



**Monitoring report form for CDM programme of activities
(Version 03.0)**

Complete this form in accordance with the instructions attached at the end of this form.

MONITORING REPORT

Title of the PoA	African Improved Cooking Stoves Programme of Activities	
UNFCCC reference number of the PoA	5342	
Version numbers of the PoA-DD applicable to this monitoring report	4.3	
Version number of this monitoring report	3.0	
Completion date of this monitoring report	05/11/2019	
Monitoring period number	Sixth monitoring period	
Duration of this monitoring period	25/10/2017 – 30/06/2019	
Monitoring report number for this monitoring period	1.0	
Coordinating/managing entity	Envirofit International Ltd.	
Host Parties	Host Party of the PoA	Is this the host Party of a CPA covered in this monitoring report? (yes/no)
	Ghana	Yes
	Nigeria	No
	Liberia	No
Applied methodologies and standardized baselines	AMS-II.G ver 3.0: Energy efficiency measures in thermal applications of non-renewable biomass Standardized baseline: NA	
Sectoral scopes	Sectoral scope: 3: Energy demand	
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by all CPAs covered in this monitoring report in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	0	2,855 tCO ₂ e
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the CPA-DDs for the CPAs covered in this monitoring report	30,636 tCO ₂ e	

PART I Monitoring of programme of activities (PoA)

SECTION A. Description of PoA

A.1. General description of PoA

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The purpose of this Programme of Activities (PoA) is the dissemination of biomass fuel based improved cooking stoves (ICS) in Ghana, Nigeria and Liberia. The Programme will promote stove categories that replace existing less efficient cooking stoves using woody-biomass (wood-fuel and/or charcoal).

The ICS distributed under the programme are more efficient in transferring heat from the fuel to the pot when compared to the stoves typically being used in the baseline. By replacing inefficient baseline stoves, the PoA saves on consumption of woody biomass (either wood-fuel or charcoal made from wood) which is the dominant fuel used for cooking in project households. The ICSs distributed in this PoA have been designed to match the traditional utensils and cooking habits of the target consumers in host countries.

In accordance with version 3.0 of the small-scale CDM methodology AMS-II.G, in the absence of the project activity, the baseline scenario would be the use of fossil fuels for meeting similar thermal energy needs. Therefore, by reducing the amount of fuel required for cooking and thus the use of non-renewable woody biomass, the replacement of less efficient stoves with more efficient ICS reduces the amount of greenhouse gases (GHG) emitted into the atmosphere.

Envirofit International Ltd. (Envirofit) is the coordinating/managing entity (CME) for this PoA and coordinates the efforts of different CPA Implementers (CPAI) / Distribution Organizations (DOs) who are involved in distribution of ICS within the boundary of the PoA and comply with the requirements of this PoA. Each CPAI / DO distributes ICSs either directly or through retailers, entrepreneurs or other agents sub-contracted by them. The CME provides training and guidance on the correct distribution and monitoring procedures to CPAI / DO. CPAI / DO act individually, implementing the CPA(s) in accordance with local circumstances and the requirements prescribed by CME.

A.1.1. Corresponding generic component project activities (CPAs)

Title and reference number of the corresponding generic CPA	Version of the PoA-DD	Sectoral scopes	Applied methodologies and standardized baselines
Title: African Improved Cooking Stoves Programme of Activities – Generic CPA Identification: Part II of revised PoA-DD version 4.3 dated 07/06/2014 Reference: http://cdm.unfccc.int/UserManagement/FileStorage/V96Q8RJG3DUWTMXIYH20Z4LPE5B7OF Version: 1.0	Version 4.3 dated 07/06/2014	Sectoral Scope 3	AMS-II.G, version 03: Energy Efficiency Measures in Thermal Applications of Non-Renewable Biomass https://cdm.unfccc.int/UserManagement/FileStorage/MLDN960OH41VWJPCZ23ERFUQT5BAGX

A.1.2. CPAs included in the PoA

Title and UNFCCC reference number of the CPA	Version of the PoA-DD	Title and reference number of the corresponding generic CPA	Crediting period type and duration	Covered in this monitoring report? (yes/no)
African Improved Cooking Stoves Programme of Activities CPA 00001 (Ghana) Version: 3.2	Version 4.3 dated 07/06/2014	Title: African Improved Cooking Stoves Programme of Activities – Generic CPA Identification: Part II of	Fixed, 15/12/2012 – 14/12/2022	No

Ref: 5342-P1-0001-CP1	revised PoA-DD version 4.3 dated 07/06/2014 Reference: http://cdm.unfccc.int/UserManagement/FileStorage/V96/Q8RJG3DUWTMXIYH20Z4LPE5B7OF Version: 1.0		
African Improved Cooking Stoves Programme of Activities CPA 00002 (Ghana) Version: 3.0 Ref: 5342-P1-0002-CP1		Fixed, 01/11/2013 – 31/10/2023	No
African Improved Cooking Stoves Programme of Activities CPA 00003 (Ghana) Version: 2.0 Ref: 5342-P1-0003-CP1		Fixed, 01/12/2013 – 30/11/2023	No
African Improved Cooking Stoves Programme of Activities CPA 00004 (Nigeria) Version: 6.1 Ref: 5342-P1-0004-CP1		Fixed, 25/10/2014 – 24/10/2024	No
African Improved Cooking Stoves Programme of Activities CPA 00005 (Nigeria) Version: 6.1 Ref: 5342-P1-0005-CP1		Fixed, 25/10/2014 – 24/10/2024	No
African Improved Cooking Stoves Programme of Activities CPA 00006 (Liberia) Version: 2.0 Ref: 5342-P1-0006-CP1		Fixed, 01/02/2015 – 31/01/2025	No
African Improved Cooking Stoves Programme of Activities CPA 00010 (Nigeria) supported by Republic of Korea Version: 4.0 Ref: 5342-P1-0007-CP1		Fixed, 05/04/2019 – 04/04/2029	No
African Improved Cooking Stoves Programme of Activities CPA 00011 (Nigeria) supported by Republic of Korea Version: 4.0 Ref: 5342-P1-0008-CP1		Fixed, 05/04/2019 – 04/04/2029	No
African Improved Cooking Stoves Programme of Activities CPA 00012 (Nigeria) supported by Republic of Korea Version: 4.0 Ref: 5342-P1-0009-CP1		Fixed, 05/04/2019 – 04/04/2029	No
African Improved Cooking Stoves Programme of Activities CPA 00013 (Liberia) supported by Republic		Fixed, 05/04/2019 – 04/04/2029	No

