



**Monitoring report form for CDM programme of activities  
(Version 02.0)**

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

**MONITORING REPORT**

<b>Title of the PoA</b>	African Improved Cooking Stoves Programme of Activities	
<b>UNFCCC reference number of the PoA</b>	5342	
<b>Version numbers of the PoA-DD applicable to this monitoring report</b>	4.3	
<b>Version number of this monitoring report</b>	4.0	
<b>Completion date of this monitoring report</b>	24/01/2019	
<b>Monitoring period number</b>	Fifth monitoring period	
<b>Duration of this monitoring period</b>	25/10/2016 - 24/10/2017	
<b>Monitoring report number for this monitoring period</b>	1.0	
<b>Coordinating/managing entity</b>	Envirofit International Ltd.	
<b>Host Parties</b>	<b>Host Party of the PoA</b>	<b>Is this the host Party of a CPA covered in this monitoring report? (yes/no)</b>
	Ghana	No
	Nigeria	Yes
	Liberia	No
<b>Sectoral scopes</b>	Sectoral scope: 3: Energy demand	
<b>Applied methodologies and standardized baselines</b>	AMS-II.G ver 3.0: Energy efficiency measures in thermal applications of non-renewable biomass	
<b>Amount of GHG emission reductions or net anthropogenic GHG removals achieved by all CPAs covered in this monitoring report in this monitoring period</b>	<b>Amount achieved before 1 January 2013</b>	<b>Amount achieved from 1 January 2013</b>
	0	11,791 tCO <sub>2</sub> e
<b>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</b>	88,318 tCO <sub>2</sub> 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 improved biomass 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 or charcoal made from wood) which is the dominant fuel used for cooking in project households. The ICSs applied 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 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 DO sells ICSs either directly or through retailers, entrepreneurs or other agents sub-contracted by the DO. The CME provides training and guidance on the correct distribution and monitoring procedures to each DO. Each DO acts 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: <a href="http://cdm.unfccc.int/UserManagement/FileStorage/V96Q8RJG3DUWTMXIYH20Z4LPE5B7OF">http://cdm.unfccc.int/UserManagement/FileStorage/V96Q8RJG3DUWTMXIYH20Z4LPE5B7OF</a> Version: 1.0	version 4.3 dated 07/06/2014	Sectoral Scope 3	AMS-II.G, version 3: Energy Efficiency Measures in Thermal Applications of Non-Renewable Biomass  <a href="https://cdm.unfccc.int/UserManagement/FileStorage/MLDN960OH41VWJPCZ23ERFUQT5BAGX">https://cdm.unfccc.int/UserManagement/FileStorage/MLDN960OH41VWJPCZ23ERFUQT5BAGX</a>

CPAs included in the PoA

Title and UNFCCC reference number of the CPA	Title and reference number of the corresponding generic CPA	Version of the PoA-DD	Crediting period type and duration	Covered in this monitoring report? (yes/no)
African Improved Cooking Stoves Programme of Activities CPA 00001 (Ghana) 5342-0001	<b>Title:</b> African Improved Cooking Stoves Programme of Activities – Generic CPA <b>Identification:</b> Part II of revised PoA-DD version 4.3 dated 07/06/2014	Version 4.3 dated 07/06/2014	Fixed, 15/12/2012 – 14/12/2022	No

African Improved Cooking Stoves Programme of Activities CPA 00002 (Ghana) 5342-0002	<b>Reference:</b> <a href="http://cdm.unfccc.int/UserManagement/FileStorage/V96Q8RJG3DUWTMXIYH20Z4LPE5B7OF">http://cdm.unfccc.int/UserManagement/FileStorage/V96Q8RJG3DUWTMXIYH20Z4LPE5B7OF</a> <b>Version: 1.0</b>	Version 4.3 dated 07/06/2014	Fixed, 01/11/ 2013 – 31/10/2023	No
African Improved Cooking Stoves Programme of Activities CPA 00003 (Ghana) 5342-0003		Version 4.3 dated 07/06/2014	Fixed, 01/12/2013 – 30/11/2023	No
African Improved Cooking Stoves Programme of Activities CPA 00004 (Nigeria) 5342-0004		Version 4.3 dated 07/06/2014	Fixed, 25/10/2014 – 24/10/2024	Yes
African Improved Cooking Stoves Programme of Activities CPA 00005 (Nigeria) 5342-0005		Version 4.3 dated 07/06/2014	Fixed, 25/10/2014 – 24/10/2024	Yes
African Improved Cooking Stoves Programme of Activities CPA 00006 (Liberia) 5342-0006		Version 4.3 dated 07/06/2014	Fixed, 01/02/2015 – 31/01/2025	No

