UPENERGY-SOCIAL AND CLIMATE IMPACT PROGRAMME- NIGERIA-1

Document Prepared by UpEnergy Group

Project Title	UpEnergy - Social and Climate Impact Programme- Nigeria-1
Version	3.0
Date of Issue	10/05/2022
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1 PROJECT DETAILS

1.1 Summary Description of the Project

A summary description of the technologies/ measures to be implemented by the project.

The project activity involves promotion and distribution of improved cooking stoves (ICS) in Nigeria. The purpose of the project is to support clean cooking interventions that moves end-user to reduce greenhouse gas (GHG) emissions from the burning of non-renewable woody biomass and/or charcoal for cooking in Nigeria.

Through this project, the distribution and installation of approximately 475,000 operational ICS will be undertaken for households in Nigeria. The estimated annual emission reductions over a 7-years period are approximately 2,179,248 tCO2e and over a 7 years period is approximately 15,254,737 tCO2e

The end user will sign or informed about carbon credit waiver with the help of sales receipt cum warranty information in advance that the use of ICS generates carbon finance which in turn is used for subsidizing the price of ICS and for recovering project implementation costs.

Location of the project

The project activity will be implemented in Nigeria. The details of the project location are provided in Section 1.12.

The ICS will substitute the currently common cooking on open fire. The ICS burns wood more efficiently thereby improving thermal transfer to pots, hence saving fuel and lowering greenhouse gas emissions

Scenario existing prior to the implementation of project activity

Prior to the implementation of the project activity the existing scenario recorded as the use of traditional cookstoves and the use of non-renewable biomass by the target population to meet similar thermal energy needs and which also cause indoor air pollution (IAP) in absence of project activity.

1.2 Sectoral Scope and Project Type

The project is categorized under type/category as below:

Sectoral Scope: 03 Energy Demand.

Project Type: Type II Energy Efficiency Improved cookstoves Projects

The project is a grouped project.

1.3 Project Eligibility

The project involves energy efficient cookstove distribution which falls under the category of efficiency improvements in thermal applications, therefore it is eligible under the scope of VCS Program.

1.4 Project Design

The project is a grouped project.

Eligibility Criteria

For the inclusion of new project activity instances, the project proponent shall ensure that it meets the eligibility criteria below:-

No.	Criterion	How the new project activity instances to comply
1	Meet the applicability conditions set out in the methodology applied to the project	The project activity instances (ICS) will meet the applicability conditions set out in Section 3.2 where the target of the end-user is household and the ICS deployed is at least 25% of thermal efficiency.
2	Use the technologies or measures specified in the project description.	Efficient improved cookstoves (ICS) to be distributed in the project.
3	Apply the technologies or measures in the same manner as specified in the project description.	Improved Cookstove to be distributed in the project and it will replace traditional cookstoves in household.
4	Are subject to the baseline scenario determined in the project description for the specified project activity and geographic area.	The project activity instances will take place within Nigeria only and subject to the same baseline scenario determined in Section 3.4.
5	Have characteristics with respect to additionality that are consistent with the initial instances for the specified project activity and geographic area	All project activity instances will use the activity method for demonstration of additionality. **Step 1: Regulatory Surplus** There is no mandated government programme or policy in host country of this project ensuring the distribution of domestic fuel-efficient cookstoves. The project is not mandated by any law, statute, or other regulatory framework, or for UNFCCC non-Annex I

		countries, any systematically enforced law, statute or other regulatory framework. Beneficiaries may only participate voluntarily in this project. It is hereby confirmed that the proposed project is a voluntary coordinated action by UpEnergy Group. **Step 2: Positive List** 1. The project activity distributes stoves at zero revenue to the program and has no other source of revenue other than sale of GHG credits. 2. The project implemented are not part of any governmental schemes or multilateral funds. **Step 3: Project Method** The distribution of stoves is not a source of net positive revenue. **Conclusion:** As the project fulfills the conditions above, it is deemed additional
6	Where a capacity limit applies to a project activity included in the project, no project activity instance shall exceed such limit. Further, no single cluster of project activity instances shall exceed the capacity limit, determined as follows: 1) Each project activity instance that exceeds one percent of the capacity limit shall be identified. 2) Such instances shall be divided into clusters, whereby each cluster is comprised of any system of instances such that each instance is within one kilometer of at least one other instance in the cluster. Instances that are not within one kilometer of any other instance shall not be assigned to clusters. 3) None of the clusters shall exceed the capacity limit and no further	1) The project instances will not exceed 1% of the capacity limit i.e., 1.8 GWhth per year. 2) As there are no instances exceeding 1% of capacity limit, there is no need for clustering. 3) Not Applicable.

	project activity instances shall be added to the project that would cause any of the clusters to exceed the capacity limit.	

1.5 Project Proponent

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1.6 Other Entities Involved in the Project

Currently, UpEnergy Group is the project proponent and shall involve project implementers in the project during registration of the project activity. The contact details will be given once the selection of other entities in the project.

1.7 Ownership

The project ownership is with UpEnergy Group.

A voluntary and irrevocable agreement signed by the end user (cookstove user) conferring project ownership to the project proponent shall be the evidence of project ownership.

Each ICS shall have a unique serial number linking it to the project activity instance and shall be necessary to establish the fact that the ICS belongs to this VCS programme. End users will be informed at the time of ICS installation/distribution that the ICS will be discounted on account of them generating carbon credits and also the fact that these credits belong to project proponent. The end user will be required to sign the carbon waiver form cum warranty card as required by the project proponent to surrender their rights to carbon credits generated by the project.

