**CLEAN DEVELOPMENT MECHANISM**
**PROJECT DESIGN DOCUMENT FORM (CDM-PDD)**
**Version 03 - in effect as of: 28 July 2006**

**CONTENTS**



**Annexes**

**Revision history of this document**

| Version Number | Date | Description and reason of revision |
|---|---|---|
| 01 | 21 January 2003 | Initial adoption |
| 02 | 8 July 2005 | • The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document.<br>• As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Refereknce/Documents>. |
| 03 | 22 December 2006 | • The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM. |

## SECTION A. General description of project activity

### A.1. Title of the project activity:

>> Stoves for Life: Energy Efficient Cook Stove Project in Kakamega, Kenya

Version of Document: 2.6
Date of Document: 16 May 2017

### A.2. Description of the project activity:

>> This project will produce and install high quality, locally made, affordable Upesi stoves to replace the traditional three-stone cooking in households around Kakamega Forest. The majority of rural households in this region cook with wood. Baseline and average project performance field tests conducted between 2011-2016 reveal that the Upesi stove reduces wood use between 41.9% (1-pot stove) and 50.1% (2-pot stove). In reducing wood use, the Upesi in households can reduce time and money spent on collecting woodfuel, reduce the demand of forest wood, and potentially reduce exposure to poor indoor air quality. In producing, selling, and installing the Upesi, the project creates jobs for local people, primarily women.

The targeted population is associated with the Kakamega Forest ecosystem.. It is one of the densest rural populations in the world (>500 people per square kilometer), with a poverty level greater than 50% (KNBS 2009).

For 90% of thedense and growing population that lives adjacent to the forest areas, the adjacent rainforest directly provides fuelwood and/or a source of livelihood (Kokwaro, 1988; Habermehl, 1994; Guthiga and Mburu, 2006, Amutabi et al. 2017). For those families living a distance away from the forest, forest products like fuelwood and purchased (Amutabi et al. 2017). Most of the products are timber related (e.g. fuelwood, polewood, charcoal) resulting in clearing and considerable disturbance related to the cutting of trees. The Kakamega Forest has lost almost 50% of its area since it was formally gazetted in 1933, and because of it unique biodiversity and threat level from the dense surrounding population, it has received a ranked conservation status by the IUCN (Wass 1995).

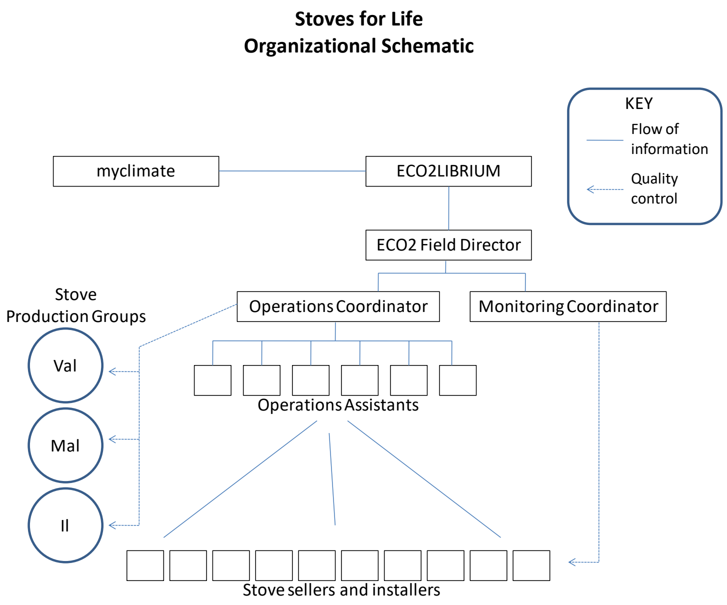
**Previous Achievements**. In the first six years of project activity, Eco2 has installed over 38,000 Upesi stoves in rural households improving the lives of over 200,000 people (based upon mean household size of 6), and in areas directly adjacent to the forest, almost every household owns and uses a Upesi stove. By the end of the 1st crediting period it is projected that 46,000 households will have stoves. This has created approximately 300 jobs for local people, almost 70% of which are women. The reduced wood use, associated with a large percentage of households using forest wood, may result in reduced forest degradation.

**New Goals**. Eco2 will continue to run Stoves for Life in a way that (1) makes the Upesi stove affordable yet maintains a commercial relationship with the end user, (2) creates training and jobs for the underserved, and (3) protects the forest areas. Based upon a slight increase in capacity from suppliers and installers, and potential customers within expanded project area, Eco2 could provide energy efficient Upesi stoves to an additional 100,000 households over seven years. This would result in almost all households within 10 kilometers of a forest edge (and about 25% of all households within project area) using a wood saving Upesi stove. This goal would improve the lives of over 1.1 million people, maintain jobs for 500 people most of which are women, and reduce forest wood use significantly.

| Project Year | Dates | Estimated new efficient stoves constructed | [1]Estimated total efficient stoves installed |
|---|---|---|---|
| 8 | *November 25 – December 31 2018 | 11000 | 57446 |
| 9 | January 1 – December 31 2019 | 16000 | 73446 |
| 10 | January 1 – December 31 2020 | 20000 | 93446 |
| 11 | January 1 – December 31 2021 | 20000 | 113446 |
| 12 | January 1 – December 31 2022 | 16000 | 129446 |
| 13 | January 1 – December 31 2023 | 11000 | 140446 |
| 14 | January 1 – December 31 2024 | 5000 | 145446 |

[1]Estimated total number includes the total number from first crediting period. This is done this way because emission reductions in second crediting period will also include stoves installed in the first crediting period. The total number of stoves installed by the end of the first crediting period is projected at 46,446.
*First crediting period ends at midnight on November 24, 2017.

**Operations.** ECO2 works with local independent groups (mostly women) to supply the liners for the stoves. ECO2 has provided training to many and start up business loans to some of these groups to build their capacity to produce and sell liners. We maintain quality by working with groups and by purchasing only quality liners. This is accomplished through visits from an ECO2 staff who has worked with Upesi stoves for over fifteen years and picking only those stoves that meet Eco2 quality criteria. ECO2 is appraised of all sales through supervisors of installer groups, and purchases liners from the suppliers. Eco2 distributes liners to the supervisors and pays installers to install the liners as permanent stoves into households. See organizational chart below.




## A.3. Project participants:

>>

| Name of Party involved (*) ((host) indicates a host Party) | Private and/or public entity(ies) project participants (*) (as applicable) | Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No) |
|---|---|---|
| Kenya (host) | Private Entity<br>- Eco2librium LLC | No |
| Switzerland<br>(Annex 1) | Private Entity<br>- myclimate Foundation | No |

This project is being developed by Eco2librium (ECO2) in collaboration with myclimate Foundation.

Eco2librium:
Eco2librium is an LLC registered in Idaho, USA with a mission devoted to promoting the environmental basis of livelihood and the sustainable use of natural resources. Eco2librium partners with organizations (e.g. non-governmental organizations, not-for-profits) with similar missions to provide business solutions to environmental problems.

myclimate:

myclimate, a non-profit foundation registered in Zurich, Switzerland, is a carbon offset project developer and offsetting provider.

**A.4. Technical description of the project activity:**

**A.4.1. Location of the project activity:**

>>Kenya

**A.4.1.1. Host Party(ies):**

>>Kenya

**A.4.1.2. Region/State/Province etc.:**

>> The project is located in the Western Province of Kenya.

**A.4.1.3. City/Town/Community etc.:**

>> Main office is located in Kakamega town (see below).

**A.4.1.4. Details of physical location, including information allowing the unique identification of this project activity (maximum one page):**

>>

**The expanded boundary for Stoves for Life** includes all of the counties within the Western Province of Kenya and parts of other counties in Rift Valley (Nandi, Trans Nzoia, Uasin Gishu) and Nyanza (Kisumu, Siaya) Provinces (Figure 2). To the west lies Uganda, to the south Lake Victoria. The map in Figure 2 has the actual locations in latitude and longitude. Kakamega, the location of Eco2 headquarters, has the following coordinates: N 0°17’00.17’’, E 34°44’59.92’’. This area encompasses households that use forest wood within the Kakamega, Nandi, and Mt. Elgon forest ecosystems. The original project boundary was smaller and is shown in Figure 2.

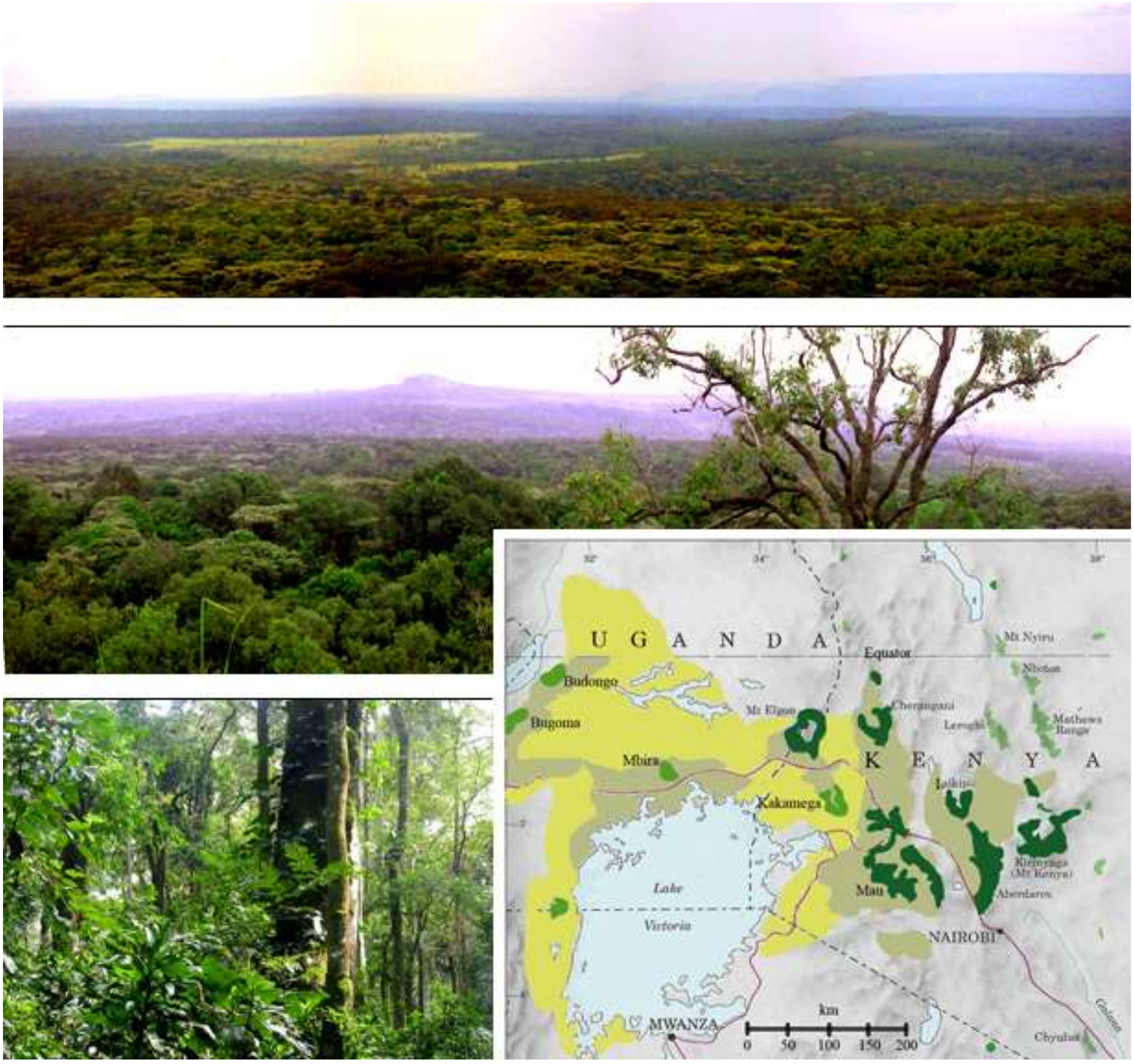



**Figure 1. Kakamega Forest images with inset map of remaining lowland (light brown) and montane (dark brown) rainforests in east Africa. Former forests are shown in yellow and gray.** ***Map adapted from Collins 1990. Photos by M. Lung.***