## 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 are as follows:

Rohit Lohia  
 Carbon Projects Development Manager  
 Envirofit International  
[rohit.lohia@envirofit.org](mailto:rohit.lohia@envirofit.org)

## SECTION B. Implementation of PoA

### B.1. Description of implemented PoA

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Envirofit International Limited is the Coordinating and Managing Entity (CME) for the PoA. The Distributing Organization(DO) for the CPAs included in the PoA are as follows:

CPA	Name of DO	Status of CPA Implementation
5342-0004	Envirofit International	Implemented
5342-0005	Envirofit International	Implemented

The DOs have subcontracted retailers/entrepreneurs (referred as dealers) for dissemination of project stoves. The implemented CPA follow the following management system:

1. Envirofit provided instructions to dealers to collect the end user information at the time of sales to make the stove eligible under the PoA. Envirofit 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. Envirofit maintains a PoA Distribution and Monitoring database. This database is a compilation of CPA distribution records. The database includes CPA wise list of stoves sales, based on following information, received from dealers (collected this information at the time of sale):
  - 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. Envirofit performed cross-checks on the ICS sales information received from the dealers. The CME's logo is clearly displayed on the CPA Distribution Record, with a copy retained by Envirofit. 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. Envirofit obtained the customer's approval during distribution to exclusively assign carbon rights to the CME as per the disclaimer specified on CPA distribution records / stove boxes.
5. Envirofit 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. Envirofit 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 ( $\mu_{old}$ )
7. Envirofit calculated emission reductions based on monitoring data collected and prepared monitoring report

Thus, by carrying out the aforesaid, Envirofit ensured that the PoA Operational and Management plan as per section A.2 of the latest approved registered PoA-DD is duly implemented for concerned CPAs.

## **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 applied standards or tools

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NA

### B.2.4. Changes to programme design

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PRC-5341-001 included changes to programme design was made to expand the project boundary to include Liberia under the PoA. The PRC was approved on 16/06/2014. For more detail, refer the following link

<https://cdm.unfccc.int/PRCContainer/DB/prcp237694862/view>

## PART II Monitoring of CPAs

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This Monitoring Report covers two CPAs i.e. 5342-0004 and 5342-0005 included in Nigeria. These CPAs have the same project boundary and follow a common generic CPA as identified in section A.1.1, Part I of this monitoring report. The following sections therefore represent both the 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 improved cooking stoves (ICS) in Nigeria. 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 Nigeria.

(b) ***Description of the technology employed and installed equipment and/or infrastructure, including information requested by the eligibility criteria;***

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	Total number of stoves installed
5342-0004	Wood Fuel	M5000	993
5342-0005	Charcoal	CH2300, CH5300	7,197

The stove model referred above are shown below:



### Stove Specifications:

Parameter description	CH2300	M5000	CH5300
Thermal Efficiency	39.4 %	29.7 %	35.7%
Unit Size	15.4 x 31.3 x 22.9 cm (height x width x depth)	28 x 32 cm (height x diameter)	36.6 x 31.5 x 26 cm (height x width x depth)
Unit Weight	2.3 kg	4.2 kg	5.0 kg
Shipping Size	16.9 x 32 x 25 cm (height x width x depth)	29.2 x 33.5 x 33.5 cm (height x width x depth)	38.2 x 32.8 x 27.5 cm (height x width x depth)
Shipping Weight	2.6 kg	5.34 kg	5.4 kg
CO emissions improvement %	--	70.9%	50%