1.8 Project Start Date

01/04/2022 (The earliest date of commissioning date of a batch distributed for first project activity instance).

1.9 Project Crediting Period

Project crediting period type : Renewable

Start date of first crediting period: 01/04/2022

End date of first crediting period: 31/03/2029

Total number of years: 7 years, 00 months.

The project activity adopts renewable crediting period of 7 years which can be renewed for maximum 2 times.

Being renewable crediting period, total crediting period of grouped project activity is 21 years.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

The estimated annual GHG emission reductions/removals of the project are:

☐ <20,000 tCO_2e/year

☐ 20,000 – 100,000 tCO_2e/year

☐ 100,001 – 1,000,000 tCO_2e/year

☒ >1,000,000 tCO_2e/year

Project Scale	
Project	
Large project	X

Year	Estimated GHG emission reductions or removals (tCO_2e)
Year 1	427,703
Year 2	1,283,109

Year 3	2,708,785
Year 4	2,708,785
Year 5	2,708,785
Year 6	2,708,785
Year 7	2,708,785
Total estimated ERs	15,254,737
Total number of crediting years	07 Years
Average annual ERs	2,179,248

1.11 Description of the Project Activity

The purpose of the project is to support clean cooking interventions that moves end-user and reduce greenhouse gas (GHG) emissions from the burning of non-renewable woody biomass and/or charcoal for cooking in Nigeria.

The project is implemented by UpEnergy Group (UpEnergy/UpE) which is also the Coordinating and Managing Entity (CME). UpEnergy will implement the programme in partnership with local partners and would ensure the last-mile distribution/installation of the Improved Cookstoves to the beneficiaries.

Through this project, the distribution and installation of approximately 475,000 operational ICS will be undertaken for households in Nigeria. It is intended that under this project residential/institutional/commercial users with Clean cooking technologies such as energy-efficient biomass Improved Cookstoves (ICS) will be distributed with the aim to eliminate/reduce greenhouse gas (GHG) emissions from the burning of non-renewable woody biomass and/or charcoal for cooking. The ICS will burn fuel more efficiently thereby improving thermal transfer to pots, hence saving fuel. Not only will this halt the rapidly progressing deforestation (In 2020, it lost 97.8 kha of natural forest, equivalent to 59.5 Mt of CO_2 of emissions[1]) in Nigeria but will also reduce health hazards from indoor smoke pollution and women and children will have to spend less time collecting firewood. The end user will

[1] https://www.globalforestwatch.org/dashboards/country/NGA/?category

be informed in advance that the use of ICS generates carbon finance which in turn is used for subsidizing the price of ICS and for recovering project implementation costs.

Exposure to smoke inside the home, from cooking with solid fuels in Nigeria, has potentially harmful health effects. In Nigeria, 69% of households use solid fuel for cooking, with 66.9% using wood.[2] Exposure to cooking smoke is greater when cooking takes place inside the house rather than in a separate building or outdoors. In 40% of households, cooking is done in the house (48% in urban areas and 34% in rural areas)[3]. Overall, only 15% of households in Nigeria use clean fuel for cooking, 27% in urban areas and 4% in rural areas[4]. 59% of households have electricity (83% of urban households and 39% of rural households[5]

As per DHS Report Nigeria, 2.7% children were with symptoms of acute respiratory infection (ARI) by using charcoal and 3% children affected ARI by using wood as fuel in households for cooking.[6]

Reliance on biomass fuels for cooking has implications for human health, climate change, conservation of forest resources, and the general well-being of people who rely on biomass fuels. Nigeria households dedicate a significant portion of their expenditures 4.4% to lighting and cooking energy.[7]

Fuel gathering consumes 1.7 hours [8] per household daily for women and children, limiting other productive activities (e.g., income generation) and taking children away from school. In less secure environments, women and children are at risk of injury and violence during fuel gathering.

96% of the target population for this project usage traditional biomass stoves which have less thermal efficiency, emitting smoke and unhealthy environment inside the kitchen in both rural and urban segments.

[2] https://dhsprogram.com/pubs/pdf/FR359/FR359.pdf

[3] https://dhsprogram.com/pubs/pdf/FR359/FR359.pdf

[4] https://dhsprogram.com/pubs/pdf/FR359/FR359.pdf

[5] https://dhsprogram.com/pubs/pdf/FR359/FR359.pdf

[6] https://dhsprogram.com/pubs/pdf/FR359/FR359.pdf

[7] https://documents1.worldbank.org/curated/en/164241468178757464/pdf/98664-REVISED-WP-P146621-PUBLIC-Box393185B.pdf

[8] https://documents1.worldbank.org/curated/en/164241468178757464/pdf/98664-REVISED-WP-P146621-PUBLIC-Box393185B.pdf

The comprehensive questionnaire was designed to capture all the information of household like family members, age group, gender, address, contact number, geographical coordinates, type of fuel & consumption and cook stove, sourcing of fuel long with time, health related issues, etc.

The baseline scenario as per the applied methodology VMR0006: Installation of High Efficiency Firewood Cookstoves, Version 1.1, is defined by the typical baseline fuel consumption patterns in a population that is targeted for the adoption of the project technology.

