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		
Title of the PoA	Improved Cookstoves Program in Honduras “Vida Mejor con Ecofogones de Alto Rendimiento”	
UNFCCC reference number of the PoA	9176	
Version numbers of the PoA-DD applicable to this monitoring report	5	
Version number of this monitoring report	4.0	
Completion date of this monitoring report	18/05/2018	
Monitoring period number	2	
Duration of this monitoring period	15/06/2016 – 14/06/2017	
Monitoring report number for this monitoring period	1	
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)
	Honduras	Yes
Sectoral scopes	Sectoral scope: 3: Energy demand	
Applied methodologies and standardized baselines	AMS-II.G ver 6.0: Energy efficiency measures in thermal applications of non-renewable biomass	
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	110,413 tCO_2e
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	119,724 tCO_2e	

PART I Monitoring of programme of activities (PoA)

SECTION A. Description of PoA

A.1. General description of PoA

>>

The goal of the PoA is to facilitate the transition away from inefficient conventional firewood stoves in Honduras by providing improved efficiency, clean burning firewood cooking stoves (ICS) to local households and SMEs. The ICS applied in this PoA have been designed to match the traditional utensils and cooking habits of the target consumers in host country.

The ICS distributed included in 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 which is the dominant fuel used for cooking in project households. By reducing the amount of fuel required for cooking (and equivalent use of non-renewable woody biomass), more efficient ICS under PoA reduce the amount of greenhouse gases (GHG) emitted into the atmosphere.

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: Improved Cookstoves Program in Honduras "Vida Mejor con Ecofogones de Alto Rendimiento" – Genric CPA **Identification:** Part II of PoA-DD version 5.0 dated 16/01/2015 **Reference:** https://cdm.unfccc.int/UserManagement/FileStorage/Y4SOEA0NL6GWTFXVUPZD915JCR2B83	PoA-DD version 5.0 dated 16/01/2015	Sectoral Scope 3	AMS-II.G. : Energy Efficiency Measures in Thermal Applications of Non-Renewable Biomass, version 6

A.1.2. 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)
Improved Cookstoves Project Activity in Honduras "Vida Mejor con Ecofogones de Alto Rendimiento" – CPA No 001, UNFCCC ref: 9176-0001	**Title:** Improved Cookstoves Program in Honduras "Vida Mejor con Ecofogones de Alto Rendimiento" – Genric CPA **Identification:** Part II of PoA-DD version 5.0 dated 16/01/2015 **Reference:** https://cdm.unfccc.int/UserManagement/FileStorage/Y4SOEA0NL6GWTFXVUPZD915JCR2B83 **Version:** 1.0	PoA-DD version 5.0 dated 16/01/2015	7 year renewable, 15/06/2015 – 14/06/2022	Yes
Improved Cookstoves Project Activity in Honduras "Vida Mejor con Ecofogones de Alto Rendimiento" – CPA No 002, UNFCCC ref: 9176-0002			7 year renewable, 01/02/2017 – 31/01/2024	Yes
Improved Cookstoves Project Activity in Honduras "Vida Mejor con Ecofogones de Alto Rendimiento" – CPA No 003, UNFCCC ref: 9176-0003				Yes
Improved Cookstoves Project Activity in Honduras "Vida Mejor con Ecofogones de Alto Rendimiento" – CPA No 004, UNFCCC ref: 9176-0004				Yes

Improved Cookstoves Project Activity in Honduras "Vida Mejor con Ecofogones de Alto Rendimiento" – CPA No 005, UNFCCC ref: 9176-0005				Yes
Improved Cookstoves Project Activity in Honduras "Vida Mejor con Ecofogones de Alto Rendimiento" – CPA No 006, UNFCCC ref: 9176-0006				Yes
Improved Cookstoves Project Activity in Honduras "Vida Mejor con Ecofogones de Alto Rendimiento" – CPA No 007, UNFCCC ref: 9176-0007				No
Improved Cookstoves Project Activity in Honduras "Vida Mejor con Ecofogones de Alto Rendimiento" – CPA No 008, UNFCCC ref: 9176-0008				No
Improved Cookstoves Project Activity in Honduras "Vida Mejor con Ecofogones de Alto Rendimiento" – CPA No 009, UNFCCC ref: 9176-0009				No

A.2. Coordinating/managing entity

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Envirofit International Ltd (Envirofit) is the coordinating/managing entity (CME) for this PoA. The CPAs are run in coordination with the local partner Fundación para el Desarrollo Integral de Honduras (FUNDEIH), who is the Distributing Organization (DO) for the CPAs and is responsible for implementing the SSC-CPAs in accordance with agreement with Envirofit.