### Information required by Eligibility criteria

Eligibility criteria # 3, 4 and 11 that require information related to project technology / infrastructure are discussed below:

No.	Eligibility criteria		Assessment for CPAs	
	Description	Conditions to be met	Means of proof	Confirmation
#3	Applicability of Methodology AMS-II. G -Technology type	The ICS uses one of the following fuel types: <ul style="list-style-type: none"> <li>Wood fuel</li> <li>Charcoal</li> </ul>	Technical specification of ICS provided	Refer D.1 (b) above for the type and number of stoves distributed in the CPAs till the end of the monitoring period. M5000 is a woodfuel stove and CH2300, CH5300 are charcoal stoves.
#4	Applicability of Methodology AMS-II. G – Minimum ICS efficiency/ specifications of technology including the level and type of service	The ICS has a minimum efficiency of 20% (AMS-II.G, V.3, para 1)	Technical specification of ICS provided (either from manufacturer's specifications or test results using the Emissions & Performance Test Protocol (EPTP))	Already specified in the registered CPA-DDs for CH2300 and M5000. For CH5300 Stove specification sheet issued by the manufacturer is being submitted

				substantiating the thermal efficiency of the ICS to be more than 20%.
#11	SSC Limit for CPAs	<p>The annual energy savings of each CPA shall not go beyond the limits of 180 GWh<sub>th</sub>/year over the entire crediting period.</p> <p>In the case of using option 1 to prove additionality under Eligibility Criteria 7, the limit shall be 60 GWh<sub>th</sub>/year over the entire crediting period.</p>	The maximum number of ICS will be determined in each CPA-DD depending on the technology used (excel sheet will be provided to show calculated energy savings). If a CPA exceeds the applicable limit in any year, the claimable emission reduction shall be capped based on the estimated GHG reductions in the CPA-DD).	Refer ER calculator, worksheet 'ER Calculations' which calculates the annual energy savings in CPAs 5342-0004 and 5342-0005. Both CPAs remain within the small-scale threshold during the monitoring period.

For detailed information on complete list of eligibility criteria refer the CPA-DDs available on UNFCCC website as mentioned in Section A.1.2, Part I of this monitoring report.

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

Description	CPA 5342-0004	CPA 5342-0005	Reference
Start Date	28/12/2012	28/12/2012	Respective CPA-DD
Date of first stove sale in database	06/02/2013	09/01/2013	PoA / CPA distribution database

- (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	Emission Reductions tCO <sub>2</sub> e
CPA00004	1,484
CPA00005	10,307
<b>Total</b>	<b>11,791</b>

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 sale in CPA Distribution Record. Thus, location of each stove in CPA distribution database can be traced. Please refer the ER calculator, worksheet 'CPA Distribution data' in which the sales information i.e. Stove unit details and the end user information for each stove is mentioned. 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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Host Parties: Nigeria

Region/State/Province: All across Nigeria

City/Town/Community: All across Nigeria

Physical Geographical location: End user households across Nigeria

The CPAs have been implemented within the boundary of the Republic of Nigeria as depicted in Figure 4 below

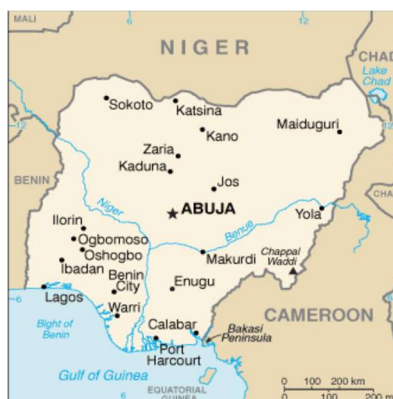


Figure 4: Map of Nigeria

### C.3. Post-registration changes to CPAs

#### C.3.1. Temporary deviations from the monitoring plans in the included CPA-DDs, applied methodologies or standardized baselines

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NA

#### C.3.2. Corrections

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NA

#### C.3.3. Changes to the startdate 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 applied standards or tools

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NA

#### C.3.6. Changes to project design

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NA

### SECTION D. Description of monitoring system of CPAs

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Stoves were either distributed to end-users by Envirofit directly or via dealers sub-contracted. Any such third parties were trained by Envirofit for ensuring correct procedures according to the PoA are fulfilled.