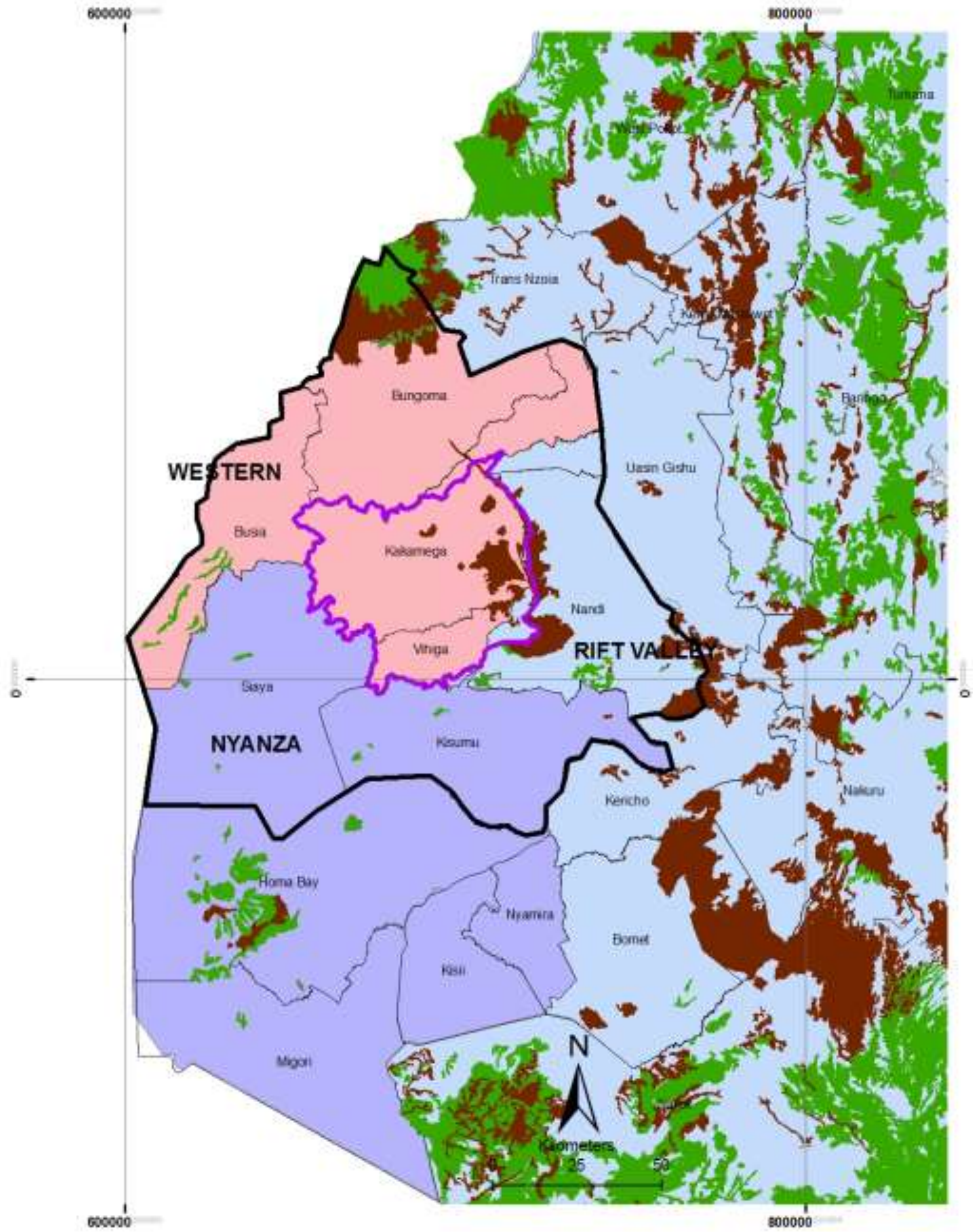



**Figure 2. Project boundary is within the dark black outline and includes the counties within Western Province (gray) as well as small areas within Rift Valley province (light blue) and Nyanza Province (dark blue). The original project boundary is a dark blue line. Kakamega Forest and satellite forests are shown in green.** Georeference markers are in WGS 1984 UTM.

**A.4.2. Category(ies) of project activity:**

>> According to the eligibility criteria of the Gold Standard Requirements 2.1, August 2009, this project belongs to the category "End-use Energy Efficiency Improvement" and is classified as a large-scale project. This has not changed with 2.2.

**A.4.3. Technology to be employed by the project activity:**

>>

1. Baseline stove: 3 stone fire

Our Kitchen/Baseline Survey (2010/2011) in the original project area found that 99% of the targeted population uses the traditional 3-stone fire and in 100% of these households wood was the primary fuel. This is supported in the literature. Habermehl (1994) reported that 80-99% of rural Kenyans use the traditional three-stone. Kiefer and Bussman (2003) reported that 98.5% of households in the project area use wood for cooking. The baseline scenario of cooking with wood using the 3 stone has also been supported by 6 years of Monitoring and Usage Surveys. Baseline Surveys in expanded areas show that wood is the primary fuel in almost all rural households. The most common stove types are the 3-stone and the locally made Chepkube stove. Therefore it is reasonable to conclude that the baseline scenario in our original target area cook with wood using the three-stone fire, while in the expanded areas wood is still the primary fuel used in the 3-stoneA small percentage of people, most of whom live in urban centers or larger towns, cook with charcoal, kerosene, or LPG. In our 2010/2011 Kitchen Survey, we found no households that used LPG or electricity to cook. From 6 years of Monitoring and Usage Surveys, this has been confirmed as no households report these fuels as the primary fuel, although in percentages less than 10%, they are present as secondary fuels. This three-stone fire is used as the baseline stove. In this cooking method, three large stones are placed in a triangle, the pot is placed on the stoves and wood fed into fire from beneath (see below).

2. Project stove: ceramic Upesi wood stove

The technology employed is the efficient ceramic wood-burning cookstove (Upesi) used for cooking in rural households in Kenya. The Upesi stove starts with a locally made, ceramic liner (see Figure 3 below). In this region it is made by hand by local groups from clay and sand mixtures (obtained locally) using metal molds (see Figure 3). The clay and sand are mixed with water and molded by hand using simple metal molds to maintain consistency and quality control to produce the liner. The soft clay liners are then baked in mud/clay kilns for 8-10 hours using wood as the fuel (see Figure 3). The finished liner is then generally installed permanently in households. This is gone by independent installers. Liners are usually installed as either a one-pot stove or a two-pot stove (see Figure 3 below) by encasing the liner in a mud/clay hearth, using materials obtained locally. In cooking, pots are placed on top of the stove while fuel wood is fed into a compartment underneath that focuses the heat directly upward instead of in all directions like a traditional three-stone fire. The stove reduces wood fuel use resulting in reductions of wood biomass burning and subsequently the reduction in the release of $CO_2$, $N_2O$, and $CH_4$.

**Figure 3. The metal mold (upper left), finished soft ceramic liners (upper middle), kiln (upper right), installed one-pot stove (below left), and two-pot stove (below right)**

In addition to the wood savings and emission reductions, use of stoves is accompanied by numerous other benefits which include reduced time spent collecting fuelwood, reduced personal income spent on fuelwood, reduced time exposed to cooking smoke, and decreases in forest degradation rates (figure 4). Much of the sustainable development challenges faced by this region can be solved in part by reducing fuel requirements from forest and by providing stove production/distribution as viable job opportunities for community members.

Figure 4. Women collecting fuel-wood from forest.

### A.4.4. Estimated amount of emission reductions over the chosen crediting period:

>>
A crediting period of 7 years with the option of renewal was chosen for the project activity. This PDD includes the renewal period of an additional 7 years (2018-2014).

| Project Year | Monitoring/Crediting Dates | Emission Reductions |
|---|---|---|
| 8 | Nov 25, 2017 - Dec 31, 2018 | 198,644 |
| 9 | Jan 1, 2019 - Dec 31, 2019 | 251,443 |
| 10 | Jan 1, 2020 - Dec 31, 2020 | 319,049 |
| 11 | Jan 1, 2021 - Dec 31, 2021 | 389,371 |
| 12 | Jan 1, 2022 - Dec 31, 2022 | 447,749 |
| 13 | Jan 1, 2023 - Dec 31, 2023 | 482,983 |
| 14 | Jan 1, 2024 - Dec 31, 2024 | 496,633 |
| **Total for 2nd crediting period** | | **2,585,872** |
| **Average for 2nd crediting period** | | **369,410** |

*Emission reduction calculations include stoves installed in the first crediting period as well, which ended at midnight on November 24, 2017.

### A.4.5. Public funding of the project activity:

>> There is no public funding involved in the project activity. See ODA declaration in the Gold Standard Passport.

## SECTION B. Application of a baseline and monitoring methodology

### B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

>> Gold Standard methodology "Technologies and Practices to Displace Decentralized Thermal Energy Consumption (24/04/2015)." is applied to this project.[1]
http://www.goldstandard.org/sites/default/files/revised-tpddtec-methodology_april-2015_final-clean.pdf

### B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

>> The project is the production and dissemination of energy efficient, wood-burning cook stoves to displace inefficient traditional, wood-burning 3-stone cook stoves. By reducing the consumption of unsustainably harvested fuel wood in households we are displacing decentralized thermal energy consumption and GHG emissions are reduced. Therefore it qualifies as an End-use, non-industrial, Energy Efficiency Improvement project that displaces decentralized thermal energy consumption.

The following conditions from the methodology apply:

1. The project boundary can be clearly identified, and the stoves counted in the project are not included in another voluntary market or CDM project: The project boundary includes the place of the kitchens where the project stoves are applied and the place of fuel collection, production, and transport in Kenya. The project takes place in one country – Kenya. Survey mechanisms are in place to become aware of similar projects in area and in households. In summary, at the project scale we will review GS registered projects annually, and keep an eye (country-wide and regional) for physical evidence of similar project activities (see Monitoring parameters , section B.7.1). In addition, at point of sale our Operations Coordinator, sales associates, and installer associates are told to install stoves only in households in which the stove is replacing the 3-stone, unless otherwise noted. If our efficient stove is installed along side another stove type, the management is made aware of this, records kept, and more information is collected about whether it is a carbon project. Finally, we weekly monitor households that have purchased a project stove and this includes observations of addition of stoves. If evidence is presented that similar carbon efficient cook stove projects are in or near our project area, our mitigation procedure is as follows: (1) contact project owners, (2) arrange meeting to check project areas, target population, stove types, etc. for overlap; (3) if overlap, then compare sales records and if overlap occurs at the household level, then; (4) negotiate with project owner an agreement on how to prevent double counting.

