



**Verified Carbon
Standard**

ENERGY EFFICIENT COOK STOVE IMPLEMENTATION IN INDIA

Document Prepared by
Enen Green Services Private Limited

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CONTENTS

1	PROJECT DETAILS.....	3
1.1	Summary Description of the Implementation Status of the Project.....	3
1.2	Sectoral Scope and Project Type	3
1.3	Project Proponent	3
1.4	Other Entities Involved in the Project	4
1.5	Project Start Date	4
1.6	Project Crediting Period	4
1.7	Project Location	4
1.8	Title and Reference of Methodology	4
1.9	Participation under other GHG Programs.....	5
1.10	Other Forms of Credit	5
1.11	Sustainable Development Contributions	5
2	SAFEGUARDS	7
2.1	No Net Harm.....	7
2.2	Local Stakeholder Consultation	7
2.3	AFOLU-Specific Safeguards	7
3	IMPLEMENTATION STATUS	7
3.1	Implementation Status of the Project Activity	7
3.2	Deviations	8
3.3	Grouped Projects.....	8
4	DATA AND PARAMETERS.....	8
4.1	Data and Parameters Available at Validation	8
4.2	Data and Parameters Monitored	11
4.3	Monitoring Plan	14
5	QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS.....	18
5.1	Baseline Emissions.....	18
5.2	Project Emissions.....	19
5.3	Leakage	19
5.4	Net GHG Emission Reductions and Removals.....	19
APPENDIX X: <TITLE OF APPENDIX>		ERROR! BOOKMARK NOT DEFINED.

1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The project activity involves promotion of improved cooking stoves (ICS) to the people of socially deprived community in India. The project intends to avail the households with clean cooking solutions; thereby, displacing the less efficient traditional cooking stoves from the kitchen with stoves of better efficiency. Replacement of the traditional cooking stoves with ICS will reduce the exposure of the family members, specifically women, to the indoor air pollution and therefore result in saving of health-related expenses.

The estimated annual emission reductions over a 10-year period of first crediting period are 58,944 tCO₂e/year. The total emission reductions for 10 years crediting period will be 589,441 tCO₂e. Total GHG emission reduction in the second monitoring period 28th June 2020 to 31st March 2022 is 71,360 tCO₂e.

To achieve the initial targeted volume of emission reductions, the project proponent aimed to disseminate 25,520 ICS under the project activity. Project started distribution from June 2019 and last batch distributed on Jan 2020 to a total of 17,379 ICS. All ICS taken account under the project activity are commissioned. During the monitoring it was found that all of 17,379 devices are in operational.

Scenario existing prior to the implementation of project activity: The scenario existing prior to the implementation of the project activity instances is the usage of traditional biomass and inefficient cook stoves with poor ventilation, causing excessive indoor air pollution (IAP) and has been a serious health risk for women and children who spend several hours in the kitchen.

1.2 Sectoral Scope and Project Type

The project activity under consideration is not a grouped project activity.

Sectoral Scope: 03 Energy Demand.

Project Type: Type II Energy Efficiency Improved Projects

Grouped Project: No

1.3 Project Proponent

Organization name	Enen Green services Private Limited
Contact person	Ruchika Sharma
Title	Director
Address	C-904, Vipul Plaza, Sector-81, Faridabad, Haryana – 121001
Telephone	+919953935506
Email	enengreen@gmail.com

1.4 Other Entities Involved in the Project

Organization name	Greentech Environment
Role in the Project	Project Implementer
Contact person	Viral Pushpavadan
Title	Director
Address	22,23, Shree Rangkutir Shopping Center, Bholav, Bharuch, Gujarat-392012
Telephone	+91-8800420771
Email	ge@enengspl.com

1.5 Project Start Date

The first ICS batch was commission on 28th June 2019. Thus, the project starts date is 28/06/2019.

1.6 Project Crediting Period

Project Crediting Period: First

Start Date: 28/06/2019 (First operating day of the project activity ICS).

End date: 27/06/2029

Total Number of Years: 10 (Fixed).