At the CPA level, Envirofit 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

(Copy this table for each data or parameter.)

Data/parameter	$Q_{\text{biomass}}$
Unit	Tonnes/year
Description	Annual average biomass consumption per appliance
Source of data	Historical data from literature, as allowed by the methodology
Value(s) applied	4.50 for CPA 0005 which includes CH2300 4.94 for CPA 0004 which includes M5000
Choice of data or measurement methods and procedures	As per registered CPA-DD for 5342-0004 and 5342-0005
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	Used for calculation of $B_{\text{old}}$

Data/parameter	$f_{\text{NRB},y}$
Unit	Fraction
Description	Fraction of woody biomass saved by the project activity in year $y$ that can be established as non-renewable biomass using national or local statistics, survey results, studies, maps or other sources of information, such as remote-sensing data.
Source of data	As per registered CPA-DD for 5342-0004 and 5342-0005
Value(s) applied	0.93
Choice of data or measurement methods and procedures	As per registered CPA-DD for 5342-0004 and 5342-0005
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	-

Data/parameter	$NCV_{\text{biomass}}$
Unit	TJ/tonne
Description	Net calorific value of the non-renewable biomass that is substituted
Source of data	2006 IPCC guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.015
Choice of data or measurement methods and procedures	As per registered CPA-DD for 5342-0004 and 5342-0005
Purpose of data/parameter	Calculation of baseline emissions

Additional comments	-
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<b>Data/parameter</b>	<b>EF<sub>projected_fossilfuel</sub></b>
Unit	tCO <sub>2</sub> /TJ
Description	Emission factor for the substitution of non-renewable biomass by similar consumers
Source of data	2006 IPCC guidelines for National Greenhouse Gas Inventories
Value(s) applied	81.6
Choice of data or measurement methods and procedures	As per registered CPA-DD for 5342-0004 and 5342-0005
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	-

<b>Data/parameter</b>	<b><math>\eta_{old}</math></b>
Unit	Fraction
Description	Efficiency of the system being replaced
Source of data	AMS-II.G version 03
Value(s) applied	0.106
Choice of data or measurement methods and procedures	As per registered CPA-DD for 5342-0004 and 5342-0005
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	-

<b>Data/parameter</b>	<b>LAF</b>
Unit	Fraction
Description	Net to gross adjustment factor to account for leakages
Source of data	AMS-II.G version 03
Value(s) applied	0.95
Choice of data or measurement methods and procedures	As per registered CPA-DD for 5342-0004 and 5342-0005
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	-

## E.2. Data and parameters monitored

(Copy this table for each data or parameter.)

<b>Data/parameter</b>	<b><math>\eta_{new,y}</math></b>		
Unit	Efficiency		
Description	Efficiency of the system being deployed as part of the project activity		
Measured/calculated/default	Measured		
Source of data	As determined through sample testing of stoves by performing WBTs		
Value(s) of monitored parameter	<b>Stove model</b>	<b>Value (%)</b>	<b>Comment</b>
	CH5300	32.59%	Applicable to 5342-0005
	CH2300	31.01%	Applicable to 5342-0005
	M5000	28.27%	Applicable to 5342-0004

Monitoring equipment	<p><b>Thermometer:</b> Brand: Omega Model: Omegaette HH308 Type K Accuracy: +/- 0.3% reading +10C Number of units: 3 S/N: and 130803109, 141203661, 141203662</p> <p><b>Mass balance:</b> Brand: KERN Model: EMS 12K0.1 Accuracy: +/- 0.3 gm Number of units: 1 S/N: WD140099205</p> <p><b>Moisture Meter:</b> Brand: TROTEC Model: T500 Accuracy: +/- 1% Number of units: 1 S/N: 3510207500</p> <p>The equipment were either externally calibrated (thermometers, weighing scale) or were auto-calibrated (Moisture Meter) at the time of use so measurements were done with the necessary guarantees.</p>
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 <a href="http://www.pciaonline.org/testing">http://www.pciaonline.org/testing</a>
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	-