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 CPAs are run in coordination with the local partner Fundación para el Desarrollo Integral de Honduras (FUNDEIH), who is the Distributing Organization (DO) for the CPAs and is responsible for implementing the SSC-CPA in accordance with agreement with CME. The implemented CPAs follows the following management system:

1. Envirofit provided instructions to FUNDEIH to collect the end user information at the time of sale through CPA distribution records. Envirofit made FUNDEIH aware of requirements of end user data collection. Guidance was provided to them on the standard procedures to be followed during ICS distribution.

2. Envirofit maintains a PoA Distribution and Monitoring database. The database includes CPA wise list of stoves sales, including the following information (collected at the time of sale by FUNDEIH):
    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 stove replaced by ICS, i.e. the fuel type used in the baseline stove – wood or charcoal.

3. Envirofit performed cross-checks on the ICS sales information received from the FUNDEIH via CPA distribution records. The CME's and DO's logo is clearly displayed on the CPA Distribution Record, with a copy retained by FUNDEIH. 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 and within a CPA.

4. FUNDEIH obtained the customer's approval during distribution to exclusively assign carbon rights to the CME as per the disclaimer specified on CPA Distribution Records and /or stove boxes/warranty cards

5. Envirofit coordinated all ex-post monitoring activities in the PoA in coordination with FUNDEIH. In addition the Envirofit ;
    a. Implemented the monitoring plan,
    b. Determined the sample size as per PoA sampling plan (stratified random sampling based on age and model, combining all CPAs) and identified the samples to be monitored
    c. Ensured the quality of monitoring data (QA/QC) obtained from field
    d. Used this data for emissions reduction calculations.

6. Monitoring staff checked and recorded the following key parameters in a CPA Monitoring Record. Key monitored parameters were:
    a. Efficiency of project stoves ($\eta_{new,i,a}$)
    b. Check if project stoves are operational and in use ($SOF_{i,a}$) to determine $N_{y,i,a}$
    c. Check fraction of end users continuing to use baseline stoves and extent of baseline stove usage to determine days of utilization of project stove ($\mu_{y,i}$)

7. Envirofit calculated emission reductions based on monitoring data collected by monitoring staff and prepared monitoring report

Thus, by carrying out the aforesaid, Envirofit and FUNDEIH ensured that the PoA Operational and Management plan as given in section A.4.4.1 of registered PoA-DD is duly implemented for concerned CPAs.

A sampling approach covering all the CPAs included in the monitoring report was applied for determination of the monitoring parameter values.

B.2. Post-registration changes to PoA

B.2.1. Corrections

>>
Not Applicable

B.2.2. Inclusion of monitoring plan

>>
Not Applicable

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

>>
Not Applicable

B.2.4. Changes to programme design

>>
Not Applicable

PART II Monitoring of CPAs

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The following CPAs have been sub-grouped together for the purpose of monitoring:

UNFCCC reference number of the CPA	Title and reference number of the corresponding generic CPA	Country	Technology / Measure	Covered in this monitoring report? (yes/no)
9176-0001	**Title:** Improved Cookstoves Program in Honduras "Vida Mejor con Ecofogones de Alto Rendimiento" – Genric CPA **Identification:** Part II of PoA-DD version 5.0 dated 16/01/2015 **Reference:** https://cdm.unfccc.int/UserManagement/FileStorage/Y4SOEA0NL6GWTFXVUPZD915JCR2B83	Honduras	Improved woodfuel cookstove	Yes
9176-0002				Yes
9176-0003				Yes
9176-0004				Yes
9176-0005				Yes
9176-0006				Yes

As demonstrated above, the CPAs covered in the monitoring report are deemed eligible for sub-grouping as they are deemed homogeneous and follow the same generic CPA-DD.

SECTION C. Implementation of CPAs

C.1. Description of implemented CPAs

>>
(a) ***Purpose of the CPA(s) and the measures taken for GHG emission reductions or net anthropogenic GHG removals;***

The purpose of the CDM Programme Activities (CPAs) is dissemination of improved cooking stoves (ICS) in domestic households in Honduras. The CPAs replace traditional cooking stoves using woodfuel with more efficient stoves using woodfuel.