1.7 Project Location

Project activity is located in District Baksa, Udalguri and Barpeta of state Assam country India. Thus, geographical area of project activity is considered as India. The geographical boundary is delineated in the form of extreme geographic coordinates as follows:

Latitude: 20.5937°N

Longitude: 78.9629°E.

1.8 Title and Reference of Methodology

Title: Methodology for Installation of High Efficiency Firewood Cookstoves

Type: Type II – Energy Efficiency Improved Projects

VMR0006 Methodology for Installation of High Efficiency Firewood Cookstoves, Version 1

Sectoral Scope: 03 Energy Demand.

<https://verra.org/methodology/vmr0006-methodology-for-installation-of-high-efficiency-firewood-cookstoves/>

1.9 Participation under other GHG Programs

The project activity has not been registered and is not seeking registration under any other GHG emission program to avail carbon benefits during the crediting period of the project activity.

1.10 Other Forms of Credit

- The net GHG emission reductions generated by the project activity will not be used for compliance with an emissions trading program or to meet binding limits on GHG emissions.
- The project proponent hereby corroborates that the project activity has not created or sought or received any other form of environmental credit.

1.11 Sustainable Development Contributions

Project's contribution to Sustainable Development

The contributions of the project activity towards sustainable development are explained below:

Environmental well-being

The project activity has resulted in the reduction of firewood consumption and emission of greenhouse gases and thus conserve forest and biodiversity.

Social well being

The project activity has paved the way for development and increased the social status and living conditions and the prevailing living standard in the vicinity of the project activity and thus results in empowering the nearby. Also it has contributed to an increase in the local employment by employing skilled and un-skilled personnel for operation and maintenance of the equipment. The project has reduced the drudgery of women by saving time and the use of saved time for other productive activities.

Economic well being

The project has created a business opportunity during construction phase for local stakeholders such as suppliers, contractors etc. contributing to economic well-being aspects. Further, the project also influenced creation of employment opportunities for local people, which would enhance their social status. Sufficiently enhanced indoor air quality thereby improving health of women and children and

reducing incidences of smoke and fire related injuries and therefore resulted in saving of health related expenses.

Technological well being

The project activity has promoted improved cook stoves that resulted in reduced fuel consumption and emissions due to cooking and heating water in homes.

Table 1: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	3.2	Good health and well being	Implemented activities to increase	The project has improved the health conditions of 17,379 project beneficiaries with the introduction of ICS.	Significant reduction of eye itching and coughing has been reported by 17,379 beneficiaries.
2)	7.0	Affordable and clean energy	Implemented activities to increase	The project has provided 17,379 families with low-cost ICS which notably uses less fuel than traditional cookstoves.	Provided 17,379 families with low-cost ICS which uses less notably fuel than traditional cookstoves.
3)	8.2	Economic well being	Implemented activities to increase	The project has provided skill development training and income opportunities to 226 and 146 number of local populations respectively.	Provided skill development training and income opportunities to 226 and 146 number of local populations respectively.

3)	13.1	Net greenhouse gas emissions	Implemented activities to decrease	The project has prevented the release of 71,360 tonnes of carbon into the atmosphere during the monitoring period	Prevented the release of 1,04,799 tonnes of carbon into the atmosphere
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2 SAFEGUARDS

2.1 No Net Harm

No potential negative environmental and socio-economic impacts have been identified by the project proponent. The project activity promotes environmental and socio-economic well-being. Also, project activity generated local employment which supports upliftment of socio-economic status of region.

2.2 Local Stakeholder Consultation

The Project is already registered with VCS (VCS ID 2336). The Local Stakeholder Consultation Process was already conducted in-line with requirement during project registration with VCS.

As a part of continuous feedback from stakeholders, there were no other major comments or protest raised by the stakeholders and they were totally in support for setting up of these kinds of projects in the region.

For ongoing communication, the PP has also placed a grievance register onsite where in the stakeholder can put down his/her complain and the same if found genuine will be addressed immediately by the local supplier or village head. However, during the current monitoring period there was no feedback/grievance reported. Therefore, no action has been undertaken.

