.11%</td></tr><tr><td>MS%, Daily Spread</td><td>0.89%</td><td>0.89%</td></tr></table>	Parameter	Dairy_cow	Market_Swine	MS%BI,liquid/slurry/ Pit-storage	99.11%	99.11%	MS%, Daily Spread	0.89%	0.89%		
Parameter	Dairy_cow	Market_Swine										
MS%BI,liquid/slurry/ Pit-storage	99.11%	99.11%										
MS%, Daily Spread	0.89%	0.89%										
Choice of data or Measurement methods and procedures	Taken from baseline survey and hence it is project specific value.											
Purpose of data	To Calculate the baseline emission											
Additional comment	The value shall be updated according to any future COP/MOP decisions.											

¹<https://www.goldstandard.org/project-developers/standard-documents>

BGTA 10

Data/parameter	VSLT,y
Unit	Kg – dm/ animal/ day
Description	Volatile solid production/excretion rate per animal of livestock LT per day
Source of data	Calculated using the equation as per the applied methodology $VS_{LT,y} = (VS_{rate,LT} \times \frac{TAM_{LT}}{1000}) \times nd_y$ Dairy cow, VSLT,y = $(15.2 \times (260 \div 1000))$ = 3.9520 Market_Swine, VSLT,y = $(8.7 \times (49 \div 1000))$ = 0.4263
Value(s) applied	Dairy Cow: 3.9520 Market Swine: 0.4263
Choice of data or Measurement methods and procedures	Calculated
Purpose of data	To Calculate the baseline emission
Additional comment	-

Data/parameter	<i>VSrate,LT</i>
Unit	(1000 KG ANIMAL MASS)-1 DAY-1)
Description	Default values for volatile solid excretion rate.
Source of data	IPCC Default Value Default values from table 10.13A of chapter 'Emissions from Livestock and Manure Management' under the volume 'Agriculture, Forestry and

	other Land use' of the 2019 IPCC Guidelines for National Greenhouse Gas Inventories ²
Value(s) applied	Dairy Cow: 15.20 Market Swine: 8.70
Choice of data or Measurement methods and procedures	IPCC value is taken as the country specific value is not available
Purpose of data	To Calculate the baseline emission
Additional comment	-

Data/parameter	TAM _{LT}
Unit	kg
Description	Default values for live weights for animal categories
Source of data	IPCC Default Value Default values from table 10A.5 (new) of chapter 'Emissions from Livestock and Manure Management' under the volume 'Agriculture, Forestry and other Land use' of the 2019 IPCC Guidelines for National Greenhouse Gas Inventories ³
Value(s) applied	Dairy Cow: 260 Market Swine: 49
Choice of data or Measurement methods and procedures	IPCC value is taken for calculation as the country specific value is not available.
Purpose of data	To Calculate the baseline emission

² Table 13.A(New) https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch10_Livestock.pdf

³ Table 10A.5 (New) https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch10_Livestock.pdf

Additional comment	-
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BGTA 11

Data/parameter	$B_{0,L,T}$
Unit	m3 CH4/kg-dm
Description	Maximum methane production potential of the volatile solid generated for animal type LT.
Source of data	IPCC ⁴ Default Value Default values from table 10.16 of chapter 'Emissions from Livestock and Manure Management' under the volume 'Agriculture, Forestry and other Land use' of the 2019 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied	Dairy Cow: 0.13 Market Swine: 0.29
Choice of data or Measurement methods and procedures	IPCC value is taken as the country specific value is not available
Purpose of data	To Calculate the baseline emission
Additional comment	-

BGTA 12

Data/parameter	$MCF_{j,k}$
Unit	%
Description	Annual methane conversion factor (MCF) for the baseline animal manure management system by climate region k.

⁴Table 10.16A https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch10_Livestock.pdf

Source of data	IPCC Default Value Default values from table 10.17 of chapter 'Emissions from Livestock and Manure Management' under the volume 'Agriculture, Forestry and other Land use' of the 2019 IPCC Guidelines for National Greenhouse Gas Inventories ⁵		
Value(s) applied	Parameter	Dairy_cow	Market_Swine
	MCF, liquid/slurry/Pit-storage	62.0%	62.0%
	MCF,daily spread	1.0%	1.0%
Choice of data or Measurement methods and procedures	IPCC value is taken as the country specific value is not available. Kenya falls under Tropical dry region. As per the baseline survey, the average time the dung stored in pit is 3.3 month and hence the value applicable for 3 month is considered from IPCC.		
Purpose of data	To Calculate the baseline emission		
Additional comment	-		

BGTA 13

Data/parameter	<i>EF_{b,i,CO2}</i>
Unit	tCO ₂ /TJ
Description	CO ₂ emission factor arising from use of fuels in baseline scenario
Source of data	IPCC Default Value Default values ⁶
Value(s) applied	Wood – 112 tCO ₂ /TJ Charcoal – 165.22 tCO ₂ /TJ LPG – 63 tCO ₂ /TJ
Choice of data or Measurement methods and procedures	IPCC value is taken as per the methodological requirement

⁵Table 10.17 https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch10_Livestock.pdf

⁶Section 2.3.2

https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/2_Volume2/19R_V2_2_Ch02_Stationary_Combustion.pdf

Purpose of data	To Calculate the baseline emission
Additional comment	-

BGTA 14

Data/parameter	$EF_{b,i,non-CO2}$
Unit	tCO ₂ /TJ
Description	Non-CO ₂ emission factor arising from use of fuels in baseline scenario
Source of data	IPCC and Methodology Default values
Value(s) applied	Wood – 9.46 tCO ₂ /TJ Charcoal – 44.83 tCO ₂ /TJ LPG – 0.17 tCO ₂ /TJ
Choice of data or Measurement methods and procedures	IPCC value is taken as per the methodological requirement
Purpose of data	To Calculate the baseline emission
Additional comment	-

BGTA 15

Data/parameter	EF_{p,i,CO_2}
Unit	tCO ₂ /TJ
Description	CO ₂ emission factor arising from use of fuels in project scenario
Source of data	IPCC Default Value ⁷
Value(s) applied	Wood – 112 tCO ₂ /TJ Charcoal – 165.2200 tCO ₂ /TJ LPG – 63 tCO ₂ /TJ
Choice of data or Measurement methods and procedures	IPCC value is taken as per the methodological requirement
Purpose of data	To Calculate the project emission
Additional comment	-

BGTA 16

Data/parameter	$EF_{p,i,non-CO_2}$
Unit	tCO ₂ /TJ
Description	Non-CO ₂ emission factor arising from use of fuels in project scenario
Source of data	IPCC and Methodology Default values
Value(s) applied	Wood – 9.46 tCO ₂ /TJ Charcoal – 44.83 tCO ₂ /TJ LPG – 0.17 tCO ₂ /TJ
Choice of data or Measurement methods and procedures	IPCC value is taken as per the methodological requirement