of Korea Version: 4.0 Ref: 5342-P1-0010-CP1				
African Improved Cooking Stoves Programme of Activities CPA 00014 (Liberia) supported by Republic of Korea Version: 4.0 Ref: 5342-P1-0011-CP1			Fixed, 05/04/2019 – 04/04/2029	No
African Improved Cooking Stoves Programme of Activities CPA 00015 (Liberia) supported by Republic of Korea Version: 4.0 Ref: 5342-P1-0012-CP1			Fixed, 05/04/2019 – 04/04/2029	No
African Improved Cooking Stoves Programme of Activities CPA 00007 (Ghana) supported by Republic of Korea Version: 2.0 Ref: 5342-P1-0013-CP1			Fixed, 12/04/2019 – 11/04/2029	Yes
African Improved Cooking Stoves Programme of Activities CPA 00008 (Ghana) supported by Republic of Korea Version: 2.0 Ref: 5342-P1-0014-CP1			Fixed, 12/04/2019 – 11/04/2029	Yes
African Improved Cooking Stoves Programme of Activities CPA 00009 (Ghana) supported by Republic of Korea Version: 2.0 Ref: 5342-P1-0015-CP1			Fixed, 12/04/2019 – 11/04/2029	Yes

A.2. Coordinating/managing entity

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Envirofit International Limited is the CME for the PoA. The responsible person for completing the CDM-PoA-MR-Form is as follows:

Rohit Lohia
Carbon Projects Development Manager
Envirofit International
rohit.lohia@envirofit.org

SECTION B. Implementation of PoA**B.1. Description of implemented PoA**

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1. Operational and Management Framework

The CPAs (5342-P1-0013-CP1, 5342-P1-0014-CP1, 5342-P1-0015-CP1) covered in this monitoring report follow same management system as given below:

1. The CME / CPA implementer (CPAI) provided instructions to DOs to collect the end user information at the time of ICS distribuion to make the stove eligible under the PoA. The CME / CPAI made them aware of requirements of end user data collection. Guidance was provided to them on the correct procedures to be followed during distribution.
2. The CME / CPAI maintains a PoA Distribution and Monitoring database. This database is a compilation of CPA distribution records. The database includes CPA wise list of stoves distributed, based on following information, received from DOs (collected this information at the time of distribution):
 - a. Name of customer
 - b. Address / location of the customer
 - c. Stove unique serial ID number
 - d. Stove Model
 - e. Stove distribution date
 - f. Type of old / baseline stove replaced by ICS, i.e. the fuel type used in the old / baseline stove.
3. The CME / CPAI performed cross-checks on the ICS distribution information received from the DOs. The CME's logo is clearly displayed on the CPA Distribution Record, with a copy retained by CME / CPAI. A unique stove id is punched on each stove and the same serial ID is mentioned on the CPA distribution record. Therefore it is possible to identify each stove in the PoA with its unique serial ID number. The unique serial number linked to each stove and its association with a unique CPA bearing a CPA ID number eliminates any risk of double-counting of ICSs between CPAs.
4. The CME / CPAI obtained the customer's approval during distribution to exclusively assign carbon rights to the CPAI as per the disclaimer specified on CPA distribution records / stove boxes.
5. The CME / CPAI coordinated all ex-post monitoring activities in the PoA as follows:
 - a. Implemented the monitoring plan,
 - b. Determined the sample size as per sampling plan and identified the samples to be monitored (the sampling plan has been applied across group of CPAs as detailed in section E.3 below)
 - c. Ensured the quality of monitoring data (QA/QC)
 - d. Used this data for emissions reduction calculations.
6. The monitoring team checked and recorded the following key parameters in a CPA Monitoring Record. Key monitored parameters were:
 - a. Efficiency of project stoves ($\eta_{new,y}$)
 - b. Check if project stoves are operational and in use (SOF)
 - c. Check fraction of end users continuing to use replaced stoves (f_{old})
 - d. If replaced stoves are being used, the consumption accounted for by the old stoves (μ_{old})
7. The CME / CPAI calculated emission reductions based on monitoring data collected and prepared monitoring report

Thus, by carrying out the aforesaid, CME / CPAI ensured that the PoA Operational and Management plan as per section C of the latest approved registered PoA-DD is duly implemented for concerned CPAs.

2.Sampling Approach

A single sampling plan has been applied to CPAs (5342-P1-0013-CP1, 5342-P1-0014-CP1, 5342-P1-0015-CP1) covered in this monitoring report. For detail, refer section E.3 below.

B.2. Post-registration changes to PoA

B.2.1. Corrections

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NA

B.2.2. Inclusion of monitoring plan

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NA

B.2.3. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents

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NA

B.2.4. Changes to programme design

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PRC-5342-P1-0001-CP1 included changes to programme design was made to expand the project boundary to include Liberia under the PoA. The PRC was approved on 16/07/2014. For more detail, refer the following link:
<https://cdm.unfccc.int/PRCContainer/DB/prcp237694862/view>

B.2.5. Changes specific to afforestation or reforestation activities

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NA

PART II Monitoring of CPAs

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This Monitoring Report covers three CPAs (5342-P1-0013-CP1, 5342-P1-0014-CP1, 5342-P1-0015-CP1) in Ghana, as listed in section A.1.2 above. These CPAs are homogeneous as they have the same project boundary/country (i.e. Ghana) and follow a common generic CPA as identified in section A.1.1, Part I of this monitoring report and implement the same technology/measure (biomass based improved cooking stoves). Thus, these CPAs have been sub-grouped for monitoring purposes. The following sections therefore represent these three CPAs.

SECTION C. Implementation of CPAs

C.1. Description of implemented CPAs

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(a) ***Purpose of the specific-case CPA(s) and the measures taken for GHG emission reductions or net GHG removals by sinks;***

The purpose of the CDM Programme Activities (CPAs) is dissemination of biomass based improved cooking stoves (ICS) in the Republic of Ghana. The CPAs replace baseline cooking stoves using charcoal / woodfuel with more efficient stoves using charcoal / woodfuel respectively.

The project ICS are more efficient in transferring heat from the fuel to the pot, thus saving fuel compared to the baseline stoves which would have been used in the absence of the project activity. Furthermore, the ICSs applied in these CPAs have been designed not only to increase heat transfer, but also to match traditional utensils and cooking habits of people in Ghana.