The baseline survey covered the following elements:

- Fuel Consumption Pattern.
- Available technology options used for cooking
- Classified the most promising biomass (wood, Charcoal, electricity, etc.) utilized during cooking.
- Estimated the potential wood fuel savings obtained by using improved charcoal technologies and identify the profitability of these technologies.

The survey in person interview was conducted in various households in Nigeria. The survey is designed to provide estimates at the national level, for urban and rural areas, and for the fuel consumption pattern. According to the baseline survey the average household size in Nigeria is 5 persons[9].

In Nigeria, 66.9% of the population from the study are using biomass for cooking out of which 61.1% of the population using fuelwood for cooking while 5.8% of the population using charcoal for cooking as the main cooking fuel. Less than 5% have access to clean cooking fuel in rural and Urban households. The penetration rate is 6% for the improved cookstove.

This project will replace conventional inefficient stoves, with higher efficiency ICS to residential/ institutional/ commercial users by leveraging resources provided by the project activity. Therefore, in the absence of the project activity, the baseline scenario would be the traditional cooking technologies with use of non-renewable biomass/charcoal for meeting similar thermal energy needs share.

[9] https://dhsprogram.com/pubs/pdf/FR359/FR359.pdf

1.12 Project Location

` The project will be located within the boundary of Nigeria having the geographical coordinates 9°4'55.2 latitude and 8°40.517 longitude. It is part of Africa and the northern hemisphere.10

Nigeria Map

1.13 Conditions Prior to Project Initiation

Prior to the implementation of the project activity the existing scenario recorded as the use of traditional cookstoves and the use of non-renewable biomass by the target population to meet similar thermal energy needs and which also cause indoor air pollution (IAP) in absence of project activity.

From 2001 to 2020, Nigeria lost 1.04 Mha of tree cover, equivalent to a 10% decrease in tree cover since 2000, and 527 Mt of CO_2e emissions which is also a region due use of

[10] https://www.geodatos.net/en/coordinates/nigeria

traditional cookstove or inefficient cookstove which also increase the demand of fuelwood for burning.11

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

There are no mandatory laws or regulations in the host country for the use of improved cookstoves in Nigeria households. The project is a voluntary effort by the project proponent. A review is made on Nigeria environmental laws and regulations as below:[12]

1) National Environmental Standards and Regulation Enforcement Agency (NESREA) Act 2007
2) Environmental Impact Assessment (EIA) Act. Cap E12, LFN2004
3) The Nigerian Urban and Regional Planning Act Cap N138, LFN 2004

1.15 Participation under Other GHG Programs

1.15.1 Projects Registered (or seeking registration) under Other GHG Program(s)

The project has not been registered, nor is it seeking registration under any other GHG program to avail carbon benefits during the crediting period.

1.15.2 Projects Rejected by Other GHG Programs

The project has not been rejected by any other GHG program.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

This project is not part of any emissions trading program or any other mechanism that includes GHG allowance trading.

1.16.2 Other Forms of Environmental Credit

The project has not sought or will receive another form of GHG-related environmental credit.

1.17 Sustainable Development Contributions

Project's contribution to Sustainable Development: -

[11] https://www.globalforestwatch.org/dashboards/country/NGA

[12] https://esrmqa.worldbank.org/program-countries/overview-environmental-legislation

The contributions of proposed project activity towards sustainable development are explained with indicators viz. social, economic, environmental, technological well-being, legislative and temporal as follows:

Environmental well-being: The project activity will result in the reduction of firewood consumption and emission of greenhouse gases and thus conserve forest and biodiversity.

Social well-being: The project activity will pave the way for development and increases 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 will contribute to a small increase in the local employment by employing skilled and un-skilled personnel for operation and maintenance of the equipment. The project will reduce 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. Further, the project also influences creation of employment opportunities for local people, which would enhance their social status. Sufficiently enhance indoor air quality thereby improving health of women and children and reducing incidences of smoke and fire related injuries and therefore result in saving of health-related expenses.

Technological well-being: The proposed project activity will promote improved cook stoves that result in reduced fuel consumption and emissions due to cooking and heating water in homes.

Legislative:

The Project Proponent has obtained all the relevant approvals required for the establishment and operation of the project activity.

Contribution to Sustainable Development Goals - SDGs	
 **SDG 1 - No poverty** - Clean cooking is part of the basic services necessary to lead a healthy and productive life and saves households time and money.	 **SDG 2 - Zero Hunger** - Efficient cookstoves reduce the amount of fuel needed to cook, thus reducing the burden on families who would otherwise have to collect it, buy it, or trade their food for it.
 **SDG 3 - Good health and well-being**- Users reporting reduction in smoke/PM after shifting to ICS in project.	 **SDG 5 - Gender Equality-** Increased access to clean cookstoves can reduce the health and safety issues caused by household air pollution and decrease the time women spend collecting cooking fuel.
 **SDG 7 - Affordable and Clean energy-** ICS distributed and operating under the project as an indicator of providing clean technology. The project will increase access to affordable and clean energy among the people of local communities.	 **SDG 8 - Decent Work and Economic Growth-** Reducing the time by 50% for local communities and time-saving will open doors for extra income generation work, this will empower women financially and give them greater household decision-making power
 **SDG 12 - Reduce Inequalities-** Providing Clean energy is a goal, continued strategic efforts are required to effectively engage women within the energy sector as a primary method of reaching sustainable development and improved health.	 **SDG 13 - Climate Action -** Improved stoves use less firewood and produce less smoke, and they have been touted as a way to reduce greenhouse gas emissions and health effects from indoor air pollution, as well as to improve forest conservation.

