DISTRIBUTION OF ONIL STOVES – MEXICO

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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

ONIL Stoves – Mexico, San Felipe Usila 1 small-scale CPA (SSC-CPA) involves the distribution and installation of ONIL Stoves for use by households in Mexico. This CPA is the first included under the "Distribution of ONIL Stoves – Mexico" PoA. Before the adoption of the ONIL Stove, households in Mexico used inefficient, conventional open fires.

The ONIL Stove is a fuel-efficient stove that reduces the amount of firewood required by households by up to 58%, compared to the baseline, and results in lower emissions based on its construction. A single ONIL Stove saves up to 2.893 tons of CO_2e per year.

HELPS International A.C. is the implementer of this project. HELPS International A.C. manufactures the ONIL stoves and distributes them to communities throughout Mexico.

- A summary description of the implementation status of the technologies/ measures (eg, plant, equipment, process, or management or conservation measure) included in the project.

  This project was registered under the CDM as the "ONIL Stoves —Mexico, San Felipe Usila 1" which is first CPA included under the "PoA: Distribution of ONIL Stoves—Mexico" (CDM PoA 8521). The first ONIL stove to participate in the PoA was installed on 30-December-2009. To date, the project has installed 31,178 stoves (3 stoves in 2009 [1], 4,361 stoves in 2010, 8,524 in 2011, 3,883 in 2013, 5,900 in 2014, 4067 in 2015 and 4440 in 2016) located across Mexico. These stoves are included in the monitoring period covered here.

- The relevant implementation dates (eg, dates of construction, commissioning, and continued operation periods).

  Date of first ONIL Stove installation in this project: 30-December-2009
  Date of last ONIL Stove installation in this project: 20-December-2016

- The total GHG emission reductions or removals generated in this monitoring period.

  The project results in a total emission reduction of 75,991 tCO_2e over the monitoring period of 29 October 2015 to 31 July 2017.

1.2 Sectoral Scope and Project Type

The project is categorised under type/category as below:

a) Sectoral scope: 03 - Energy demand

[1] These 3 stoves installed in 2009 could not be monitored because the area where these were installed presents security problems and are therefore inaccessible for monitoring and removed from ER calculation. Evidence of the security problems was provided to the Validation and Verification Body.

b) Type: I – Energy efficiency improvement projects

The project is not a grouped project.

1.3 Project Proponent

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1.4 Other Entities Involved in the Project

Not applicable.

1.5 Project Start Date

30-December-2009, which is the date of the first ONIL stove installation under this project.[2]

1.6 Project Crediting Period

01-January-2011 to 31-December-2020; ten years; renewable twice, but not extending beyond December 31, 2033 when the maximum CDM crediting period expires.[3]

[2] Note: stoves installed in 2009 could not be accessed in the previous monitoring period due to social instability in the area of installation leading to unsafe conditions at the time of monitoring and hence were removed from the CPA. Evidence of unsafe conditions was provided to the Verification Body at the time of the previous monitoring.

1.7 Project Location

The boundary of the PoA is determined by the sum of the locations of the individual households within which the ICSs in this PoA are installed, but all limited to Mexico.[4]

The geographic coordinates for Mexico are the following: Northernmost and Westernmost point: 32.500000 and -117.033333 (Tijuana); Southernmost point: 14.550000 and -92.166667 (desembocadura del Rio Suchiate); Easternmost point: 21.200000 and -86.716667 (Isla Mujeres).

[3] This is in accordance with the VCS standard version 3.7 paragraph 3.8.1 that states "For non-AFOLU projects and ALM projects focusing exclusively on reducing N2O, CH4 and/or fossil-derived CO2 emissions, the project crediting period shall be a maximum of ten years which may be renewed at most twice." Paragraph 3.8.3 of the standard mentions "Projects registered under other GHG programs are not eligible for VCU issuance beyond the end of the total project crediting period under those programs. For example, a CDM project with a seven year twice renewable project crediting period is not eligible for VCU issuance beyond the end of those 21 years".

[4] Geographic coordinates (where available) of stoves have been provided to the Validation/Verification Body (VVB).

1.8 Title and Reference of Methodology

- CDM Methodology: AMS-II.G. version 3 - Energy efficiency measures in thermal applications of non-renewable biomass.
- Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities version 7
- Guidelines for Sampling Surveys in Project Activities and Programme of Activities version 4

1.9 Other Programs

The ONIL Stoves – Mexico, San Felipe Usila 1 is registered as a Small-Scale Component Project Activity under the Clean Development Mechanism (CDM) and under the Programme of Activities "Distribution of ONIL Stoves – Mexico" (Ref. PoA 8521).[5] Evidence has been provided to the Validation and Verification Body that the emissions reductions arising from this program are not double counted under the CDM and VCS.