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

(b) ***Description of the installed technology, technical processes and equipment for the CPAs***

The Envirofit ICSs 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 image illustrates a typical CPA stove

Figure D.1.1: Envirofit Plancha ICS

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

CPA	Type of Project stoves eligible	Stove models installed	Total number of stoves installed
9176-0001	Wood fuel	HM5000	29488
9176-0002	Wood fuel	HM4000, HM5000	27500
9176-0003	Wood fuel	HM4000, HM5000	27500
9176-0004	Wood fuel	HM4000, HM5000	27500
9176-0005	Wood fuel	HM4000, HM5000	27500
9176-0006	Wood fuel	HM4000, HM5000	27274
Total			166762

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

Description	Start Date	Date of first stove distribution	Reference
CPA 9176-0001	07/07/2013	10/07/2013	Registered CPA-DD and PoA / CPA distribution database
CPA 9176-0002	09/01/2015	09/01/2015	Registered CPA-DD and PoA / CPA distribution database
CPA 9176-0003	19/11/2015	22/11/2015	Registered CPA-DD and PoA / CPA distribution database
CPA 9176-0004	11/02/2016	18/02/2016	Registered CPA-DD and PoA / CPA distribution database
CPA 9176-0005	08/04/2016	22/04/2016	Registered CPA-DD and PoA / CPA distribution database

CPA 9176-0006	25/05/2016	20/06/2016	Registered CPA-DD and PoA / CPA distribution database

C.2. Location of CPAs

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The physical boundary of the SSC-CPA is determined by the location of installed ICS. This SSC-CPA's geographic boundary is the national borders of Honduras, which is within the boundary of the PoA.

Figure D.2.1: Map of SSC-CPA project boundary –Honduras.[1]

The country is located in the Central American region with coordinates 14°6′N 87°13′W.

Unique Identification of CPAs

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 'Installation database' 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 within a CPA as well as amongst CPAs.

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

>>

Not applicable

C.3.2. Corrections

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No corrections have been made to the CPAs in the current monitoring period. However, following corrections to the listed CPAs were made prior to the monitoring period:

Sl. No.	Description of Correction	CPA number, CPA-DD version	Reference
1	1. Minor Editorial Changes	9176-0001,	http://cdm.unfccc.int/Programme

[1] Map Source: Honduras map: http://geography.about.com/library/cia/blchonduras.htm

	2. Correcting FUNDEIH as the CPA Implementer (Distributing Organization) 3. Correcting the CPA Operational and management plan to indicate FUNDEIH as the Distributing Organization (DO) instead of Envirofit International Ltd. (FUNDEIH was earlier referred as a seller)	version 5.1 dated 11/01/2017	OfActivities/cpa_db/1TLA4MWSU9OZJCFDNYXE3V26K5Q0HB/view

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

>>
Not applicable

C.3.4. Inclusion of monitoring plan

>>
Not applicable

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

>>
Not applicable

C.3.6. Changes to project design

>>
Not applicable

SECTION D. Description of monitoring system of CPAs

>>
At the CPA level, Envirofit provided instructions to the FUNDEIH to collect the end user information, at the time of sale, via CPA distribution records. Envirofit made them aware of requirements and procedures for end user data collection. Necessary data was correctly obtained from the customers at the time of installation and recorded in the CPA Distribution Record, firstly to avoid double counting and secondly to enable tracking of the ICS for monitoring purposes, ex-post.

The 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 stove replaced by ICS, i.e. the fuel type used in baseline stove – wood or charcoal.

All other monitoring parameters have been determined via sampling as detailed in section E.3 below.

Detailed training was provided by the CME to all monitoring staff including for efficiency tests and surveys. This training ensured that roles and responsibilities for monitoring activities were understood and how data should be collected and returned to the CME for QA/QC procedures.

Upon receipt of monitoring data, a thorough QA/QC process was completed by the CME's technical team to ensure the integrity of received data and to determine the completeness of monitoring activities. This included, amongst other things, checking for transcription errors, outlying results and deficiencies in field activities.

SECTION E. Data and parameters

E.1. Data and parameters fixed ex ante

(Copy this table for each data or parameter.)

Data/Parameter	$B_{old,i}$
Unit	tonnes / year / project device
Description	Quantity of woody biomass that would be used in the absence of the project activity for Residential users
Source of data	Registered CPA-DDs, section D.6.2
Value(s) applied	3.10 for Residential biomass user stoves used for residential purposes
Choice of data or measurement methods and procedures	Fixed ex-ante for the crediting period
Purpose of data/parameter	Calculation of Baseline Emissions
Additional comments	--

Data/Parameter	η_{old}
Unit	Percentage
Description	Efficiency of the system being replaced as part of the SSC-CPA
Source of data	Registered CPA-DDs, section D.6.2, AMS II.G. version 6
Value(s) applied	10%
Choice of data or measurement methods and procedures	Default value as prescribed by methodology applied, Fixed ex-ante for the crediting period
Purpose of data/parameter	Calculation of Baseline Emissions
Additional comments	This parameter is applicable as AMS-II.G step-6 option-2 is chosen for this CPA.