2.3 AFOLU-Specific Safeguards

Not applicable.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

Project was commissioned on 28th June 2019 and the project is operational since then. However, only 68.1% of the cookstoves were distributed in total but there has been no exchange of cookstove

during the monitoring period. No event occurred during this monitoring period, which may have impact on the applicability of the methodology as well as on emission reduction.

3.2 Deviations

3.2.1 Methodology Deviations

There is no methodology deviation taken for this monitoring period.

3.2.2 Project Description Deviations

There is no project description deviation taken for this monitoring period.

3.3 Grouped Projects

Not applicable. This is not a grouped project activity.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	Bold,p
Data unit	tonnes/person/year
Description	Annual quantity of woody biomass that would have been used per person in the household in the absence of the project activity to generate useful thermal energy equivalent to that provided by the project devices.
Source of data	Equation 3 VMR0006
Value applied	0.5
Justification of choice of data or description of measurement methods and procedures applied	This parameter shall be determined ex-ante
Purpose of Data	Calculation of emission reduction
Comments	This parameter shall remain fixed for the monitoring periods

Data / Parameter	N _{p,HH}
Data unit	No of persons/HH
Description	Average number of person per Household

Source of data	Latest National family Health Survey (NFHS-4) 2015-16 (https://dhsprogram.com/pubs/pdf/FR339/FR339.pdf) (Page 17)
Value applied	4.6
Justification of choice of data or description of measurement methods and procedures applied	This parameter shall be determined ex-ante
Purpose of Data	Calculation of emission reduction
Comments	This parameter shall remain fixed for the monitoring periods.

Data / Parameter	$f_{NRB,y}$
Data unit	Fraction
Description	Fraction of woody biomass saved by the project activity during year y that can be established as non-renewable biomass
Source of data	Fraction of non-renewable biomass is calculated as per the f_{NRB} calculation TOOL30: Calculation of the fraction of non-renewable biomass version 3
Value applied	74%
Justification of choice of data or description of measurement methods and procedures applied	Any changes/ revisions to this value would be monitored and if new default values are approved by the CDM EB the value of the fraction of NRB used will be updated.
Purpose of Data	Calculation of share of non-renewable biomass
Comments	This parameter shall remain fixed for the monitoring periods.

Data / Parameter	$NCV_{wood\ fuel}$
Data unit	TJ/tonne
Description	Net calorific value of the non-renewable woody biomass that is substituted
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories; Volume 2 Energy, Chapter 1 Introduction
Value applied	0.0156
Justification of choice of data or description of measurement methods and procedures applied	IPCC default value
Purpose of Data	Emission reduction calculation
Comments	This parameter shall remain fixed for the monitoring periods.

Data / Parameter	EF _{wf, CO2}
Data unit	tCO ₂ /TJ
Description	CO ₂ emission factor for the use of wood fuel in baseline scenario
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories; Volume 2 Energy, Chapter 2 Stationary Combustion
Value applied	112
Justification of choice of data or description of measurement methods and procedures applied	IPCC default value
Purpose of Data	Emission reduction calculations
Comments	This parameter shall remain fixed for the monitoring periods.

Data / Parameter	EF _{wf, non CO2}
Data unit	tCO ₂ /TJ
Description	Non-CO ₂ emission factor for the use of wood fuel in baseline scenario
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories; Volume 2 Energy, Chapter 2 Stationary Combustion
Value applied	26.23
Justification of choice of data or description of measurement methods and procedures applied	IPCC default value
Purpose of Data	Emission reduction calculations
Comments	This parameter shall remain fixed for the monitoring periods.

Data / Parameter	η_{old}
Data unit	Fraction
Description	Efficiency of baseline cookstove
Source of data	Methodological default value
Value applied	0.1
Justification of choice of data or description of measurement methods and procedures applied	The default value of 0.10 is used as the replaced system is a three stone fire, or a conventional device with no improved combustion air supply or flue gas ventilation, i.e. without a grate or a chimney.
Purpose of Data	Calculation of Quantity of woody biomass that is saved in tonnes per device
Comments	This parameter shall remain fixed for the monitoring periods.