The CPAI / DO involved in the CPAs included in this monitoring report are as follows:

CPA	CPA Implementer	CPA Distributing Organization	Status of CPA Implementation
5342-P1-0013-CP1	CERPD Co., Ltd.	Envirofit International	Implemented
5342-P1-0014-CP1	CERPD Co., Ltd.	Envirofit International	Implemented
5342-P1-0015-CP1	CERPD Co., Ltd.	Envirofit International	Implemented

CERPD Co., Ltd. (CERPD) a company based in the Republic of Korea, has provided all implementation costs for these CPAs. CERPD has fully sponsored the ICS to make ICS affordable to beneficiary households, as well covered the cost of operation and management of the CPAs in a financially sustainable condition. As the ICS are being fully sponsored, it is ensured at the time distribution, that only one ICS unit is given to a household and no household in the CPA database owns more than one project ICS unit.

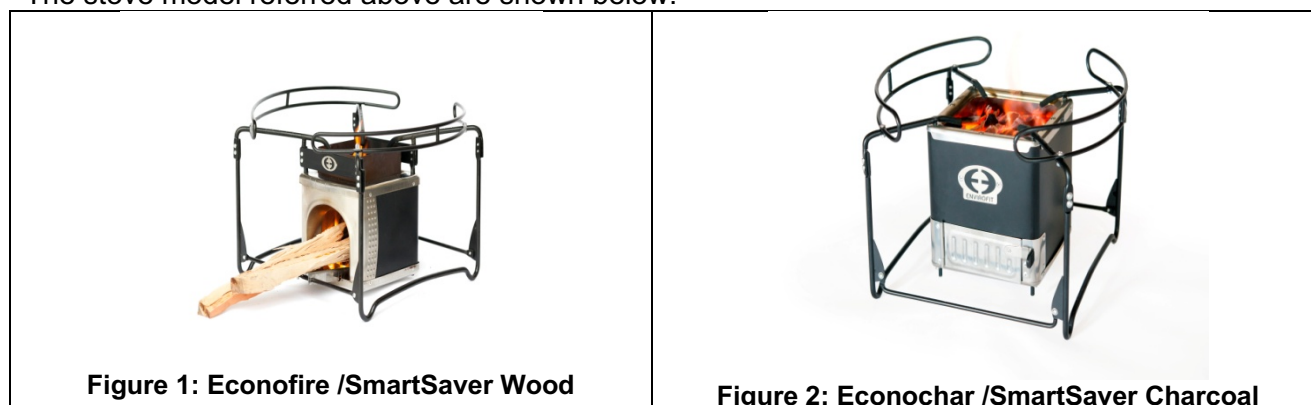
(b) **Description of the technology employed and installed equipment and/or infrastructure**

The Envirofit stoves have been designed with the specific intention of maximizing thermal efficiency while simultaneously minimizing the production of toxic emissions. While many interrelated factors need to be considered in order to achieve these goals, primary aspects of stove performance were explored during the development of the stoves: 1) fuel and air mixing 2) heat transfer to the pot. In order to maximize temperature, the combustion chamber shape, fuel amount, and air flow through the stove all need to be considered and correctly coordinated. In order to use the available thermal energy in the most efficient manner possible, specific stove geometry and configuration choices were made; including reducing stove thermal mass and minimizing heat flux through the sides and bottom of the stove. In order to minimize emissions, the combustion chamber shape, fuel amount, and air flow rate through the stove all need to be considered and correctly coordinated in order to maintain a proper air to fuel mixture.

The following table details the implementation status of the CPAs along with technology involved:

CPA	Type of Project stoves eligible	Stove models installed
5342-P1-0013-CP1	Wood Fuel, Charcoal	Woodfuel- Econofire
5342-P1-0014-CP1		Charcoal - Econochar /SmartSaver Charcoal,
5342-P1-0015-CP1		CH5200 ¹

The stove model referred above are shown below:



¹ Due to the small number of CH5200 stove units distributed in the current monitoring period, CH5200 is not included in monitoring and ER calculations.

Stove Specifications:

Parameter description	Econofire /SmartSaver Wood	Econochar /SmartSaver Charcoal
Thermal Efficiency	30.2 %	34.3 %
Unit Size	25.5 x 40 x 35.5 cm (height x width x depth)	28 x 37 x 42 cm (height x width x depth)
Unit Weight	2.7 kg	3.7 kg
Type	Portable	Portable
Grate / Chimney	Grate	Grate

- (c) **Relevant dates for the specific-case CPA(s) (e.g. construction, commissioning, continued operation periods, etc.);**

CPA Reference number	5342-P1-0013-CP1 to 5342-P1-0015-CP1
Start date of the CPA	17/12/2018
Continued operation period	Since 17/12/2018

- (d) **Total GHG emission reductions or net GHG removals by sinks achieved in this monitoring period for the specific-case CPA(s), including information on how double counting is avoided**

CPA Reference Number	Emission Reductions tCO ₂ e
5342-P1-0013-CP1	959
5342-P1-0014-CP1	1,132
5342-P1-0015-CP1	764
Total	2,855

Each stove bears a unique serial ID punched on the stove. The same is recorded to trace the stove later and avoid double counting. Further, for each stove included under each CPA, information on the location of the stove has been collected by collecting address of the user at the time of distribution in CPA Distribution Record. Thus, location of each stove in CPA distribution database can be traced. The system of recording the unique serial on each stove along with its location serves toward avoiding double counting of stoves amongst various CPAs.

C.2. Location of CPAs

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All the CPAs have a common project boundary as follows:

Host Parties: Ghana

Region/State/Province: All across Ghana

City/Town/Community: All across Ghana

Physical Geographical location: The geographical locations of Ghana is depicted by the map below.



Figure: Map of Ghana

C.3. Post-registration changes to CPAs**C.3.1. Temporary deviations from the monitoring plans in the included CPA-DDs, applied methodologies, standardized baselines or other methodological regulatory documents**

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NA

C.3.2. Corrections

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NA

C.3.3. Changes to the start date of the crediting period

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NA

C.3.4. Inclusion of monitoring plan

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NA

C.3.5. Permanent changes to the included monitoring plans, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents

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NA

C.3.6. Changes to project design

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NA

C.3.7. Changes specific to afforestation or reforestation CPA

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NA

SECTION D. Description of monitoring system of CPAs

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Stoves were distributed to end-users by CME / CPAI directly or via the DO. DO was trained by CME / CPAI for ensuring correct procedures according to the PoA are fulfilled.