Data/Parameter	$NCV_{biomass}$
Unit	TJ/tonne
Description	Net calorific value for biomass
Source of data	AMS-II.G. version 6, default value
Value(s) applied	0.015
Choice of data or measurement methods and procedures	Default value as prescribed by methodology applied, Fixed ex-ante for the crediting period
Purpose of data/parameter	Calculation of Baseline Emissions
Additional comments	None

Data/Parameter	$EF_{projected\_fossil\_fuel}$
Unit	tCO2/TJ
Description	Emission factor for the substitution of non-renewable woody biomass by similar consumers.
Source of data	AMS-II.G. version 6, default value
Value(s) applied	81.6
Choice of data or measurement methods and procedures	Default value as prescribed by methodology applied, Fixed ex-ante for the crediting period

Purpose of data/parameter	Calculation of Baseline Emissions
Additional comments	None

Data/Parameter	$f_{NRB,y}$
Unit	Fraction
Description	Fraction of woody biomass saved by the project activity in year y that can be established as non-renewable
Source of data	Registered CPA-DDs, section D.6.2
Value(s) applied	0.8382
Choice of data or measurement methods and procedures	Fixed ex-ante at the PoA level
Purpose of data/parameter	Calculation of Baseline Emissions
Additional comments	--

Data/Parameter	LE_y
Unit	tCO_2e
Description	Leakage
Source of data	AMS II.G. para 30
Value(s) applied	0
Choice of data or measurement methods and procedures	Not applicable
Purpose of data/parameter	Account for leakage adjustment in calculation of baseline emissions
Additional comments	A default leakage correction factor (LCF) of 0.95, as per AMS II.G. paragraph 30, has already been applied to adjust the $B_{old,i}$ during period y instead of separate calculation of LE_y

E.2. Data and parameters monitored

(Copy this table for each data or parameter.)

Data/Parameter	$N_{y,i,a}$
Unit	Number
Description	Number of project devices of type *i* and age *a* that are operating in year y
Measured/calculated/ Default	Measured
Source of data	Stove sales database and Monitoring survey records
Value(s) of monitored parameter	See table below
Monitoring equipment	Not applicable. The stove installations are monitored via CPA distribution record and operational rate is monitored on sampling basis using questionnaire survey

Data	**CPA 01**	**CPA 02**	**CPA 03**	**CPA 04**	**CPA 05**	**CPA 06**
$N_{y,i=HM5000,a=1}$	0	--	303	7074	563	144
$N_{y,i=HM5000,a=2}$	7871	1173	47	--	--	--
$N_{y,i=HM5000,a=3}$	11247	--	--	--	--	--
$N_{y,i=HM5000,a=4}$	3560	--	--	--	--	--
$N_{y,i=HM4000,a=1}$	0	-	17442	17047	23582	23803
$N_{y,i=HM4000,a=2}$	0	21119	5874	--	--	--

Measuring/reading/recording frequency	An Annual monitoring frequency was selected using 95/10 confidence / precision.
Calculation method (if applicable)	CME maintains the database of all stoves installed. The number of operating stoves for each age category has been determined on a sampling basis. The stove population in the database was categoried on the basis of age and stratified random sampling was applied to identify the samples for each age. The identified samples were monitored for operational status of stove. The results from monitoring were used to calculate $N_{y,i,a}$ as follows $N_{y,i,a} = (n_{y,i,a,operational} / n_{y,i,a,total}) * N_{y,i,a,installed}$ Where: N = number of stoves n = number of samples Please refer ER calculator for more details.
QA/QC procedures	The CME conducted QA/QC of the installation database to remove incompleted, erroneous entries. The CME provided training, guidelines and monitoring survey templates to ensure that the Monitoring team responsible for survey followed appropriate standard procedure for measurement of operational status of project stove.
Purpose of data/parameter	Calculation of Baseline Emissions.
Additional comments	In the Ex-post sampling based monitoring, none of the sampled household was found using more than one ICS stoves.

Data/Parameter	$\eta_{new,i,a}$
Unit	%
Description	Efficiency of the device of type *i* and age *a* being deployed as part of the project activity
Measured/calculated/ default	Measured on sampling basis
Source of data	WBT records for the monitoring period
Value(s) of monitored parameter	

Data Ex Post	**Value**	**Unit**
$\eta_{new,i=HM5000,a=1}$	28.10%	percentage
$\eta_{new,i=HM5000,a=2}$	27.36%	percentage
$\eta_{new,i=HM5000,a=3}$	26.38%	percentage
$\eta_{new,i=HM5000,a=4}$	25.81%	percentage
$\eta_{new,i=HM4000,a=1}$	27.51%	percentage
$\eta_{new,i=HM4000,a=2}$	26.73%	percentage