Data / Parameter	η_p
Data unit	Fraction
Description	Efficiency of the project stove at the start of project activity
Source of data	Manufacturer's specification
Value applied	0.3325
Justification of choice of data or description of measurement methods and procedures applied	This parameter shall be determined ex-ante
Purpose of Data	Calculation of $\eta_{new,y,l,j}$
Comments	This parameter shall remain fixed for the monitoring periods.

4.2 Data and Parameters Monitored

Data / Parameter	$N_{y,i,j}$
Data unit	Number
Description	Number of project devices of type i and age a that are operating in year y
Source of data	Biennial ICS users' survey
Description of measurement methods and procedures to be applied	Based on a representative sample. Sampling standard has been used for determining the sample size to achieve 90/10 confidence precision according to the latest version of Standard for sampling and surveys for CDM project activities and programme of activities.
Frequency of monitoring/recording	At least once every two years
Value monitored	17,379
Monitoring equipment	Biennial user survey
QA/QC procedures to be applied	-
Purpose of the data	Emission reduction calculation
Calculation method	The households that were found continuing the use of traditional stoves, such households were counted for having non-operational project device and equal proportion of households has not been counted towards emission reductions. Nevertheless, some households have retained their traditional stoves for religious reason where the traditional stoves are not used, the biennial ICS

	users' survey has captured this information and it has been used accordingly while calculating the emission reductions.
Comments	

Data / Parameter	$\eta_{new,y,i,j}$																				
Data unit	Fraction																				
Description	Efficiency of the improved cookstove type i and batch j determined through water boiling test (WBT) during year y																				
Source of data	Calculation																				
Description of measurement methods and procedures to be applied	To adopt Option V given in the methodology: "Efficiency of the improved cook stoves to be estimated using equation 5 above where loss in efficiency per year is calculated, and therefore this parameter does not need to be monitored"																				
Frequency of monitoring/recording	Annual																				
Value monitored	<table border="1"> <tr><td>Year 1</td><td>33.25%</td></tr> <tr><td>Year 2</td><td>30.94%</td></tr> <tr><td>Year 3</td><td>30.63%</td></tr> <tr><td>Year 4</td><td>30.33%</td></tr> <tr><td>Year 5</td><td>30.02%</td></tr> <tr><td>Year 6</td><td>29.72%</td></tr> <tr><td>Year 7</td><td>29.43%</td></tr> <tr><td>Year 8</td><td>29.13%</td></tr> <tr><td>Year 9</td><td>28.84%</td></tr> <tr><td>Year 10</td><td>28.55%</td></tr> </table>	Year 1	33.25%	Year 2	30.94%	Year 3	30.63%	Year 4	30.33%	Year 5	30.02%	Year 6	29.72%	Year 7	29.43%	Year 8	29.13%	Year 9	28.84%	Year 10	28.55%
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Year 7	29.43%																				
Year 8	29.13%																				
Year 9	28.84%																				
Year 10	28.55%																				
Monitoring equipment	-																				
QA/QC procedures to be applied	-																				
Purpose of the data	Calculation of emission reductions																				
Calculation method	Calculation to be performed using equation below: $\eta_{new,y,i,j} = \eta_p \times (DF_n)^{y-1} \times 0.94$																				
Comments																					

Data / Parameter	μ_y
Data unit	Fraction
Description	Adjustment to account for any continued use of pre-project devices during the year y
Source of data	Monitoring survey
Description of measurement methods	This parameter has been monitored using one of the following methods:

and procedures to be applied	If the baseline cookstoves are decommissioned and no longer used, as determined by the monitoring survey its value is 0 and B_{old}, adjusted is equal to B_{old}. If both the improved cookstove and baseline cookstoves are used together then surveys shall be conducted to record the average continued operation of baseline cookstoves in a sample of households. The surveys should be designed to capture the cooking habits and stove usage of households in the region, including quantification of use of baseline cookstoves, by formulating questions and/or collecting evidences to determine the frequency of usage of both the improved cookstoves and baseline cookstoves. For example, if there were 3 baseline cookstoves in a household and it was determined during the survey that use of one of them continues during the crediting period then a conservative adjustment factor of 0.33 is applied to B_{old}. Another example would be the case where there was only one baseline cookstove per household and its use during the project period continues along with the improved cookstove to meet 25% of the cooking needs of the household in which case the adjustment factor will be 0.25. Another example would be to interview the household and have them estimate the time of usage of the baseline cookstoves and improved cookstove on an average day.
Frequency of monitoring/recording	Once every 2 years
Value monitored	0.0019
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of the data	Calculation of emission reductions
Calculation method	For Projects that opt for $B_{y=1, new, I,j,survey}$ i.e, direct measurement of biomass used in project stoves, then μ_y is not required to be computed.
Comments	