At the CPA level, DO ensured that necessary data was correctly obtained from the customer and recorded in the CPA Distribution Record, firstly to avoid double counting and secondly to enable tracking of the ICS for monitoring purposes. This data captured included:

- a. Name of customer
- b. Address / location of the customer
- c. Stove unique serial ID number
- d. Stove Model
- e. Stove distribution date
- f. Type of old / baseline stove replaced by ICS, i.e. the fuel type used in the old / baseline stove.

All other monitoring activities have been carried out at the PoA level, single stage sampling plan.

SECTION E. Data and parameters**E.1. Data and parameters fixed ex ante**

Data/Parameter	Q_{biomass}
Unit	Tonnes/year
Description	Annual average biomass consumption per appliance
Source of data	Historical data from various literature has been used to establish a conservative national value, as allowed by the methodology
Value(s) applied	1.90 Tonnes/year for firewood stoves 4.10 Tonnes/year for charcoal stoves
Choice of data or measurement methods and procedures	As per registered CPA-DDs
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	Used for calculation of B _{old}

Data/parameter	f_{NRB,y}
Unit	Fraction
Description	Fraction of biomass saved by the project activity in year y that can be established as non-renewable biomass
Source of data	Value from CPA 5342-P1-0001-CP1 for Ghana
Value(s) applied	0.99
Choice of data or measurement methods and procedures	Since in the CPA 5342-P1-0001-CP1, this value was calculated for Ghana using data extracted from FAO and IPCC, this same value can be used for this CPA in Ghana
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	-

Data/parameter	NCV_{biomass}
Unit	TJ/tonne
Description	Net calorific value of the non-renewable biomass that is substituted
Source of data	AMS II.G. v 03
Value(s) applied	0.015
Choice of data or measurement methods and procedures	Default value as prescribed by methodology applied
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	-

Data/parameter	EF_{projected_fossilfuel}
Unit	tCO ₂ /TJ
Description	Emission factor for the substitution of non-renewable woody biomass by similar consumers
Source of data	AMS II.G. v 03
Value(s) applied	81.6
Choice of data or measurement methods and procedures	Default value as prescribed by methodology applied
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	-

Data/parameter	η_{old}
Unit	Fraction
Description	Efficiency of the system being replaced
Source of data	AMS-II.G. v 03
Value(s) applied	0.101
Choice of data or measurement methods and procedures	Value from CPA 5342-P1-0001-CP1 for Ghana
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	-

Data/parameter	LAF
Unit	Fraction
Description	Net to gross adjustment factor to account for leakages
Source of data	AMS-II.G. v 03
Value(s) applied	0.95
Choice of data or measurement methods and procedures	Default value as prescribed by methodology applied
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	-

E.2. Data and parameters monitored

Data/Parameter	$\eta_{new,y}$			
Unit	%			
Description	Efficiency of the device being deployed as part of the project activity in year y			
Measured/calculated/Default	Measured			
Source of data	As determined through sample testing of ICS by performing WBTs			
Value(s) of monitored parameter	Stove model		Value (%)	
	Econochar /SmartSaver Charcoal		33.65%	
	Econofire /SmartSaver Wood		29.34%	
Monitoring equipment	Name of equipment	Thermocouple Thermometer	Weighing Scale	Moisture meter
	Name of manufacturer	Proster	WKA	Proster
	Name of model	Digital Dual Channel Thermometer	WKA ZD30	PST049
	Measurement accuracy	$\pm 1.5\%$	1g	0.5 %
	Number of units used	1	1	1
	Serial Number	1861053	20190102318	RZ MT-10
	The equipment were newly purchased at the time of use so measurements were done with the necessary guarantees.			
Measuring/reading/recording frequency	WBTs were carried out for a sample of installed ICSs in operation in line with the PoA Sampling Plan on an annual basis.			
Calculation method (if applicable)	N/A			

QA/QC procedures	WBTs were conducted in line with the guidance provided by the CME and according to a methodology supported by PCIA. Documentation can be found on PCIA website http://www.pciaonline.org/testing
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	-

Data/parameter	N _{all}			
Unit	Number			
Description	Total number of stoves installed			
Measured/calculated/default	Calculated			
Source of data	CPA Distribution Records			
Value(s) of monitored parameter	Parameter	5342-P1-0013-CP1	5342-P1-0014-CP1	5342-P1-0015-CP1
	N _{wood}	446	693	941
	N _{Charcoal}	1,656	1,863	1,096
	N _{all}	2,102	2,556	2,037
Monitoring equipment	N/A			
Measuring/reading/recording frequency	<p>The CPA Distribution Records provided the data used to calculate this parameter. This data was uploaded to the PoA Distribution and Monitoring Database maintained by the CME.</p> <p>The recording of the ICS distribution was done in a regular basis during the crediting period and the monitoring in a yearly basis.</p>			
Calculation method (if applicable)	Sum of all stove records in the CPA Distribution Records			
QA/QC procedures	The CME supervised the activities of the DO, and provided training, guidelines and distribution templates to facilitate accurate record keeping during the ICS distribution. The CME also maintained a record of the stove serial numbers supplied to the DO, and was able to cross-check these against the CPA Distribution Reports it receives back from the DO.			
Purpose of data/parameter	Calculation of baseline emissions			
Additional comments	-			

Data/parameter	SOF		
Unit	Fraction		
Description	Stove Operation Fraction – used to determine the share of distributed stoves that are still operating, measured ex-post through sampling		
Measured/calculated/default	Measured		
Source of data	Survey of end user behaviour as part of the PoA Sampling Plan		
Value(s) of monitored parameter	Parameter	SOF _{charcoal}	SOF _{wood}
	SOF	1.000	0.950
Monitoring equipment	No specific monitoring equipment has been used for the surveys.		
Measuring/reading/recording frequency	The actual value applied for emissions reduction calculations and request for issuance of CERs was measured ex-post by investigation of the number of ICS installations within the sampled ICS which are operational. This was done on an annual basis as per the PoA monitoring requirements		
Calculation method (if applicable)	SOF = n _{Operational} / n _{Total} Where n= number of samples		
QA/QC procedures	The CME provided training, guidelines and monitoring templates to ensure that the Monitoring Organization responsible for monitoring followed appropriate procedures.		
Purpose of data/parameter	Calculation of baseline emissions		