2. The improved cook-stoves do not number more than ten per kitchen and each have continuous useful energy outputs of less than 150kW: There is one efficient cook stove per household (either a one-pot stove or a two-pot stove) and it is used only for domestic cooking activities. The calculation of potential energy output of the efficient Upesi stove based on mean fuel consumption data results in a

[1] Initially the 2nd version of the Gold Standard Methodology for Improved Cook-stoves and Kitchen Regimes V.02 – 08/02/2010 was applied when submitting the PDD to validation. Since a new version of the methodology was published by the Gold Standard in April 2011, this new version called "Technologies and Practices to Displace Decentralized Thermal Energy Consumption (11/04/2011)" was applied and the PDD was amended during validation to comply with the new rules. The latest version is now applied.

range from 11.20 to 33.60 depending on the assumption of how many hours are used to cook per day. Habermehl (1994) provides some data of hours cooked per day (pages 3, 4) and estimates of 1-3 hours used below are conservative based on Habermehl's (1994) report. Tables below provide the details for the calculations for 1 hour and for 3 hours of cooking.

**Maximum energy ouput of efficient Upesi stoves in Kenya**
May 2011

**Project fuel consumption**

| Item | value | Source |
|---|---|---|
| Wood t/year/stove | 2.83 | mean from Kitchen Test for 2-pot stove |

**Fuel energy content**

| Item | value | Source |
|---|---|---|
| NCV wood TJ/t | 0.0156 | IPCC, Volume 2, Chapter 1, Table 1.2 |

**Calculation of potential energy output**

| Item | value | Source |
|---|---|---|
| total energy per stove TJ/day | 0.000121 | calculated |
| total energy per stove GWh/day | 0.000034 | calculated |
| total energy per stove kWh/day | 33.6 | calculated |
| stove operation/cooking event in hours | 1 | conservative assumption* |
| **Max energy ouput of the stove in kW** | **33.60** | **calculated** |

**Maximum energy ouput of efficient Upesi stoves in Kenya**
May 2011

**Project fuel consumption**

| Item | value | Source |
|---|---|---|
| Wood t/year/stove | 2.83 | mean from Kitchen Test for 2-pot stove |

**Fuel energy content**

| Item | value | Source |
|---|---|---|
| NCV wood TJ/t | 0.0156 | IPCC, Volume 2, Chapter 1, Table 1.2 |

**Calculation of potential energy output**

| Item | value | Source |
|---|---|---|
| total energy per stove TJ/day | 0.000121 | calculated |
| total energy per stove GWh/day | 0.000034 | calculated |
| total energy per stove kWh/day | 33.6 | calculated |
| stove operation/cooking event in hours | 3 | conservative assumption* |
| **Max energy ouput of the stove in kW** | **11.20** | **calculated** |

Since useful energy output is lower than potential energy output (due to inefficiencies), which is below 150kW, it is also demonstrated that the efficient Upesi stove has a useful energy output of less than 150kW.

3. Low-emission cook-stoves replace relatively high-emission baseline scenarios: As described in section A.4.2, efficient Upesi cook stoves replace inefficient baseline stove technology (3-stone fire). The project will completely replace the baseline (3-stone), except on rare occasions (e.g. ceremonies) in which the three stone is used as an additional cooking source. This will be ensured through promotions and incentives to discard the 3-stone and use only the Upesi stove. The primary incentive is eligibility of households to receive substantial awards if there is evidence they have discarded the 3-stone and are regularly using the Upesi energy efficient stove. The incentive program is called "Scott's Club." A customer who buys a Stoves For Life stove automatically receives a unique Scott's Club number and this goes into a database. Regular weekly monitoring of households with stoves will confirm if the 3-stone has been discarded and if the Upesi is being used. This is a random selection of households that are visited using the Annex 3 questionnaire, which includes information on use of

Upesi and use of the 3-stone. If it is confirmed the household is not using the 3-stone then it is entered into quarterly drawings to receive awards.. Eco2 has a sizable budget to provide these awards to many households per year. In addition to the incentive program, Eco2 regularly monitors households for use of stove and of disuse of baseline 3-stone. If the incentives do not provide complete disuse of baseline stoves, then we will change incentives and /or amend General Monitoring to gather additional information in order to better facilitate use of stove and disuse of baseline.

4. Project Proponents have included a waiver on each Purchase and Sales Agreement (see Annex 6). By signing, each customer waives rights to carbon emissions. Each salesperson is trained, as they sit with each buyer, to explain that the stove price and other benefits (e.g. Scott's Club, future community benefits) are made possible by the sell of the carbon credits from stoves. The carbon rights have also been explained in detail to production and installation groups and they recognize that the benefits that they now receive (e.g. production groups are selling 200+ stoves per month in project where prior to project they were selling less than 50 per month – see supporting document, "Signed Letter from Production Groups_Sept2011"). Memorandums of Understanding (MoU) were signed between ECO2 and stove Installer and stove Seller Associates. This MoU contains a statement about carbon rights (see supporting document_- "MoU_SalesAssoc" and "MoU_InstallerAssoc"). ECO2 has a Purchase Agreement between itself and the stove Producer Groups. This agreement has language referring to the carbon rights (see supporting documents – "Valongi Purchase Agreement_Sept2011," "Malachake Purchase Agreement_Sept2011," "IlesiMunasio Purchase Agreement_Sept2011").

5. There is no biomass feedstock involved in the project activity.

**B.3. Description of the sources and gases included in the project boundary:**

>> As defined in the applied methodology three parameters have to be delineated: Project Boundary, Target Area, and Fuel Collection Area.

a. Project Boundary:
The project boundary in this case is defined as including the place of the kitchens where the project stoves are applied. The specific project boundary is defined in Figure 2 in section A.4.1.4
b. Target Area:
The target area is defined as delineated in the map in Figure 2 under 4.1.4. (with descriptions)and includes counties within the western part of Kenya. Within this area, the target population are rural households that use wood in the 3-stone stove.
c. Fuel Collection Area:
This Fuel Collection area is the area within the project boundary and also includes all of Kakamega National Forest and North and South Nandi Forest and Mt. Elgon Forest (green areas) in Figure 2 under 4.1.4.
The following emission sources are included or excluded from the project boundary:

| | Source | Gas | Included? | Justification / Explanation |
|---|---|---|---|---|
| **Baseline** | Cooking, production of fuel, and transport of fuel | $CO_2$ | Yes | Important source of emissions |
| | | $CH_4$ | Yes | Important source of emissions |
| | | $N_2O$ | Yes | Can be significant in some fuels |
| **Project Activity** | Cooking, production of fuel, and transport of fuel | $CO_2$ | Yes | Important source of emissions |
| | | $CH_4$ | Yes | Important source of emissions |
| | | $N_2O$ | Yes | Can be significant in some fuels |

**B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:**

>> **Baseline Description and Development**. The baseline scenario is described here as the "typical baseline fuel consumption pattern" in the population targeted for the project within the project boundary. The baseline scenario was based upon a comprehensive literature review, an in depth community field study/survey within the old project boundary (Lung 2008), including a preliminary kitchen survey and kitchen performance test, a comprehensive Kitchen Survey and Kitchen Test conducted in 2010/2011,six Monitoring/Usage Surveys between 2011-2016 (see Table B.4.2), and baseline surveys conducted in expanded new areas between 2014-2017

Our original Kitchen Survey (2010/2011) and all subsequent monitoring have found that 99% of the original targeted population uses the traditional 3-stone fire and in nearly 100% of these households wood was the primary fuel. This is supported in the literature. Habermehl (1994) reported that 80-99% of rural Kenyans use the traditional three-stone. Kiefer and Bussman (2003) reported that 98.5% of households in the project area use wood for cooking. A national survey was consistent with this findings (see Table below). Therefore it is reasonable to conclude that over 90% of households in our original target area cook with wood using the three-stone fire. When interviewees were asked the secondary fuel source and cooking stove, the majority of people responded that the secondary cooking method was the 3-stone (58%) while 18% responded cooking with a charcoal stove (Kitchen Survey 2010/2011). No respondents answered that they use any other fuel source (e.g. LPG, kerosene, electricity, cattle dung). From baseline surveys conducted in expanded project areas, we found that wood is the only primary fuel and that the 3-stone is the primary stove in all areas except in Nandi county. In this county, the 3-stone was the primary stove in 20% of households and the Chepkube was the primary stove in 70% of households. This project will not replace the Chepkube stove with the Upesi.

**Table Summarizing findings by Kenya National Survey 2006**

| Region | Kakamega | Vihiga | Busia | Bungoma | Siaya | Kisumu | Trans Nzoia | Nandi |
|---|---|---|---|---|---|---|---|---|
| % 3 stone fire | 87.7 | 83.1 | 90.0 | 87.9 | 86.2 | 47.8 | 74.0 | 56.5 |

The price of alternative fuels and the price of the cookers make their use in this region with high poverty difficult for most people. We discuss each of the fuels in detail below. To compare divergent fuels (e.g. LPG and wood) we calculated the cost of each fuel per a standard energy output. In other words, it is difficult to compare costs of fuels to cook using the units they are sold by (e.g. kilograms of charcoal, liters of kerosene). We converted each fuel into the amount of energy output using a standard energy unit – MMBTU's (million BTU's). This was done by first obtaining the heat/energy content (i.e. net calorie value) for each fuel (except electricity) from IPCC (2006, Chapter 1, Table 1.2), which is given in terajoules per million tons. We then converted this into MMBTU's per kilogram (using standard energy and mass conversions). We then converted each fuel into a cost per kilogram (i.e. kerosene is sold by the liter, so we used the density of kerosene to get the equivalent kilograms for every liter). Using cost per kilogram and MMBTU's per kilogram we then calculated cost per MMBTU's. See excel file "price per energy content of fuels" for more details.

**Table B.4.1: Costs in 2017**

| Fuel | [1]Cost of cooker (KES) | [2]Cost of fuel per unit (KES/unit) | [3]Cost of fuel per kilogram (KES) | [4]Cost of fuel (KES) per MMBTU's | Total Cost to Cook |
|---|---|---|---|---|---|
| 3 Stone Wood | **0** | 137/head load | 4.7 | **318** | **318** |
| Upesi Wood | **300** | 137/head load | 4.7 | **318** | **618** |
| Charcoal | **510** | 996/sack | 28.9 | **1,034** | **1,544** |
| Kerosene | **991** | 67.2/liter | 67.2 | **1,619** | **2,610** |
| LPG | **4293** | 943/6kg cylinder | 157.0 | **3,501** | **7,794** |
| Electricity | **6495** | 17.2/kwh | NA | **5,041** | **11,536** |

1. Based on prices obtained from local supermarket (see pdf: "*nakumatt quotation for stoves*") and known price of Upesi. We obtained quotes (without VAT) from the local Nakumatt store in downtown Kakamega. For clarification in the quotation:
   Clay jikos = charcoal cookers
   Cook and Lite stoves = LPG cookers

2. Sources: Wood – Average permit for head load (100 KES) plus market price for head load (175 KES) – Amutabi 2017
   Charcoal – survey data (and www.allafrica.com/stories/201412051189)
   LPG – average of 3 quotations from local vendors and
   www.businessdailyafrica.com

3. Sources: Wood: Amutabi 2015 – average weight of head load = 29 kg (100 KES/29 kg = 3.4 KES/kg)
   Charcoal weight per sack: based on survey data and weighed containers
   LPG – average per quotation for refill of small 6 kg cylinder.

4. Sources: See excel file, "*price per energy content of fuels*"

With limited access to alternative fuels like electricity and LPG (the grid is minimal in rural Kenya and LPG is sold primarily in urban centers), high entry costs (LPG cooker is 4239 KES compared to no cost for 3 stone) and operating costs (Charcoal is 3.25 x and LPG is 11 times more than wood), and high levels of unemployment and poverty in the project area, it is reasonable to assume that the current scenario of wood use using the 3 stone will continue in the future.

From six years of Monitoring and Usage Surveys we found that wood is the primary fuel and that other fuels and stoves are used as secondary but wood is still the most common secondary fuel (see Table B.4.2).