Data / Parameter	Life Span
Data unit	Number of years
Description	The operating lifetime of the project device. The life span should be reported if the methodology equation 5 is adopted to determine the project stove efficiency
Source of data	Manufacturer's specification
Description of measurement methods and procedures to be applied	-

Frequency of monitoring/recording	Once at the time of project stove installation
Value monitored	5
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of the data	Calculation of emission reductions
Calculation method	NA
Comments	NA

4.3 Monitoring Plan

The purpose of the monitoring plan is to ensure successful monitoring of the emission reductions of the proposed project during its crediting period. The overall monitoring is managed by the project implementer Greentech Environment, India.

Activities and performance related to emissions reduction are monitored by EGSPL. The PP proposed the following structure for data monitoring, collection, data archiving and calibration of equipment for this project activity instance. The team comprise will follow the below organizational structure.

The monitoring activities will involve data collection during distribution as well as usage information post distribution. The data collected during distribution will involve information about the stove, the purchaser and location to enable one to uniquely identify each ICS unit and avoid double counting. This will form what is called the sales record. Greentech Environment will distribute the stoves, as well as carry out the monitoring activities that occur during the distribution of stoves. Greentech Environment or through their associates will ensure that the distributor is trained on how to capture the sales data. The project activity implementer is fully responsible to ensure the correct distribution process and data gathering is followed. In turn, the distributing agent will link remuneration to the complete and accurate collecting of information during the distribution of stoves.

The following information will be recorded at the time of distribution of ICS to the user:

- Name of the User
- Name of the Households Head
- Total Family Members
- District
- Municipality/Rural Municipality
- Ward No.
- Ethnicity
- Installation Date
- Unique ID

However, during post distribution, monitoring activities will involve selecting a sample of stove from the sales record and visiting the premises where these stoves are located to monitor key parameters pertinent in ER Calculation.

Data collecting & handling is conducted in a transparent way to secure high quality of recording and storing of data. Data collected and monitored are stored electronically in a secure and retrievable manner for at least two years after the end of the project crediting period. Uncertainty

related to data handling (if any) would be rectified, if necessary, by revising monitoring procedures. The changes would be approved by a verifier (e.g., Designated Operational Entity)

Roles and responsibilities of different participators are proposed to be as follows:

Entity/Person	Roles & Responsibilities
Enen Green	✓ VCS documentation development ✓ Communicate with VERRA for all VCS related matters ✓ Communicate with DOEs for validation & verification ✓ Engage consultant or any entity for CDM process (if required) ✓ Identify local partners for local representation and support ✓ Identity suitable ICS manufacturers (both local & for import) ✓ Design the distribution plan for on ground implementation of ICS ✓ Design the monitoring system (including data collection using digital tool & too collate in an electronic database) ✓ Training and development of local resources (as may be required) ✓ Regular Monitoring and quality assurance of data ✓ Monitor & Supervise on-ground distribution, etc. ✓ Annual Review meeting with Local Teams and other associated entity in order to ensure continuous improvements of the project activity
Greentech Environment (Local Representative)	✓ To support & assist Enen Green in achieving the stated goal of the project activity ✓ Assist and facilitate Enen Green in baseline data collection, efficiency testing, etc. ✓ To be the local representative and communicate, act and engage in implementation activities of project activity ✓ To identify and deploy suitable local team and resources for ICS distribution, data collection, regular spot-check at households etc. ✓ Assist and facilitate Enen Green during training of the Operational Team and capacity building across the end users. ✓ To bridge any gap in between end users of ICS and Enen Green in order to ensure smooth operation of the program to achieve overall objective of the project activity
Operational Team	The operational team(s) would consist of different members depending on the requirement at the time of dissemination of the ICS. A proposed team composition would be as follows: ✓ ICS Distributor(s) – who will be responsible for deploying the ICS at household and register the end user in the digital tool. They will also be responsible for giving demonstration of ICS use, discussing with the end users on its benefits and educate them on continued use of ICS and discontinuation of the use of conventional/traditional open firing practice. They will also conduct periodic check at households to gather feedback, address to any technical concerns, collect necessary data and transmit the information.
ICS Manufacturer or Supplier	✓ To design and develop ICS as per required standard ✓ To provide technical parameters and manufacturer's efficiency etc. at the time of supply