⁷ Section 2.3.2 https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/2_Volume2/19R_V2_2_Ch02_Stationary_Combustion.pdf

Purpose of data	To Calculate the project emission
Additional comment	-

BGTA 17

Data/parameter	$NCV_{b,i}$
Unit	TJ/ton
Description	Net calorific value of the fuels used in the baseline ⁸
Source of data	IPCC Default Value Default values
Value(s) applied	Wood – 0.0156 TJ/ton Charcoal – 0.0295 TJ/ton LPG – 0.0473 TJ/ton
Choice of data or Measurement methods and procedures	IPCC value is taken as per the methodological requirement
Purpose of data	To Calculate the baseline emission
Additional comment	-

BGTA 18

Data/parameter	$NCV_{p,i}$
Unit	TJ/ton
Description	Net calorific value of the fuels used in the project

⁸ Section 1.4.1.3 https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/2_Volume2/19R_V2_1_Ch01_Introduction.pdf

Source of data	IPCC Default Value Default values ⁹
Value(s) applied	Wood – 0.0156 TJ/ton Charcoal – 0.0295 TJ/ton LPG – 0.0473 TJ/ton
Choice of data or Measurement methods and procedures	IPCC value is taken as per the methodological requirement
Purpose of data	To Calculate the project emission
Additional comment	-

BGTA 20

Data/parameter	$P_{b,i,y}$			
Unit	tonnes/household/year			
Description	Average yearly consumption of baseline fuel i per household before the start of the project activity or at the renewal of each crediting period, whichever is later			
Source of data	Kitchen Performance Test & Baseline survey			
Value(s) applied	Primary fuel	Fuel Wood	Charcoal	LPG
	Amount	3.09	0.89	0.02
	The sample size has been calculated with 90/30 confidence/precision level considering the expected mean & standard deviation from the data derived from baseline survey. As per the sample size calculation the minimum sample size required is 5. However, we have conducted 41 households (32 households using fuel wood and 9 household using charcoal). The KPT results achieve			

⁹ Section 1.4.1.3 https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/2_Volume2/19R_V2_1_Ch01_Introduction.pdf

	required precision level of 30%. Please refer the ER calculation sheet.
Choice of data or Measurement methods and procedures	The fuel wood consumption & charcoal consumption are determined through KPT and the LPG consumption is determined through baseline survey.
Purpose of data	To Calculate the baseline emission
Additional comment	As per KPT, the fuel wood consumption per capita is 0.706 t/year which is lesser than Threshold value of 0.75 t/year. The value is also on par with the UNFCCC standardize baseline 'Baseline woody biomass consumption for household cookstoves in Kenya' v1 (Expired on 26th Feb 2020). As per KPT, the charcoal consumption per capita is 0.21 t/year which is in line with Threshold value of 0.195 t/year. The value is also on par with the UNFCCC standardized baseline 'Baseline woody biomass consumption for household cookstoves in Kenya' v1 (Expired on 26th Feb 2020).

BGTA 21

Data/parameter	$f_{NRB,i,y}$
Unit	percentage
Description	Fractional non-renewability status of woody biomass fuel during year y , in case the baseline fuel is biomass or charcoal.
Source of data	Calculated from various data. Please refer ER sheet
Value(s) applied	0.8249
Choice of data or Measurement methods and procedures	Determined by following the CDM TOOL30, Calculation of the fraction of non-renewable biomass.
Purpose of data	To Calculate the baseline emission & Project Emission
Additional comment	Determined ex-ante and fixed for a given crediting period

D.2 Data and parameters monitored

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SDG 13

BGTA 24

Data / Parameter	Avoidance of double counting or double claiming among project technology end users
Unit	NA
Description	Evidence of avoidance of double counting or double claiming with project technology end users
Source of data	Each biogas unit constructed are given a unique identification number so that they can be easily identified during the monitoring surveys and to avoid double counting of the total installed units.
Value(s) applied	No double counting
Measurement procedures (if applicable)	-
Monitoring frequency	Monitored whenever project technology is sold or otherwise disseminated.
QA/QC procedures	Cross check using general internet search and search of public records of Gold Standard and other voluntary market and UNFCCC mechanisms.
Purpose of data	To confirm no double counting.
Additional comment	-

BGTA 25

Data / Parameter	Up,y
Unit	Percentage
Description	Average usage rate in project scenario p during year y
Source of data	Users survey.
Value(s) applied	Usage rate as per survey: 100% Usage rate sued for ER calculation: 90%
Measurement procedures (if applicable)	It is based on the monitoring surveys to be carried for the project activity. The 'Requirements and Guidelines: Usage Rate Monitoring' is followed. The following mandatory guidelines are followed:

	- The stoves used within last 30 days is defined as the devices are in 'Use' and if the stove is not used for last 30 days is considered as 'non-use' - PP conducted annual household survey on sample basis and the following are considered during survey, Kitchen observation by surveyor, Interviewed the primary cook, Photos of the cooking area is taken, GPS coordinates of the household has been noted down - Verification checks done randomly by Homebiogas & consultant through physical visit & telephone to the sample households confirms recorded responses are correct CME also followed the Good Practices: - CME provided detailed training to all its monitoring staffs on the conducting usage survey. This is confirmed through verification of training records. During site visit the CME team also confirmed that the random checks were conducted during the survey to confirm the procedure followed by the monitoring staff are correct. - Provided trainings to all biogas users on the usage of the biogas at the start of the project. - Conducted awareness campaign to end users regularly to encourage use of biogas. PP followed the mandatory monitoring requirement & good practice requirement as per the section 2.2 & 2.3 of the Usage rate guideline. Hence claimed maximum possible usage rate of 90% as per the usage rate guideline.
Monitoring frequency	Annual
QA/QC procedures	Compliance with the general requirements for sampling (Section 4.4 of methodology) and general requirements for QA/QC (Section 4.5 of methodology)
Purpose of data	To calculate the baseline & project emission.
Additional comment	-

Parameters related to AWMS

BGTA 26

Data / Parameter	NLT,y
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Unit	Number
Description	Annual average number of animals of type <i>LT</i> in year <i>y</i>
Source of data	Monitoring Survey
Value(s) applied	Dairy Cow – 4.661 Market Swine- 0.636
Measurement procedures (if applicable)	Monitoring survey including photographic evidence with timestamps and GIS coordinates.
Monitoring frequency	Annual
QA/QC procedures	-
Purpose of data	To calculate the baseline & project emission.
Additional comment	-

BGTA 31

Data / Parameter	$MS\%_{i,y}$
Unit	%
Description	Fraction of manure handled in project animal manure management system <i>i</i>
Source of data	Survey
Value(s) applied	70%
Measurement procedures (if applicable)	This is determined through sample survey determined from representative sample (90/10 precision).
Monitoring frequency	Annual
QA/QC procedures	-
Purpose of data	To calculate the baseline & project emission.
Additional comment	-

Parameters related to Thermal application

BGTA 38

Data / Parameter	$Nb_{p,y}$
Unit	Days
Description	Number of project technology-days included in the project database for each project scenario in year <i>y</i> .
Source of data	Calculated from the Project database as the sum of the number of installed project technology unit's times the calendar days during the year <i>y</i> that they were used at the end user locations.
Value(s) applied	316,054

Measurement procedures (if applicable)	-
Monitoring frequency	Calculated annually
QA/QC procedures	Cross checked the results of the usage survey with the contents of the project database to confirm whether the project technology units surveyed are present at end user locations as expected, or not. No discrepancy observed.
Purpose of data	To calculate the baseline & project emission.
Additional comment	Applicable for Baseline Emission and Project Emission calculation.