SDG 15 - Life on Land- ICS helps in conserving the forest and improving forest cover as well as reduce degradation.

1.18 Additional Information Relevant to the Project

Leakage Management

There is no leakage for this project activity and the project activity is already including 0.95 as a discount factor.

Commercially Sensitive Information

No commercially sensitive information has been excluded from the public version of the project description.

Further Information

The Project Proponent has obtained all the relevant approvals required for the establishment and operation of the project activity.

2 SAFEGUARDS

2.1 No Net Harm

No potential negative environmental or socio-economic impacts have been identified for the project.

2.2 Local Stakeholder Consultation

The details of the Stakeholder Meetings will be included during registration of project activity.

The brief process to be followed for local stakeholder consultation is as below: -

The locations will be identified for baseline survey and details of local personnel, official representatives of local community, local NGOs were taken for survey. The public notice is to be placed as common places of location and civil authority personnel of the desired region will be invited via means of physical and digital medium to consult and receive their feedback.

In the introductory speech, the representative of Upenergy (Project Proponent), will welcome the gathering and will give a brief about the climate mitigation project activities. Subsequent to the introductory speech, stakeholders will be explained about the purpose of distribution of high efficient cook stoves which will burn wood more efficiently thereby improving thermal efficiency, hence saving fuel. Project also reduce the rapidly progressing deforestation but will also reduce health hazards from indoor smoke pollution and women and children will have to spend less time collecting fuelwood contributing to reduction in GHG emissions and better health standards for women and children inside the households. The Project will also assist to the local population by providing employment opportunities to both skilled & unskilled labours.

The Minutes of meeting with stakeholder's queries, invitation letter will be submitted to the DOE/VVB.

The question raised by the stakeholders will be summarized in the VCS PD and it will be ensured that stakeholders are satisfied from the overall socio-economic impacts of the project implemented by the project activity and their feedback is recorded for future reference.

As a part of on-going communication with local stakeholders, end users will be informed about grievance register. The distributors will have the responsibility to take grievances regarding the project activity and same will be conveyed to PP during operation of project activity. Thus ongoing communication of stakeholders will be followed through grievance mechanism. If any concerns received during operation of project activity, same will be addressed if relevant to project activity

2.3 Environmental Impact

No negative environmental impacts have been identified from the project and environmental impact assessment (EIA) is not required for the project.

2.4 Public Comments

This section will be completed after 30 days public comment period. It will be checked if there are any comments received during 30 days public comment period.

2.5 AFOLU-Specific Safeguards

This section is not applicable as the project is a non-AFOLU project.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

Following approved baseline & monitoring methodology is applied.

Methodology: VMR0006- Methodology for Installation of High Efficiency Firewood Cookstoves. Ver: 1.1.

https://verra.org/wp-content/uploads/2021/07/VMR0006-Methodology-for-Installation-of-High-Efficiency-Firewood-Cookstoves-v1.1.pdf

Sectoral Scope: 03

3.2 Applicability of Methodology

Applicability criterion	How the project complies
Project activities shall be implemented in domestic premises or in community-based kitchen	The proposed project activity involves distribution of ICS in residential/institutional/ commercial.
The project stove shall have specified high power thermal efficiency of at least 25% per the manufacturer's specifications and shall exclusively use woody biomass and can be single pot or multi-pot; in case of project stove replacing fossil fuel baseline stove, it shall exclusively use renewable biomass.	Improved Cookstoves planned to be distributed under this project are EZY stoves that have an efficiency of 27.1 % and SmartHome Pro stove that have an efficiency of 37.9% as per the manufacturer's specifications The project does not involve replacement of fossil fuel-based stoves.
Both 'Projects' and 'Large Projects' can use this methodology	The proposed project is a large-scale project
Non-renewable biomass has been used in the project region since 31 December 1989, using survey methods or referring to published literature, official reports or statistics;	According to the U.N. FAO, 9.9% or about 9,041,000 ha of Nigeria is forested, according to FAO. Nigeria had 382,000 ha of planted forest. Change in Forest Cover: Between 1990 and 2010, Nigeria lost an average of 409,650 ha or 2.38% per year. In total, between 1990 and 2010, Nigeria lost 47.5% of its forest cover, or around 8,193,000 ha. Nigeria's forests contain 1,085 million metric tons of carbon in living forest biomass. Biodiversity and

	Protected Areas: Nigeria has some 1417 known species of amphibians, birds, mammals and reptiles according to figures from the World Conservation Monitoring Centre. Of these, 1.2% are endemic, meaning they exist in no other country, and 3.5% are threatened. Nigeria is home to at least 4715 species of vascular plants, of which 4.3% are endemic. 3.6% of Nigeria is protected under IUCN categories I-V.[13]
For the specific case of biomass residues processed as a fuel (e.g., briquettes, wood chips), it shall be demonstrated that: (a) It is produced using exclusively renewable biomass (more than one type of biomass may be used). (b) The consumption of the fuel should be monitored during the crediting period and (c) Energy use for renewable biomass processing (e.g. shredding and compacting in the case of briquetting) may be considered as equivalent to the upstream emissions associated with the processing of the displaced fossil fuel and hence disregarded.	Not applicable. The project stove which is improved energy efficient technology is introduced to replace baseline stoves and reduce the use of non-renewable biomass for combustion.