Data/parameter	N <sub>all</sub>		
Unit	Number		
Description	Total number of stoves installed		
Measured/calculated/default	Calculated		
Source of data	CPA Distribution Records and logbooks		
Value(s) of monitored parameter	Stove type	Value (number)	Comment
	Charcoal	6,901	Applicable to 5342-0005
	woodfuel	961	Applicable to 5342-0004
Monitoring equipment	n/a		
Measuring/reading/recording frequency	<p>The DO maintained CPA Distribution Records which 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 sales 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, (adjusted, refer additional comment)		
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	Based on the monitoring survey results, the stove number in each CPA has been discounted by the fraction of samples that have reported using more than one EF stove.
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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	Stove type	Value (fraction)	Comment
	Charcoal	0.945	Applicable to 5342-0005
	woodfuel	0.903	Applicable to 5342-0004
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)	-		
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	$f_{old}$		
Unit	Fraction		
Description	Fraction of end users that are still using baseline stoves		
Measured/calculated/default	Measured		
Source of data	Survey data of end user behaviour as part of the PoA Sampling Plan		
Value(s) of monitored parameter	Stove type	Value (fraction)	Comment
	Charcoal	0.101	Applicable to 5342-0005
	woodfuel	0.498	Applicable to 5342-0004
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 estimation of a representative sample of end users using the deployed ICS, as conducted in line with the PoA Sampling Plan.  Sampling estimated the value of this parameter through monitoring the fraction of end users not using baseline stoves ( $f_{non,old}$ ),  This was done on an annual basis as per the PoA monitoring requirements		
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	$\mu_{old}$									
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>Stove type</th><th>Value (kg/year)</th><th>Comment</th></tr><tr><td>Charcoal</td><td>1,904</td><td>Applicable to 5342-0005</td></tr><tr><td>Woodfuel</td><td>1,762</td><td>Applicable to 5342-0004</td></tr></table>	Stove type	Value (kg/year)	Comment	Charcoal	1,904	Applicable to 5342-0005	Woodfuel	1,762	Applicable to 5342-0004
Stove type	Value (kg/year)	Comment								
Charcoal	1,904	Applicable to 5342-0005								
Woodfuel	1,762	Applicable to 5342-0004								
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 <math>\mu_{old}</math> will be estimated by comparing the number of meals before and after buying ICS.</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-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	-									

<b>Data/parameter</b>	$Stove_{year}$						
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	<table> <tr> <th>CPA</th><th>Value (fraction)</th></tr> <tr> <td>5342-0005</td><td>0.50</td></tr> <tr> <td>5342-0004</td><td>0.62</td></tr> </table>	CPA	Value (fraction)	5342-0005	0.50	5342-0004	0.62
CPA	Value (fraction)						
5342-0005	0.50						
5342-0004	0.62						
Monitoring equipment	No specific monitoring equipment has been used for the surveys.						
Measuring/reading/recording frequency	<p>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 fraction of year, for which the stoves included in the emissions reduction calculations, shall be accounted.</p> <p>The recording of the sales date was done in a regular basis during the crediting period and the monitoring on an annual basis.</p>						

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
5342-0005	Small	Charcoal	7,197	25/10/2016 – 24/10/2017
5342-0004	Small	Woodfuel	993	25/10/2016 – 24/10/2017

#### 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	$\mu_{old}$	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 5342-0004 & 5342-0005, 95/10 reliability level was selected for cross-CPA sampling for the parameters mentioned above.