	✓ To educate and train Greentech Environment team on the installation (delivery), uses, handling etc. of the ICS at households.
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Sampling Plan

As per the Guideline for Sampling and Surveys for CDM Project Activities and Programme of Activities, version 04.0, the sampling plan is the following:

(a) Sampling design

Due to the large number of ICS envisioned to be distributed under the project, it is not economically feasible to monitor each individual ICS unit distributed. Therefore, representative sampling shall be undertaken for each batch of ICS. The sampling plan to be designed in line with the requirements of the Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities, version 08.0. Samples will be drawn from ICS recorded in the project database administered by the project proponent. A detailed explanation of this database is found in Section 1.11 of project description. Objectives and Reliability Requirements, The objective is to obtain an unbiased and reliable estimate of the proportion or mean value of the following key variables over the course of the crediting period. As per methodology, 90/10 confidence/precision shall be applied for annual sampling requirement and 95/10 for biennial sampling inspection. As per Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities, 90/10 confidence/precision to be adopted for small-scale project and 95/10 for large-scale project. Given that the size of the project is under the category of small scale projects, hence 90/10 confidence/precision shall be adopted for all parameters unless the average annual emission reductions of the project below the threshold

Monitored Parameters:

The project involves introduction of improved cook stoves as energy efficiency measure:

Sr. No.	Monitoring Parameters	Sampling Parameters	Parameter type	Monitoring frequency
1	$N_{y,i,j}$ Number of project devices of type i and batch j operating during year y	Proportion of ICS still in operation	Proportion	Biennial
2	$B_{y=1,new,i,j,survey}$ Quantity of woody biomass used by project devices in tonnes per device of type i. and batch j	Daily consumption of woody biomass per ICS	Proportion	Determined in the first year of project implementation

Target Population

The target population will be the complete set of appliances (ICS) deployed under the project.

Sampling Method

The project involves distribution of ICS throughout the project area thereby replacing traditional cooking devices. The population is heterogeneous in nature i.e. common technology with similar operating characteristics but dispersed i.e. distribution of ICS is spread across 3 district of state Assam. The population consists of sub-populations which are homogeneous called as Strata. The characteristics of population (for example quantity of biomass consumed) are more similar within the stratum (ICS of same type, vintage and project area in which they are operating) than across the strata. Therefore, Stratified Sampling technique will be used to conduct sampling survey among ICS batches. The populations of each batch will be combined together, the sample size is determined, and a single survey will be undertaken to collect data. To ensure the survey result is representative of the entire population, the dissimilarity (such as ICS type, vintage and project area in which they are operating) within the included CPAs will be taken into account in the sample size calculation. The ICS of same type, vintage and project area in which they are

operating will be grouped in the same strata. Samples will be drawn by using the random number generator.

To determine the parameters, sampling will involve the following approaches (outcome in brackets):

N_{y,i,j} = Visual inspection of the premises to see if ICS is operational and in use. Interview with end user if required to verify that ICS is still in use (Yes/No)

B_{y=1, new,i,j,survey} = Interview with end user and estimate the daily consumption of woody biomass of ICS (Daily consumption of woody biomass)

Sample Size

The procedure to determine the sample of households will ensure that they adequately represent the broader project population, minimizing sampling error. Using, a 90 per cent confidence level, and a 10 per cent margin of error, a random sample will be selected from each strata. In order to calculate the required sample size estimates, values for the proportions, mean values, and standard deviations are required. As per Guideline for Sampling and surveys for CDM project activities and programmes of activities, version 04.0, there are different ways available to obtain the estimates of the parameter of interest:

- Refer to the result of previous studies and use these results;
- In a situation where information from previous studies is not available, a preliminary sample as a pilot could be conducted and use that sample is used to provide the estimates;
- Use best guesses based on the researcher's own experiences.

