ENERGY EFFICIENT COOK STOVE IMPLEMENTATION IN INDIA

Document Prepared by

ENEN Green Services Private Limited

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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 has reduced the exposure of the family members, specifically women, to the indoor air pollution and therefore result in saving of health-related expenses.

The project promotes an advanced smart stove with a prefabricated metallic or ceramic combustion chamber, ensuring durability and consistent performance in efficiency, air pollution reduction, and safety. The cube-shaped design features an L-shaped combustion chamber, pot skirt, and isolative material. A horizontal fuel magazine and vertical chimney enhance combustion, promoting even wood feed and controlled rates. Improved convective heat transfer minimizes indoor pollutants, creating a smoke-free kitchen.

The estimated annual emission reductions over a 10-year period of first crediting period are 58,944 tCO_2e/year. The total emission reductions for 10 years crediting period will be 589,441 tCO_2e. Total GHG emission reduction in the third monitoring period 01-April-2022 to 27-June-2023 is 50,099 tCO_2e.

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.

Audit Type	Period	Program	VVB Name	Number of years
Validation & Verification	(28-June-2019 -- 27-June-2020)	VCS	Applus+ Certification	1 year
Verification	(28-June-2020 -- 31-March-2022)	VCS	4K Earth Science Private Limited	1 year 9 months and 4 days

Verification	(01-April-2022 -- 27-June-2023)	VCS	VKU Certification Private Limited	1 year 2 months 27 days
Total	(28-June-2019 -- 27-June-2023)	VCS		4 years 0 months 0 days

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
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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 28-June-2019. Thus, the project starts date is 28-June-2019.

1.6 Project Crediting Period

Project Crediting Period: First

Start Date: 28-June-2019 (First operating day of the project activity ICS).
End date: 27-June-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:

State	District	Tehsil	Lat Long (Coordinates)
Assam	Baksa	Baksa	26°41'15"N, 91°36'06"E
		Goreswar	26°31'57"N, 91°43'46"E
		Jalah	26°39'22"N, 91°13'25"E
		Mushalpur	26°39'33"N, 91°20'27"E
		Rangia	26°26'49"N, 91°37'05"E
	Udalguri	Dalgaon	26°33'43"N, 92°12'00"E
		Dhekiajuli	26°41'54"N, 92°29'06"E
		Mazbat	26°47'34"N, 92°17'24"E
		Udalguri	26°44'45"N, 92°05'45"E
		Khoirabari	26°36'8"N, 91°49'02"E
		Kalaigaon	26°34'07"N, 91°58'31"E
		Harisinga	26°43'15"N, 91°59'26"E
	Barpeta	Baghbor	26°13'15"N, 90°50'57"E
		Bajali (pt)	26°32'39"N, 91°11'10"E
		Barn agar (pt)	26°29'47"N, 90°54'06"E
		Barpeta	26°19'46"N, 91°00'21"E

1.8 Title and Reference of Methodology

Title: Methodology for Installation of High Efficiency Firewood Cookstoves
Type: Type II – Energy Efficiency Improved Projects
Sectoral Scope: 03

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

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 and Supply Chain (Scope 3) Emissions

- 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.

[1] https://verra.org/methodology/vmr0006-methodology-for-installation-of-high-efficiency-firewood-cookstoves/

- The project proponent hereby corroborates that the project activity has not created or sought or received any other form of environmental credit.

Supply Chain (Scope 3) Emissions:

The project activity is a greenfield activity which uses locally procured materials. Thus, it does not affect any existing supply chain so there is no impact on Scope 3 emissions.

1.11 Sustainable Development Contributions

Project's contribution to Sustainable Development

The contributions of the project activity towards sustainable development goals are not mandated by any national/state regulations or laws and the contributions of the PA towards SDG 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. The project has reduced the drudgery of women, time saving 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. 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)	1.2	1.2.1 Proportion of population living below the national poverty line, by sex and age	Implemented activities to decrease	No further changes this monitoring period	The project has uplifted 146 underprivileged local youth from poverty by providing them employment for the installation of improved cookstoves, its maintenance and monitoring purpose.
2)	2.3	2.3.1 Volume of production per labour unit by classes of farming/pastoral/forestry enterprise size	Implemented activities to increase	No further changes this monitoring period	The project has reduced the cooking time by 50% by installing ICS in households. Now women can partake in agricultural activities and help increase the productivity.
3)	3.9	3.9.1 Mortality rate attributed to household and ambient air pollution	Implemented activities to decrease	No further changes this monitoring period	Significant reduction of eye itching and coughing has been reported by 17,379 beneficiaries due to negligible ambient smoke.