Monitoring equipment	**Thermometer:** Brand: Omega Model: Omegaette HH308 Type K Accuracy: +/- 0.3% reading +1^{0}C Number of units: 1 S/N: 170503964 **Mass balance** Brand: LW Measurements Model: MCT-33 Accuracy: +/- 2 division, +/- 0.002 lbs Number of units: 1 S/N: MC1506041 **Moisture Meter** Brand: Lignomat Model: Mini Ligno DX Accuracy: +/- 1.0% Number of units: 1 S/N: not available These equipment were either newly purchased (Thermometer: Omegaette HH308) or were auto calibrated at the time of use (Mass Balance: MCT-33, Moisture Meter: Mini Ligno DX) 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 The team performing WBTs was trained by testing experts from Colorado State University Biomass Lab
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	

Data/Parameter	$\mu_{y,i}$
Unit	Days
Description	number of days of utilization of the project device during the year 'y'
Measured/calculated/ default	Measured on sampling basis
Source of data	Monitoring survey records
Value(s) of monitored parameter	**Sampling Population** / **Monitored Utilization rate** / **$\mu_{y,i}$** **HM4000** / 0.89 / 326 **HM5000** / 0.85 / 309
Monitoring equipment	Not applicable. utilization is monitored on sampling basis using questionnaire survey
Measuring/reading/recording frequency	Annual

Calculation method (if applicable)	The sampled households were checked for presence of baseline stove and if it was being used along with HM5000 for cooking. For samples where baseline stove was found not being used, project stove utilization factor has been taken as 1.0 For samples where the baseline stove was found to be in use, project stove utilization factor has been deterrmined as: • 1.0 for days on which only ICS is used; • 0.0 for days on which on traditional stove is used • 0.5 for days when both ICS and traditional stoves are used $\mu_{y,i}$ = Average utilization factor * 365
QA/QC procedures	The CME provided training, guidelines and monitoring survey templates to ensure that the Monitoring team responsible for survey followed appropriate standard procedure for measurement of utilization rate of project stove.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	

E.3. Implementation of sampling plan

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Due to the large number of ICS distributed under the CPAs 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 parameters mentioned in section G.2.

Sl.No.	Parameter	Description of parameter
1	$N_{y,i,a}$	Number of project devices of type *i* and age *a* that are operating in year y
2	$\eta_{new,i,a}$	Efficiency of the device of type *i* and age *a* being deployed as part of the project activity
3	$\mu_{y,i}$	number of days of utilization of the project device during the year 'y'

Based on the registered CPA-DDs, 95/10 reliability level was selected for PoA level sampling for the parameters mentioned above.

The initial target population were the stoves distributed and recorded under CPA 9176-0001 to CPA 9176-0006. As per page 31 of the CPA-DD, *"the ICS shall be stratified by region, target user group, stove category (fuel) and ICS model combination (model and age)"*. Thus, following strata were defined.

Stratification Condition	Characteristic of Population	Stratification
Region - Country	all units have been distributed in the same country, i.e. Honduras	Not applicable
Fuel Type – charcoal / wood fuel	There is only one fuel type in the population: Woodfuel.	Not applicable
End user – domestic / small-medium enterprises / community	all units are for domestic (household) usage as per their design	Not applicable
Stove Type – model and age	The CPAs included two stove models i.e HM4000 and HM5000. These were sold over a period of time (2013 – 2016)	The population was divided in strata based on age and stove model: 1. HM5000, age =1 2. HM5000, age =2 3. HM5000, age =3

		4. HM5000, age =4 5. HM4000, age =1 6. HM4000, age =2

Stratifed Random Sampling approach (the population was divided into strata based on stove model and age) was applied to determine the sample size for the parameters $N_{y,i,a}$ and $\eta_{new,i,a}$. For parameter $\mu_{y,i}$, the population was considered into two strata only as the methodology does not require determination of this parameter based on different ages.

The following is the number of samples covered during the monitoring activity. The required sample sizes mentioned below have been derived using equation (19), (20), (21), (22) and (27) of Appendix 3 of the Guideline: Sampling and surveys for CDM project activities and programmes of activities, Version 04.0 for mean based parameter ($\eta_{new,i,a}$) as follows:

$$n \geq \frac{z^2 * N * V}{(N-1) * precision^2 + z^2 * V}$$

Where,

n = number of stoves to be sampled

N = Total number of ICS in the population

z = Constant referring to level of confidence (e.g. 1.645 for 90 %; 1.96 for 95 % confidence)