3.3 Project Boundary

Source		Gas	Included?	Justification/Explanation
Baseline	Emission of non-renewable biomass	CO_2	Yes	Major Source
		CH_4	Yes	Major Source
		N_2O	Yes	Major Source
		Other	No	No other source identified
Project	Emission of non-renewable biomass	CO_2	Yes	Major Source
		CH_4	Yes	Major Source
		N_2O	Yes	Major Source
		Other	No	No other source identified

[13] https://rainforests.mongabay.com/deforestation/2000/Nigeria.html

A representation of the baseline Scenario and project scenario are given as below Figure 3:

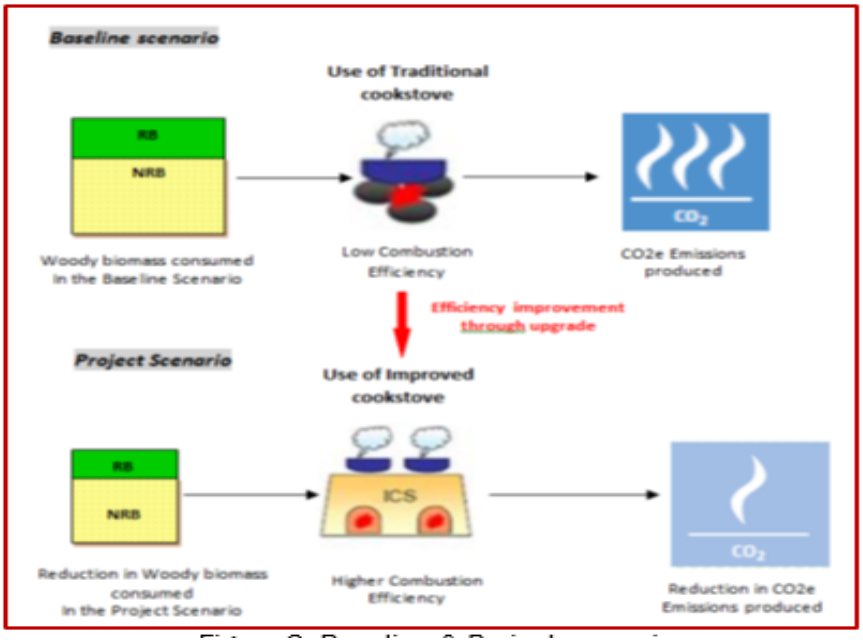

Figure 3: Baseline & Project scenario

3.4 Baseline Scenario

The baseline scenario is the use of non-renewable biomass and inefficient traditional cook stoves within the project boundary by the target population to meet similar thermal energy needs as provided by project cookstoves in absence of project activity.

3.5 Additionality

The methodology uses activity method for the demonstration of additionality

Activity Method

Step 1: Regulatory Surplus

There is no mandated government programme or policy in host country of this project ensuring the distribution of domestic fuel-efficient cookstoves. The project is not mandated by any law, statute, or other regulatory framework, or for UNFCCC non-Annex I countries, any systematically enforced law, statute or other regulatory framework. Beneficiaries may only participate voluntarily in this project. It is hereby confirmed that the proposed project is a voluntary coordinated action by UpEnergy Group.

Step 2: Positive List

1. The project activity distributes stoves at zero revenue to the program and has no other source of revenue other than sale of GHG credits.

2. The project implemented are not part of any governmental schemes or multilateral funds.

Step 3: Project Method

The distribution of stoves is not a source of net positive revenue.

Conclusion: As the project fulfills the conditions above, it is deemed additional.

3.6 Methodology Deviations

The project activity has not taken any deviation in the applied approved methodology VMR0006.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

The methodology does not account for baseline emissions separately, but instead quantifies net emission reductions achieved by the project. Please refer to Section 4.4.

4.2 Project Emissions

The methodology does not account for project emissions separately, but instead quantifies net emission reductions achieved by the project. Please refer to Section 4.4.

4.3 Leakage

Leakage shall be considered as default 0.95 in accordance with methodology.

4.4 Net GHG Emission Reductions and Removals

Net GHG emission reductions are calculated by applying Equations 1 and 2 for project activities replacing baseline stoves using non-renewable biomass (firewood/charcoal) and Equation 1 and 7 for project activities replacing baseline stoves using fossil fuel.

$$ER_y = \sum_i \sum_j ER_{y,i,j} \quad \text{Equation (1)}$$

Where:

ER_Y= Emission reductions during year y in t CO_2e

i **=** Indices for the situation where more than one type/model of improved cookstove is introduced to replace three-stone fire.

j = Indices for the situation where there is more than one batch of improved cookstove of type i

$ER_{y,i,j}$= Emission reductions by improved cook stove of type i and batch j during year y in tCO_2e

$$ER_{y,,} = B_{y,savings,i,j} \times NCV_{wood\ fuel} \times f_{NRB,y} \times (EF_{wf,CO2} + EF_{wf,non\ CO2}) \times N_{y,,j} \times 0.95 \quad \text{Equation (2)}$$

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})[14]

$NCV_{wood\ fuel}$ = Net calorific value of the non-renewable woody biomass that is substituted (IPCC default for wood fuel, 0.0156 TJ/tonne)[15]

$EF_{wf,\ co2}$ = CO_2 emission factor for the use of wood fuel in baseline scenario (IPCC default for wood fuel, 112 tCO2/TJ)[16]