4)	7.1	7.1.2 Proportion of population with primary reliance on clean fuels and technology	Implemented activities to increase	No further changes this monitoring period	Provided 17,379 families with low-cost ICS which uses less notably fuel than traditional cookstoves.
5)	8.6	8.6.1 Proportion of youth (aged 15-24 years) not in education, employment, and training	Implemented activities to increase	No further changes this monitoring period	Provided skill development training and income opportunities to 226 and 146 number of local populations respectively.
6)	13.2	13.2.2 Total greenhouse gas emissions per year	Implemented activities to decrease	The project has prevented the release of 50,099 tonnes of carbon into the atmosphere during the monitoring period	The project activity has prevented the release of 1,54,898 tonnes of carbon (sum of 50,099 t CO_2e and 1,04,799 t CO_2e in current and previous monitoring periods respectively) into the atmosphere till the end of this monitoring period.

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.

Invitations for stakeholder consultation meeting were sent out by ENEN Green via an email and personal phone calls from 21-October-2021 to 24-October-2021. Stakeholders were identified as those whose activities directly or indirectly impact the project, and those who were to be impacted by the project activities Full lists of invitees and attendees submitted to VVB. Due to COVID-19 participation was less and PP also follow government guideline of social distancing and public gathering less than 50 persons.

ENEN Green organized the stakeholder consultation meeting on 28-October-2020 at Jalaram Mandir, Fatasil Ambari, Guwahati, Assam. The meeting was attended by the teachers, students, consultants, suppliers, contractors, local NGOs, and the local residents in the area. The objective of the meeting was to inform the stakeholders about the environmental and social impacts of the project activity and discuss their concerns regarding the same, if any. The comments and suggestions were invited throughout the period of Stakeholders meet.

The overall response to the project, from all invited stakeholders, was encouraging and positive. In all, no adverse reactions, comments, or clarifications were received during the Stakeholder Consultation process. The project participants did not recognize any need to make changes to the project design or monitoring plan. During the stakeholder consultation no comments have been received from local stakeholders.

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 with local stakeholder, users can record their grievance on the register present at local supplier or village heads or via phone calls (on the contact no which was provided during the ICS distribution) from all villages involved in project activity from all 3 district and this grievance directly taken care by project participants, same was communicated in

stakeholder consultation meeting to local stakeholders. And if found genuine will be addressed immediately by the local supplier or village head. Any grievances raised by the beneficiaries are resolved promptly starting from any repair work to replacements. However, during the current monitoring period there was no feedback/grievance reported. Therefore, no action has been undertaken.

2.3 AFOLU-Specific Safeguards

The project activity is non-AFOLU activity. Hence, this is not applicable.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

Project was commissioned on 28-June-2019 as the project activity completed the first installation of the ICS on 28-June-2019 after beneficiary identification through a baseline level survey and the project is operational since then. The survey focused in identifying underprivileged households with annual income less than INR 1,25,000. The project activity installed the ICS at the beneficiary's house at free of cost. The installation of ICS was completed in 10-January-2020 covering 17,379 households from 3 District Baksa, Udalguri and Barpeta of state Assam country India.

However, only 68.1% (17,379) of the cookstoves were distributed in total under this project activity although the PP has initially aimed to distribute 25,520 ICS. There has been no exchange of cookstove during the monitoring period also, PP will not further distribute ICS under this project activity in the crediting period. No event occurred during this monitoring period, which may have impact on the applicability of the methodology as well as on emission reduction. The technical details of ICS are listed below: achieved

Name of the ICS	GTW-M
Efficiency of the ICS	33.25%
Life-span of the ICS	5 years
Height	190 mm
Diameter	250 mm
Chimney	
Internal Diameter	105 mm
Outer Diameter	110 mm
Thickness	5 mm
Made up of red clay, treated at high temperature	700° C
Outer Body	
Material used	Aluminum

Thickness	20 gauge
Total Weight	4.5 kg
Insulator used	Glass wood used as insulator

A monitoring survey was conducted by a third-party organisation through a stratified random sampling approach to assess the operational ICS. The data collections were performed by their field team in July 2023 in between 03-July-2023 to 21-July-2023. In the survey, it was found that all of the ICS were operational and positive feedbacks were received from the beneficiaries on efficiency of the ICS and positive health impacts.