**Table B.4.2**

Summary of percent of households reporting secondary fuel use from Monitoring/Usage Surveys (2011-2016) and average percentage over all years.

| Secondary Fuel | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Average |
|---|---|---|---|---|---|---|---|
| Wood | 73.8 | 65.9 | 77 | 78.6 | 75.3 | 89 | **76.6** |
| Charcoal | 17.9 | 27.3 | 13.3 | 14 | 16.4 | 8.2 | **16.2** |
| LPG | 2.6 | 2.9 | 2.9 | 5.6 | 3.8 | 2.7 | **3.4** |
| Kerosene | 10.1 | 2.7 | 5.9 | 1.5 | 4.3 | 1.8 | **4.4** |
| Electricity | 0 | 0 | 0 | 0 | 0.3 | 0 | **0.1** |
| Other (e.g. sawdust) | 0 | 1.2 | 2.6 | 2.6 | 1.4 | 0 | **1.3** |

Sources are Monitoring/Usage Survey Reports from verifications 2011-2016.

Based upon the literature and recent field surveys from past verifications (2011-2016) and from other data (Table B.4.2), the "typical baseline fuel consumption pattern" in this targeted population is wood use with a 3-stone fire. In addition, the analysis of cost per obtained energy for different fuels and the cost of obtaining the cookers, in the context of poverty, make alternatives (especially compared to wood and 3-stone which are virtually free) difficult for most people in our target population. We will sell the project technology only to those with 3 stones or if sold to homes with other technologies we will remove from the project database. Thus we used only one scenario for baseline - wood consumption in a 3-stone fire, and the only kitchen regime used is the domestic use of wood in the 3-stone for cooking.

Most plausible baseline scenario:

The most plausible baseline scenario for this project, and the default under the chosen methodology, is a fixed baseline. The methodology states: "In project activities where all units are installed at the start or in project activities targeting non-industrial applications, the baseline is considered by-default fixed in time during the considered crediting period" (page 7, last paragraph of baseline scenario). This project disseminates efficient cook stoves for households, and thus targets non-industrial application.

**4. Baseline Studies:**

The applied methodology, "Technologies and Practices to Displace Decentralized Thermal Energy Consumption," requires Project Proponent to conduct the following with regards to baseline emissions:

A. Baseline NRB
B. Baseline survey (BS)
C. Baseline performance field test (BFT) (i.e. Kitchen Performance Test) of fuel consumption.

A. Baseline NRB assessment

We conducted a thorough assessment of NRB fraction in 2010 for the 1st crediting period. However, we adopted the CDM default value for Kenya (http://cdm.unfccc.int/DNA/fNRB/index.html) and will continue to use this figure for the 2nd crediting period.

**B. Baseline Survey**

1. Original Survey-2010.We conducted the original baseline survey in accordance with the following methodological guidelines:

– Representativeness. A random sample was drawn from the pilot sales record (initial households which had purchased a stove) from two pre-defined clusters (one-pot households and two-pot households). The selected households were all interviewed in person with standardized questionnaire.
- Sample Sizing. For each pre-defined scenario we used the following sample sizes:

The following group sizes are recommended by the methodology;

- Group size < 300: Minimum sample size 30
- Group size 300 to 1000: Minimum sample size 10% of group size
- Group size > 1000 Minimum sample size 100

Sample sizes for the assessed scenarios

| *Scenarios* | *Scenario size (stoves constructed until 31 January 2011)* | *Minimum Kitchen Survey Sample Size* | *Actual Kitchen Survey Sample Size* |
|---|---|---|---|
| **Scenario 1:** One efficient installed 2-pot stove per household using fuelwood for cooking. | 375 | ≥38 | 86 |
| **Scenario 2:** One efficient installed 1-pot stove per household using fuelwood for cooking | 100 | >30 | 30 |

The procedure and results of the orginal Baseline Survey (i.e. Kitchen Survey) is described in the Baseline Survey Report_2010. The analysis of the Baseline Survey data leads to the following recommendations:

(1) there is only one kitchen regime with regards to baseline cooking method and fuel use
(2) it is reasonable to continue with different scenarios for emission reductions differences between the one-pot and two-pot stove users
(3) kitchen tests will be conducted with samples sizes for each cluster approaching forty to reach 15% of the mean at the 90% confidence interval.
(4) kitchen tests will be conducted during weekdays to be conservative on estimates of wood use as the result of weekly and seasonal variations.
(5) the question of space heating and lighting with regard to stove usage should be explored more closely.

2. Updated Baseline Surveys - 2014-2017.
   In 2014, we conducted baseline surveys prior to project technologies in proposed expanded areas. The results of these surveys are found in Baseline Survey Report 2014. In summary we found the following:
   1. There are two kitchen regimes for cooking –
      a. Cooking with wood in the 3 stone
      b. Cooking with wood using the Chepkube stove

*Cooking with wood in the 3 stone is our baseline as we will not sell to those with the Chepkube or if we do, these are not included in project emission reduction calculations.

   2. Wood is the primary secondary fuel reinforcing the baseline
   3. Wood use in baseline was estimated in this survey as bundles per week to be consistent with above. This will be followed by baseline performance test values.

**C. Baseline Performance Field Test (i.e. Kitchen Tests)**

1. Original Study. According to the applied Gold Standard methodology "TPDDTC" it is recommended to conduct 20 to 60 kitchen tests (randomly chosen) with a paired-sample design such that impact of daily and/or seasonal variations are accounted for. Based upon sample size, variation, using a paired sampling design, we apply the 90/30 rule and use the mean of estimated savings if the endpoints of the 90% confidence interval lie within +/- 30% of the estimated mean.

We used the following outline for the Performance Field Test provided by the methodology in Annex 4:

(1) We used a random sample, paired test design in which subjects were randomly chosen with excel's random number generator from a pilot sales record.
(2) We measured fuel use over a three-day period during the weekdays for both project and baseline technologies to help ensure normal cooking behaviors.
(3) Participants were encouraged to cook normally during the tests (i.e. number of people, number of meals, and types of foods) and kept food diaries so that this could be checked.
(4) A wood pile was pre-weighed and set aside for the tests and then the households were visited once per day where possible.
(5) A food diary was kept by participating households to make them aware of cooking consistently between paired tests and allow us to check for this consistently and normal cooking behaviors.
(6) During the tests households used the fuel that they typically use for cooking (wood was not provided for the households).
(7) A paired sample t-test (1-tailed) was performed on the data after checking for outliers and normal distribution to estimate mean fuel savings.
(8) After the tests were completed, participating households were given gifts for their participation.

The procedure and results of the Baseline and Project Kitchen Test is described in the Baseline and Project Field Performance Test Report. Below main results are presented:

(1) Baseline wood consumption was 4.88 (+/- 0.36) tonnes per household per year, and this baseline wood consumption was consistent with other findings (Habemehl 1994, Kituyi et al. 2001).
(2) Project wood consumption among all households was 2.65 (+/- 0.22) tonnes per household per year, which equals reductions of 1.67 (+/- 0.14) tonnes per household per year.
(3) Upesi stove wood reductions are consistent with other findings (Habermehl 1994,).
(4) One-pot and two-pot stoves significantly differ in their wood use reductions. It is thus appropriate (as per applied methodology page 7) to define two project scenarios, one for the 1-pot stove and a

separate one for the 2-pot stove.

(5) Household size is significantly different between households that purchased a one-pot stove and those that purchased a two-pot stove.

(6) 90% confidence intervals were generally less than 10% of the mean, except for one-pot (11.7%) and two-pot (11.6%) baseline figures. Thus we use the estimated mean of fuel savings and/or emission reductions.

(7) Both one-pot and two-pot stoves significantly reduce emissions from the baseline scenario.

**The statistical analysis of the Baseline and Project Field Performance Tests shows the following savings for Scenario 1 and Scenario 2:**

Scenario 1: installed 2-pot stove:

| **Average WOOD use before and after appliance of new stoves** | **t wood / (year*stove)** |
|---|---|
| Mean before | 4.883 |
| Mean after | 2.832 |
| Mean change | 2.052 |
| Sample size | 29 |

Scenario 2: installed 1-pot stove:

| **Average WOOD use before and after appliance of new stoves** | **t wood / (year*stove)** |
|---|---|
| Mean before | 3.783 |
| Mean after | 2.505 |
| Mean change | 1.278 |
| Sample size | 35 |

**After this BPPFT in 2011, we conducted another BPPFT in 2013 to account for seasonality. This data is presented in section B.6.3.**

**Project Scenario Crediting in Relation to Appropriate Baseline Scenario**

Based on the applied methodology we use the following formula to calculate emission reductions:

$$ER_y = \Sigma_{b,y} (N_{p,y} * U_{p,y} * P_{p,b,y} * NCV_{b,fuel} * (f_{NRB,b,y} * EF_{fuel,CO2} + EF_{fuel, nonCO2})) – LE_{p,y}$$

Where:

$\Sigma_{b,y}$ = sum over all relevant (baseline b/project p) couples

$N_{p,y}$ = cumulative number of project technology days included in the project database for project scenario p against the baseline scenario b in year y.

$U_{p,y}$ = cumulative usage rate for technologies in project scenario p in year y, based on cumulative adoption rate and drop off rate revealed by usage surveys (fraction)

$P_{p,b,y}$ = Specific fuel savings for an individual technology of project p against an individual technology of baseline b in year y, in tons/day, as derived from the statistical analysis of the data collected from field tests.

$NCV_{b,fuel}$ = Net calorific value of the fuel that is substituted or reduced ((IPCC default for wood fuel, 0.015 TJ/ton)

$f_{NRB,b,y}$ = fraction of biomass used in year y for baseline scenario b that can be established as non-renewable biomass

$EF_{fuel,CO2}$ = CO2 emission factor of the fuel that is substituted or reduced. 112 tCO2/TJ for wood/wood waste.

$EF_{fuel,\ nonCO2}$ = Non-CO2 emission factor of the fuel that is reduced

$LE_{p,y}$ = leakage for project scenario p in year y (tCO2eq/yr)

The following are the summary data for baseline and project fuel consumption and resultant fuel savings ($P_{p,b,y}$) for each applied stove (one-pot and two-pot). Here we report estimated means and 90% confidence intervals  for household wood use and savings per year and per day. The full report is available in the Baseline and Project Field Performance Test Report.

**Baseline fuel use per applied stove**:

One-pot stove:
Per household per year = 3.78 (+/- 0.44) tons
Per household per day = 0.0105 (+/- 0.0012) tons

Two-pot stove:
Per household per year = 4.88 (+/- 0.57) tons
Per household per day = 0.0134 (+/- 0.0016) tons

**Project fuel use per applied stove**:

One-pot stove:
Per household per year = 2.51 (+/- 0.22) tons
Per household per day = 0.0069 (+/- 0.0006) tons

Two-pot stove:
Per household per year = 2.83 (+/- 0.40) tons
Per household per day = 0.0078 (+/- 0.0011) tons

**Fuel Savings ($P_{p,b,y}$) per applied Stove**

One-pot stove:
Per household per year = 1.28 (+/- 0.29) tons
Per household per day = 0.0036 (+/- 0.0008) tons

Two-pot stove:
Per household per year = 2.05 (+/- 0.40) tons
Per household per day = 0.0056 (+/- 0.0011) tons

This was followed up with a baseline/project performance field test in the dry season (2013) as resquested by GS in FAR. Additional Project Performance Field tests updates were conducted in 2013 and in 2015/2016. This data is presented in section B.6.3.