Precision = Required precision (e.g. 10% = 0.1)

$$V = \left(\frac{SD}{Mean} \right)^2$$

Where

$$SD^2 = \frac{\sum_{i=1}^{k} g_i * SD_i^2}{N}$$

$$Mean = \frac{\sum_{i=1}^{k} g_i * m_i}{N}$$

Where

SD_i = expected standard deviation of strata i in the population

m_i = expected mean of strata i in the population

k = total number of strata in the population

The required sample sizes mentioned below have been derived using equation (1), (2), (3), (4) and (9) of Appendix 3 of the Guideline: Sampling and surveys for CDM project activities and programmes of activities, Version 04.0 for proportion based parameter ($N_{y,i,,a}$ and $\mu_{y,i}$) as follows:

$$n \geq \frac{z^2 * N * V}{(N-1) * precision^2 + z^2 * V}$$

Where,

n = number of stoves to be sampled

N = Total number of ICS in the population

z = Constant referring to level of confidence (e.g. 1.645 for 90 %; 1.96 for 95 % confidence)

Precision = Required precision (e.g. 10% = 0.1)

$$V = \frac{SD^2}{\overline{p}^2}$$

Where:

$$SD^2 = \frac{\sum_{i=1}^{k} g_i * p_i * (1 - p_i)}{N}$$

$$\overline{p} = \frac{\sum_{i=1}^{k} g_i * p_i}{N}$$

Where,

g_i = weight of strata i in the population

p_i = expected proportion of strata i in the population

k = total number of strata in the population

The following section lists the number of samples covered during the monitoring activity. Refer ER calculator worksheet 'MP#2 Sample Size Cal and Results' 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"

Sampling Population (Batch)	Age	Sampling frame size	Expected Mean Efficiency(%)	Expected SD
HM4000 Batch 1	2	33222	27.0	2.7
HM4000 Batch 2	1	93245	28.0	2.8
HM5000 Batch 1	4	4747	26.0	2.6
HM5000 Batch 2	3	14621	27.0	2.7
HM5000 Batch 3	2	11688	28.0	2.8
HM5000 Batch 4	1	9239	29.0	2.9

The stoves were selected by randomly assigning, in corresponding stratum, 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 stratum and the numbers obtained were used to identify the samples from the population. A higher number of samples were monitored than that required to ensure that the desired precision / confidence is achieved.

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

Data was collected for $N_{y,i,a}$ and $\mu_{y,i}$ following a specially design survey form. The information collected was introduced into an electronic database, the CPA Monitoring Record. The survey form was design to allow the surveyor collect the necessary information from field visit for the ER calculations. In order to achieve the 95/10 reliability level, additional stoves were sampled from the database than that required to cover for non responses, if any.

As for the thermal efficiency of the stoves, water boiling tests were conducted using WBT as given 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

monitoring officers who were trained by testing experts from Colorado State University, Biomass Lab. The monitoring surveys were conducted from 13 March – 04 April 2017 and WBTs were conducted from 24 April - 06 May 2017.

b) Analysis of the collected data;

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

Sampling Constants	Values
Monitoring period start	15-Jun-16
Monitoring period end	14-Jun-17
Monitoring frequency (years)	1.00
Level of sampling	PoA
Confidence (%) (90 or 95)	95%
Margin of Error (%)	10%
Z value	1.96

Monitoring parameter(s)		Stove Operating Fraction for determination of $N_{y,i,a}$		
Sampling frame(s)		**Given stove model and age population**		
Sampling approach		Stratified random sampling across stove model and age		
Sampling Population (Batch)	**Age**	**Stove population**	**expected operational proportion (SoF)**	**Calculated Sample Size (n)**
HM4000 Batch 1	**2**	**33222**	0.85	13
HM4000 Batch 2	**1**	**93245**	0.90	34
HM5000 Batch 1	**4**	**4747**	0.70	2
HM5000 Batch 2	**3**	**14621**	0.75	6
HM5000 Batch 3	**2**	**11688**	0.80	5
HM5000 Batch 4	**1**	**9239**	0.85	4
Sample size determination				
Estimated SOF (p)				0.86
Estimated Standard Deviation of SOF (SD)				0.341
$V_{SOF} = (SD/p)^2$				0.157
Sample Size required (SOF)				**60**
Monitoring results				
Sampling Population (Batch)	**Age**	**Sampling frame size**	**Monitored Sample Size**	**Monitored Operating Fraction**
HM4000 Batch 1	**2**	**33222**	16	0.81
HM4000 Batch 2	**1**	**93245**	41	0.88
HM5000 Batch 1	**4**	**4747**	8	0.75
HM5000 Batch 2	**3**	**14621**	13	0.77
HM5000 Batch 3	**2**	**11688**	18	0.78
HM5000 Batch 4	**1**	**9239**	8	0.88
Reliability Check				
Samples Monitored				104
SoF Measured				0.84
Standard Error of SoF				3.75%
Relative precision (Margin of error)				4.35%