BGTA 39

Data / Parameter	LE _{p,y}
Unit	tCO ₂ e per year
Description	Leakage in project scenario p during year y
Source of data	Sources established by following section 3.7 of methodology, Leakage emissions
Value(s) applied	0
Measurement procedures (if applicable)	The leakage assessment is provided in section E.3 below
Monitoring frequency	Every two years, or default discount value of 0.95 applied to emission reductions
QA/QC procedures	Compliance with the general requirements for sampling (Section 4.4 of methodology) and general requirements for QA/QC (Section 4.5 of methodology).
Purpose of data	To calculate the leakage emission.
Additional comment	Monitoring parameters required for calculating leakage emissions shall be included in the monitoring plan in the PDD as required to monitor and quantify the sources of leakage determined by following section 3.7 Leakage emissions.

c. Parameters related to other project emission

BGTA 42

Data / Parameter	P _{p,i,y}
Unit	tonnes/household/year
Description	Quantity of fuel that is consumed in project scenario p during year y.

Source of data	Project performance field tests
Value(s) applied	Firewood – 0.0989 Charcoal – 0 LPG – 0.0060
Measurement procedures (if applicable)	During the monitoring survey the households are interviewed to know whether the households use other fuel other than biogas for cooking. Then the KPT is conducted at the households who use the other fuels. But the LPG consumption is determined through baseline survey only.
Monitoring frequency	Updated every two years, or more frequently. The KPT values are valid for two years and may be applied for before or after period.
QA/QC procedures	Compliance with the general requirements for sampling (Section 4.4 of methodology), general requirements for QA/QC (Section 4.5 of methodology) and Annex 2: Complementary Guidelines For Kitchen Performance Testing.
Purpose of data	To calculate the project emission.
Additional comment	Applicable for Thermal application method 1

SDG 1

Data / Parameter	Proportion of population living in households with access to basic services
Unit	%
Description	The SDG 1 outcome will be estimated on the total number of beneficiaries, who will have “continuous access” to biogas (renewable energy) for daily cooking. The access to the use biogas for cooking will also ensure that the target beneficiaries have “free” access to basic energy needs for cooking and a sense of ownership of the installed biodigesters. The beneficiaries will also be trained on the proper maintenance of the units during the crediting years. The project beneficiaries are poor and cannot always afford to invest in other fuels for cooking (e.g. LPG), which makes them highly dependent on firewood for cooking. Therefore, in the longer term, the project activity will build the resilience among the project population who are

	vulnerable climate related and other socio-economic shocks.
Source of data	Monitoring surveys
Value(s) applied	100%
Measurement methods and procedures	The actual values will be based on the data collected during the monitoring surveys.
Monitoring frequency	Annually or more frequently
QA/QC procedures	Transparent data analysis and reporting.
Purpose of data	To monitor the positive contribution of the proposed project related to the SDG1.
Additional comment	-

SDG 2

Data / Parameter	Number of farmers adopted practices promoted by the project
Unit	Total number of households
Description	The SDG 3 outcome has been estimated on the total number of beneficiaries, who are making use of the slurry generated from biogas as biofertilizer.
Source of data	Monitoring surveys
Value(s) applied	1355 households
Measurement methods and procedures	The actual values will be based on the data collected during the monitoring sample surveys. The households will be asked about the reduction in indoor air pollution.
Monitoring frequency	Annually or more frequently
QA/QC procedures	Transparent data analysis and reporting.
Purpose of data	To monitor the positive contribution of the proposed project related to the SDG2.
Additional comment	

SDG 3

Data / Parameter	Percentage of project population using polluting fuels
Unit	%
Description	The SDG 3 outcome has been estimated on the total number of beneficiaries, who will avoid polluting fuel in cooking. The regular use of biogas will eventually reduce health problems related to indoor air pollution, especially among women who are constantly exposed and inhale harmful smoke while cooking with firewood.
Source of data	Monitoring surveys
Value(s) applied	5.96% (81.6% reduction from baseline)
Measurement methods and procedures	The actual values are based on the data collected during the monitoring sample surveys. The households are asked about the usage of other polluting fuels in cooking such as fuel wood & charcoal.
Monitoring frequency	Annually or more frequently
QA/QC procedures	Transparent data analysis and reporting.
Purpose of data	To monitor the positive contribution of the proposed project related to the SDG3.
Additional comment	As per WHO, about 3.8 million people a year die prematurely from illness attributable to the household air pollution caused by the inefficient use of solid fuels and kerosene for cooking ¹⁰ . By providing biogas systems for cooking needs the project avoids the indoor air pollution and thereby avoiding the related mortality

SDG 5

Data / Parameter	Average time saving associated with cooking time and fuel collection
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¹⁰<https://www.who.int/news-room/fact-sheets/detail/household-air-pollution-and-health>

Unit	Hours
Description	The SDG 5 outcome has been estimated on the total number of beneficiaries, who saved time in collecting firewood and cooking.
Source of data	Monitoring surveys
Value(s) applied	2.89 (3.55 hours reduction)
Measurement methods and procedures	Baseline & Monitoring survey
Monitoring frequency	Annually or more frequently
QA/QC procedures	-
Purpose of data	To monitor the positive contribution of the proposed project related to the SDG5.
Additional comment	

SDG 7

Data / Parameter	Number of beneficiaries: Households
Unit	Total number of households
Description	The SDG 7 outcome has been estimated on the total number of beneficiaries of the project activity, who will have continuous access to biogas. The project activity allows each household to benefit a free access to renewable and sustainable energy (biogas) for cooking.
Source of data	Project database
Value(s) applied	1355
Measurement methods and procedures	As and when a bio digester is installed the same is recorded in the project database.
Monitoring frequency	Continuous monitoring
QA/QC procedures	Transparent data analysis and reporting.