Sample Size calculation

Proportion parameter to estimate the sample size for proportion parameters, the following equation is used:

$$n \geq \frac{1.96^2 NV}{(N-1) \times 0.1^2 + 1.96^2 \times V}$$

Where:

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

n = Sample size

N = Population size (Total number of households or ICS)

P = Weighted overall expected proportion

SD² = Weighted overall expected variance

1.645 = Represents the 90% confidence required

0.1 = Represents the 10% relative precision

District	No of cookstove device distributed	Proportion of cookstove in operational ¹
Baksa	5779	0.78
Udalguri	5845	0.59
Barpeta	5755	0.71

$$SD^2 = \frac{5779 \times 0.78 \times (1 - 0.78) + 5845 \times 0.59 \times (1 - 0.59) + 5755 \times 0.71 \times (1 - 0.71)}{17379}$$

$$SD^2 = 0.2066$$

¹ Proportion has been taken same as the 1st Monitoring Report as a conservative approach

$$\bar{p} = \frac{5779 \times 0.78 + 5845 \times 0.59 + 5755 \times 0.71}{17379}$$

$$\bar{p} = 0.69$$

$$V = \frac{0.2066}{0.69^2}$$

$$V = 0.430$$

$$n \geq \frac{1.645^2 \times 17379 \times 0.430}{(17379 - 1) \times 0.1^2 + 1.645^2 \times 0.430}$$

$$n \geq \frac{20236.14}{173.78 + 1.16}$$

$$n \geq 115.67 \approx 116$$

Sample size per district

$$Baksa = \frac{5779}{17379} \times 116 = 38.57 \approx 39$$

$$Udalguri = \frac{5845}{17379} \times 116 = 39.01 \approx 40$$

$$Barpeta = \frac{5755}{17379} \times 116 = 38.41 \approx 39$$

As the project has implemented 17379 stoves in Baksa, Udalguri and Barpeta district of Assam state in India, a sample survey of 135 households has been collected whereas required sample was 118. During survey surveyor has checked ICS unique id, name of beneficiary, installation date, usage of any traditional cookstove, quantity of fuel use per month, operational status of ICS etc (detailed questionnaire can refer in monitoring survey report issued by third party). The data collections were performed by a field team in April 2022 in between 1st April to 15th April, the survey households were chosen from the potential ICS beneficiaries using Stratified random sampling approach.

S. No.	District	Number of Households Surveyed
1	Baksa	45
2	Udalguri	45
3	Barpeta	45

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

The methodology does not account for baseline emissions separately, but instead quantifies emission reductions as a function of the reduction in the amount of non-renewable biomass fuel consumption in the efficient project stoves as compared to baseline stoves.

5.2 Project Emissions

The methodology does not account for project emissions separately, but instead quantifies emission reductions as a function of the reduction in the amount of non-renewable biomass fuel consumption in the efficient project stoves as compared to baseline stoves.

5.3 Leakage

Leakage shall be considered as default 0.95 in accordance with Section 5.4 of AMS-II.G

5.4 Net GHG Emission Reductions and Removals

The improved cookstove is introduced as energy efficiency measure in the project, therefore equations 1 and 2 of the methodology will be applied to calculate the net GHG emission reductions.

$$ER_y = \sum_i \sum_j ER_{y,i,j} - LE_y$$

Where:

i = Indices for the situation where more than one type of project device is introduced to replace the pre-project devices

j = Indices for the situation where there is more than one batch of project device

ER_y = Emission reductions during year y in tCO₂e

$ER_{y,i,j}$ = Emission reductions by project device of type i and batch j during year y in tCO₂e

LE_y = Leakage emissions in the year y

$$ER_{y,i,j} = B_{y,savings,i,j} \times NCV_{wood\ fuel} \times f_{NRB,y} \times (EF_{wf,CO_2} + EF_{wf,non\ CO_2}) \times N_{y,i,j} \times 0.95$$