The project has not been submitted for validation/certification under any other GHG or environmentally related program or mechanism, so it is not eligible to create another form of GHG-related environmental credit other than CERs and VCUs.

1.10 Sustainable Development

Environmental sustainability

(i) The project reduces the use of non-renewable biomass:
In Mexico, approximately a quarter of the population (27 million) uses firewood for cooking.[6] Firewood is the main energy source for approximately 80% of rural households, and the majority of households still use open fires which are inefficient in regards to fuel usage.

By adopting the higher efficiency ICS, households reduce the quantity of fuel wood they must consume for daily cooking needs. Since a very high proportion of fuel wood comes from non-renewable sources, this translates directly into reduced emission reductions from the non-renewable extraction of wood. Thus, the PoA lowers the greenhouse gas (GHG) balance for the country.

(ii) The project produces real and measurable reductions in GHG emissions:
The programme will utilize an approved methodology, AMS II.G., version 3 "*Energy Efficiency Measures in Thermal Applications of Non-Renewable Biomass*", to ensure that all measurements of greenhouse gas emission reductions are robust, conservative and verifiable. The programme

[5] CDM documentation can be accessed through: https://cdm.unfccc.int/ProgrammeOfActivities/poa_db/2BH1T0SFERD67JCZXAIWMKLO8PN5UQ/view (PoA) and https://cdm.unfccc.int/ProgrammeOfActivities/cpa_db/3NLVJQM5FYWDA604R2GCPS8ZOEIB9U/view (San Felipe Usila 1 project).

[6] Masera, Omar, Rodolfo Diaz and Victor Berrueta, "From cookstoves to cooking systems: the integrated program on sustainable household energy use in Mexico", *Energy for Sustainable Development*, Volume IX No. 1, Page 26.

will maintain high standards of monitoring to ensure that all emission reductions claimed are measurable and real.

Economic Sustainability

The project reduces household expenditures:

The project will contribute significantly to Mexico's economic sustainability through the more efficient use of firewood. Energy savings at both individual household and national levels make important contributions to their economic efficiency and sustainability. In Mexico, households spend up to 15 to 20 per cent of their income on firewood purchases.[7] The use of efficient stoves will have a significant impact on reducing these household expenditures.

According to World Bank reports, in 2002 approximately half of the population in Mexico was living in poverty and a fifth in extreme poverty.[8] By installing ICS, these households would save significantly on household expenditures related to firewood purchases along with saving time spent gathering firewood, which would free up time for households for more income generating activities. Thus, these saving would help improve living conditions for households in Mexico.

Social Sustainability

The project helps to improve health conditions

There are very tangible and significant health benefits associated with the switch in technology from traditional open fires to improved cook stoves as well. Traditional cooking methods involve open fires that result in the emissions of local pollutants such as carbon monoxide and particulate matter in often poorly ventilated rooms, which lead to respiratory problems. In addition, open fires are frequent causes of burns and other injuries. Switching from fireplaces to ICS reduces the incidence of such injuries and health problems.

Through demonstration, training and implementation, the project will also generate a range of less tangible social outcomes in education and awareness. This project will build awareness of the health problems associated with open fire pits traditionally used for cooking and create an opportunity for collective action on climate change, enhancing a sense of community, and empowering individual households.

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

[7] Masera, Omar, Rodolfo Diaz and Victor Berrueta, "From cookstoves to cooking systems: the integrated program on sustainable household energy use in Mexico", *Energy for Sustainable Development*, Volume IX No. 1, Page 26
[8] World Bank (2009): Poverty in Mexico-Fact Sheet

The project installed[9] 3 stoves in 2009, 4,361 stoves in 2010, 8,524 in 2011, 3,883 in 2013, 5,900 in 2014, 4067 in 2015 and 4440 in 2016 for a total of 31,178 stoves making part of this project[10]. The monitoring period (29-October-2015 to 31-July-2017) covered all these stoves.

Only one stove model (ONIL Plancha Stove) was distributed in the project. Before the monitoring period, HELPS International A.C. created an online platform to input and access stove data and user information, as user registration became available.

CDM methodology AMS-II.G version 03 allows the use of a correction factor of 0.95 applied to the overall emissions reductions to account for any possible leakage. This factor has been applied to the emissions reductions presented in this report.

2.2 Deviations

2.2.1 Methodology Deviations

This project did not apply any methodology deviations.