As per page 53 of the PoA-DD, for the parameter  $\eta_{new}$ , 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  $\eta_{new}$  considering each stove model as separate population. As per page 53 and page 57 of the PoA-DD, for other parameters (SOF,  $f_{old}$ ,  $\mu_{old}$ ), 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. Nigeria	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	For charcoal it is CH2300 and CH5300 whose efficiency is within +/-10% and for woodfuel there is only one model i.e. M5000)	homogeneous

The initial target population were the stoves distributed and recorded under CPA 5342-0004 and 5342-0005. 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 ( $\mu_{old}$ ). Thus, the sample size calculations for parameters SOF,  $f_{old}$ ,  $\mu_{old}$  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:

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

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

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

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

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

Parameter	Total population (N)	Expected results	Reliability	Required Sample Size (n)	Monitored samples
$\eta_{new,yCH2300}$	6,559	31.0% (mean); 3.1% (SD)	95/10	7	10
$\eta_{new,yCH5300}$	638	32.0% (mean); 3.2% (SD)	95/10	7	10
$\eta_{new,yM5000}$	993	28.0% (mean); 2.8% (SD)	95/10	7	10
SOF <sub>Charcoal</sub>	7,197	90%	95/10	43	73
SOF <sub>Woodfuel</sub>	993	90%	95/10	41	62
$f_{old}$ Charcoal	6,477	10% ( $f_{non\ old} = 90\%$ )	95/10	43	69

$f_{old}$ woodfuel	894	10% ( $f_{non\ old} = 90\%$ )	95/10	41	56
$\mu_{old}$ Charcoal	648	2270 kg/yr (mean); 227.0 kg/yr (SD)	95/10	7	7
$\mu_{old}$ woodfuel	89	2470 kg/yr (mean); 247.0 kg/yr (SD)	95/10	7	21

The stoves were selected by randomly assigning a number to each stove and sorting in increasing order from lower to higher number. 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  $\mu_{old}$ .

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

Data was collected for SOF,  $f_{old}$  and  $\mu_{old}$  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 in-house experts with prior experience of conducting WBTs.

The surveys and WBTs were conducted during March - May 2018.

**d) Analysis of the collected data;**

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

Parameter	Results	Unit
$\eta_{new,y}$ CH5300	32.59	%
$\eta_{new,y}$ CH2300	31.01	%
$\eta_{new,y}$ M5000	28.27	%
SOF <sub>charcoal</sub>	0.945	fraction
SOF <sub>woodfuel</sub>	0.903	fraction
$f_{old}$ - charcoal	0.101	fraction
$f_{old}$ - woodfuel	0.498	fraction
$\mu_{old}$ - charcoal	1904	kg / year
$\mu_{old}$ - woodfuel	1762	kg / year

**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:

$\eta_{new,y}$ CH5300	32.59%	percentage	Calculated
total number of stoves	638	number	CPA Installation Databases
Samples monitored for ( $\eta_{new}$ CH2300)	10	number	WBT data
Mean	32.59%	percentage	Calculated
Standard Deviation	0.56%	percentage	Calculated
Standard error of mean ( $\eta_{new}$ CH2300)	0.17%	percentage	Calculated



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Precision for $\eta_{\text{new CH5300}}$	1.21%	percentage	Calculated
Result for $\eta_{\text{new CH5300}}$	ok, acceptable	--	Calculated

<b><math>\eta_{\text{new,y CH2300}}</math></b>	<b>31.01%</b>	<b>percentage</b>	<b>Calculated</b>
total number of stoves	6559	number	CPA Installation Databases
Samples monitored for ( $\eta_{\text{new CH2300}}$ )	10	number	WBT data
Mean	31.01%	percentage	Calculated
Standard Deviation	0.68%	percentage	Calculated
Standard error of mean ( $\eta_{\text{new CH2300}}$ )	0.21%	percentage	Calculated
Precision for $\eta_{\text{new CH2300}}$	1.56%	percentage	Calculated
Result for $\eta_{\text{new CH2300}}$	ok, acceptable	--	Calculated