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Additional comments	-								
Data/parameter	f _{old}								
Unit	Fraction								
Description	Fraction of end users that are still using baseline stoves								
Measured/calculated/default	Measured								
Source of data	Survey of end user behaviour as part of the PoA Sampling Plan								
Value(s) of monitored parameter	<table><tr><td>Parameter</td><td>f_{old} charcoal</td><td>f_{old} wood</td></tr><tr><td>f_{old}</td><td>0.133</td><td>0.123</td></tr></table>	Parameter	f _{old} charcoal	f _{old} wood	f _{old}	0.133	0.123		
Parameter	f _{old} charcoal	f _{old} wood							
f _{old}	0.133	0.123							
Monitoring equipment	No specific monitoring equipment has been used for the surveys.								
Measuring/reading/recording frequency	<p>The actual value applied for emissions reduction calculations and request for issuance of CERs was measured ex-post by estimation of a representative sample of end users using the deployed ICS, as conducted in line with the PoA Sampling Plan.</p> <p>Sampling estimated the value of this parameter through monitoring the fraction of end users not using baseline stoves (f_{non,old}),</p> <p>This was done on an annual basis as per the PoA monitoring requirements</p>								
Calculation method (if applicable)	Based on the registered CPA-DD, the fraction of users not using the baseline stoves (f _{non,old}) has been monitored. Then f _{old} has been calculated as 1 - f _{non,old}								
QA/QC procedures	The CME provided training, guidelines and monitoring templates to ensure that the Monitoring Organization responsible for monitoring followed appropriate procedures.								
Purpose of data/parameter	Calculation of baseline emissions								
Additional comments	-								

Data/parameter	μ _{old}								
Unit	kg/year								
Description	The amount of woody biomass consumption that is consumed through the continued use of old stoves								
Measured/calculated/default	Measured								
Source of data	Data from survey of end user behaviour as part of PoA Sampling Plan combined with the same source of data as for Q _{biomass}								
Value(s) of monitored parameter	<table><tr><th>Parameter</th><th>μ_{old} charcoal</th><th>μ_{old} wood</th></tr><tr><td>μ_{old}</td><td>1,324</td><td>905</td></tr></table>	Parameter	μ _{old} charcoal	μ _{old} wood	μ _{old}	1,324	905		
Parameter	μ _{old} charcoal	μ _{old} wood							
μ _{old}	1,324	905							
Monitoring equipment	No specific monitoring equipment has been used for the surveys.								
Measuring/reading/recording frequency	<p>The actual value applied for emissions reduction calculations and request for issuance of CERs was measured ex-post by estimation of a representative sample of end users using the deployed ICS, as conducted in line with the PoA Sampling Plan.</p> <p>During the survey, the interviewer conducted an interview with the end user to identify how much the baseline (replaced) stove as being used. The value of μ_{old} will be estimated by comparing the number of meals before and after buying ICS. Where:</p> $\mu_{old} = \frac{MPM_{after\ ICS}}{MPM_{before\ ICS}} \cdot \text{Total annual fuel consumption (kg)}$ <p>This was done on an annual basis as per the PoA monitoring requirements</p>								
Calculation method (if applicable)	Based on the registered CPA-DDs, this parameter has been calculated by multiplying the Total Annual Fuel Consumption, Q _{biomass} , by the ratio of meals cooked by the traditional stove in operation before and after purchasing the Envirofit Stove.								

QA/QC procedures	The CME provided training, guidelines and monitoring templates to ensure that the Monitoring Organization responsible for monitoring followed appropriate procedures
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	-

Data/parameter	Stove_{year}			
Unit	Year			
Description	Calculated average stove operation years in the monitoring period. If stoves have been operating for 365 days then Stove _{year} = 1.0. If less than 365 days, then Stove _{year} is represented as a fraction of 365 (eg. 180 days= 0.5).			
Measured/calculated/default	Calculated			
Source of data	PoA Distribution and Monitoring Database			
Value(s) of monitored parameter	Parameter	5342-P1-0013-CP1	5342-P1-0014-CP1	5342-P1-0015-CP1
	STOVE _{year} wood	0.19	0.19	0.17
	STOVE _{year} charcoal	0.16	0.16	0.16
Monitoring equipment	No specific monitoring equipment has been used for the surveys			
Measuring/reading/recording frequency	Each ICS entered into the PoA Distribution and Monitoring Database was linked to a distribution date (recorded during distribution). Thus for any monitoring period, it is possible to calculate the period of time that the stoves included in the emissions reduction calculations for that period have been operating. Monitored on annual basis.			
Calculation method (if applicable)	Average of all stove records in the CPA Distribution Records.			
QA/QC procedures	The CME was responsible for overseeing the collection of data by DOs during distribution, training the DOs in correct data recording practices, maintaining a secure Database, and back up of files contained in the Database.			
Purpose of data/parameter	Calculation of baseline emissions			
Additional comments	-			

E.3. Implementation of sampling plan

>>

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

The eligible stoves distributed under the CPAs included in this monitoring report are as follows:

Table 1: CPA and Stove Installation

CPA	Scale	Type of Project stoves eligible under CPA	Total number of stoves in the CPA	CPA monitoring period covered
5342-P1-0013-CP1	Small	Charcoal, Woodfuel	2,102	25/10/2017 – 30/06/2019
5342-P1-0014-CP1	Small	Charcoal, Woodfuel	2,556	25/10/2017 – 30/06/2019
5342-P1-0015-CP1	Small	Charcoal, Woodfuel	2,037	25/10/2017 – 30/06/2019

b) *Description of implemented single sampling design;*

Due to the large number of ICS distributed under the PoA, it was not economically feasible to monitor each individual ICS unit distributed. Therefore, representative sampling was undertaken as part of a PoA-wide Sampling Plan. The sampling plan consisted of monitoring the following four parameters mentioned in section D.2.:

Sl.No.	Parameter	Description of parameter
1	$\eta_{new,y}$	The thermal efficiency of the ICS distributed (%)
2	SOF	The Stove Operating Fraction, i.e. the fraction of users using the ICS
3	f_{old}	The fraction of stove users still using baseline (replaced) stoves
4	μ_{old}	The amount of woody biomass that continues to be used in the replaced stoves (kg)