Result	Ok, reliability level met
Lower Bound confidence value	Not applicable

Monitoring Parameter	**Stove Efficiency $\eta_{new,i,a}$**				
Sampling Frame requirement as per PoA-DD	**Given stove model and age population**				
Sampling approach	Stratified random sampling across stove model and age				
Sampling Population (Batch)	**Age**	**Sampling frame size**	**Expected Mean Efficiency(%)**	**Expected SD**	**Calculated Sample Size**
HM4000 Batch 1	**2**	**33222**	27.0	2.7	2
HM4000 Batch 2	**1**	**93245**	28.0	2.8	4
HM5000 Batch 1	**4**	**4747**	26.0	2.6	2
HM5000 Batch 2	**3**	**14621**	27.0	2.7	2
HM5000 Batch 3	**2**	**11688**	28.0	2.8	2
HM5000 Batch 4	**1**	**9239**	29.0	2.9	2
Sample size determination					
Estimated efficiency (mean)					27.71
Estimated Standard Deviation of efficiency (SD)					2.77
V_{mean} = (SD/mean)^2					0.01
Minimum Sample Size required (efficiency)					4
tDistribution sample size adjustment				**Iteration 1**	11
				Iteration 2	5
				Iteration 3	8
				Iteration 4	6
				Iteration 5	7
				Iteration 6	6
Sampling Population (Batch)	**Age**	**Sampling frame size**	**Monitored Sample Size**	**Monitored Efficiency (%)**	**Monitored Standard Deviation**
HM4000 Batch 1	**2**	**33222**	2.0	26.73%	0.40%
HM4000 Batch 2	**1**	**93245**	7.0	27.51%	1.35%
HM5000 Batch 1	**4**	**4747**	2.0	25.81%	0.27%
HM5000 Batch 2	**3**	**14621**	2.0	26.38%	0.47%
HM5000 Batch 3	**2**	**11688**	2.0	27.36%	0.01%
HM5000 Batch 4	**1**	**9239**	2.0	28.10%	0.84%
Reliability Check					
Samples Monitored					17
Mean Efficiency					27.23%
Standard error of mean					0.29%
Relative precision (Margin of error) (%)					0.03%
Result					Ok, reliability level met
Lower Bound confidence value					Not

	applicable

Monitoring parameter(s)	Utilization of Project stoves - $\mu_{y,i}$		
Sampling frame(s)	**Given stove model population**		
Sampling approach	Stratified random sampling across stove models		
Sampling Frame	**Stove population**	**Expected value**	**Calculated Sample Size (n)**
HM4000	126467	0.90	38
HM5000	40296	0.85	12
Estimated results based sample size determination			
Estimated utilization (p)			0.89
$V_{Utilization}$= p(1-p)/p^2			0.13
Minimum Sample Size required (days of utilization)			**49**
Monitoring results			
Sampling Population	**Sampling frame size**	**Monitored Sample Size**	**Monitored Utilization**
HM4000	**126466**	57	0.89
HM5000	**40297**	47	0.85
Reliability Check			
Samples Monitored			104
Utilization Measured			0.88
Standard Error of Utilization			3.37%
Relative precision (Margin of error)			3.74%
Result			Ok, reliability level met
Lower Bound confidence value			Not applicable

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

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

The population was categorised model and age wise. Stoves were selected randomly after arranging them in chronological order of date of sale and assigning a reference 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 category and the corresponding reference numbers were selected from each category to identify the samples to the monitored. The approach ensured that the samples picked are stratified random and representative of 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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Emission reductions are calculated as follows:

$$ER_y = \sum_i ER_{y,i}$$ Equation (1)

Where:

i = Indices for the situation where more than one type of project

device is introduced to replace the pre-project devices

ER_y = Emission reductions during year *y* in tCO_2e

$ER_{y,i}$ = Emission reductions by project device of type *i* during year *y* in t CO_2e

Equation (2)

$$ER_{y,i} = \sum_{a=1}^{a=y} B_{y,savings,i,a} \times N_{y,i,a} \times \frac{\mu_{y,i}}{365} \times f_{NRB,y} \times NCV_{biomass} \times EF_{projected\_fossilfuel} - LE_y$$

Where:

a = 'a' is the indices for the age (in years) of the cook stoves that are operating in the year 'y' of the crediting period.

$B_{y,savings,i,a}$ = Quantity of woody biomass that is saved in tonnes per cook stove device of type i and age a in year y (tonnes)

$f_{NRB,y}$ = Fraction of woody biomass saved by the project activity in year y that can be established as non-renewable biomass

$NCV_{biomass}$ = Net calorific value of the non-renewable woody biomass that is substituted (IPCC default for wood fuel, 0.015 TJ/tonne, based on the gross weight of the wood that is 'air-dried') (TJ/tonnes)

$EF_{projected\_fossilfuel}$ = Emission factor for the fossil fuels projected to be used for substitution of non-renewable woody biomass by similar consumers. Use a value of 81.6 tCO_2/TJ

$N_{y,i,a}$ = Number of project devices of type i and age a operating in year y

$\mu_{y,i}$ = Number of days of utilization of the project device during the year 'y'.