Purpose of data	To monitor the positive contribution of the proposed project related to the SDG7.
Additional comment	-

SDG 8

Data / Parameter	Total Number of Jobs
Unit	Total number of households
Description	The SDG 8 outcome has been estimated on the total number of jobs created by the project activity
Source of data	Employment records
Value(s) applied	56
Measurement methods and procedures	The employment records will be maintained by the HomeBiogas.
Monitoring frequency	Continuous monitoring
QA/QC procedures	Transparent data analysis and reporting.
Purpose of data	To monitor the positive contribution of the proposed project related to the SDG8.
Additional comment	-

SDG 15

Data / Parameter	Total non-renewable wood fuel saved
Unit	Tonnes
Description	The SDG 15 outcome has been estimated based on the quantity of firewood used per day for cooking and heating water, which eventually should decrease compared to the baseline situation without the availability of biogas for cooking. This will reduce the pressure on the forest land in the project area. The use of biogas will reduce the quantity of firewood use by 80-100% in the initial years of the project.

	In the long term the decrease in firewood demand will eventually reduce the adverse impacts on local forests. .
Source of data	Estimation based on the baseline & project KPT data
Value(s) applied	1,922
Measurement methods and procedures	The actual values will be based on the data collected during the monitoring surveys.
Monitoring frequency	Annually or more frequently
QA/QC procedures	Transparent data analysis and reporting.
Purpose of data	To monitor the positive contribution of the proposed project related to the SDG15.
Additional comment	-

D.3. Comparison of monitored parameters with last monitoring period

Data/Parameter	Value obtained in this monitoring period	Value obtained last monitoring period
NA	NA	NA

D.4. Implementation of sampling plan

The sampling approach, used to determine all the parameters mentioned in section B.7.1, is as per the guidelines provided in the applied GS methodology. The monitoring surveys will be carried out in the project scenario using representative and random sampling. The following parameters will be determined through annual sample survey:

- Average usage rate in project scenario p during year y
- Annual average number of animals of type *LT* in year y
- Fraction of manure handled in project animal manure management system
- Proportion of population living in households with access to basic services
- Percentage of project population using polluting fuels
- Average time saving associated with cooking time and fuel collection
- Number of farmers adopted practices promoted by the project

The required minimum sample methodology guidelines for minimum sample size:

- Group size <300: Minimum sample size 30 or population size, whichever is smaller
- Group size 300 to 1000: Minimum sample size 10% of group size
- Group size > 1000 Minimum sample size 100

Therefore, for the total biogas units installed in the project activity (ie, 1355), a minimum sample size required is 100. However, we have conducted monitoring survey in 118 households and hence the in line with requirement of the methodology. The 118 households are selected randomly from the total population. The field staffs are provided with training on the survey & KPT by the consultant before conducting survey. The monitoring survey was conducted on April & May 2023. The survey results and the precision level are provided below:

Proportion parameters:

Parameter	Usage rate/percentage population have access to basic services	% of project population using polluting fuels	% of farmers adopted practices promoted by project
p	1	0.08	0.992
q	0	0.92	0.008
n	118	118	118
N	1355	1355	1355
f	0.087	0.09	0.087
Reliability	0	0.02	0.008
z Value	1.6449	1.6449	1.6449
Precision (+/-)	0	4.0%	0.013
Relative precision	0.0%	47.5%	1.3%
Remarks	Precision level met	Only 8% households use polluting fuel. Hence NA	Precision level met

Mean parameter

Parameter	Average number of Cow	Average number of Swine	Manure collected	Manure fed to Digester	Average Time taken for fuel wood collection	Average time taken for cooking
Total	550	75	9965	7015	3	336
Mean	4.661	0.636	84.449	59.449	0.025	2.843
Standard Deviation	2.73	2.22	42.14	11.03	0.11	0.50
90% Confidence	1.645	1.645	1.645	1.645	1.645	1.645
V	0.34	12.21	0.25	0.03	21.43	0.03
N	118	118	118	118	118	118
Achieved precision level	8.9%	52.9%	7.6%	2.8%	70.1%	2.6%
Remarks	Precision level met	Only 10% households have	Precision level met	Precision level met	Only 3.3% households collect fuel	Precision level met

		swine. Hence NA			wood. Hence NA	
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Field Test

The following parameter has been determined through field test:

- Quantity of fuel that is consumed in project scenario p during year y.

For the project field test, the sample size will be determined any one of the following options;

- 90/30 rule. When the sample sizes are large enough to satisfy the "90/30 rule," i.e. the endpoints of the 90% confidence interval lie within +/- 30% of the estimated mean, overall emission reductions can be calculated on the basis of the estimated MEAN annual emission reduction per unit or MEAN fuel annual savings per unit.
- 90% confidence rule. When the sample sizes are such that the "90/30 rule" is not complied with, the emission or fuel saving result is not the mean (or average) test result, but a lower value, i.e. the LOWER BOUND of the one-sided 90% confidence interval.

However, in any cases CME shall ensure the sample size of FT is greater than 30.

However, as determined from the monitoring survey that only 7 households use fuel wood for cooking among the 118 households selected for monitoring survey. Hence, KPT has been conducted only in the 7 households. The survey results and the precision level are provided below:

Parameter	Fuel wood consumption
Total	32
Mean	0.271
Standard Deviation	1.16
90% Confidence	1.645
V	18.39
N	118
Achieved precision level	64.9%
Remarks	Only 5.9% households uses fuel wood. Hence NA

SECTION E. CALCULATION OF SDG IMPACTS

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

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SDG 1 – End poverty in all its forms everywhere

From the baseline survey it is observed that the target project beneficiaries do not have access to clean and affordable form of energy to meet their daily cooking needs. It can be observed that most of the families are highly dependent on the use of firewood for cooking. No households of the target population in the project area have access to the biogas technology

Monitoring parameter	Number of beneficiaries: Households
Baseline estimation approach	This is determined through baseline survey. As per baseline survey no households in target population have biogas units.
Baseline value	0 households

SDG 2– Zero Hunger

HomeBiogas system's liquid fertilizer has demonstrated excellent economic and operational efficiency. Farmers reported higher crop yields, a stronger natural flavor, larger harvests, healthier and more fertile soil, and less need for pesticides due to the bio-fertilizer generated from the installed bio-digesters.

Monitoring parameter	Number of farmers adopted practices promoted by the project.
Baseline estimation approach	As per baseline survey no households have the biogas units and hence no households have access to biogas slurry
Baseline value	0

SDG 3– Ensure healthy lives and promote well-being for all at all ages

The target population in the project mostly use firewood for cooking in inefficient traditional cook stoves due to which they are continuously exposed to indoor air pollution. The health of the women is the most affected due to continuous exposure to smoke while cooking due to usage of polluting fuel such as fuel wood and charcoal.