Based on the registered PoA-DD and CPA-DD for CPAs 5342-P1-0013-CP1, 5342-P1-0014-CP1 & 5342-P1-0015-CP1, 95/10² reliability level was selected for cross-CPA sampling for the parameters mentioned above. As per page 53 of the PoA-DD, for the parameter η_{new} , the population of each stove model shall be deemed homogeneous across CPAs as the stoves have been designed to meet stringent efficiency specifications and are manufactured in factories to specification. Hence the sample size was calculated for η_{new} considering each stove model as separate population. As per page 53 and page 57 of the PoA-DD, for other parameters (SOF, f_{old} , μ_{old}), the homogeneity of the population is demonstrated in compliance with the following conditions;

Homogeneity condition	Characteristic of Population	Status of population
Country	All units have been distributed in the same geographical area, i.e. Ghana	Homogeneous
Fuel Type – charcoal / wood fuel	There are two fuel type in the population: Charcoal and woodfuel.	Charcoal stoves have been considered as one sampling frame and wood fuel stove have been considered as another sampling frame.
End user – domestic / small-medium enterprises / community	All units are for domestic (household) usage as per their design	Homogeneous
Stove Type - efficiencies are in a similar range defined as being within +/-10% of each other and they have other common design features	The stove models disseminated have efficiencies within +/-10% of each other	Homogeneous

The initial target population were the stoves distributed and recorded under CPA 5342-P1-0013-CP1, 5342-P1-0014-CP1 and 5342-P1-0015-CP1. The population was divided into two sampling frames based on fuel type. Simple Random Sampling approach was applied in each sampling frame separately to monitor the three parameters i.e. stove operation (SOF), fraction of traditional stoves still in operation (f_{old}) and amount of woody biomass that continues to be used by the replaced stoves (μ_{old}). Thus, the sample size calculations for parameters SOF, f_{old} , μ_{old} were calculated considering PoA population under two sampling frames.

The required sample sizes were derived using equation(1) on page 68 and equation (4) on page 70 of the Guideline: Sampling and surveys for CDM project activities and programmes of activities, Version 04.0 for proportion based and mean based parameters respectively as follows:

$$n = \frac{z^2 \cdot N \cdot V}{(N - 1) \cdot c^2 + z^2 \cdot V}$$

² Although the PoA monitoring period for monitoring report is from 25 Oct 2017 to 30 Jun 2019, the crediting period start date for all the CPAs covered under this monitoring period is 12 Apr 2019. Hence the applicable monitoring period is from 12 Apr 2019 to 30 Jun 2019 making it an annual monitoring period. Thus, a 95 / 10 as confidence / precision levels has been applied.

$$V = \left(\frac{SD}{Mean} \right)^2 \text{ for mean parameters}$$

$$V = \frac{p \cdot (1 - p)}{p^2} \text{ for proportion parameters}$$

Where:

n = sample size

N = population size

z = Confidence value constant (1.96 for 95%)

c = Desired precision (10%)

SD = expected standard deviation for mean parameter

$Mean$ = expected mean for mean parameter

p = expected proportion for proportion based parameter

The following table gives the number of samples covered during the monitoring activity. Refer ER calculator worksheet 'Sample Size Calculations' for more details on calculation of sample size for each parameter. The expected parameter values (mean, standard deviation and proportion) have been determined based on project developer's knowledge and experience as per para 12(b) and 12(c) of the "Standard:Sampling and surveys for CDM project activities and programmes of activities", Version 07.0 available at:

<https://cdm.unfccc.int/filestorage/e/x/t/extfile-20170509173059588>

[Methodology_standard05_EB94a02-ver07.0-4may17-](#)

[.pdf/Methodology_standard05_EB94a02%28ver07.0%2C%204may17%29?t=RG18cGJzcnFifDBRUFYaiLUWYwFhMb4j2VL](#)

Parameter	Total population (N)	Expected results	Reliability	Required Sample Size (n)	Monitored samples
$\eta_{new,y}$ Econochar	4,615	34.3% (mean); 3.4% (SD)	95/10	7	10
$\eta_{new,y}$ Econofire	2,080	30.2% (mean); 3.0% (SD)	95/10	7	10
SOF _{Charcoal}	4,615	0.90	95/10	43	60
SOF _{Woodfuel}	2,080	0.90	95/10	42	60
f_{old} Charcoal	4,154	0.10 ($f_{non\ old} = 0.90$)	95/10	43	60
f_{old} woodfuel	1,872	0.10 ($f_{non\ old} = 0.90$)	95/10	42	57
μ_{old} Charcoal	415	2270 kg/yr (mean); 227.0 kg/yr (SD)	95/10	7	8
μ_{old} woodfuel	187	2470 kg/yr (mean); 247.0 kg/yr (SD)	95/10	7	7

The stoves were selected by randomly assigning a number to each stove and sorting in increasing order from lower to higher number. 75 Random numbers were generated using online random number generator for each sampling frame separately and the numbers obtained were used to identify the samples from the population within the applicable sampling frame. A higher number of samples were monitored than that required to ensure that the desired precision / confidence is achieved as well as have sufficient number of samples that use both ICS and baseline stove for determining μ_{old} .

c) Collected data (electronic spreadsheets may be attached and referenced);

Data was collected for SOF, f_{old} and μ_{old} following a specially design survey form. The information collected was introduced into an electronic database, the CPA Monitoring Record. This survey form was design in a way that would allow the surveyor first to check the validity of the records from the CPA Distribution Records, and secondly to collect the necessary information form field visit for the ER calculations. In order to achieve the 95/10 reliability level for cross-CPA sampling few additional stoves were sampled from the database than that required (as mentioned in the table above) to cover for non responses, if any.