VCS methodology VMR0006, version 1 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. During the current monitoring period, no incident or event occurred, that could affect GHG emissions reduction and approved monitoring plan.

3.2 Deviations

3.2.1 Methodology Deviations

There is no methodology deviation taken for this monitoring period.

3.2.2 Project Description Deviations

The project has not applied/requested for any deviations from Project Description under previous monitoring periods (28-June-2019 to 31-March-2022). However, the following project description deviation is requested in 3rd verification (3rd monitoring period: 01-April-2022 to 27-June-2023):

The project location coordinates in approved PD had an editorial mistake. The coordinate mentioned in approved PD were inconsistent with the project locations. The coordinates of the project activity have now been corrected to the exact locations.

3.3 Grouped Projects

This is not a grouped project activity. Hence, this is not applicable.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	$B_{old,p}$
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 has been determined ex-ante
Purpose of Data	Calculation of emission reduction
Comments	This parameter is fixed.

Data / Parameter	$N_{p,HH}$
Data unit	No of persons/HH
Description	Average number of persons 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 has been determined ex-ante
Purpose of Data	Calculation of emission reduction
Comments	This parameter is fixed.

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	Default values

measurement methods and procedures applied	
Purpose of Data	Calculation of share of non-renewable biomass
Comments	This parameter is fixed.

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 is fixed.

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 is fixed.

Data / Parameter	$EF_{wf,\ non\text{-}CO2}$
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 is fixed.

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 is fixed.

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 has been determined ex-ante
Purpose of Data	Calculation of $\eta_{new,y,i,j}$
Comments	This parameter is fixed.

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	Annual 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	Annual 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 annual 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	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%
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of the data	Emission reduction calculation
Calculation method	Calculation to be performed using equation below: $\boldsymbol{\eta_{new,y,i,j} = \eta_p \times (DF_n)^{y-1} \times 0.94}$
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 and procedures to be applied	This parameter has been monitored using one of the following methods: 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 Bold. 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	0.0025
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of the data	Emission reduction calculation
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.

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 followed the below organizational structure.

The monitoring activities involved data collection during distribution as well as usage information post distribution. The data collected during distribution involved information about the stove, the purchaser and location to enable one to uniquely identify each ICS unit and avoid double counting. This has been formed what is called the sales record. Greentech Environment has distributed the stoves, as well as carried out the monitoring activities that occurred during the distribution of stoves. Greentech Environment or through their associates has ensured 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 has linked remuneration to the complete and accurate collecting of information during the distribution of stoves.

The following information have been 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, post distribution, monitoring activities are involved 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. The monitoring activities are carried out in two phases to ensure

more accurate data. One being conducted by Greentech Environment's staff and another by a third-party agency, independently.

During this monitoring period, the monitoring activities (spot-check) has been conducted on regular basis by the employed people at ground level and no ICS was found damaged or needed replacement. These exercises ensure all the distributed ICS are operational. Also, no grievance has been received from the beneficiaries in the current monitoring period for ICS replacement. Thus, there has been no replacement of ICS in the current monitoring period.

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.gs., 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) consists of different members depending on the requirement at the time of dissemination/Spot-check of the ICS. A proposed team composition would be as follows: • ICS Distributor(s) is responsible for deploying the ICS at household and register the end user in the digital tool. They are also 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 stay regularly in touch with the beneficiaries. They also conduct periodic check/Spot 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.

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:

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 has been 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 have been 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 has been 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 has been 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	Annual
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 is 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, Simple Random Sampling technique has been used to conduct sampling survey among ICS batches. The populations of each batch have been combined together, the sample size is determined, and a single survey has been 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 have been taken** into account in the sample size calculation. The ICS of same type, vintage and project area in which they are operating have been grouped in the same strata. Samples have been drawn by using the random number generator.