Monitoring parameter	Percentage of project population using polluting fuels
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Baseline estimation approach	This is determined through baseline survey. As per baseline survey, about 87.5% households use firewood & Charcoal for cooking in the traditional cook stove which leads to indoor air pollution. Hence, the households, especially the woman are constantly exposed and inhale harmful smoke while cooking. Hence, in the baseline there are no households having reduced indoor pollution.
Baseline Value	87.5%

SDG 5– Gender Equality

In baseline scenario, households, in particular women in the households spent lot time in collection of fuel wood and cooking.

Monitoring parameter	Average time saving associated with cooking time and fuel collection
Baseline estimation approach	This is determined through baseline survey. As per baseline survey, about 6.05 hrs spent by households for cooking and fuel wood collection.
Net estimation approach	6.05 hrs

SDG 7– Ensure access to affordable, reliable, sustainable and modern energy for all

In the project areas, most of the target beneficiaries are dependent on firewood for cooking. Very few families can afford to buy LPG due to its high costs and the time taken to go and collect it from the nearest city center.

Monitoring parameter	Proportion of population living in households with access to basic services
Baseline estimation approach	This is determined through baseline survey. As per baseline survey no households in target population have biogas units or any clean cooking devices.
Net estimation approach	0 household

SDG 8 – Promote inclusive and sustainable economic growth, employment and decent work for all

The project provides new job opportunities during pre-construction (baseline survey), construction and operation of bio digesters. In baseline scenario, no additional employment created.

Monitoring parameter	Total Number of Jobs
Baseline estimation approach	In the baseline scenario, no bio digesters would have been installed and hence no additional job is created
Net estimation approach	0 jobs

SDG 15 – Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss

In the baseline the fuel wood is collected from fields and nearby forests and this increase the pressure on the forests. Using biogas units for cooking will completely avoid the fuel wood usage and hence reduce the pressure on the forests. The methodology used to estimate the SDG outcome will be through the monitoring surveys to know the total number of project beneficiaries who have, first replaced the use of firewood by using biogas for daily cooking and secondly used the Bio-fertilizer for agricultural use to improve the soil quality.

Monitoring parameter	Total non-renewable wood fuel saved
Baseline estimation approach	This is determined from the baseline survey. As per the baseline survey most of the households use fuel wood for cooking which lead to exploiting the forest. As per baseline KPT, average of 3.09 tonnes/year of fuel wood is consumed by each household or 0.89 tonnes/year charcoal (equivalent to 5.36 tonnes of fuel wood) is consumed per household.
Net estimation approach	0 tonne

For the SDG 13, the emission reduction calculations were carried out as per the applied GS methodology.

The baseline emission involves carbon emission from

1. Fuel used for cooking among the target population
2. Animal waste management practiced in the target population

In order to determine total baseline emissions, the emissions per household are calculated as follows:

$$BE_{b,y} = BE_{ta} + BE_{awms}$$

Where:

$BE_{b,y}$ = Total Baseline emissions for baseline scenario b in year y (tCO₂e/yr)

$BE_{TA,y}$ = Baseline emissions from fuel consumption for cooking and water heating (tCO₂e/yr)

$BE_{AWMS,y}$ = Baseline emissions from animal waste handling (tCO₂e/yr)

I. Baseline emissions from fuel consumption for cooking and heating water are calculated as follows:

The Baseline emission from thermal application in year y shall be calculated as per the methods outlined in paragraph 3.5.12 of the methodology. As per the Thermal application method 1, based on avoided quantity of fuel consumption

$$BE_{TA,y} = \sum_{b,p} (N_{b,p,y} \times U_{p,y} \times (f_{NRB,i,y} \times SE_{b,y,CO2} + SE_{b,y,non-CO2}))$$

Where:

$BE_{TA,y}$	Baseline emissions for total project activity in year y (tCO ₂ e.yr)
$\sum_{b,p}$	Sum over all relevant baseline b/project p pairs
$N_{b,p,y}$	Number of project technology-days included in the project data base for each project scenario in year y. The start date is the day a plant starts producing biogas. A default of 2 weeks may be used for the period from installation date and start date.
$U_{p,y}$	Usage rate for technologies in project scenario pin year y (fraction)
$SE_{b,y,CO2}$	Specific CO ₂ emission for a baseline b technology in year y (tCO ₂ /technology*day)
$SE_{b,y,non-CO2}$	Specific non-CO ₂ emissions for a baseline b technology in year y (tCO ₂ /technology*day)
$f_{NRB,I,y}$	Fraction of biomass used in year y for baseline scenario b that can be established as non-renewable biomass (fraction).

$$SE_{b,y,CO2} = \sum P_{b,i,y} \times NCV_{b,i,fuel} \times EF_{b,i,CO2}$$

$$SE_{b,y,non-CO2} = \sum P_{b,i,y} \times NCV_{b,i,fuel} \times EF_{b,i,non-CO2}$$

Where,

i	Index for the type of baseline/fossil fuel consumed
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$P_{b,i,y}$	Average yearly consumption of baseline fuel i per household before the start of the project activity or at the renewal of each crediting period, whichever is later (tonnes/household/day)
$NCV_{b,i}$	Net calorific value of the fuels i that is substituted in baseline b (TJ/tonne)
EF_{b,i,CO_2}	CO ₂ emission factor arising from use of fuels i in baseline scenario (tCO ₂ /TJ)
$EF_{b,i,non-CO_2}$	Non-CO ₂ emission factor arising from use of fuels in baseline scenario (tCO ₂ e/TJ)

$P_{b,i,y}$ may be determined via KPT survey or using number of persons served per household multiplied by default fuel consumption (if the baseline stoves are the conventional types) per person per year (parameter BGTA 20) in baseline scenario.

Baseline emission from thermal application

Parameter	Unit	Firewood	Charcoal	LPG	Source
Pb,y	Tonnes/day	0.0085	0.0024	0.0000548	Baseline survey
NCVb,fuel	TJ/tonne	0.0156	0.0295	0.0473	IPCC
EFb,f,CO2	tCO2/TJ	112	165.22	63	IPCC-VOL-1-CH-1
EFb,f,non-CO2	tCO2/TJ	9.46	44.83	0.17	IPCC-VOL-1-CH-2
Np,y	day	1	1	1	Assumption
Up,y	Percentage	90%	90%	90%	Assumption
f NRB,, y	-	0.8249	0.8249		CALCULATED
SEb,y,CO2	tCO2/technology*day	0.015	0.012	0.000	Calculated as per IPCC default value
SEb,y,nonCO2	tCO2/technology*day	0.001	0.003	0.000	Calculated as per IPCC default value
BEb,y	tCO2e/day	0.012	0.012	0.000	Calculated
Ratio		84.4%	3.1%		
BEb,y (Total)	tCO2e/day	0.011			