[14] Default values endorsed by designated national authorities and approved by the Board are available at https://cdm.unfccc.int/DNA/fNRB/index.html

[15] AMS II.G. Version 12

[16] 2006 IPCC Guidelines for National Greenhouse Gas Inventories; Chapter 2 Stationary Combustion

$EF_{wf,non\ CO2}$ = Non-CO_2 emission factor for the use of wood fuel in baseline scenario (IPCC default for wood fuel, 26.23 tCO2/TJ)[17]

$N_{y,i,j}$ = Number of project devices of type i and batch j operating during year y

0.95 = Discount factor to account for leakage

The quantify of woody biomass saved By, $savings$, i, j due to implementation of improved cook stoves can be estimated by one of the following options 10 set out in Equations 3 and 4.

$$B_{y,saving,l,j} = B_{old} \times \left(1 - \frac{\eta old}{\eta new,i,j}\right) \quad \textit{Equation (3)}$$

$$B_{y,saving,l,j} = B_{y=1,new,l,survey} \times \left(\frac{\eta new,i,j}{\eta old} - 1\right) \quad \textit{Equation (4)}$$

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. A default wood to charcoal conversion factor of 6 kg of firewood per kg of charcoal may be used in line with paragraph 35 of AMS II.G, version 12. Alternatively, default value of 0.5 t/capita/year may be used.

η_{old} = Efficiency of baseline cookstove

$\eta_{new,i,y}$ = Efficiency of the improved cook stove type i and batch j determined through water boiling test (WBT). Alternatively, efficiency may be determined using Equation 5.

$By = new,i,j, survey$ = Annual quantity of woody biomass used by improved cook stoves in tonnes per device of type i and batch j, determined in the first year of the implementation of the project through a sample survey.

The efficiency of project stoves can be estimated using equation 5:

$$\eta new,i,y = \eta p \times (DFn)^{y-1} \times 0.94 \quad \text{Equation (5)}$$

Where:

ηp = Efficiency of project stove (fraction) at the start of project activity.

[17] 2006 IPCC Guidelines for National Greenhouse Gas Inventories; Chapter 2 Stationary Combustion

$(DFn)^{y-1}$ = 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.

Where the project households continue to use baseline cookstoves along with improved cookstoves, B_{old} shall be adjusted ex-post based on the percentage of project households found to continue such practice according to Equation 6. For such cases, the quantity of woody biomass saved $B_{y,\ savings,\ i,\ j}$, due to implementation of improved cook stoves shall be calculated using an adjusted value to account for ex-post use of baseline stoves in addition to improved cookstove

$$B_{old,\ adjusted} = B_{old} \times (1 - \mu_y) \quad \text{Equation (6)}$$

$B_{old,\ adjusted}$ = Adjusted 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.

The quantity of firewood consumed in absence of project activity *(B_{old})* shall be determined using an estimation of average annual consumption of firewood per household which may be derived using any of the following options:

a. **Historical Data** : Project proponent shall ensure that the relevance of data is appropriately justified for the target population and is the latest available data from credible source(s).

b. **Baseline Survey of Local Usage** : Project proponent shall carry out a survey of usage prior to implementation of the project activity following the sampling approach described in the latest version of CDM document Sampling and surveys for CDM project activities and programme of activities. Alternatively, the project participant may follow the simple random sampling approach and the minimum sample size should be determined as per the following guidelines:

- Project target population < 300: Minimum sample size 30
- Project target population 300 – 1000: Minimum sample size 10% of group size
- Project target population > 1000: Minimum sample size 100

This simplified approach may also be used for determining minimum sample size for parameters listed under Sections 4.1 and 4.2 in which case it is not requisite for the sample size to meet confidence/precision requirements

c. **Minimum Service Level.** Where historical data or a baseline survey has not been conducted, a default value of 0.5 ton/capita/year may be considered as the baseline biomass consumption. Household size shall be determined using credible references/literature or target population specific surveys. The survey shall be conducted as per guidelines outlined in option (b) above

In order to address the potential source of leakage which can be attributed to diversion of non-renewable biomass saved by project devices to non-project households which previously used renewable biomass; a net to gross adjustment factor of 0.95 is applied to $ER_{y,i,j}$.

The above equations assume that a single baseline stove is replaced by a single project stove. However, in some cases more than one project stove may be required to achieve service levels equal to baseline stove. For such cases, the displaced biomass shall be apportioned between the project stoves while calculating Bold.

The equations below shall be used for calculating biomass consumed in absence of project activity in case more than one project stove is used in household

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

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

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

For projects opting for By=1, new,i,j,survey , it shall be demonstrated that the consumption of biomass for individual project stoves can be measured exclusive of one another.

For project stoves replacing fossil fuel with renewable biomass, the following equations shall apply

$$ER_{y,i,j} = N_{y,i} \times B_{renewable,y} \times EF_{ff} \times \eta_{PJ/BL} \times NCV_{biomass} - LE_y \quad \text{Equation (7)}$$

Where:

$N_{y,I}$ = Number of improved cook stoves of type i operating during year y

$B_{renewable,y}$ = The net quantity of renewable biomass consumed by the project stove in year y (tons)

EF_{ff} = CO2 emission factor for fossil fuel j (tCO2/TJ)

$\eta_{PJ/BL}$ = Ratio of efficiencies of project equipment and baseline equipment

$NCV_{biomass}$ = Net calorific value of renewable biomass substituting fossil fuel

LE_y = Only, if the energy generating equipment introduced by the project activity is transferred from outside the boundary to the project activity, leakage is to be considered

$$EF_{ff} = EF_{ff\_CO_2} + EF_{ff\_CH4} \times GWP_{CHC} + EF_{ff\_N20} \times GWP_{N20} \quad \text{Equation (8)}$$

Where:

EF_{ff_Co2} = CO2 emission factor for fossil fuel 'j'. Default values are mentioned in the table below.