As per the PDD, to calculate the thermal efficiency of the stoves, water boiling tests (WBT) were conducted using the “Emissions and Performance Test Protocol”, or EPTP (a water boiling test protocol developed by Colorado State University), a testing protocol approved by GACC. Refer ER calculator worksheet “Survey summary” and “WBT Summary” for details on data collected during monitoring. Those involved in field survey monitoring were adequately trained to ensure that the surveys are performed correctly. The WBTs were carried out by external experts with prior experience of conducting WBTs. The monitoring surveys were conducted from 11 July, 2019 to 23 July, 2019 and WBT tests were conducted from 03 August, 2019 to 15 August, 2019.

d) Analysis of the collected data;

Analysis of the data monitored through sampling revealed the following results:

Parameter	Results	Units	Precision Achieved (%)	Result
$\eta_{\text{new Econochar}}$	33.65	%	0.48	Ok, acceptable
$\eta_{\text{new Econofire}}$	29.34	%	0.88	Ok, acceptable
SOF _{charcoal}	1.0	fraction	0.00	Ok, acceptable
SOF _{wood}	0.950	fraction	5.72	Ok, acceptable
fold charcoal	0.133	fraction	9.86	Ok, acceptable
fold wood	0.123	fraction	9.57	Ok, acceptable
$\mu_{\text{old charcoal}}$	1.324	tonnes/year	6.29	Ok, acceptable
$\mu_{\text{old wood}}$	0.905	tonnes/year	9.68	Ok, acceptable

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

The following tables demonstrate the status of precision/confidence for each of the monitored parameters:

$\eta_{\text{new Econochar}}$	33.65%	%	Calculated
Total number of stoves	4615	number	CPA Installation Databases
Sample Size for ($\eta_{\text{new Econochar}}$)	10	number	WBT data
Mean ($\eta_{\text{new Econochar}}$)	33.65%	%	Calculated
Standard Deviation ($\eta_{\text{new Econochar}}$)	0.23%	%	Calculated
Standard error of mean ($\eta_{\text{new Econochar}}$)	0.07%	%	Calculated
Precision for $\eta_{\text{new Econochar}}$	0.48%	%	Calculated
Result for $\eta_{\text{new Econochar}}$	ok, acceptable	--	Calculated

$\eta_{\text{new Econofire}}$	29.34%	%	Calculated
total number of stoves	2080	number	CPA Installation Databases
Sample Size for ($\eta_{\text{new Econofire}}$)	10	number	WBT data
Mean ($\eta_{\text{new Econofire}}$)	29.34%	%	Calculated
Standard Deviation ($\eta_{\text{new Econofire}}$)	0.36%	%	Calculated
Standard error of mean ($\eta_{\text{new Econofire}}$)	0.11%	%	Calculated
Precision for $\eta_{\text{new Econofire}}$	0.88%	%	Calculated
Result for $\eta_{\text{new Econofire}}$	ok, acceptable	--	Calculated

SOF _{charcoal}	1.000	Fraction	Calculated
Population Size	4615	number	CPA Installation Databases
Samples monitored	60	number	Calculated
Proportion for SOF _{charcoal}	1.000	Fraction	Calculated
Standard error of proportion for SOF _{charcoal}	0.00%	%	Calculated
Precision for SOF _{charcoal}	0.00%	%	Calculated
Result for SOF _{charcoal}	ok, acceptable	--	Calculated

SOF _{wood}	0.950	Fraction	Calculated
Population Size	2080	number	CPA Installation Databases
Samples monitored	60	number	Calculated
Proportion for SOF	0.950	Fraction	Calculated
Standard error of proportion for SOF	2.77%	%	Calculated
Precision for SOF	5.72%	%	Calculated
Result for SOF	ok, acceptable	--	Calculated

As per paragraph 11(a) of the Standard - Sampling and surveys for CDM project activities and programmes of activities, $f_{\text{non old}}$ has been determined through sampling and f_{old} has been determined as $f_{\text{old}} = 1 - f_{\text{non old}}$.

f_{old} charcoal	0.133	Fraction	Calculated
Population Size	4615	number	CPA Installation Databases
Samples monitored	60	number	Calculated
Proportion for $f_{\text{non-old charcoal}}$	0.867	Fraction	Calculated
Standard error of proportion for $f_{\text{non-old charcoal}}$	4.36%	%	Calculated
Precision for $f_{\text{non-old charcoal}}$	9.86%	%	Calculated
Result for $f_{\text{non-old charcoal}}$	ok, acceptable	--	Calculated

f_{old} wood	0.123	Fraction	Calculated
Population Size	1976	number	CPA Installation Databases
Samples monitored	57	number	Calculated
Proportion for $f_{\text{non-old wood}}$	0.877	Fraction	Calculated
Standard error of proportion for $f_{\text{non-old wood}}$	4.28%	%	Calculated
Precision for $f_{\text{non-old wood}}$	9.57%	%	Calculated
Result for $f_{\text{non-old wood}}$	ok, acceptable	--	Calculated

μ_{old} charcoal	1.324	tonnes/y	Calculated
Population Size	615	number	CPA Installation Databases
Samples monitored	8	number	Calculated
Mean for $\mu_{\text{old charcoal}}$	0.32	tonnes/y	Calculated
Standard Deviation $\mu_{\text{old charcoal}}$	0.03	tonnes/y	Calculated
Standard error of mean $\mu_{\text{old charcoal}}$	1.03%	%	Calculated
Precision for $\mu_{\text{old charcoal}}$	6.29%	%	Calculated
Result for $\mu_{\text{old charcoal}}$	ok, acceptable	--	Calculated

μ_{old} wood	0.905	tonnes/y	Calculated
Population Size	243	number	CPA Installation Databases
Samples monitored	7	number	Calculated
Mean for $\mu_{\text{old wood}}$	0.48	tonnes/y	Calculated
Standard Deviation $\mu_{\text{old wood}}$	0.06	tonnes/y	Calculated
Standard error of mean $\mu_{\text{old wood}}$	2.35%	%	Calculated
Precision for $\mu_{\text{old wood}}$	9.68%	%	Calculated
Result for $\mu_{\text{old wood}}$	ok, acceptable	--	Calculated

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

Stoves were selected by randomly after arranging them in chronological order of date of distribution and assigning a number to each stove. 75 Random numbers were generated using online random number generator available at <http://stattrek.com/statistics/random-number-generator.aspx> for each sampling frame and the random numbers received were selected from sampling frames to identify the samples to be monitored. The approach ensured that the samples picked are random and represent the population.