<b><math>\eta_{\text{new,y M5000}}</math></b>	<b>28.27%</b>	<b>percentage</b>	<b>Calculated</b>
total number of stoves	993	number	CPA Installation Databases
Samples monitored for ( $\eta_{\text{new M5000}}$ )	10	number	WBT data
Mean	28.27%	percentage	Calculated
Standard Deviation	0.63%	percentage	Calculated
Standard error of mean ( $\eta_{\text{new M5000}}$ )	0.20%	percentage	Calculated
Precision for $\eta_{\text{new M5000}}$	1.60%	percentage	Calculated
Result for $\eta_{\text{new M5000}}$	ok, acceptable	--	Calculated

<b>SOF<sub>Charcoal</sub></b>	<b>0.945</b>	<b>fraction</b>	<b>Calculated</b>
Population Size	7,197	number	CPA Installation Databases
Samples monitored	73	number	Calculated
Proportion for SOF <sub>charcoal</sub>	0.945	fraction	Calculated
Standard error of proportion for SOF <sub>charcoal</sub>	2.65%	percentage	Calculated
Precision for SOF <sub>Charcoal</sub>	5.50%	percentage	Calculated
Result for SOF <sub>Charcoal</sub>	ok, acceptable	--	Calculated

<b>SOF<sub>woodfuel</sub></b>	<b>0.903</b>	<b>fraction</b>	<b>Calculated</b>
Population Size	993	number	CPA Installation Databases
Samples monitored	62	number	Calculated
Proportion for SOF <sub>woodfuel</sub>	0.903	fraction	Calculated
Standard error of proportion for SOF <sub>woodfuel</sub>	3.64%	percentage	Calculated
Precision for SOF <sub>woodfuel</sub>	7.89%	percentage	Calculated
Result for SOF <sub>woodfuel</sub>	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  $f_{\text{old}}$  has been determined as  $f_{\text{old}} = 1 - f_{\text{non old}}$ .

<b><math>f_{\text{old Charcoal}}</math></b>	<b>0.101</b>	<b>fraction</b>	<b>Calculated</b>
Population Size	6803	number	CPA Installation Databases
Samples monitored	69	number	Calculated
Proportion for $f_{\text{non old charcoal}}$	0.899	fraction	Calculated
Standard error of proportion for $f_{\text{non old charcoal}}$	3.62%	percentage	Calculated
Precision for $f_{\text{non old Charcoal}}$	7.89%	percentage	Calculated

Result for $f_{\text{non old Charcoal}}$	ok, acceptable	--	Calculated
$f_{\text{old woodfuel}}$	<b>0.498</b>	<b>fraction</b>	<b>Calculated</b>
Population Size	897	number	CPA Installation Databases
Samples monitored	56	number	Calculated
Proportion for $f_{\text{non old woodfuel}}$	0.625	fraction	Calculated
Standard error of proportion for $f_{\text{non old woodfuel}}$	6.26%	percentage	Calculated
Precision for $f_{\text{non old woodfuel}}$	19.64%	percentage	Calculated
Result for $f_{\text{non old woodfuel}}$	Use lower bound value	--	Calculated

$\mu_{\text{old Charcoal}}$	<b>1.904</b>	<b>tonnes/yr</b>	<b>Calculated</b>
Population Size	690	number	CPA Installation Databases
Samples monitored	7	number	Calculated
Mean for $\mu_{\text{old CH2300}}$	0.29	tonnes/y	Calculated
Standard Deviation $\mu_{\text{old charcoal}}$	0.14	tonnes/y	Calculated
Standard error of mean $\mu_{\text{old charcoal}}$	5.34%	percentage	Calculated
Precision for $\mu_{\text{old Charcoal}}$	35.81%	percentage	Calculated
Result for $\mu_{\text{old Charcoal}}$	Use upper bound value	--	Calculated

$\mu_{\text{old woodfuel}}$	<b>1.762</b>	<b>tonnes/yr</b>	<b>Calculated</b>
Population Size	446	number	CPA Installation Databases
Samples monitored	21	number	Calculated
Mean for $\mu_{\text{old M5000}}$	0.31	tonnes/y	Calculated
Standard Deviation $\mu_{\text{old woodfuel}}$	0.10	tonnes/y	Calculated
Standard error of mean $\mu_{\text{old woodfuel}}$	2.04%	percentage	Calculated
Precision for $\mu_{\text{old woodfuel}}$	12.74%	percentage	Calculated
Result for $\mu_{\text{old woodfuel}}$	Use upper bound value	-	Calculated

For detailed calculations refer ER calculator, worksheet 'Survey Summary' and 'WBT Summary'.