II. Baseline emissions from Animal waste management systems

The baseline emissions, from animal waste handling have been estimated using the IPCC TIER 2 approach which requires information about the characteristics of the manure and its management systems in the baseline. Manure characteristics include the amount of volatile solids (VS) produced by the livestock and the maximum amount of methane that can be potentially produced from that manure (Bo). The formulae are:

$$BE_{AWMS,y} = N_{b,p,y} \div 365 \times GWP_{CH_4} \times D_{CH_4} \times UF_b \times U_{p,y} \times \sum_k \sum_{j,LT} N_{LT,y} \times B_{0,LT} \times VS_{LT,y} \times MCF_{j,k} \times MS\%_{BL,j}$$

Where:

$BE_{AWMS,y}$ Baseline emissions in year y tCO₂e

$N_{b,p,y}$	Number of project technology-days included in the project database for each project scenario in year y.
U_{Fb}	Model correction factor to account for model uncertainties (0.94) ¹¹
$U_{p,y}$	Usage rate for technologies in project scenario pin year y (fraction). For baseline emission calculation at Design Certification, the ex-ante $U_{p,y}$ shall be estimated.
GWP_{CH_4}	Global Warming Potential (GWP) of CH ₄ applicable to the crediting period.
D_{CH_4}	CH ₄ density (0.00067 t/m ³ at room temperature (20 deg celcius) and 1 atm pressure)
LT	Index for all types of livestock
j	Index for animal manure management system
k	Climate region k
$Bo_{,LT}$	Maximum methane production potential of the volatile solid generated for animal type LT (m ³ CH ₄ /kg-dm).
$MCF_{j,k}$	Annual methane conversion factor (MCF) for the baseline animal manure management system j by climate region k. (%)
$N_{LT,y}$	Annual average number of animals of type LT in year y (numbers)
$VS_{LT,y}$	Volatile solids production/excretion per animal of livestock LT in year y (on a dry mater weight basis, kg-dm/animal/year)
$MS\%_{0Bl,j}$	Fraction of manure handled in baseline animal manure management system j.(%)

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Reference: FCCC/SBSTA/2003/10/Add.2, page 25.

Baseline emission from manure management system

Parameter	Unit	dairy_cow	Market Swine	Source
Nb,p,y	day	1	1	Assumptions
UFb	%	0.94	0.94	Methodology
Up,y	%	90%	90%	Assumptions
GWPCH4	tCO2e/tCH4	28	28	https://www.goldstandard.org/project-developers/standard-documents
DCH4	t/m3	0.00067	0.00067	Methodology
BO,LT	m3 CH4/kg-dm	0.13	0.29	2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories 1 (Table 10.16A)
MCFBL,liquid/slurry/Pit-storage	%	62%	62%	2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories 1 (Table 10.17)
MCFBL,Daily Sprad	%	1%	1%	2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories 1 (Table 10.17)
MS(T,k), liquid/slurry/Pit-storage	%	99.11%	99.11%	Baseline Survey
MS(T,k), Daily Spread	%	0.89%	0.89%	Baseline survey
NLT,y	Nos	4.661	0.636	Baseline Survey
VSrate,LT KG VS	KG VS (1000 KG ANIMAL MASS)-1 DAY-1	15.2000	8.7000	https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Vol4/V4_4a_10_19_2019rf.pdf
TAMLT (kg)	kg	260	49	
ndy (year)	days	1	1	Assumption
VS LT,y	kg-dm/animal/day	3.952	0.4263	Calculated
BEAWMS,y	tCO2e/yr	0.02336	0.00077	
Total	tCO2e/yr	0.02412		Calculated

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

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SDG 1 – End poverty in all its forms everywhere

Monitoring parameter	Proportion of population living in households with access to basic services
Project Estimation approach	Proportion of population living in households with access to basic services are monitored annually through monitoring survey (sample survey)

Achieved during monitoring period	1355
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SDG 2 – Zero Hunger

Monitoring parameter	Number of farmers adopted practices promoted by the project
Project Estimation approach	Number of farmers adopted practices promoted by the project are monitored annually through monitoring survey (sample survey)
Achieved during monitoring period	1355

SDG 3– Ensure healthy lives and promote well-being for all at all ages

Monitoring parameter	Percentage of project population using polluting fuels
Project Estimation approach	The SDG 3 outcome will be estimated on the total number of beneficiaries, who will have a clean, smoke free kitchen with the use of biogas for cooking and who still use polluting fuel like fuel wood and charcoal Annual monitoring survey (sample survey) will be conducted among the beneficiary households and percentage of households who confirmed still using the polluting fuel are recorded
Achieved during monitoring period	5.98% (reduction of 81.6% from baseline)

SDG 5– Achieve gender equality and empower all women and girls

Monitoring parameter	Average time saving associated with cooking time and fuel collection
Project Estimation approach	Average time saving associated with cooking time and fuel collection are monitored through annual monitoring survey (sample survey).

Achieved during monitoring period	2.87 hours (3.18 hours reduction)
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SDG 7– Ensure access to affordable, reliable, sustainable and modern energy

Monitoring parameter	Number of beneficiaries: Households
Project Estimation approach	The Number of households where the bio digesters are installed are monitored continuously and recorded in project database as and when a bio digester is installed.
Achieved during monitoring period	1355

SDG 8 – Promote inclusive and sustainable economic growth, employment and decent work for all

Monitoring parameter	Total Number of Jobs
Project Estimation approach	The employment records will be maintained by the HomeBiogas.
Achieved during monitoring period	56

SDG 15 – Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss

Monitoring parameter	Total non-renewable wood fuel saved
Project Estimation approach	Project fuel consumption will be determined using KPT during the project scenario which is multiplied with fNRB to get the nonrenewable biomass weight. It is expected to be much lower than the baseline estimates due to the use of biogas for cooking.
Achieved during monitoring period	1,922 tonnes

SDG 13: Climate Action

1. The Project emission from thermal application in year y shall be calculated as follows:

$$PE_y = \sum (b_{p,y} Nb_{p,y} \times Up_{p,y} \times (f_{NRB,i,y} \times SE_{p,y,CO2} + SE_{p,y,non-CO2}))$$

E_y	Project emissions for total project activity in year y (tCO ₂ e/yr)
$\sum b_{p,y}$	Sum over all relevant baseline b/project p pairs
$Nb_{p,y}$	Number of project technology-days included in the project database for each project scenario in year y
$Up_{p,y}$	Usage rate for technologies in project scenario p in year y (fraction)
$SE_{p,y,CO2}$	Specific CO ₂ emissions for a project p technology in year y (tCO ₂ /technology*day)
$SE_{p,y,non-CO2}$	Specific non-CO ₂ emissions for a project p technology in year y (tCO ₂ e/technology*day)
$f_{NRB,i,y}$	Fraction of biomass used in year y for project scenario p that can be established as non-renewable biomass (fraction). The parameter $f_{NRB,p,y}$ is excluded from the when the observed project additional fuel is fossil fuel.