2.2.2 Project Description Deviations

1 Sampling method. The sampling method applied in the registered monitoring plan is multi-stage sampling. Multi-stage sampling is a sophisticated method which is not easy to be implemented and the data analysis is difficult. Given that the population being studied is relatively homogeneous with respect to the parameter being studied, therefore simple random sampling is chosen to replace the existing sampling method.

2 Number of stoves included in the project. A deviation is requested to increase the number of stoves to 31,178. This deviation results in annual energy savings of 38.22 GWh in year 2015, 175.36 GWh in year 2016 and 109.59 GWh in year 2017. The energy savings achieved still lower than the 180 GWh/year that would qualify the project as small scale as per the CDM thresholds for type II projects.

3 Crediting period. No further changes are made on crediting period. The end date of the project remains the same which is 31 December 2020.

2.3 Grouped Project

Not applicable. This is not a grouped project.

2.4 Safeguards

2.4.1 No Net Harm

The ONIL Stove installed under this project presents positive environmental impacts wherever they are applied and no negative environmental impacts have been identified.

[9] Note: the monitoring report for the period 01-January 2011 to 31-December 2012 included 3 stoves installed in 2009, but the zone where these stoves are installed could not be accessed due to security concerns and the stoves were removed from the project database.

[10] The stoves from year 2009 do not form part of this count as they were removed from the database.

2.4.2 Local Stakeholder Consultation

The local stakeholder consultation was done at PoA level, prior to the registration of the PoA. The first stakeholder meeting for the POA was conducted in Benito Juarez, San Miguel Chimalapa, Oaxaca in 30 December 2009. A series of similar meetings followed this.

The outcomes from the local stakeholder consultation is available in Section D of the PoA-DD[11].

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

Data / Parameter	**B_{old}**
Data unit	Tonnes/year
Description	Quantity of Biomass used in the absence of the project activity (per appliance)
Source of data	Baseline surveys, ex-ante
Value applied:	5.34
Justification of choice of data or description of measurement methods and procedures applied	The baseline survey assessed the average biomass usage per household per annum amongst users of traditional 3-stone fires or traditional pot support, according to interviews in Mexico. Since no countrywide baseline existed, HELPS International A.C. implemented the baseline interview in November of 2009. The sample conforms to the Standard for Sampling and Surveys in CDM Project Activities and Programmes of Activities.
Purpose of the data	Calculation of baseline and project emissions
Comments	See CDM PoA-DD for more details on the baseline measurement

Data / Parameter	**L**
Data unit	Fraction
Description	Net to gross adjustment factor to account for leakage
Source of data	Paragraph 13 (a) of the AMS II.G methodology, version 3
Value applied:	0.95
Justification of choice of data or description of measurement methods and procedures applied	A net to gross adjustment factor (0.95 default) is applied in order to adjust B_{old} to account for leakages as per paragraph 13 (a) of the AMS II.G, version 3 methodology.
Purpose of the data	Calculation of leakage

[11] https://cdm.unfccc.int/UserManagement/FileStorage/ST76NWH1FPCI3M05UADVXGJLQY28O9

Comments	

Data / Parameter	η_{old}
Data unit	Fraction
Description	Efficiency of the system being replaced
Source of data	Paragraph 6, Option 2 (b) of the AMS II.G methodology, version 3, default
Value applied:	0.10 (default for conventional open fires, as stated in the methodology)
Justification of choice of data or description of measurement methods and procedures applied	Provided as default value since replaced system is conventional open fire.
Purpose of the data	Calculation of baseline and project emissions
Comments	

Data / Parameter	$f_{NRB,y}$
Data unit	Fraction
Description	Fraction of non-renewable biomass saved by the project activity
Source of data	FAO, ex-ante, calculated
Value applied:	0.87
Justification of choice of data or description of measurement methods and procedures applied	For biomass savings to be calculated, the portion of biomass used that is renewable must be accounted for based on the methodology. The FAO 2010 report[12] gives a reforested area value of 247,600 ha/yr (p. 38), average forest densities of 60.25 m^3/ha for conifers and 38.82 m^3/yr for hardwoods. Reforested areas in Mexico are 0.2527 conifer and 0.7473 hardwoods, which give a total reforested volume of 10,952,872.76 m^3. Value of 0.6 tonnes/m^3 (average density of oak of which baseline survey identified as most commonly used fuel wood) is used to translate DRB to mass. Since reforested trees have a survival rate of 57.6% DRB is adjusted accordingly to exclude the trees which did not survive.[13] The B_{old} number (5.34 tonnes of fuel wood per household per year) obtained from the baseline survey is multiplied by the estimated number of homes in Mexico (5.44 million) that still use open fires to obtain an estimate of the total amount of fuel wood used in Mexico