**Additional baseline and project field tests will be carried out prior to first verification of 2$^{nd}$ crediting period.**

**Leakage**

The potential leakages as set out in the methodology are assessed regarding their risk;

| *Form of Leakage* | *Risk* | *Justification* |
| --- | --- | --- |
| a) The displaced baseline technologies are reused outside project boundary in place of lower emitting technology or in a manner suggesting more usage than would have occurred in the absence of the project | No risk | The technology displaced is the 3-stone fire, which is the major cooking method in areas outside project boundary already, as well as inside the project boundary. This technology consists of 3 stones placed on the ground and if wished could be constructed by any user by just taking 3 stones. Moreover, the 3 stone fire is the least efficient technology and it is unlikely that households applying a more efficient, more covenient and lower emitting technology (such as LPG, Kerosene, electricity) would switch back to the 3 stone fire. |
| b) The non-renewable biomass or fossil fuels saved under the project activity are used by non-project users who previously used lower emitting energy sources | No risk | The majority of households collect wood and do not purchase it (see Kitchen Survey Report). The savings of wood will thus have no large impact on fuelwood prices on the local markets. Second, those households that currently cook with other sources of energy like kerosene or LPG or electricity (that may be lower-emitting) are paying at least 10 times more than cooking with wood (see comparison of fuel prices on page 21 of the PDD). They made the switch to these sources even though they were 10 times more expensive than wood because they were able and/or did not have access to wood. It seems reasonable that households that can afford to cook with kerosene, LPG, or electricity (which are more convenient and are associated with status) would not |

| | | |
|---|---|---|
| | | switch to cooking with wood if market prices for wood decreased. Further, wood is collected and used at a personal level. Any wood saved by a household would be eventually used by the household. And in this area non-project users would be using a 3-stone and this is not a lower-emitting technology than the project technology. The 3-stone fireplace is the least efficient cooking technology available in the project area. A replacement of the 3-stone fireplace will therefore always result in emission reductions. >90% of rural households in target area use wood for cooking with a 3-stone. The remaining households within our target population use primarily locally-made charcoal (which is not a lower-emitting source). There is a small percentage of people in project area that use other, lower emitting fuel sources (e.g. LPG, kerosene, electricity), but it is not likely they will switch back to the least convenient cooking method which is the 3 stone fire. No other energy source is used to any extent. Therefore there is a low probability that any users in project area use renewable sources. Because of the density of this population and the amount of wood consumed, a very negligible amount is renewable. The project goal is to introduce stoves into a quarter of the targeted population. |
| c) The project significantly impacts the NRB fraction within an area where other CDM or VER projects account for NRB fraction in their baseline scenario. | No risk | NRB fraction prior to project is estimated at 89.6% and CDM value of 92% The impact of the project is calculated considering fuel savings from households using project stoves. This is done with 2 sceanrios: 1) considering the average annual number of households with project technology, and 2) considering total number of stoves installed under this project. The first scenario results in a decrease of fNRB to 88.2%, and the second scenario in a decrease of fNRB to 86.6%. The conclusion is that the project does not make a significant impact on |

| | | |
|---|---|---|
| | | NRB fraction and thus does not affect NRB fraction of other CDM or VER projects in the project region[2]. For a more detailed assessment, see "*Assessment of Project Impact on NRB Fraction.*" |
| d) The project population compensates for loss of space heating effect of inefficient technology by adopting some other form of heating or by retaining some use of inefficient technology | No risk | As indicated by the results of the Kitchen Survey and Kitchen Test, stoves are not used for space heating purposes, nor for lighting purposes. This form of leakage is covered by moniroting Kitchen Surveys. Baseline and project performance filed tests would subsume this potential for leakage, but later would not be addressed in case of a single sample performance test and efficiency ratio multiplier (see footnote 17 on page 11 methodology). Since for this project both baseline and project performance field tests have been conducted, this form of leakage is subsumed in the test results. |
| e) By virtue of promotion and marketing of new technology with high efficiency, the project stimulates substitution within households who commonly used a technology with relatively lower emissions, in cases where such a trend is not eligible as an evolving baseline | No risk | The baseline stove is the 3-stone which has higher emissions than other forms available. It is present in over 90% of households in project area. |
| | | |

Additional Sources of Leakage

| | | |
|---|---|---|
| Emissions from transportation or construction of the stoves | Emissions negligible | Emissions from construction and transportation of the stoves are considered negligible.<br><br>Construction: 120 liners are produced in a kiln that burns 100 kg of wood (source: observations from production groups). In |

[2] There is only one other CDM or Gold Standard project with NRB in the baseline in the same area according to GS registry and CDM pipeline: GS886 Sustainable Deployment of the LifeStraw Family in rural Kenya.

| | | |
|---|---|---|
| | | one year of producing 7500 liners this amounts to 6.25 tons wood consumed annually and the subsequent emissions. In addition, this equates to one liner consuming 0.00083 tons of wood in its construction.<br><br>Under the baseline scenario, each household in the area burns about 4 tons of wood per year. At 52,000 households (one stove per household) targated in project area, this equates to 208,000 tons of wood consumed annually and the subsequent emissions. Emissions to produce one liner is 0.0014 tCO2e. Emissions from stove (i.e. the liners) production is less than 0.001% of emissions from cooking. In addition, one stove (in one household) over its lifetime saves 5.08 tons of wood. The amount of wood consumed to produce a liner is 0.0002% of this. Overall expected emissions from liner production over 7 years crediting period amount to 129 tCO2e.<br><br>With regards transportation, approximately 375 liners are transported per month (only about half of liners are transported by vehicle) with average fuel use of about 45 liters (2.26 kg CO2 per liter). This equates to about 0.00027 tons CO2 per liner over its lifetime. Overall expected emissions from transportation of liners over 7 years crediting period amount to 12.5 tCO2e.<br><br>See excel sheet: production_*transport_emisssions*, in excel file: ER calculation_ECO2 for details. |

All leakage effects are considered to be insignificant in this project activity. However, as indicated in the table above, leakage effects d) and e) are tracked in the monitoring Kitchen Surveys. We will be monitoring space heating use by 3-stone and substitution of 3-stone for other methods. Should there be evidence from the survey's results that leakage effects take place, they will be considered in the emission reduction calculation.

**Emission reduction (ERy)**

1. **2nd Crediting Period. The overall reductions of GHG emissions induced by the project are calculated as follows (based upon wood EF for non-CO2 gases – CH4 and NO2 equal to 0.1356 tCO2e/t wood), and assuming a CDM default NRB, assuming a 1.0 usage rate and 365 days of cumulative project days. We use the latest figures for baseline and project fuel consumption.**

$ER_y = \Sigma_{b,y} (N_{p,y} * U_{p,y} * P_{p,b,y} * NCV_{b,fuel} * (f_{NRB,b,y} * EF_{fuel,CO2} + EF_{fuel,\ nonCO2})) – LE_{p,y}$

For single stoves over 1 year:

One-pot $ER_y$ = 365 * 1.0 * 0.0042 * (0.92 * 1.7472 + 0.1356) – 0
= 2.67 tCO2eq

Two-pot ERy = 365 * 1.0 * 0.0067 * (0.92 * 1.7472 + 0.1356) – 0
= 4.26 tCO2eq

*NCV was excluded because EF was in units of CO2e/t fuel.

Overall ER estimated over entire 2nd crediting period: 2,585,872

Estimate includes the following:

1. Stoves from 1st crediting period
2. 2% drop off rate
3. Even installation of stoves over a year as a means to calculate project technology days
4. Seasonal weighted average of baseline consumption and latest PFT update in 2015/16.

**B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):**

>> The project activity reduces the amount of GHG emitted from the burning of fuelwood used for cooking by introducing an efficient cook stove, which replaces less efficient stove technology in Kenya.

**Additionality**

In order to demonstrate additionality of the project activity the UNFCCC's "Tool for the demonstration and assessment of additionality", Version 05.2 is used to show that the project activity would not possible to be implemented without carbon finance.

The project has never been publicly announced to be implemented without carbon finance. First local stakeholder meeting was conducted on 23 May 2008 discussing the possibilities of project activity with carbon funds. Discussion between myclimate and Eco2librium regarding funding this project started as early as April 2009. A MoU between Eco2librium and myclimate was signed on 29 September 2009. Local Stakeholder meeting according to Gold Standard requirements was conducted on 26 October 2009 and Stakeholder report was uploaded to Gold Standard registry on 10 December 2009. The project started with production and dissemination of first stoves on 25 Nov 2010. The stakeholder meeting for renewal of the crediting period was held on April 11, 2017.

Timeline of project history:

| Date | Decision | Source |
|---|---|---|
| 23 May 2008 | First local stakeholder meeting conducted | GS Passport |
| 29 Sept 2009 | MoU between Eco2librium and myclimate signed | MoU |
| 26 Oct. 2009 | Stakeholder meeting conducted according to GS requirements | Stakeholder Report |
| 10 Dec. 2009 | Stakeholder report uploaded to Gold Standard registry | GS registry |
| 20 Oct 2010 | VERPA between Eco2librium and myclimate | VERPA |
| 25 Nov 2010 | Start with production and dissemination of first stoves | Sales record |
| 11 April 2017 | Stakeholder meeting conducted according to GS requirements for renewal of crediting period | Stakeholder Report |

**Step 1: Identification of alternatives to the project activity consistent with mandatory laws and regulation:**

***Sub-step 1a: Define alternatives to the project activity:***

The output / service that the project activity is delivering is heat for cooking purposes to rural households who in the baseline scenario cook with wood using the 3-stone fire. Below, we provide a discussion of each of the alternatives that offer similar service of heat for cooking with comparable quality, properties and application area.[3]

*Alternative 1: cooking with 3-stone fireplace (current situation)*

Our original Kitchen/Baseline Survey (2011) and subsequent monitoring found that 99% of the population in target area use wood in the 3-stone fire. This is supported by the literature (Habermehl 1994, page 3, Kiefer and Bussman 2008, page 367) and a national survey (see Table below). Three stone fires are simply 3 stones arranged in a triangle and the cooking pot sits on the stones, while wood is burned under. The stones are available everywhere and free. Wood is also very plentiful in the project

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[3] To compare divergent fuels (e.g. LPG and wood) we calculated the cost of each fuel per a standard energy output. In other words, it is difficult to compare costs of fuels to cook using the units they are sold by (e.g. kilograms of charcoal, liters of kerosene). We converted each fuel into the amount of energy output using a standard energy unit – MMBTU's (million BTU's). This was done by first obtaining the heat/energy content (i.e. net calorie value) for each fuel (except electricity) from IPCC (2006, Chapter 1, Table 1.2), which is given in terajoules per million tons. We then converted this into MMBTU's per kilogram (using standard energy and mass conversions). We then converted each fuel into a cost per kilogram (i.e. kerosene is sold by the liter, so we used the density of kerosene to get the equivalent kilograms for every liter). Using cost per kilogram and MMBTU's per kilogram we then calculated cost per MMBTU's. See excel file "price per energy content of fuels" for more details.

area and virtually free; in our Kitchen/Baseline Survey, only 34% of respondents reported spending money on wood with the average amount, of those that spent money, being KES 514 per month (KES 17.1 per day). Those that collect from the forest sometimes pay a permit fee for a head load (KES 100). Head loads are also sold in markets at KES 175 (Amutabi 2017). Based on the average weight of a head load (29 kg) and the average price of a permit versus market price (KES 137), this equates to approximately KES 4.7 per kilogram.. Adjusted to cost per obtained energy this equates to KES 318 per MMBTU's (Table B.5.1; and see excel file: "price per energy content of fuels").