LE_y = Leakage emissions in the year y, to be taken as 0 as leakage correction factor of 0.95 shall be directly applied to $B_{y,savings,i,a}$

Using AMS-II.G, <u>Option 2</u>:

$$B_{y,savings,i,a} = B_{old,i} \times \left(1 - \frac{\eta_{old}}{\eta_{new,i,a=1} \times \Delta\eta_{y,i,a}}\right)$$ Equation (3)

Where:

$B_{old,i}$ = Annual quantity of woody biomass that would be used in the absence of the project activity to generate thermal energy equivalent to that provided by the project device type *i*, if the project device operates throughout the year *y*. (tonnes)

η_{old} = Efficiency of the pre-project device (fraction)

$\eta_{new,i,a=1}$ = Thermal efficiency of the device of type *i* being deployed as part of the project activity (fraction)

$\Delta\eta_{y,i,a}$ = Factor to consider the efficiency loss of the project device type *i* due to its aging at the year *y*, as expressed as follows:

$$\Delta\eta_{y,i,a} = \frac{\eta_{new,i,a}}{\eta_{new,i,a=1}}$$

where $\eta_{new,i,a}$ is the thermal efficiency of the device '*i*' with age '*a*' determined using the WBT

The calculation snapshot is given below. As per type II category, the annual thermal energy savings from each of the CPA remains below the type II / methodology threshold. For details refer the ER calculator.

Data Ex Post	CPA 01	CPA 02	CPA 03	CPA 04	CPA 05	CPA 06	Unit
$N_{y,i=HM5000,a=1}$	0	0	303	7074	563	144	number
$N_{y,i=HM5000,a=2}$	7871	1173	47	0	0	0	number
$N_{y,i=HM5000,a=3}$	11247	0	0	0	0	0	number
$N_{y,i=HM5000,a=4}$	3560	0	0	0	0	0	number
$N_{y,i=HM4000,a=1}$	0	0	17442	17047	23582	23803	number
$N_{y,i=HM4000,a=2}$	0	21119	5874	0	0	0	number
$\mu_{y,i=HM5000}$	309	309	309	309	309	309	days/year
$\mu_{y,i=HM4000}$	326	326	326	326	326	326	days/year
$STOVE_{year}$	1.00	0.37	0.37	0.37	0.37	0.37	fraction
$B_{y,savings,i=HM5000,a=1}$	-	-	605	14,127	1,124	288	t biomass
$B_{y,savings,i=HM5000,a=2}$	15,484	2,307	92	-	-	-	t biomass
$B_{y,savings,i=HM5000,a=3}$	21,650	-	-	-	-	-	t biomass
$B_{y,savings,i=HM5000,a=4}$	6,760	-	-	-	-	-	t biomass
$B_{y,savings,i=HM4000,a=1}$	-	-	34,415	33,637	46,531	46,967	t biomass
$B_{y,savings,i=HM4000,a=2}$	-	40,975	11,398	-	-	-	t biomass
Annual Thermal Energy savings	147	153	165	167	169	167	GWhth
ERy	**36,196**	**13,831**	**14,916**	**15,096**	**15,277**	**15,097**	**tCO2e**
EX-ante estimates as per registred CPA-DDs	**42,222**	**15,500**	**15,501**	**15,500**	**15,500**	**15,501**	**tCO2e**

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

>>
Not applicable

F.3. Calculation of leakage emissions

>>
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_2e)	Project GHG emissions or actual net GHG removals (t CO_2e)	Leakage GHG emissions (t CO_2e)	GHG emission reductions or net anthropogenic GHG removals (t CO_2e)		
				Before 01/01/2013	From 01/01/2013	Total amount
9176-0001	36196	0	0	0	36196	36196
9176-0002	13831	0	0	0	13831	13831
9176-0003	14916	0	0	0	14916	14916
9176-0004	15096	0	0	0	15096	15096
9176-0005	15277	0	0	0	15277	15277
9176-0006	15097	0	0	0	15097	15097
Total	**110,413**	**0**	**0**	**0**	**110,413**	**110,413**

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_2e)	Amount estimated ex ante (t CO_2e)
9176-0001	36196	42222
9176-0002	13831	15500
9176-0003	14916	15501
9176-0004	15096	15500
9176-0005	15277	15500
9176-0006	15097	15501
Total	**110,413**	**119,724**

F.6. Remarks on increase in achieved emission reductions

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The actual achieved ERs are lower than the estimated value in the included CPA-DD as stated above.

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Document information

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