[12] FAO, *Evaluacion de los Recursos Forestales Mundiales, Informe Nacional, 2010, Mexico*, World Forest Resources Assessment, National Report, 2010, Mexico. www.fao.org/forestry/fra/67090/en/mex/; Data on reforested hectares on Page 38, data on average tree density and percentage of each on Page 43

[13] *Reforestacion, Evaluacion Externa Ejercicio Fiscal 2007,* CONAFOR, Colegio de Postgraduados and SEMARNAT, http://www.era-mx.org/biblio/Evaluacion_Colpos_Reforestacion_2007.pdf

	($B_{old,mexico}$). NRB is $B_{old,Mexico}$ (excluding fuel wood used in baseline stoves) minus the DRB component (excluding trees that did not survive). Then, fNRB = NRB/(NRB +DRB)
Purpose of the data	Calculation of baseline and project emissions
Comments	

Data / Parameter	$NCV_{biomass}$
Data unit	TJ/t
Description	Net calorific value of non-renewable biomass that is substituted
Source of data	IPCC default value for fuel wood, *ex-ante,* AMS II.G methodology, version 3.
Value applied:	0.015 TJ/tonne
Justification of choice of data or description of measurement methods and procedures applied	Default value that is provided in AMS II.G, version 3
Purpose of the data	Calculation of baseline and project emissions
Comments	

Data / Parameter	$EF_{projected\_fossilfuel}$
Data unit	tCO_2/TJ
Description	Emission factor for the substitution of non-renewable biomass by similar consumers
Source of data	IPCC default value for LPG, *ex-ante,* AMS II.G methodology, version 3.
Value applied:	81.6 t CO2/TJ
Justification of choice of data or description of measurement methods and procedures applied	Default value that is provided in AMS II.G, version 3
Purpose of the data	Calculation of baseline and project emissions
Comments	

3.2 Data and Parameters Monitored

Data / Parameter	$n_{y,i}$
Data unit	Quantity
Description	Number of ONIL Stoves in operation during the monitoring period as determined by the monitoring survey. This includes total number of stoves distributed/installed in the entire CPA.
Source of data	ONIL Stove registration data and data from monitoring surveys
Description of measurement methods and procedures to be applied	The percentage of stoves found to be still in operation based on the sampling plan in this monitoring period is applied to the total number of stoves distributed/installed in each CPA included in the sample (according to the ICS registration records in the monitoring database and the applicable sample frame). The proportion of sampled ICS found in operation in this monitoring period was applied to the total number of stoves for each CPA when calculating emission reductions. Because the confidence/precision requirements set out in EB 69 Annex 4 and the PoA-DD Section E.7.2 were not satisfied, then CPA Implementers followed the procedures outlined in the Monitoring Plan (E.7.2 of the PoA-DD) to ensure appropriate conservative values as defined by AMS II.G Version 3 were used.
Frequency of monitoring/recording	Data from Registration Cards was uploaded to database continuously to come up with the overall number of stoves installed under the CPA. Monitoring surveys captured the fraction of operational ONIL stoves.
Value monitored:	18,353
Monitoring equipment	Monitoring surveys and registration card records loaded into CPA database
QA/QC procedures to be applied	Staff was trained to obtain unbiased and reliable survey data. Monitoring database was checked for errors. There were four cases in which the stoves were not considered in use despite users affirming using stoves: 1. When surveyors discovered, based on visual inspections or their observations that a stove was not in use. 2. When users had another type of improved cookstove along with the ONIL stove. The measure was taken to prevent double counting with other programs and to accurately estimate emissions reductions (as the presence of another improved cookstove may affect the baseline). 3. In cases where there was no prior use of three stone fires. In these cases, the firewood baseline would not be applicable. 4. When stoves were modified to operate as three stone fires (e.g. when insulating material and combustion chamber were removed).

Purpose of the data	Calculation of baseline and project emissions
Calculation method	18,353 = 0.5887 multiplied by 31,175 stoves eligible in the database. Note: The percentage of ONIL stove was found in operation from the survey is 58.87%.
Comments	Stoves that that were used along other types of improved cookstoves, or where the baseline was not applicable (because households were not using three-stone fires prior to the ONIL stove installation or because they were already using another type of improved cookstove) were considered as non-operational and discounted from the fraction of stoves that remain in operation. The removal of these stoves resulted in more conservative emissions reductions estimates.