SECTION F. Calculation of emission reductions or net anthropogenic removals

F.1. Calculation of baseline emissions or baseline net removals

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$$ER_y = B_{y,savings} \cdot f_{NRB} \cdot NCV_{biomass} \cdot EF_{projected\ fossil\ fuel}$$

$$B_{y,savings} = B_{old} \cdot \left(1 - \frac{\eta_{old}}{\eta_{new}}\right)$$

$$B_{old} = LAF \cdot N_{all} \cdot SOF \cdot \left(Q_{biomass} - \left(\frac{\mu_{old}}{1000} \cdot f_{old}\right)\right) \cdot Stove_{year}$$

Data Ex Ante		Value		Unit	Source			
Q _{biomass} (charcoal)		4.10		tonne/year	Ex-ante, PoA-DD / CPA-DDs			
Q _{biomass} (wood)		1.90		tonne/year	Ex-ante, PoA-DD / CPA-DDs			
f _{NRB}		0.99		fraction	Ex-ante, PoA-DD / CPA-DDs			
NCV _{biomass}		0.015		TJ/tonne	Ex-ante, PoA-DD / CPA-DDs			
EF _{projected} f _{ossilfuel}		81.6		tCO2/TJ	Ex-ante, PoA-DD / CPA-DDs			
η _{old}		0.101		fraction	Ex-ante, PoA-DD / CPA-DDs			
LAF		0.95		fraction	Ex-ante, PoA-DD / CPA-DDs			
Data Ex Post		Value		Unit	Source			
Monitored								
η _{new,y Econochar}		33.65%		percentage	WBT Summary			
η _{new,y Econofire}		29.34%		percentage	WBT Summary			
SOF _{charcoal}		1.000		fraction	Survey Summary			
SOF _{wood}		0.950		fraction	Survey Summary			
f _{old charcoal}		0.133		fraction	Survey Summary			
f _{old wood}		0.123		fraction	Survey Summary			
μ _{old charcoal}		1324		kg/year	Survey Summary			
μ _{old wood}		905		kg/year	Survey Summary			
Data Ex Post		5342-P1-0013-CP1		5342-P1-0014-CP1		5342-P1-0015-CP1	Unit	Source
N _{charcoal}		1656		1863		1096	Number	PoA database
N _{wood}		446		693		941	Number	PoA database
N _{all}		2102		2556		2037	Number	PoA database
STOVE _{yearcharcoal}		0.16		0.16		0.16	Fraction	Calculated
STOVE _{yearwood}		0.19		0.19		0.17	Fraction	Calculated
η _{new,ycharcoal}		33.65%		33.65%		33.65%	Percentage	Calculated
η _{new,ywood}		29.34%		29.34%		29.34%	Percentage	Calculated
B _{old charcoal}		1001.63		1138.86		664.28	Tonnes/year	Calculated
B _{old wood}		138.66		210.19		253.30	Tonnes	Calculated
B _{y,savings charcoal}		701.0		797.0		464.9	Tonnes/year	Calculated
B _{y,savings wood}		90.9		137.8		166.1	Tonnes/year	Calculated
B _{y,savings total}		791.9		934.8		631.0	Tonnes/year	Calculated
Total Annual Energy savings		3.30		3.90		2.63	GWhth	Calculated
Scale?		Small		Small		Small	--	Calculated
Capacity Utilization		2%		2%		1%	%	Calculated
ER _v		959		1,132		764	tCO2e	Calculated

F.2. Calculation of project emissions or actual net removals

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As explained above, the methodology directly provides equation for emission reductions; without separate baseline, project or leakage emission reduction equations. Calculation of Emission Reductions has already been explained above as per the methodology. Thus, this section is not applicable.

F.3. Calculation of leakage emissions

>>

As explained above, the methodology directly provides equation for emission reductions; without separate baseline, project or leakage emission reduction equations. Calculation of Emission Reductions has already been explained above as per the methodology by application of Gross to Net Leakage adjustment factor of 0.95 to baseline emissions. Thus, this section is not applicable.

F.4. Calculation of emission reductions or net anthropogenic removals

CPA UNFCCC reference number	Baseline GHG emissions or baseline net GHG removals (t CO ₂ e)	Project GHG emissions or actual net GHG removals (t CO ₂ e)	Leakage GHG emissions (t CO ₂ e)	GHG emission reductions or net anthropogenic GHG removals (t CO ₂ e)		
				Before 01/01/2013	From 01/01/2013	Total amount
5342-P1-0013-CP1	959	0	0	0	959	959
5342-P1-0014-CP1	1,132	0	0	0	1,132	1,132
5342-P1-0015-CP1	764	0	0	0	764	764
Total	2,855	0	0	0	2,855	2,855

F.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the included CPA-DDs

CPA UNFCCC reference number	Amount achieved during this monitoring period (t CO ₂ e)	Amount estimated ex ante for this monitoring period in the CPA-DD (t CO ₂ e)
5342-P1-0013-CP1	959	10,212
5342-P1-0014-CP1	1,132	10,212
5342-P1-0015-CP1	764	10,212
Total	2,855	30,636

F.5.1. Explanation of calculation of “amount estimated ex ante for this monitoring period in the CPA-DD”

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The ex-ante estimate for the monitoring period has been calculated as follows:

$$\begin{aligned}
 &= \text{Ex-ante ER as per CPA-DD (Section B.4.4) * effective duration of monitoring period}^3 / 365 \\
 &= 46,594 * 80 / 365 \\
 &= 10,212
 \end{aligned}$$

F.6. Remarks on increase in achieved emission reductions

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NA

³ The effective duration of monitoring period is deemed as 80 days as per following:
Monitoring period start date = 25 Oct 2017

Crediting period start date of CPAs = 12 April 2019

End date of monitoring period = 30 June 2019

effective duration of monitoring period = 30 June 2019 – 12 April 2019 + 1 = 80 days

F.7. Remarks on scale of small-scale CPAs

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The emission reductions are lower than the ex-ante estimates substantiating that the CPAs are below the limit of type II category.

Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
03.0	31 May 2019	Revision to: <ul style="list-style-type: none"> • Ensure consistency with version 02.0 of the “CDM project standard for programmes of activities” (CDM-EB93-A07-STAN); • Add a section on remarks on the observance of the scale limit of small-scale CPAs during the crediting periods; • Add "changes specific to afforestation or reforestation activities/CPA" as a possible post-registration changes; • Clarify the reporting of net anthropogenic GHG removals for A/R PoAs between two commitment periods; • Make structural and editorial improvements.
02.0	7 June 2017	Revision to: <ul style="list-style-type: none"> • Ensure consistency with version 01.0 of the “CDM project standard for programmes of activities” (CDM-EB93-A07-STAN); • Make editorial improvements.
01.0	1 April 2015	Initial publication.
Decision Class: Regulatory Document Type: Form Business Function: Issuance Keywords: monitoring report, programme of activities		