EF_{ff_CH4} = CH4 emission factor for fossil fuel 'j'. Default values are mentioned in the table below.

GWP_{CH4} = Global warming potential of CH4 according to fifth assessment report[18].

EF_{ff_N20} = N2O emission factor for fossil fuel 'j'. Default values are mentioned in the table below.

GWP_{N20} = Global warming potential of N2O according to fifth assessment report.

Emission factor	Kerosene	Coal
CO_2 emission factor (kg/TJ)	71,900	94,600
CH4 emission factor (kg/TJ)	10	300
CH4 emission factor (kg/TJ)	0.6	1.5

[18] https://www.ghgprotocol.org/sites/default/files/ghgp/Global-Warming-Potential-Values%20%28Feb%2016%202016%29_1.pdf

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
Year 1	427,703	0	0	427,703
Year 2	1,283,109	0	0	1,283,109
Year 3	2,708,785	0	0	2,708,785
Year 4	2,708,785	0	0	2,708,785
Year 5	2,708,785	0	0	2,708,785
Year 6	2,708,785	0	0	2,708,785
Year 7	2,708,785	0	0	2,708,785
Total	**15,254,737**	**0**	**0**	**15,254,737**

The annual average of 7 years' period for project activity is 2,179,248 tCO_2e

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	B_{old}
Data unit	Tonnes/year/HH
Description	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.
Source of data	Calculated through Baseline survey assessment & KPT
Value applied	4.96
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	Parameter Bold once determined shall remain fixed for the entire crediting period. Where charcoal is used by baseline devices, a default wood to charcoal conversion factor of 6 Kg of firewood per kg of charcoal may be used in line with paragraph 35 of AMS II.G, version 12.

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	Value determined from survey methods using the CDM tool 30
Value applied	0.89
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 reductions
Comments	The report of f_{NRB} will be made available to VVB during the validation.

Data / Parameter	$\boldsymbol{EF_{wf,co2}}$
Data unit	tCO_2/TJ
Description	CO2 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	Calculation of emission reductions
Comments	N/A

Data / Parameter	$EF_{wf,non\ CO2}$
Data unit	tCO2/TJ
Description	Non-CO2 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	Calculation of emission reductions
Comments	-

Data / Parameter	ηp
Data unit	Fraction
Description	Efficiency of project stove at the start of project activity.
Source of data	Manufacturer's specification
Value applied	Smart Home Pro stove – 37.9%[19] EZY stove – 27.1%
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 $\eta_{new,\,i,j}$
Comments	N/A

[19] More similar cookstove models may be included during the project implementation period

5.2 Data and Parameters Monitored

Data / Parameter	$N_{y,i.y}$
Data unit	Number
Description	Number of project devices of type i and batch j operating during year y
Source of data	Monitoring
Description of measurement methods and procedures to be applied	Measured directly or based on a representative sample. Sampling standard will be used for determining the sample size to achieve 90/10 confidence precision according to the latest version of Standard for sampling and surveys for project activities and programme of activities.
Frequency of monitoring/recording	At least once every two years
Value applied	For ex-ante emission reduction calculation, it is assumed that the project will distribute 475,000 ICS and the distribution of ICS will be done in 3 batches (75,000, 150,000 and 250,000)
Monitoring equipment	Monitoring Survey
QA/QC procedures to be applied	-
Purpose of data	Calculation of emission reduction
Calculation method	Proportion of operational stoves obtained from the survey is multiplied by the total commissioned stoves to arrive at this value.
Comments	-

Data / Parameter	$\boldsymbol{\eta new, i,,y}$
Data unit	%
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	"Efficiency of the improved cookstoves 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	Annually
Value applied	For ex-ante calculation, the value below is applied EZY stove – 27.1% SmartHome Pro – 37.9%
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of emission reduction
Calculation method	Latest protocol of WBT
Comments	-

Data / Parameter	η_{old}
Data unit	Fraction
Description	Efficiency of baseline stove
Source of data	Conducting efficiency tests on pre-project devices in accordance with AMS II G Version 12 (this is allowed as per the statement in the Methodology VMR0006, Version 1.1, "Project proponents must apply this methodology revision in conjunction with the latest version of AMS II.G".
Description of measurement methods and procedures to be applied	For Traditional charcoal stove, WBT will be conducted in the pre project activity for determining the efficiency. For 3 stone firewood stove, default value of 0.10 will be considered as per the methodology.
Frequency of monitoring/recording	Fixed for each individual household at the time of project implementation.
Value applied	Traditional Charcoal Stove - 0.14

	3 Stone Firewood Stove – 0.10
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of emission reduction
Calculation method	-
Comments	-

Data / Parameter	µy
Data unit	Fraction
Description	Adjustment to account for any continued use of pre-project devices during the year y
Source of data	Monitoring
Description of measurement methods and procedures to be applied	Minimum sample size of each type i and batch j will be in line with the guidelines provide in section 3.4 option (b) above. This parameter will be 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 Bold, adjusted is equal to $B_{old.}$ If both the improved cookstove and baseline cookstoves are used together then surveys will be conducted to record the average continued operation of baseline cookstoves in a sample of households. The surveys will 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 evidence to determine the frequency of usage of both the improved cookstoves and baseline cookstoves[20.21]
Frequency of monitoring/recording	At least once every two years

[20] 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 periodcontinues along with the improved cookstove to meet 25% of the cooking needs of the household in which case the adjustment factorwill 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.