Table Summarizing findings by Kenya National Survey 2006

| Region | Kakamega | Vihiga | Busia | Bungoma | Siaya | Kisumu | Trans Nzoia | Nandi |
|---|---|---|---|---|---|---|---|---|
| % 3 stone fire | 87.7 | 83.1 | 90.0 | 87.9 | 86.2 | 47.8 | 74.0 | 56.5 |

*Alternative 2: cooking with charcoal stove*
Charcoal is readily available in the project area as well as the charcoal cookers and very little infrastructure is needed for this fuel source. The price of charcoal in this area retailed in 2016 between KES 1000 and KES 1500 ($10-15 USD). In Kenya in general, the price was about 960 KES in 2014 (www.allafrica.com/stories/201412051189). Although, we could find little evidence as to the weight of a charcoal sack, one report has one sack equal to approximately 55 kg (http://www.fao.org/docrep/Q1085e/q1085e0c.htm). This is supported by our own data of weighing sacks of charcoal in our region. If we use this Kenyan figure (800 KES/55 kg), this equates to about 14.54 KES per kilogram in 2010 and 17.45 KES per kilogram in 2014. If we adjust this to a cost per energy obtained, this equates to KES 520 per MMBTU's in 2010 and 624 KES per MMBTU's in 2014, which is over 5 times more than cooking with wood in both years (Table B.4.1; and see excel file: "price per energy content of fuels"). To add to that, a family must purchase a charcoal burning stove (jiko) to be able to cook with charcoal. These jikos retail in the region between KES 600.00 to KES 1600.00 ($6-16 USD) depending on the size and "model" (see "Nakumatt Quotation for Stoves").
*Alternative 3: Cooking with Kerosene stove*

*Kerosene:* Kerosene is readily available alternative to firewood. Kerosene is available primarily in towns in rural Kenya, which means families must travel to towns to obtain it. The cookers are also available, but sold primarily in towns as well. The most recent price from www.total.co.ke has kerosene at 67.2 KES per liter. Adjusted to cost per obtained energy this equates to KES 2,653 per MMBTU's in 2010 and 19,38 KES per MMBTU's in 2017, which is more than 25 times more than wood (Table B.4.1; and see excel file: "price per energy content of fuels"). In addition to the kerosene, a kerosene stove retails for about KES 990 (see "Nakumatt Quotation for Stoves"), and families must travel to obtain it, involving transport costs. From our Monitoring/Usage survey report from verifications (2011-2016), kerosene was reported as a secondary fuel in less than 5% of households.

*Alternative 4: cooking with LPG gas*

*LPG (liquid petroleum gas)*: LPG is sold in cylinders with a 13 kilogram cylinder of gas costing KES 2386 in 2014 in Kenya. Excluding the upfront cost of purchasing a LPG cylinder this equates to KES 183 in 2014. Adjusted to cost per obtained energy, LPG costs KES 4,134 per MMBTU's in 2014, which is over 35times more expensive than wood (Table B.5.1; and see excel file: "price per energy content of fuels"). In addition, LPG stoves retail from KES1300.00 to over KES10,000 ($16-$125 USD) (see "Nakumatt Quotation for Stoves"). Furthermore, LPG is only sold in urban areas and a family intending to use LPG would have to pay for transport to an urban area, plus transport of the LPG cylinder from the urban area to their home. From our Monitoring/Usage survey report from verifications (2011-2016), LPG was reported as a secondary fuel in less than 5% of households.

*Alternative 5: cooking with Electricity*

*Electricity*: Electricity is mostly unavailable in rural Kenya (http://www.csmonitor.com/2007/1115/p06s01-woaf.html, Abdullah and Markandya-page 3.pdf). Where it is available, there are costs of getting connected to the grid as well as paying for transformers that step down the voltage to homes (http://rru.worldbank.org/documents/publicpolicyjournal/006plas.pdf - page 3). Electricity costs are about KES 17.2 per kwh (see references in table above) which is 24 times more than wood (Table B.4.1; and see excel file: "price per energy content of fuels"). In addition, electric stoves retail from KES 6495 (see "Nakumatt Quotation for Stoves"). From our Monitoring/Usage survey report from verifications (2011-2016), electricity was reported as a secondary fuel in less than 1% of households.

*Alternative 6: project activity (efficient Upesi stoves) without carbon credit funding*

Based upon 2016 financials and number of stoves installed, the cost per stove based only on production, transportation and installation was $10.50 and based on overall operating expenses incurred in 2016 was $36.

Stoves for Life is selling installed stoves for 150 KES ($1.50 USD) for one-pot stoves, and 300 KES ($3.00 USD) for two-pot stoves. Upesi stoves burn wood and thus their cost per obtained energy would be similar to the 3-stone with adjustments for increased efficiency.

Table B.5.1: Comparison of fuels in terms of costs of cookers and adjuated cost of fuel per energy obtained (in million BTU's-MMBTU).

| Fuel | [1]Cost of cooker (KES) | [2]Cost of fuel per unit (KES/unit) | [3]Cost of fuel per kilogram (KES) | [4]Cost of fuel (KES) per MMBTU's | Total Cost to Cook |
|---|---|---|---|---|---|
| 3 Stone Wood | **0** | 137/head load | 4.7 | **318** | **318** |
| Charcoal | **510** | 996/sack | 28.9 | **1,034** | **1,544** |
| Kerosene | **991** | 67.2/liter | 67.2 | **1,619** | **2,610** |
| LPG | **4293** | 943/6kg cylinder | 157.0 | **3,501** | **7,794** |
| Electricity | **6495** | 17.2/kwh | NA | **5,041** | **11,536** |
| Upesi without carbon financing | **1049** | 137/head load | 4.7 | **318** | **1,367** |

1. Based on prices obtained from local supermarket (see pdf: "*nakumatt quotation for stoves*") and known price of Upesi. We obtained quotes (without VAT) from the local Nakumatt store in downtown Kakamega. For clarification in the quotation:
   Clay jikos = charcoal cookers
   Cook and Lite stoves = LPG cooker

2. Sources: Wood – Average permit for head load (100 KES) plus market price for head load (175 KES) – Amutabi et al. 2017
   Charcoal – survey data (and www.allafrica.com/stories/201412051189)
   LPG – average of 3 quotations from local vendors and www.businessdailyafrica.com

Electricity - https://stima.regulusweb.com/historic (April 2017 average over all sectors)

3. Sources: Wood: Amutabi et al. 2017 – average weight of head load = 29 kg (137 KES/29 kg = 4.7 KES/kg)
Charcoal weight per sack: based on survey data and weighed containers
LPG – average per quotation for refill of small 6 kg cylinder.

4. Sources: See excel file, "*price per energy content of fuels*"

***Outcome of Step 1a:***
The realistic and credible alternative scenarios to the project activity are:

1. Cooking on 3-stone fireplace (current situation)
2. Cooking with charcoal stove
3. Cooking with kerosene stove
4. Cooking with LPG stove
5. Cooking with electricity
6. Project activity (efficient Upesi stoves) without carbon credit funding

***Sub-step 1b. Consistency with mandatory laws and regulations:***
All alternatives comply with all mandatory applicable legislation and regulations.

***Outcome of Step 1b:***
The realistic and credible alternative scenarios to the project activity that are in compliance with mandatory legislation and regulations are:

1. Cooking on 3-stone fireplace (current situation)
2. Cooking with charcoal stove
3. Cooking with kerosene stove
4. Cooking with LPG stove
5. Cooking with electricity
6. Project activity (efficient Upesi stoves) without carbon credit funding

**Step 2. Investment analysis**
We are doing a Barrier Analysis, thus this step is not required by methodology.

**Step 3. Barrier analysis**
This step is conducted in order to determine whether the proposed project activity faces barriers that:
a) prevent the implementation of this type of proposed project activity; and
b) do not prevent the implementation of at least one of the alternatives.

The CDM Guidelines for Objective Demonstration of Assessment of Barriers (Version 02) are applied where necessary to substantiate barrier analysis.

***Sub-step 3a. Identify barriers that would prevent the implementation of the proposed project Activity:***

*Investment barrier:*
Capital investment is a significant barrier to this project in the absence of carbon financing for two reasons. First, the originalcredit rating for Kenya reported a rating of B+ (in 2010), which is four levels below investment grade (Bloomberg, by Paul Richardson, November 19, 2010. http://www.bloomberg.com/news/2010-11-19/kenyan-rating-is-raised-to-b-by-s-p-citing-political-economic-stability.html), and the rating has remained a B+ as of October 2016 (www.tradingeconomies.com) Thus, this credit rating deters private capital investment, as a B+ rating is far below what is generally perceived as an acceptable risk. To our knowledge, there are no known private entities that use or have used investment capital to implement similar project activities in the region.
Second, the project generates no rate of return without carbon financing because the cost of producing, distributing, and installing stoves exceeds the revenue generating from the sale of stoves. It is the specific design of the project to sell stoves at a price that is affordable to all rural households (in a region where more than 50% of the people earn less than $1 per day (KNBS 2009; UNDP 2005, NCADP 2005, page 7), and to use the sell of stoves to generate jobs and income for the same people.

Based upon 2016 financials and number of stoves installed, the cost per stove based only on production, transportation and installation was $10.50 and based on overall operating expenses incurred in 2016 was $36.
Stoves for Life is selling installed stoves for 150 KES ($1.50 USD) for one-pot stoves, and 300 KES ($3.00 USD) for two-pot stoves. This price is not sufficient to cover costs.

**Role of Carbon Financing**. The selling of VER's provide almost 100% of the inflows. This clearly shows that carbon funds are critical for implementing project activities.A significant part of the project investment was provided upfront by myclimate as a pre-payment for expected GS VERs. This is an objective demonstration (as per CDM Guidelines for Objective Demonstration of Assessment of Barriers (Version 01), page 4/5, Guideline 6, Example 2) that the GS actually enabled the financing of the project. This is an objective means to demonstrate the barrier.

*Financial barrier:*
Poverty levels (< $1 USD per day) in this region are estimated to be over 50% (KNBS 2009; UNDP 2005, NCADP 2005 -Kakamega, page 7, NCAPD 2005-Vihiga, page 7) with many households having no source of consistent income (Dose 2007, page 17). Dose (2007) concluded that families in this area lack the income and capital to break the cycle of poverty without introduced funding. UNEP (2006) proposed the policy to remove the barriers to adoption of energy efficient stoves in Kenya and one of these identified barriers was access to innovative funding mechanisms (page 50). The Upesi stove has historically sold for $2-4 USD (see references in Investment Barrier) and based upon project expenses from 2016stoves cost over $36 (if all costs are included – see Table a below) and $10.50 (if only direct costs associated with stove production, transportation, and installation are included – see Table b below). See contracts with stove producers, sellers, and installers in Annex 7, as well as excel file, *"November_May_OpCosts"* for details. Transportation costs are based upon monthly expenses for transportation divided by the number of stoves transported that month.

Table a: Average cost per stove (2016) based upon total project costs (excluding U.S. costs)

| **Item** | **Value** |
|---|---|

| | |
|---|---|
| Total expenses | $194,669 (excludes all U.S. costs – e.g. Director salaries) |
| Number of stoves installed | 5265 |
| **Average cost per stove** | **$36.97** |

Table b: Cost per stove* (2016) based upon what is paid to people to produce, transport, and install stoves.

| **Item** | **Value** |
|---|---|
| Production | 225 KES ($2.25) |
| Transportation | 100 KES ($1) |
| Installation | 600 KES ($6) |
| Other PD&I (ex. serialization, etc.) | 125 KES ($1.25) |
| **Cost per stove** | **1050 KES ($10.50)** |

*Costs provided are for a two-pot stove. A two-pot stove makes up about 90% of installations
Carbon financing allows ECO2 to sell the stoves at subsidized prices for $1.50 (one-pot stove) and $3.000 (two-pot stove). At this price, the demand for stoves is very high.