Where:

$B_{y,savings,i,j}$	=	Quantity of woody biomass that is saved in tonnes per cookstove device of type i and batch j during year y
$f_{NRB,y}$	=	Fraction of woody biomass that can be established as non-renewable biomass (f_{NRB})
$NCV_{biomass}$	=	Net calorific value of the non-renewable woody biomass that is substituted (IPCC default for wood fuel, 0.0156 TJ/tonne, based on the gross weight of the wood that is 'air-dried')
EF_{wf,CO_2}	=	CO ₂ emission factor for the use of wood fuel in baseline scenario (IPCC default for wood fuel, 112 tCO ₂ /TJ)
$EF_{wf,non\ CO_2}$	=	Non-CO ₂ emission factor for the use of wood fuel in baseline scenario (IPCC default for wood fuel, 26.23 tCO ₂ /TJ)
$N_{y,i,j}$	=	Number of project devices of type i and batch j operating during year y
0.95	=	Discount factor to account for leakage

Determination of $B_{y,savings,i,j}$

The quantity of woody biomass saved due to implementation of improved cookstoves to be estimated using equation below:

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

Where,

B_{old}	=	Annual quantity of woody biomass that would have been used in the absence of the project activity (in tonnes per device) to generate useful thermal energy equivalent to that provided by the improved cook stove. The value of B_{old} can be sourced from historical data or baseline surveys. Alternatively, a default value of 0.5t/capita/year may be used.
η_{old}	=	Efficiency of baseline cookstove
$\eta_{new,i,j}$	=	Efficiency of the improved cookstove type i and batch j determined through water boiling test (WBT) during year y Alternatively, efficiency may be determined using Equation 4.

$$\eta_{new,i,j} = \eta_p \times (DF_n)^{y-1} \times 0.94$$

Where,

η_p	=	Efficiency of project stove (fraction) at the start of project activity.
$(DF_n)^{y-1}$	=	Discount factor to account for efficiency loss of project cookstove per year of operation (fraction). This value may be based on actual monitoring or based on manufacturer's declaration on expected loss in efficiency or through publicly available literature on relevant industry standards. Alternatively default value of 0.99 efficiency loss per year can be considered.
0.94	=	Adjustment factor to account for uncertainty related to project cookstove efficiency test.

As per survey result $\mu = 0$ therefore $B_{old,adjusted} = B_{old}$

$$B_{old,adjusted} = B_{old} \times (1 - \mu_y)$$

Where:

$B_{old,adjusted}$ = Adjust B_{old} to account the ex post usage of firewood in baseline cookstove(s) by project households in addition to improved cookstove (in tonnes per device)

μ_y = Baseline stove usage factor to account for use of baseline cookstoves along with improved cookstoves.

In accordance with AMS.II-G version 11.1 paragraph 23, It is assumed that in the absence of the project activity, the baseline scenario would be the projected use of fossil fuels to meet similar thermal energy needs as those provided by the project devices. The actual baseline scenario is the use of NRB. Since NRB has higher carbon intensity than the fossil fuels proposed in AMS II.G, this assumption reduces the emission reductions significantly, making the outcome more conservative. The detailed calculations are provided in section 4.4 of the VCS PD.

Period	No of days	Estimated emission reduction (tCO ₂ e)	Actual Emission Reduction considering leakage (tCO ₂ e)
28 th June 2020 – 31 st Dec 2020	187	30,721.28	20,880
01 st Jan 2021 – 31 st Dec 2021	365	59,577.00	40,495
01 st Jan 2022 – 31 st March 2022	90	14,690.22	9,985
Total		1,04,988.50	71,360

Actual achieved emission reduction is 32.28% lower than estimated emission reduction.

Total emission reduction for period 28th June 2020 to 31st March 2022 is 71,360 tCO₂e.

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
2020 (28 th June 2020 – 31 st Dec 2020)	21,979.93	0	1,099.00	20,880
2021	42,626.35	0	2,131.32	40,495
2022 (01 st Jan 2022 – 31 st March 2022)	10,510.61	0	525.53	9,985
Total	75,117.56	0	3,755.88	71,360