Data / Parameter	SS_y
Data unit	Fraction
Description	The fraction of ongoing baseline stove use within the population of in-use ONIL Stoves during a monitoring period.
Source of data	ONIL Stove registration data and data from monitoring surveys.
Description of measurement methods and procedures to be applied	A survey asked for usage of baseline stoves as per the monitoring plan outlined in Section E.7.2 of the PoA-DD. SS_y was calculated in each monitoring period as follows: the number of sampled households with operational ICS that also continue to use a baseline stove divided by the total number of operational ICS in the sample. This parameter was used to calculate the ex-post baseline adjustment factor in each monitoring period, as outlined in section E.6.2 of the PoA-DD.
Frequency of monitoring/recording	Once per monitoring period
Value monitored:	94.94%
Monitoring equipment	Surveys
QA/QC procedures to be applied	Data for this parameter was collected using the same survey for the fraction of $n_{y,j}$ (appliances in operation) conducted by trained project staff members.
Purpose of the data	Calculation of baseline and project emissions
Calculation method	The number of households with operational ONIL stoves and continuing to use baseline stoves divided by the total number of households with operational ONIL Stoves.
Comments	-

Data / Parameter	$\eta_{new,i}$
Data unit	Fraction
Description	Efficiency of the ICS
Source of data	Efficiency tests conducted in monitoring period
Description of measurement methods and procedures to be applied	The Water Boiling Test (WBT) protocol used was the WBT version 4.2.2 published by the Global Alliance for Clean Cookstoves. The WBTs were conducted by trained staff from the Grupo Interdisciplinario de Tecnologia Rural Apropiada, A.C. (GIRA), a third party to the project. Stoves were tested at the place of installation (i.e. in stove user households) using firewood available in the same households. Each sampled stove was tested once for the cold start phase and once for hot start phase. GIRA staff ensured the stoves were at room temperature before applying cold start tests. Each test used two aluminium pots with 2.5 litres of water in each. Testers supplied clean water to the households where tests were conducted. Pots were put in direct contact with fire by removing the metal rings around the stove burners. Boiling point temperatures used in calculations were adjusted based on altitude that was taken with GPS instruments. On each stove, GIRA performed one cold start and one hot start. The calorific value of the different species of wood was taken from the literature, where available. When not available in the literature, a broader distinction was made between softwoods and hardwoods and average values of these types of woods were applied accordingly to the species of wood for which data was unavailable.
Frequency of monitoring/recording	Water Boiling Tests were implemented over stove samples of 2010, 2011, 2013, 2014, 2015 and 2016 vintages during monitoring period.
Value monitored:	
Monitoring equipment	• Digital scales • Firewood moisture meters • Digital thermometers • Thermocouples
QA/QC procedures to be applied	WBT version 4.2.2 A check was performed for outliers, but none were found (defined as those thermal efficiency values 3 standard deviations above or below the vintage sample mean, as per the CDM PoA-DD section E.7.2).
Purpose of the data	Calculation of project emissions

Vintage	Efficiency
$\eta_{new,2010}$	21.48%
$\eta_{new,2011}$	21.19%
$\eta_{new,2013}$	21.62%
$\eta_{new,2014}$	21.67%
$\eta_{new,2015}$	21.67%
$\eta_{new,2016}$	22.48%