*Barrier due to prevailing practice:*
Most households in this region use the traditional 3-stone cooking method (Habermehl 1994, page 3, Kiefer and Bussman 2008, page 367, Kitchen Survey 2010/2011, KNBS 2006) and habitual and essentially free use of this method, in the context of poverty (UNEP 2006, page 40), will impose a strong barrier to adoption of stoves without the project. Although the project technology (Upesi energy efficient cook stove) was introduced into the area around 20 years ago (Habermehl 1994), it was not currently widely used. Specifically, the Kakamega Integrative Conservation Project, in collaboration with Intermediate Technology Development Group reported installing 1123 Upesi stoves in the Kakamega forest communities by the end of 2001 (www.mnh.si.edu/kakamega/energy.html); Debaan reported in 2003 that 10,000 Upesi stoves had been installed since 2000 (www.kfpe.ch/projects/echangesuniv/de_baan.php); GTZ reported installing 25,870 Upesi stoves (called Maendeleo) in the whole of Kenya up to 2006 (http://www.bioenergylists.org/en/ingwegtzkenya). In our Kitchen Survey in 2010/2011 in the targeted population within the project area, we found that only 1% had the Upesi stove in use. Although projects have tried to sell Upesi stoves, the number still represents a small percentage of households. UNEP (2006) suggested that as poverty levels remain constant, it is difficult to purchase energy efficient stoves like the Upesi (page 40). We could find no evidence of projects since 2006 that have installed Upesi stoves in our project area. If we even assume that all recorded stoves (including numbers for all of Kenya) are present in households in our project area in 2011 (35,870: 10,000 by Debaan in 2003 + 25,870 by GTZ by 2006), with at least 263,209 households in project area in the early 2000's (see Baseline Section under fNRB for details), this represents only 13.6% of total households with the project technology. The actual proportion is probably much lower since we found only 1% of households with a Upesi stove in 2010/2011 (Baseline/Kitchen Survey 2010/2011). This is additionally supported by the UNEP (2006) report which set forth energy goals to increase adoption of energy efficient wood stoves in rural Kenya to 10% (page 47). Based upon the criteria set forth in the applied methodology (page 9, 1st paragraph), the evidence suggest that less than 20% of the households in the target population used the project technology, and thus there is a barrier due to first of its kind.

***Sub-step 3 b. Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity)***

The barriers discussed above do not affect the alternative scenario of the continuation of the current situation (1. Cooking on 3-stone fireplace). The current situation, represented by our target population of rural households, is cooking with wood using a 3-stone fire. Three stone fires are simply 3 stones arranged in a triangle and the cooking pot sits on the stones, while wood is burned under. The stones are available everywhere and free. Wood is also very plentiful in the project area and virtually free (see above). This is supported by the literature (Habermehl 1994, page 3, Kiefer and Bussman 2008, page 367).

- *Financial Barrier*: Because the stones defining the stove are free and wood is available and free for most, the cost of using wood in the 3-stone is negligible, especially in comparison with the alternatives. For comparison among alternative fuels, we adjusted the cost of each fuel based upon obtained energy (Table B.5.1; and see excel file: "price per energy content of fuels"). Cooking with wood costs KES 318 per million BTU's (MMBTU's), which is more than 5 times lower than the least expensive alternative (charcoal), and therefore finances do not prevent the current situation.

- *Technology/Capacity Barrier:* No technology is required for the 3-stone fire cooking with wood and it has been culturally used for thousands of years, therefore the barrier of technology/capacity would not prevent continuation of the current situation.

- *Prevailing Practice Barrier:* Three-stone fires cooking with wood can be found in 70-99% of households in our project area (Habermehl 1994, page 3, Kiefer and Bussman 2008, page 367, Kitchen/Baseline Survey 2010/2011, KNBS 2006) in the baseline scenario. This is the prevailing practice and thus prevailing practice would not prevent the same current situation from continuing.

The barriers prevent the other alternative scenarios of cooking with charcoal, kerosene, LPG, electricity and the project activity without carbon funding.

2. Based upon the financial situation for most people in this area in which poverty is over 50%, income is low and often less than expenditures (Dose 2007), and the relative costs of cooking with wood versus the alternatives (see Table B.5.1), cooking with charcoal, kerosene, LPG, and electricity are prevented by financial barriers. For example, cooking with charcoal is 4.8 times that of wood, cooking with kerosene is 8.2 times that of wood, cooking with LPG is 24.5 times that of wood and cooking with electricity is 27.5 times that of wood. LPG and electricity (see above) also do not have infrastructure for rural people and thus are also prevented by technical barriers.

**Project activity (efficient Upesi stoves) without carbon funding**: Upesi stoves were introduced into the project area around 20 years ago (stopping in 2006) using European funding to offer it at a 'controlled nominal price' around KES 120 (see Prevailing Practice above). Our Baseline/Kitchen Survey (2010/2011) found that 99% of households are still cooking with the 3-stone, suggesting that the introduction of these energy efficient stoves was not successful longterm. This is supported by UNEP (2006) which stated energy efficient stove goals of reaching 10% of rural Kenya households (i.e. if the actual number of stoves in households was higher than 10%, then it is presumed that there would not be a goal to reach that number but a higher number). Based only upon actual costs of production, distribution and installation of stoves, stoves would cost KES 1049. Adding all operational costs (etc. management salaries, etc.) the costs would increase four times. In the context of little or no income (seeabove) in the targeted population, Upesi stoves (without carbon financing) is not a financially viable alternative to the 3-stone and wood. Thus, prevailing practice and financial barriers prevent this alternative.

As all other alternatives face one or more barriers, the baseline of the project activity is Alternative 1 representing the current situation (cooking on 3-stone fireplace)

Overview of the barriers faced by the different alternatives:

| | Alternative 1: Cooking on the 3-stone fireplace | Alternative 2: Cooking with charcoal stove | Alternative 3: Cooking with Kerosene stove | Alternative 4: Cooking on a LPG stove | Alternative 5: Cooking on a electric stove | Alternative 6: Efficient Upesi stove without carbon finance |
|---|---|---|---|---|---|---|
| Financial barrier* | n/a | x | x | x | x | x |
| Lack of capacity/technology barrier | n/a | | | x | x | |
| Barrier of prevailing practice | n/a | | x | x | x | x |

*We assume, based upon the financial barrier analysis (see above),that this barrier applies to all alternatives except the current situation of cooking with wood on a 3-stone fire.

***Conclusions***

The barriers discussed above prevent the implementation of the project activity without carbon funding as well as alternative scenarios discussed. Therefore, the most likely alternative scenario, the baseline scenario, is the continued use of low efficient 3-stone fires using wood for cooking.

Gold Standard registration will give the project the needed funding to overcome barriers as follows:

Investment Barrier: Forecasted revenues from carbon credits and upfront financing based upon future selling of carbon credits allowed ECO2 to attract an investor. ECO2 obtained pre-payment from Foundation myclimate toward the future delivery of carbon credits. Financing of the project was only assured due to the benefit of the Gold Standard Registration.

- Financial Barrier: Revenues from carbon credits allow the project to subsidize stoves and sell them $35.00 below actual costs per stove ($36.00 per stove – see Financial Barrier above) making them affordable to poor, rural households. Carbon funds also allow ECO2 to create awareness activities among local population, and capacity build local production groups. The carbon funds also provide the jobs for production, distribution and installation of stoves.
- Prevailing Practice Barrier: Although Upesi stove projects have occurred among target population in project area in the last 20 years, greater than 90% of the households were still cooking with the 3-stone (Kiefer and Bussman 2008, Baseline/Kitchen Survey 2010/2011). Carbon funding will allow ECO2 to sell stove at price that will overcome this prevailing practice

barrier. Project records since December 2010 show that at the subsidized price, the demand is very high.

Based upon the analysis above, the project activity would not be implemented without carbon funds and is therefore additional.

## B.6. Emission reductions:

### B.6.1. Explanation of methodological choices:

>> Gold Standard Methodology "Technologies and Practices to Displace Decentralized Thermal Energy Consumption (24/04/2015)" was applied to estimate emission reductions. Thus all requirements found in methodology are used here.

1. Project boundary

a. Project Boundary:

The project boundary is defined by the domestic kitchens of the project population using the specific models of improved cook-stoves and the specific GHG-reducing measures introduced by the project. In this case the project boundary is defined as including the place of the kitchens where the project stoves are applied. See map on page 9.

b. Target Area:

The target area is the area, in which the project has its target population. In this case the target area is defined as delineated in the map in Figure 2 under 4.1.4. and includes counties within the western part of Kenya. Within this area, the target population are rural households that use wood in the 3-stone stove.

c. Fuel Collection Area:

This Fuel Collection area is the area within the project boundary and also includes all of Kakamega National Forest and North and South Nandi Forest and Mt. Elgon Forest (green areas) in Figure 2 under 4.1.4.

Emission Sources included in project boundary: We included those from production, transportation and consumption of fuels related to project.

2. Selection of baseline scenarios and project scenarios

The applied methodology states that where all units are non-industrial the baseline is by default a fixed baseline with no monitoring of baseline parameters during the crediting period. The baseline scenario is defined by the "typical baseline fuel consumption pattern" in the population targeted.

Project scenario includes the installation of the one-pot and two-pot Upesi stoves which from the Baseline and Project Field Performance Test (2010/2011) have shown to have significantly different fuel consumption patterns. They are thus monitored and credited separately.

3. Additionality

As required by the Gold Standard Methodology the most recent version of the UNFCCC's "Tool for the demonstration and assessment of additionality", in this case Version 07.0, is used to demonstrate additionality. Details of the additionality assessment can be found in section B.5 of this PDD.

4. Baseline emissions
Baseline emissions are calculated as outlined in the stated applied methodology . The sections B.4. step. 2.4 and B.6.3. of this PDD describe the mode for calculating baseline emissions.

5. Project emissions
Project emissions are calculated as outlined in the stated applied methodology The sections B.4. step. 2.4 and B.6.3. of this PDD describe the mode for calculating project emissions.

6. Leakage
Leakage emissions are assessed as outlined in the stated applied methodology. Leakage effects for this project are assessed and discussed in section B.4. step. 2.4 of this PDD. Leakage effects are considered to be insignificant and thus overall leakage of this project is L = 0.

7. Emissions reduction
Emission reductions are calculated as outlined in the stated applied methodology.
We used equation 1 (page 15) where baseline and project fuels are similar:

$$ERy = \Sigma_{b,y} (N_{p,y} * U_{p,y} * P_{p,b,y} * NCV_{b,fuel} * (f_{NRB,b,y} * EF_{fuel,CO2} + EF_{fuel,\ nonCO2})) – LE_{p,y}$$

Where:

$\Sigma_{b,y}$ = sum over all relevant (baseline b/project p) couples

$N_{p,y}$ = cumulative number of project technology days included in the project database for project scenario p against the baseline scenario b in year y.

$U_{p,y}$ = cumulative usage rate for technologies in project scenario p in year y, based on cumulative adoption rate and drop off rate revealed by usage surveys (fraction)

$P_{p,b,y}$ = Specific fuel savings for an individual technology of project p against an individual technology of baseline b in year y, in tons/day, as derived from the statistical analysis of the data collected from field tests.

$NCV_{b,fuel}$ = Net calorific value of the fuel that is substituted or reduced ((IPCC default for wood fuel, 0.015 TJ/ton)

$f_{NRB,b,y}$ = fraction of biomass used in year y for baseline scenario b that can be established as non-renewable biomass

$EF_{fuel,CO2}$ = CO2 emission factor of the fuel that is substituted or reduced. 112 tCO2/TJ for wood/wood waste.