Value applied	-
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of emission reduction
Calculation method	For Projects that opt for $\boldsymbol{By}=\mathbf{1}$, $\boldsymbol{new}$, $\boldsymbol{i}$, $\boldsymbol{j}$, $\boldsymbol{survey}$ i.e., direct measurement of biomass used in project stoves, then $\boldsymbol{\mu y}$ is not required to becomputed.
Comments	

Data / Parameter	Life Span
Data unit	Years
Description	The operating lifetime of project technology for projects opting Equation 5 for determining project stove efficiency.
Source of data	Manufacturer's Specification
Description of measurement methods and procedures to be applied	"Efficiency of the improved cookstoves 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	Once at the time of Project stove installation
Value applied	5
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of data	Calculation of emission reduction

Calculation method	-
Comments	This the average lifespan of the project with proper maintenance, this lifespan can be more than 5 years.

5.3 Monitoring Plan

Sampling Design

Due to the large number of ICS envisioned to be distributed as part of the project to be included in the grouped project, it was not economically feasible to monitor each individual ICS unit distributed. Therefore, representative sampling was undertaken as part of a project-wide Sampling Plan. The Sampling may be conducted annually or biennially by meeting 90/10 or 95/10 confidence/precision respectively.

Objectives and Reliability Requirements

The objective was to obtain an unbiased and reliable estimate of the proportion or mean value of the following parameters over the course of the monitoring period, and with 90/10 confidence/precision for annual sampling or 95/10 for biennial sampling.

1. Efficiency of the improved cook stove type i and batch j: $\eta_{new,y,i}$
2. Number of project devices of type i and batch j operating during year y: $Ny_{,i,j}$
3. Baseline stove usage factor to account for use of baseline cookstoves along with improved cookstoves: μ_y

Target Population

The target population for the three parameters stated above are all ICS recorded in the project database.

Sampling Frame

For the parameters Stove Efficiency ($\eta_{new,y,i}$) and Stove Usage rate (U_y), the ICS population was stratified based on the stove models part of the project. For monitoring the quantity of woody biomass used in the project activity by traditional stove (μ_{old}) the ICS were stratified based on the year of distribution/installation.

Sampling Method

The sampling was conducted using stratified random sampling technique over the aforesaid sampling frames created. The ICS population in each stratum was arranged by date of distribution, assigning them a sampling serial number. Random numbers were generated using the online random number generator ranging from 1 to total number of ICS in a given stratum and the samples corresponding to the random numbers obtained, were picked for sampling. This approach ensured that each ICS listed in the database has an equal chance of being selected. A slightly higher number of samples were picked than that needed to be monitored to cover for non-responses.

Sampling Size

The required sample sizes were derived using equation (1), (2), (3), (4) and (9) of Appendix 3 of the Guideline: Sampling and surveys for CDM project activities and programmes of activities, Version 04.0 for monitoring parameter as follows:

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

Where:

n = number of ICS to be sampled

N = Total number of ICS in the population

z = Constant referring to level of confidence (1.96 for 95 % confidence)

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

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

Where (for proportion parameters):

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

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

Where**:**

g_i = weight of strata i in the population

p_i = expected proportion of strata i in the population

k = total number of strata in the population

and Where (for mean parameters):

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

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

Where**:**

SD_i = expected standard deviation of strata i in the population.

mi = expected mean of strata i in the population.

Stratified Random Sampling was applied by dividing the population into various strata. The expected parameter values were determined based on project developer's knowledge and experience as per para 13(b) and 13(c) of the "Standard: Sampling and surveys for CDM project activities and Programmes of activities".

The project instances were arranged chronologically for each stratum. The ICS were selected by randomly assigning, in corresponding stratum, a number to each stove and sorting in increasing order from lower to higher number. Random numbers were generated using online random number generator for each stratum and the numbers obtained were used to identify the samples from the stratum population. A slightly higher number of samples were identified than that required to cover for outliers / non-response and ensure that the desired precision / confidence is achieved.

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

Data was collected using surveys / WBTs done by either external third party or project implementer team. The data collected from the surveys were compiled into the Excel spreadsheet. In order to achieve the required confidence precision few additional stoves were sampled from the database than that required to cover for non-responses, if any. As for the thermal efficiency of the stoves, water boiling tests were conducted using latest WBT protocol by PCIA/GACC as available on GACC website.

b. Analysis of the collected data

Data obtained from the samples were used to estimate proportions and mean values for the parameters described above. The values were then being factored into the emissions reduction calculations.

c. Demonstration of whether the required confidence/precision has been met

Refer the source above.

d. Demonstration of whether the samples were randomly selected and are representative of the population

The samples were randomly selected using Stratified Random Sampling across the project instances. Random numbers were generated using online random number generator for each stratum and the ICS corresponding to the random numbers obtained, were selected as samples to be monitored. Under Stratified Random Sampling, the entire target population has an equal chance of being selected, thus the samples selected were deemed to be representative of population.

APPENDIX