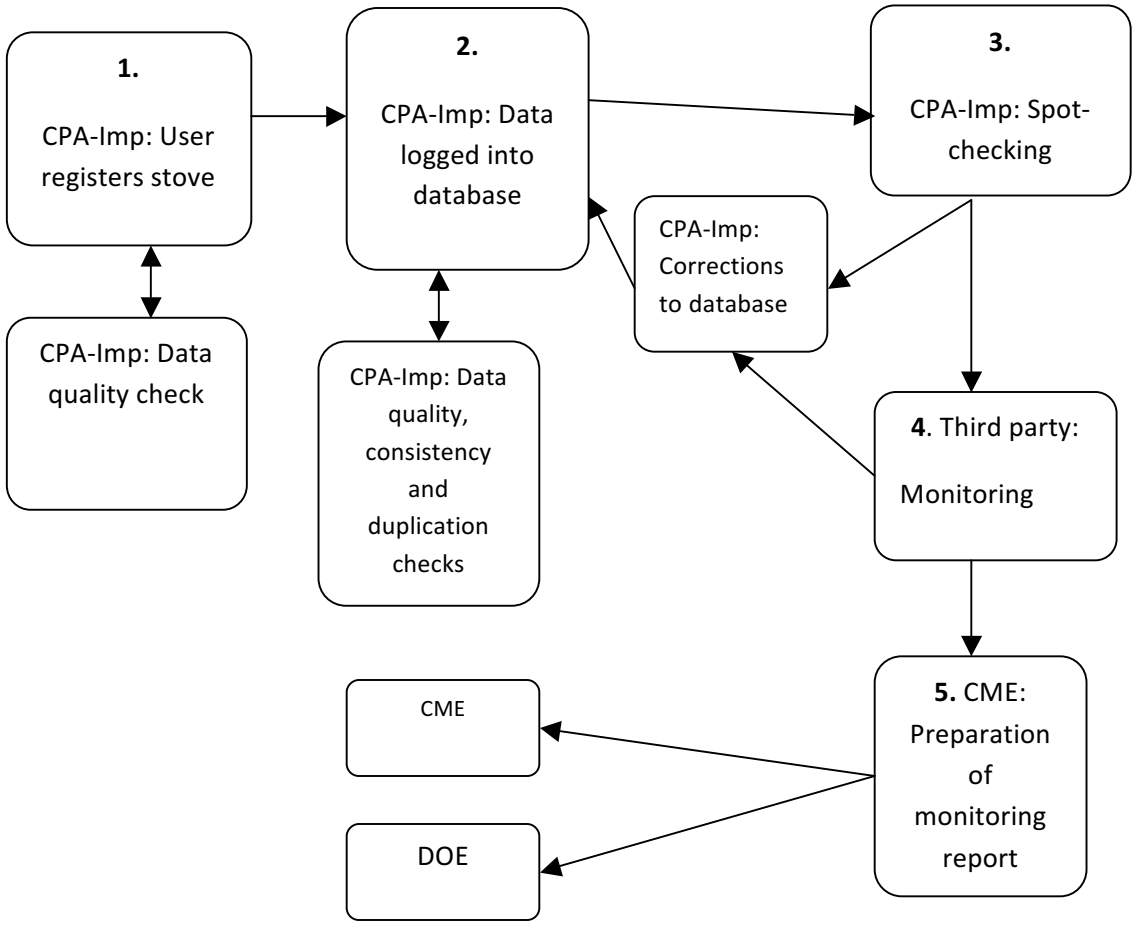
Calculation method	WBT version 4.2.2 calculation methods.
Comments	

Data / Parameter	$t_{y,j}$
Data unit	Fraction
Description	Fraction of project's monitoring period the stove is in operation (weeks in operation/total weeks in monitoring period)
Source of data	ONIL Stove registration data in monitoring database and length of monitoring period
Description of measurement methods and procedures to be applied	Calculated from database records
Frequency of monitoring/recording	Continuous monitoring
Value monitored:	0.94 [average]
Monitoring equipment	--
QA/QC procedures to be applied	Cross checks and spot checks in the database to ensure installation/registration dates are correctly captured
Purpose of the data	Calculation of baseline and project emissions
Calculation method	Days in operation during monitoring period divided by total number of days in monitoring period. This calculation is applied to every ONIL stove in the database.
Comments	

3.3 Monitoring Plan

The project's monitoring system follows the monitoring plan described in section E.7.2 of the PoA.

Organizational structure, responsibilities and competencies: To obtain the monitoring variables, the CPA implementer follows the steps, organizational structure and responsibilities in the flow chart below. Appendix 1 contains description of monitoring personnel competencies.



The CME coordinated, managed and assisted HELPS international A.C. and monitoring third parties with each element of the monitoring plan. Details of the monitoring steps on the flowchart are the following:

1. **HELPS international A.C.: User registered stove**. HELPS International A.C. field personnel collected the information in the Registration Card from the users. Information was collected via a Registration Card filled by HELPS International A.C. staff and partner organizations. HELPS International A.C. staff double-checked the accuracy of the information and requested clarifications if needed.
2. **HELPS international A.C.: Data logged into database**. HELPS International A.C.'s trained staff inputted the information from the Registration Card into the database. HELPS International A.C. and CQC checked the database records and removed duplicates (this included completing the serial number, checking for name duplicates, etc...).

3. **HELPS international A.C.: Spot-checks (ongoing).**[14] HELPS International A.C. visited locations in the field and reported updates to office either via telephone or forms. HELPS International A.C. personnel corrected the database and clearly marked stoves that were not installed, were given away, the end user died or left town, or had any other issues that made the stove no longer eligible to participate in the CPA. These stoves were excluded from the emission reduction calculations.
4. **Third Parties: Monitoring.** Third Parties followed the sampling plan outlined in the PoA-DD (Section E.7.2) and reported in section D.2 below.
5. **CME Preparation of monitoring report**. CQC prepared the final monitoring report and retained copies of the document.