$$SE_{p,y,CO2} = \sum P_{p,i,y} \times NCV_{p,i,fuel} \times EF_{p,i,fuel,CO2}$$

$$SE_{p,y,non-CO2} = \sum P_{p,i,y} \times NCV_{p,i,fuel} \times EF_{p,i,fuel,non-CO2}$$

i	Index for the type of project/fossil fuel consumed
$P_{p,i,y}$	Average daily consumption of project fuel i per household (tonnes/household/day)
$NCV_{p,i,fuel}$	Net calorific value of the fuel(s) i that is used in project p (TJ/tonne)
$EF_{p,i,fuel,CO2}$	CO ₂ emission factor arising from use of fuels i in project scenario (tCO ₂ /TJ)
$EF_{p,i,fuel,non-CO2}$	Non-CO ₂ emission factor arising from use of fuels in baseline scenario (tCO ₂ e/TJ)

Project emission from thermal application

Parameter	Unit	Firewood	Charcoal	LPG	Source
$P_{p,i,y}$	Tonnes/day	0.0003	0.0000	0.0000	Assumption (5% of baseline consumption)
$NCV_{p,i,fuel}$	TJ/tonne	0.0156	0.0295	0.0473	IPCC
$EF_{p,i,fuel,CO2}$	tCO ₂ /TJ	112	165.2200	63	IPCC
$EF_{p,i,fuel,non-CO2}$	tCO ₂ /TJ	9.4600	44.8300	0.1665	IPCC
$Nb_{p,y}$	day	1	1	1	Assumption
$Up_{p,y}$	Percentage	90%	90%	90%	Assumption
$f_{NRB,i,y}$	-	0.82496	0.8249		CALCULATED
$SE_{p,y,CO2}$	tCO ₂ /technology*day	0.0005	0.0000	0.0000	Calculated as per IPCC default value

<i>SEp,y,nonCO2</i>	tCO2/technolog y*day	0.0000	0.0000	0.0000	Calculated as per IPCC default value
<i>PEy</i>	tCO2e/day	0.0004	0.0000	0.0000	
<i>PEy (Total)</i>	tCO2e/day	0.0004			

2. Project Emissions from Animal Manure Management

The project emissions involve emissions from the bio-digester, which include physical leakage and incomplete combustion of biogas, as well as emissions from the animal waste not treated in the bio-digester are calculated as per the following equation:

$$PE_{AWMSy} = PE_{PL,y} + PE_{power,y} + PE_{transp,y} + PE_{storage,y}$$

$PE_{AWMS,y}$	Project emissions in year y (t CO _{2e})
$PE_{PL,y}$	Emissions due to physical leakage of biogas in year y (t CO _{2e})
$PE_{power,y}$	Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year y (t CO _{2e})
$PE_{transp,y}$	Emissions from incremental transportation of input manure for the digesters in the year y (t CO _{2e})
$PE_{storage,y}$	Emissions from the storage of manure (t CO _{2e})

Project emission from physical leakage has been calculated as below:

$$PE_{PL,y} = 0.10 \times N_{b,p,y} \div 365 \times U_{p,y} \times GWP_{CH4} \times D_{CH4} \times \sum_k \sum_{i,LT} B_{o,LT} \times N_{LT,y} \times VS_{LT,y} \times MS\%_{i,y}$$

$PE_{PL,y}$ = Project emissions from physical leakage in year y (t CO_{2e})

GWP_{CH4} = Global Warming Potential (GWP) of CH₄ applicable to the crediting period.

D_{CH4} = CH₄ density (0.00067 t/m³ at room temperature (20 °C) and 1 atm pressure)

T = Index for all types of livestock

i = Index for animal manure management system

k = Climate region k

$B_{o,LT}$ = Maximum methane producing potential of the volatile solid generated for animal type LT.

$MS\%,$ = Fraction of manure handled in project animal manure management system i

Since,

$PE_{power,y} = 0$ tCO₂e/year (no electricity is required to operate the digester)

$PE_{transp,y} = 0$ tCO₂e/year (no transportation is involved)

$PE_{storage,y} = 0$ tCO₂e/year (no storage is involved)

Hence,

$$PE_{AWMSy} = PE_{PLY}$$

Project emission physical leakage				
Parameter	Unit	dairy_cow	Market Swine	Source
$N_{b,p,y}$	day	1	1	Assumption
$U_{p,y}$	%	90%	90%	As per the usage survey guidance
GWPC _H 4	tCO ₂ e/tCH ₄	28	28	https://www.goldstandard.org/project-developers/standard-documents
DCH ₄	t/m ³	0.00067	0.00067	Methodology
BoLT _y	m ³ CH ₄ /kg VS	0.1300	0.2900	IPCC
NLT _y	Nos	4.6610	0.6356	Monitoring Survey
VSLT _y	kg dry matter/head/year	3.9520	0.4263	https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch10_Livestock.pdf
MS%, _{i,y}	%	70%	70%	Monitoring Survey
PE _{awms,h}	tCO ₂ e/day	0.0028	0.0001	Calculated
PE _{awms,h (total)}	tCO ₂ e/day	0.0029		Calculated

In addition, the project emission from amount of dung that is not treated in the biogas unit are calculated using the baseline emission calculation formula:

$$BE_{AWMS,y} = N_{b,p,y} \div 365 \times GWP_{CH_4} \times D_{CH_4} \times UF_b \times U_{p,y} \times \sum_k \sum_{j,LT} N_{LT,y} \times B_{0,LT} \times VS_{LT,y} \times MCF_{j,k} \times MS\%_{BL,j}$$

Where

MS%_{BL,j} is the percentage of still treated in the baseline treatment method.

Project emission from manure management system

Parameter	Unit	dairy_cow	Market_Swine	Source
$N_{b,p,y}$	day	1	1	Assumptions
UF _b	%	0.94	0.94	Methodology
$U_{p,y}$	%	90%	90%	Assumptions
GWPC _H 4	tCO ₂ e/tCH ₄	28	28	GS

DCH4	t/m3	0.00067	0.00067	Methodology
BO,LT	m3 CH4/kg-dm	0.13	0.29	2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories 1 (Table 10.16A)
MCFBL,liquid/slurry/Pit-storage	%	62%	62%	2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories 1 (Table 10.17)
MCFBL,Daily Sprad	%	1%	1%	2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories 1 (Table 10.17)
MS(T,k), liquid/slurry/Pit-storage	%	29.34%	29.34%	Baseline Survey
MS(T,k), Daily Spread	%	0.26%	0.26%	Baseline survey
NLT,y	Nos	4.661	0.636	Baseline Survey
VSrate,LT KG VS	KG VS (1000 KG ANIMAL MASS)-1 DAY-1	15.2000	8.7000	https://www.ipcc-nggip.iges.or.jp/public/2019rfk.pdf
TAMLT (kg)	kg	260	49	
ndy (year)	days	1	1	Assumption
VS LT,y	kg-dm/animal/day	3.952	0.4263	Calculated
PE AWMS,y	tCO2e/yr	0.00691	0.00023	Calculated
Total	tCO2e/yr	0.00714		