**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 sale and assigning a number to each stove. 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

>>

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

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

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

Data Ex Ante	Value	Unit	Source
Q <sub>biomass</sub> (woodfuel)	4.94	tonne/year	Ex-ante, PoA-DD / CPA-DDs
Q <sub>biomass</sub> (charcoal)	4.50	tonne/year	Ex-ante, PoA-DD / CPA-DDs
f <sub>NRB</sub>	0.93	fraction	Ex-ante, PoA-DD / CPA-DDs
NCV <sub>biomass</sub>	0.015	TJ/tonne	Ex-ante, PoA-DD / CPA-DDs
EF <sub>fossil_fuel</sub>	81.6	tCO <sub>2</sub> /TJ	Ex-ante, PoA-DD / CPA-DDs
old, woodfuel	0.106	fraction	Ex-ante, PoA-DD / CPA-DDs
old, charcoal	0.106	fraction	Ex-ante, PoA-DD / CPA-DDs
LAF	0.95	fraction	Ex-ante, PoA-DD / CPA-DDs
Data Ex Post	Value	Unit	Source
<b>Monitored</b>			
η <sub>new,y</sub> M5000	28.27%	percentage	WBT Summary
η <sub>new,y</sub> CH2300	31.01%	percentage	WBT Summary
η <sub>new,y</sub> CH5300	32.59%	percentage	WBT Summary
SOF <sub>woodfuel</sub>	0.903	fraction	Survey Summary
SOF <sub>charcoal</sub>	0.945	fraction	Survey Summary
f <sub>old</sub> woodfuel	0.498	fraction	Survey Summary
f <sub>old</sub> charcoal	0.101	fraction	Survey Summary
μ <sub>old</sub> woodfuel	1762	kg/year	Survey Summary
μ <sub>old</sub> charcoal	1904	kg/year	Survey Summary
Data Ex Post	5342-0004	5342-0005	Source
N <sub>all</sub>	961	6901	Calculated
STOVE <sub>year</sub>	0.62	0.50	Calculated
η <sub>new,y</sub>	28.27%	32.48%	Calculated
B <sub>old</sub>	2085.96	13440.63	Calculated
B <sub>y,savings</sub>	1,303.9	9,054.9	Calculated
Total Annual Energy savings	5.43	37.73	Calculated
Scale?	Small	Small	Calculated
Capacity Utilization	3%	21%	Calculated
ER <sub>y</sub>	1,484	10,307	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 <sub>2</sub> e)	Project GHG emissions or actual net GHG removals (t CO <sub>2</sub> e)	Leakage GHG emissions (t CO <sub>2</sub> e)	GHG emission reductions or net anthropogenic GHG removals (t CO <sub>2</sub> e)		
				Before 01/01/2013	From 01/01/2013	Total amount
5342-0004	1,484	0	0	0	1,484	1,484
5342-0005	10,307	0	0	0	10,307	10,307
<b>Total</b>	<b>11,791</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>11,791</b>	<b>11,791</b>

**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 (tCO <sub>2</sub> e)	Amount estimated ex ante (tCO <sub>2</sub> e)
5342-0004	1,484	44,159
5342-0005	10,307	44,159
<b>Total</b>	<b>11,791</b>	<b>88,318</b>

**F.6. Remarks on increase in achieved emission reductions**

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There is no increase in the GHG emission reductions or net GHG removals by sinks achieved by the specific-case CPA(s) during this monitoring period.

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**Document information**

Version	Date	Description
02.0	7 June 2017	Revision to: <ul style="list-style-type: none"> <li>Ensure consistency with version 01.0 of the "CDM project standard for programmes of activities (CDM-EB93-A07-STAN);</li> <li>Make editorial improvements.</li> </ul>
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