Data measuring, recording Method and Implementation of Sampling Approaches

Steps 1, 2 and 3 captured end user information and populated the database, as well as provided database quality control.

Step 4 involves creating sampling surveys to capture data on continuous use of stove ($n_{y,j}$) and use of baseline systems along with ICS (SS_y) as well as stove thermal efficiency ($\eta_{new,i}$) as described in the table below.

Parameter	Description of Parameter	Sampling approach (outcome in brackets)
$n_{y,j}$	Proportion of ONIL Stoves still in operation	Visual inspection of the premises to see if ONIL stove is operational and in use. Interview with end user if required to verify that ONIL stove is still in use [Yes/No]
SS_y	Percentage of continued baseline stove use among ONIL stove households in the database	Interview with end user and visual inspection to determine if a baseline (replaced) stove is still being used in addition to ONIL stove [Yes/No]
$\eta_{new,i}$	Thermal Efficiency of operational ONIL Stoves	ONIL Stoves were tested using WBTs [ONIL stove thermal efficiency]

Sampling captured information on monitoring variables with required confidence/precision[15] and used multi-stage sampling (as per of EB 69 Annex 5 Section E). The method involved, in a first stage, grouping ONIL stoves by implementer and model and randomly selecting villages to sample. In a second stage, stoves within the selected municipalities were also randomly selected. Since all stoves were of the same model and managed by the same CPA Implementer, no further stratification was needed to capture parameter $n_{y,i}$ and SS_y data. Stoves were divided into three Primary Sampling Units for $\eta_{new,i}$ (stoves managed by same CPA Implementer, of the same model and vintage) given that multiple stove vintages were present. Each stove vintage was sampled separately using the multi-stage sampling method described below.

[14] PPs presented the DOE with evidences that spot checks were performed independently from monitoring during monitoring period.

[15] According to paragraph 22 of Methodology AMS-II.G version 03, 95/10 confidence/precision for annual and 95/5 for biennial sampling across CPAs. In case a single CPA is sampled, 90/10 confidence/precision for annual and 95/5 confidence/precision shall be required for biennial sampling.

Step 5 involved monitoring analyses and accuracy and precision checks. The CPA implementer and CME scrutinized the monitoring data to confirm accuracy of results, analyzed the data, and estimated the resulting emissions reductions outlined in this monitoring report.

The following parameters were obtained though sampling:

1. $n_{y,i}$: proportion of stoves in operation
2. SS_y: fraction of households that continue to use baseline systems (3-stone fires) along with ONIL stoves
3. $\eta_{new,i}$: thermal efficiency of ONIL Stoves

Multi-stage sampling was used for all monitoring parameters in accordance with the Sampling Plan of section E.7.2 of the PoA-DD. The objective was to obtain reliable and unbiased estimates of the monitoring parameters. Reliability levels were set at 95% confidence and 5% precision as per AMS II.G version 3, paragraph 22 for biennial sampling.

A single homogeneous population (Primary Sampling Unit, as per PoA-DD) was considered for $n_{y,i}$ and SS_y (proportion parameters) since the CPA Implementer and stove model (HELPS International A.C. and ONIL Stove respectively) were the same throughout the CPA. Seven sampling populations (Primary Sampling Units) were considered for parameter $\eta_{new,i}$: stoves from the 2010 vintage, 2011 vintage, 2013 vintage, 2014 vintage, 2015 vintage, 2016 vintage and 2017 vintage. No other vintages were included in the CPA since these three populations comprise the entire CPA.

The following table summarizes the sample sizes and results.

Monitored Parameter	Sample size	Survey Results	Precision achieved
Proportion of stoves in operation (ny,i)	276	0.5887	No. The lower bound of confidence interval is used for conservativeness.
Stoves in operation (SSy)	276	0.9494	Yes

Monitored Parameter	Sample size	Test results	Precision achieved
Efficiency of 2010 ONIL Stove vintage	7	21.48%	Yes
Efficiency of 2011 ONIL Stove vintage	7	21.19%	Yes
Efficiency of 2013 ONIL Stove vintage	7	21.62%	Yes
Efficiency of 2014 ONIL Stove vintage	7	21.67%	Yes
Efficiency of 2015 ONIL Stove vintage	7	21.67%	Yes
Efficiency of 2016 ONIL Stove vintage	7	22.48%	Yes

Implementation and quality assurance and control and procedures used for handling any internal auditing performed and any non-conformities identified: CME trained monitoring personel on monitoring procedures, including provisions for maximizing response rates, documenting out-of-population cases, refusals and other sources of non-response. The monitoring survey included several questions to support the information on the key monitoring parameters. These included visual inspections to confirm stove use and presence of baseline stoves, comments by surveyors, check of randomly selected households against actual household information, and refusal tracking. These strategies aimed at minimizing surveyor or non-response biases. The questionnaire was piloted in the field prior to implementation.