E.3. Calculation of leakage

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As per methodology there are five potential sources through which leakages can occur in this project activity which are investigated as below:

Leakage Source	Justification
(a) The displaced baseline technologies are reused outside the project boundary in place of lower emitting technology or in a manner suggesting more usage than would have occurred in the absence of the project.	The baseline technology is traditional three stone cook stove or mud stove. These do not have any economic value as these can be made easily with local materials. Hence, there is no way the baseline stoves are shifted and reused outside the project boundary. Hence, this leakage is considered as zero.
(b) Non-project users who previously used lower emitting energy sources use the non-renewable biomass or fossil fuels saved under the project activity.	The baseline survey was carried out for non-project users. And the data obtained shows that the target population are highly dependent on non-renewable biomass or fossil fuels

	for cooking. Therefore, the risk is highly low because they do not use any other lower emitting energy sources.
(c) The project significantly impacts the NRB fraction within an area where other CDM or VER project activities account for NRB fraction in their baseline scenario.	There are 122 GS projects registered in Kenya. The NRB saving during the monitoring period is only 1,922 t. The impact of this on the fNRB that affects other projects are negligible.
(d) The project population compensates for loss of the space heating effect of inefficient technology by adopting some other form of heating or by retaining some use of inefficient technology.	The project activity is implemented in project areas where the target population does not use fuels for space heating.
(e) By virtue of promotion and marketing of a new technology with high efficiency, the project stimulates substitution within households who commonly used a technology with relatively lower emissions, in cases where such a trend is not eligible as an evolving baseline.	The biogas technology leads to lower emissions compared to the fuels in the baseline scenario, therefore, this risk is not applicable to the project activity

As per the above assessment, the leakage risks deemed very low and hence leakage from the project is considered as zero

E.4. Calculation of net benefits or direct calculation for each SDG Impact

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	Thermal Application (tCO ₂ /hh/day)	Manure Management (tCO ₂ /hh/day)	Total (tCO ₂ /hh/day)	Total For the monitoring period (tCO ₂)
Baseline Emission	0.0113	0.0241	0.0354	11,194
Project Emission (tCO ₂ /hh/day)	0.0005	0.0101	0.0105	3,328
Leakage Emission (tCO ₂ /hh/day)	0.0000	0.0000	0.0000	0
Emission Reduction (tCO ₂ /hh/day)	0.0108	0.0140	0.0249	7,692

Total Number of Biodigesters Installed	1355
Total Number of biogas days	316209

SDG Impact	Baseline estimate	Project estimate	Net benefit
Amount of GHG Emission reduction (tCO ₂ e)	0	7,692	7,692
Proportion of population living in households with access to basic services	0	100%	100%
Number of farmers adopted practices promoted by the project	0	1355	1,355
Percentage of project population using polluting fuels	87.6%	5.98%	81.6%
Average time saving associated with cooking time and fuel collection (Hrs)	6.05	2.87	3.18
Number of beneficiaries: Households	0	1355	1,355
Total Number of Jobs	0	56	56
Total non-renewable wood fuel saved (tonne)	0	1,922	1,922

E.5. Comparison of actual SDG Impacts with estimates in approved PDD

SDG	Values estimated in ex ante calculation of approved PDD for this monitoring period	Actual values ¹² achieved during this monitoring period
13	45,718 tCO ₂ Emission reduction	7,692 tCO ₂ Emission reduction

¹² Whenever emission reductions are capped, both the original and capped values used for calculations must be transparently reported. Use brackets to denote original values.

1	100% households having basic access	100% households having basic access
2	5,379 Number of households adopted practices promoted by the project	1,355 Number of households adopted practices promoted by the project
3	0% project population using polluting fuels (87.5% reduction from baseline)	5.98% project population using polluting fuels (81.6% reduction from baseline)
5	3.55 hours saving associated with cooking time and fuel collection	3.18 hours saving associated with cooking time and fuel collection
7	5,379 Number of household installed with biodigester	1,355 Number of household installed with biodigester
8	60 jobs created	56 jobs created
15	11,269 t non-renewable wood saved per per year	1,922 t non-renewable wood saved per per year

E.5.1. Explanation of calculation of value estimated ex ante calculation of approved PDD for this monitoring period

SD G	SDG Impact	Estimated Annual Average	Number of days	Total Estimation for the MP	Units or Products
13	Amount of GHG Emission reduction - Year 1	13,569	365	45,718	tCO2e/y
	Amount of GHG Emission reduction - Year 2	135,687	122		
1	Proportion of population living in households with access to basic services	100%		100%	-
2	Number of farmers adopted practices promoted by the project -Year 1	1,500	365	5,379	Nos
	Number of farmers adopted practices promoted by the project -Year 2	15,000	122		
3	Percentage of project population using polluting fuels	87.5% (reduction)		87.5% (reduction)	Nos.
5	Average time saving associated with cooking time and fuel collection	3.55		3.55	Hrs.
7	Number of beneficiaries: Households-year 1	1,500	365	5,379	Nos.
	Number of beneficiaries: Households-year 1	15,000	122		
8	Total Number of Jobs	60		60	Nos
15	Total non-renewable wood fuel saved -Year 1	3,262	365	11,269	Tonnes/year
	Total non-renewable wood fuel saved -Year 2	32,622	122		

E.6. Remarks on increase in achieved SDG Impacts from estimated value in approved PDD

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Not applicable as the achieved SDGs impacts are less than estimated value in the PDD.

SECTION F. SAFEGUARDS REPORTING

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No safeguarding parameters required monitoring. Hence not applicable.

SECTION G. STAKEHOLDER INPUTS AND LEGAL DISPUTES

G.1. List all Inputs and Grievances which have been received via the Continuous Input and Grievance Mechanism together with their respective responses/mitigations.

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During the monitoring period no grievances received from any stakeholders other than the repair request of the project device.

G.2. Report on any stakeholder mitigations that were agreed to be monitored.

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Not applicable

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

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No legal contest arisen during the monitoring period.

Revision History

Version	Date	Remarks
1.1	14 October 2020	Hyperlinked section summary to enable quick access to key sections Improved clarity on Key Project Information Section for POA monitoring Forward action request section Improved Clarity on SDG contribution/SDG Impact term used throughout Clarity on safeguard reporting Clarity on design changes Leakage section added for VER/CER projects Addition of Comparison of monitored parameters with last monitoring period Provision of an accompanying Guide to help the user understand detailed rules and requirements
1.0	10 July 2017	Initial adoption