To determine the parameters, sampling is involved 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 ensured 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 has been 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:

(a) Refer to the result of previous studies and use these results;
(b) 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;
(c) 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:

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

Where:

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

n = Sample size
N = Population size (Total number of households or ICS)
P = Weighted overall expected proportion
SD^2 = 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[2]
Baksa	5779	0.78
Udalguri	5845	0.59
Barpeta	5755	0.71

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

$$SD^2 = 0.2066$$

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

[2] The proportion has been considered as per the registered PD

$$\bar{P} = 0.69$$

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

$$V = 0.430$$

$$n \geq \frac{1.645^2 \times 17379 \times 0.43}{(17379 - 1) \times 0.1^2 + 1.645^2 \times 0.43}$$

$$n \geq \frac{20236.14}{173.78 + 1.1636}$$

$$n \geq 115.67 \approx 116$$

Sample size per district

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

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

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

Survey Results:

As the project has implemented around 17,379 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 July 2023 in between 3rd July to 21st July, 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

The survey team found all of 135 beneficiaries were continuing to use the ICS and all of them reported reduction in eye itching and coughing issues due to smoke. The team also found out that one of the beneficiaries was still using traditional cookstove alongside the ICS but occasionally for one meal. However, to arrive at a more conservative result, the team has considered the usage to be regular and the same has been discounted from the ER calculation.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

As per Section 8.1 of the VMR0006 v1, 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

As per Section 8.2 of the VMR0006 v1, 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

As per section 8.3 of the VMR0006 v1, leakage has been considered "as default 0.95 in accordance with Section 5.4 paragraph 39 of AMS-II.G. version 11.1".

5.4 Net GHG Emission Reductions and Removals

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

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

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 tCO_2e
$ER_{y,i,j}$	Emission reductions by project device of type i and batch j during year y in tCO_2e
LE_y	Leakage emissions in the year y

$$\boldsymbol{ER_{y,i,j} = B_{y,savings,i,j} \times NCV_{wood\ fuel} \times f_{NRB,y} \times \left(EF_{wf,CO2} + EF_{wf,non\ CO2}\right) \times N_{y,i,j} \times 0.95}$$

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})
$NCV_{wood\ fuel}$	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')

$EF_{wf,CO2}$	CO_2 emission factor for the use of wood fuel in baseline scenario (IPCC default for wood fuel, 112 tCO_2/TJ)
$EF_{wf,non\text{-}CO2}$	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:

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

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 Bold can be sourced from historical data or baseline surveys. Alternatively, a default value of 0.5 t/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.

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

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 μ = 0.0025 therefore, $B_{old\ adjusted}$:

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

Where;

$B_{old,adjusted}$	Adjust Bold 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

The quantity of firewood consumed in absence of project activity ***(B_{old})*** is determined by using an estimation of average annual consumption of firewood per household by following:

$$B_{old,i,j} = B_{old,HH} \div N_{d,HH}$$

$$B_{old,HH} = B_{old,p} \times N_{p,HH}$$

Where;

$B_{old,HH}$ Annual quantity of woody biomass that would have been used in the household in the absence of the project activity to generate useful thermal energy equivalent to that provided by the project devices (tonnes/household/year)

$N_{d,HH}$ Number of project devices per household

$B_{old,p}$ 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 (tonnes/person/year)

$N_{p,HH}$ Average number of households

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_2e)	Actual Emission Reduction considering leakage (tCO_2e)
01-April-2022 – 31-December-2022	275	44,886	30,491
01-January-2023 – 27-June-2023	178	28,865	19,608
Total	**453**	**73,751**	**50,099**

Total emission reduction for period 01-April-2022 to 27-June-2023 is 50,099 tCO_2e.

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)
2022 (01-April-2022 -- 31-December-2022)	32,096	0	1,605	30,491
2023 (01-January-2023 -- 27-June-2023)	20,640	0	1,032	19,608

Total	**52,736**	**0**	**2,637**	**50,099**

Actual achieved emission reduction is 0.25% lower than estimated emission reduction. The ex-ante GHG emissions reductions and removals and the achieved emission reductions and removals for this monitoring period is listed in the following table:

Ex-ante emissions reductions /removals	Achieved emissions reductions /removals	Percent difference	Justification for the difference
50,224 tCO_2e	50,099 tCO_2e	-0.25%	In the current monitoring period, it was found that 0.25% households were still using pre-project devices.