CME also scrutinized the data to check for inconsistencies and cases of non-response which indicate the stoves are no longer in use (e.g. where surveyors could see an abandoned ONIL Stove or when the user emigrated and could no longer be found). Records were flagged and fixed accordingly.

WBTs were managed by third-party technicians trained in proper WBT implementation. WBT records were checked for data points above or below three standard deviations from the mean, as per section E.7.2 of the PoA-DD. However, no records above or below 3 standard deviations away from the mean were found.

Monitoring staff also certified lack of conflicts of interest and agreement with the monitoring procedures.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

Emissions reductions can be calculated as per methodology AMS-II.G version 3 using the following equations:

$$ER_y = B_{y,savings} * f_{NRB,y} * NCV_{biomass} * EF_{projected\_fossilfuel} * L$$

Where:

ER_y	Emissions reductions during the year in tCO2e
$B_{y,savings}$	Quantity of woody biomass that is saved in tonnes
$f_{NRB,y}$	Fraction of woody biomass saved by the project activity in year y that can be established as non-renewable biomass (0.87)
$NCV_{biomass}$	Net calorific value of non-renewable woody biomass that is substituted (IPCC default value for fuel wood 0.015 TJ/tonne)
$EF_{projected\_fossilfuel}$	Emission factor for the substitution of non-renewable woody biomass by similar consumers. Use a value of 81.6 tCO_2/TJ
L	A net to gross adjustment factor (0.95 default) is applied above (equation (1) of AMS II.G, version 3) in order to adjust B_{old} to account for leakages as per paragraph 13 (a) of the methodology.

To calculate $B_{y,savings}$, we use Option 2[16]

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

Where:

B_{old}	Quantity of wood fuel used in the absence of the project activity in tonnes
η_{old}	A default value of 0.10 may be optionally used if the replaced system is a three stone fire, or a conventional system with no improved combustion air supply or flue gas ventilation system, i.e. without a grate or a chimney
η_{new}	Efficiency of the system being deployed as part of the project activity (fraction), as determined using the Water Boiling Test (WBT) protocol.

And

$$B_{y,savings} = B_{old,adjusted} \cdot \left[\sum_{i=1}^{n} N_{y,i} \left(1 - \frac{\eta_{old}}{\eta_{new,i}} \right) \right]$$

Where:

$N_{y,i}$	Total number of stoves in operation for a full monitoring period equivalent in the project
η_{old}	Efficiency of the baseline system/s being replaced. The 0.10 default value is used as the replaced systems are three-stone fires or conventional systems lacking improved combustion air supply mechanism and flue gas ventilation system i.e., traditional stoves.
$\eta_{new,i}$	Efficiency of the system being deployed as part of the project activity (fraction), as determined using the Water Boiling Test (WBT) protocol.

η_{old} = 0.10

$\eta_{new,2010}$= 0.2148

$\eta_{new,2011}$= 0.2119

$\eta_{new,2013}$= 0.2162

$\eta_{new,2014}$= 0.2167

$\eta_{new,2015}$= 0.2167

$\eta_{new,2016}$= 0.2248

[16] Paragraph 6 of AMS II.G

$B_{y,savings}$ =4.5918 x [2,567x(1- 0.1/0.2148) + 5,018x(1-0.1/0.2119) + 2,286x(1-0.1/0.2162) + 3,473(1-0.1/0.2167) + 2,385x(1-0.1/0.2167) + 1,613x(1-0.1/0.2248) x (642/365)

= 75,117.69 tonnes

ER_y = 75,117.69 tonnes * 0.015 TJ/tonne * 81.6 tCO_2/TJ * 0.95 * 0.87

= 75,991 tCO_2

4.2 Project Emissions

Not applicable.

4.3 Leakage

Not applicable.

4.4 Net GHG Emission Reductions and Removals

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
29-Oct-15 to 31-Dec-15	6,809	0	0	6,809
01-Jan-16 to 31-Dec-16	42,575	0	0	42,575
01-Jan-17 to 31-Jul-17	26,607	0	0	26,607
Total	75,991	0	0	75,991