$EF_{fuel,\ nonCO2}$ = Non-CO2 emission factor of the fuel that is reduced

$LE_{p,y}$ = leakage for project scenario p in year y (tCO2eq/yr)

In the above formula, $P_{b,p,y}$ (which is fuel savings between baseline and project scenarios) was calculated in the following way. First, from the literature and Kitchen/Baseline Surveys, we confirmed that the 3-stone with wood for cooking is the baseline scenario. We then conducted two paired sample Baseline and

Project Field Performance Tests (wet season and dry season) with a randomly drawn sample size from the sales record.. In the Field Performance Test, we weighed fuelwood consumption in the baseline scenario then fuelwood consumption in the project scenario (with Upesi efficient stove) keeping other variables to a miminum. Based upon the Kitchen/BaselineSurvey, which confirmed pre-defined clusters/scenarios (one-pot stove users and two-pot stove users), we conducted the Field Performance Test on each of these clusters/scenarios. We calculated both daily household and yearly household wood savings (Baseline wood use – Project wood use) and used the estimated mean fuel savings as $P_{b,p,y.}$ We used a weighted average from the wet and dry season estimations. For exante emission estimations we assumed usage rate ($U_{p,y}$) at 100% and cumulative number of project days ($N_{p,y}$) as 365. ER is calculated for each of the clusters and then summed.

### B.6.2. Data and parameters that are available at validation:

| **Data / Parameter:** | EFb,co2 |
|---|---|
| Data unit: | tCO2/t_fuel |
| Description: | CO2 emission factor arising from use of wood-fuel in baseline scenario |
| Source of data used: | 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Tables 1.2/2.5 |
| Value applied: | 1.7472 tCO2/t wood |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Default IPCC values for wood / wood waste are applied |
| Any comment: | |

| **Data / Parameter:** | EFb,non-co2 |
|---|---|
| Data unit: | tCO2/t_fuel |
| Description: | Non-CO2 emission factor arising from use of wood-fuel in baseline scenario |
| Source of data used: | 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Table 2.5 |
| Value applied: | 0.1356 tCO2eq/t wood (CH4: 0.1170 tCO2e/t wood; N2O: 0.0186 tCO2eq/t wood) |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Default IPCC values for CH4 and N20 emissions for wood / wood waste are applied and summed.<br>The following GWP100 are applied: 25 for CH4, 298 for N20 |
| Any comment: | |

| **Data / Parameter:** | EFp,co2 |
|---|---|

| | |
|---|---|
| Data unit: | tCO2/t_fuel |
| Description: | CO2 emission factor arising from use of wood-fuel in project scenario |
| Source of data used: | 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Tables 1.2/2.5 |
| Value applied: | 1.7472 tCO2/t wood (=112.0 tCO2/TJ * 0.0156 TJ/ t ) |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Default IPCC values for wood / wood waste are applied |
| Any comment: | |

| | |
|---|---|
| **Data / Parameter:** | EFp,non-co2 |
| Data unit: | tCO2/t_fuel |
| Description: | Non-CO2 emission factor arising from use of wood-fuel in project scenario |
| Source of data used: | 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Table 2.5 |
| Value applied: | 0.1356 tCO2eq/t wood (CH4: 0.1170 tCO2e/t wood; N2O: 0.0186 tCO2eq/t wood) |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Default IPCC values for CH4 and N20 emissions for wood / wood waste are applied and summed.<br>The following GWP100 are applied: 25 for CH4, 298 for N20 |
| Any comment: | |

The parameter $NCV_b$ and $NCV_p$ are not applicable to this project since EF in units of tCO2/t_fuel. These parameters are therefore not listed here (see methodology page 21).

**Parameters supplied but not monitored**. Since a fixed baseline is applied, the following baseline parameters are also known. They will not be monitored.

| | |
|---|---|
| **Data / Parameter:** | fnrb,i,y |
| Data unit: | Fractional non-renewability |
| Description: | Non-renewability status of woody biomass fuel in scenario I during year y |
| Source of data used: | CDM default value for Kenya http://cdm.unfccc.int/DNA/fNRB/index.html |
| Value applied: | 92.0% |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | The CDM default value for fNRB published on the CDM website for Kenya and approved by the Kenyan DNA is applied. |
| Any comment: | The NRB fraction is updated, because now an official CDM default value is |

| | |
|---|---|
| | available for Kenya.<br>The applied methodology states on page 25: "The non-renewable biomass fraction is fixed based on the results of the NRB assessment. Over the course of a project activity the project proponent may at any time choose to re-examine renewability by conducting a new NRB assessment. In case of a renewal of the crediting period and as per GS rules, the NRB fraction must be reassessed as any other baseline parameters and updated in line with most recent data available". |

| **Data / Parameter:** | Pb1,y |
|---|---|
| Data unit: | t_biomass/unit-year and t_biomass/unit-day |
| Description: | Quantity of woody biomass consumed in the baseline scenario 1 (2-pot) during in year y and per day in year y. |
| Source of data used: | Baseline and Project Field Performance Test 2011 and 2013 |
| Value applied: | 2-pot scenario: 4.43 t wood/year and 0.01214 t wood/day |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Estimated mean (justified because statistical analysis fits within 90/30 rule). |
| Any comment: | |

| **Data / Parameter:** | Pb2,y |
|---|---|
| Data unit: | t_biomass/unit-year and t_biomass/unit-day |
| Description: | Quantity of woody biomass consumed in the baseline scenario 2 (1-pot) during year y |
| Source of data used: | Baseline and Project Field Performance Test 2011 and 2013 |
| Value applied: | 1-pot scenario: 3.55 t wood/year or 0.00973 t wood/day |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Estimated mean (justified because statistical analysis fits within 90/30 rule). |
| Any comment: | |

### B.6.3. Ex-ante calculation of emission reductions:

>>

The ex-ante calculation of emission reductions in based upon the following formula (see above):

$ERy = \Sigma_{b,y} (N_{p,y} * U_{p,y} * P_{p,b,y} * NCV_{b,fuel} * (f_{NRB,b,y} * EF_{fuel,CO2} + EF_{fuel,\ nonCO2})) – LE_{p,y}$

In the above formula, the primary number to be calculated (from field Kitchen Performance Tests) is fuel savings ($P_{p,b,y}$). We following is the summary data from the field Kitchen Performance Tests, including fuel savings ($P_{p,b,y}$) in tons/year and tons/day (as per methodology) for each cluster (one-pot stoves and two-pot stoves):

Scenario 1: installed 2-pot stove:

| | Scenario 1 (2pot stoves) | | Scenario 2 (1pot stoves) | |
|---|---|---|---|---|
| | Daily (t wood) | Annual (t wood) | Daily (t wood) | Annual (t wood) |
| [1]Baseline | .0121 | 4.42 | .0097 | 3.55 |
| [2]Project | .0053 | 1.95 | .0055 | 2.01 |
| Savings | .0068 | 2.41 | .0042 | 1.54 |

[1]Baseline figures are weighted averages for separate wet and dry season BPFT.
[2]Project figures are from the latest PPFT updates (2015 and 2016) and are weighted averages for separate wet and dry season tests.

Based on the above fuel savings ($P_{p,b,y}$) in tons/day, the overall reductions of GHG emissions induced by the project are estimated as follows (based upon EF for non-CO2 gases, CH4 and N20, summing to 0.304 [CH4=0.3, N2O=0.004), and assuming a 1.0 usage rate ($U_{p,y}$) and 365 days of cumulative project-days ($N_{p,y}$)

$$ER_y = \Sigma_{b,y} (N_{p,y} * U_{p,y} * P_{p,b,y} * NCV_{b,fuel} * (f_{NRB,b,y} * EF_{fuel,CO2} + EF_{fuel, nonCO2})) – LE_{p,y}$$

One-pot $ER_y$ = 365 * 1.0 * 0.0042 * (0.92 * 1.7472 + 0.1356) – 0
= 2.67 tCO2eq

Two-pot ERy = 365 * 1.0 * 0.0068 * (0.92 * 1.7472 + 0.1356) – 0
= 4.33 tCO2eq

*NCV was excluded because EF was in units of tCO2e/t fuel as per methodology (page 21).

| Project Year | Monitoring/Crediting Dates | Number of new One-pot stoves installed | Number of new Two-pot stoves installed | ER One-Pot Stoves | ER Two-Pot Stoves | Total Expected ER volume |
|---|---|---|---|---|---|---|
| 8 | Nov 25, 2017 - Dec 31, 2018 | 1,100 | 9,900 | 22,987 | 175,657 | 198,644 |
| 9 | Jan 1, 2019 - Dec 31, 2019 | 1,600 | 14,400 | 26,201 | 225,241 | 251,443 |
| 10 | Jan 1, 2020 - Dec 31, 2020 | 2,000 | 18,000 | 30,347 | 288,702 | 319,049 |
| 11 | Jan 1, 2021 - Dec 31, 2021 | 2,000 | 18,000 | 34,665 | 354,706 | 389,371 |
| 12 | Jan 1, 2022 - Dec 31, 2022 | 1,600 | 14,400 | 38,233 | 409,516 | 447,749 |
| 13 | Jan 1, 2023 - Dec 31, 2023 | 1,100 | 9,900 | 40,246 | 442,737 | 482,983 |
| 14 | Jan 1, 2024 - Dec 31, 2024 | 500 | 4,500 | 40,906 | 455,726 | 496,633 |
| **Total for 2nd Crediting Period** | | | | | | **2,585,872** |

* The above chart does not follow PDD guidelines to include a baseline emissions column, project emissions column, and leakage emissions column because those are subsumed in the equation used in the applied methodology to calculate ER.

*Emission reduction calculations include stoves installed in first crediting period. Calculations are based pm" (1) fuel savings based on above figures (page 59), (2) usage rates that drop 1% per year, (3) project technology days calculated based on stoves installed evenly throughout the year.

### B.6.4 Summary of the ex-ante estimation of emission reductions:

>>
Total emission reduction estimates for the 2nd crediting period: 2,585,872

## B.7. Application of the monitoring methodology and description of the monitoring plan:

Applied monitoring methodology:
Section III of the "Technologies and Practices to Displace Decentralized Thermal Energy Consumption – 11/04/2011"

### B.7.1 Data and parameters monitored over the crediting period:

Since a fixed baseline scenario is applied, the baseline parameters mentioned under B.6.2. are not monitored. All data collected as part of monitoring will be archived electronically and be kept at least for 2 years after the end of the crediting period.

| **Data / Parameter:** | $P_{p1,y}$ |
|---|---|
| Data unit: | t_biomass/unit-year and t_biomass/unit-day |
| Description: | Quantity of woody biomass consumed in the project scenario 1 (2-pot) during year y |
| Source of data: | Total sales record, Project Field Tests (FT), project FT updates, and any applicable adjustment factors |
| Monitoring frequency | Updated every two years |

| | |
|---|---|
| QA/QC procedures: | Transparent data analysis and reporting (see Monitoring Plan below for more specific QA/QC). |
| Any comment: | A single project fuel consumption parameter is weighted to be representative of the quantity of project technologies of each age being credited in a given project scenario. |

| **Data / Parameter:** | $P_{p2,y}$ |
|---|---|
| Data unit: | t_biomass/unit-year and t_biomass/unit-day |
| Description: | Quantity of woody biomass consumed in the project scenario 2 (1-pot) during year y |
| Source of data: | Total sales record, Project FT, project FT updates, and any applicable adjustment factors |
| Monitoring frequency | Updated every two years |
| QA/QC procedures: | Transparent date analysis and reporting (see Monitoring Plan below for more specific QA/QC). |
| Any comment: | A single project fuel consumption parameter is weighted to be representative of the quantity of project technologies of each age being credited in a given project scenario. |

| **Data / Parameter:** | $U_{p,y}$ |
|---|---|
| Data unit: | Percentage |
| Description: | Usage rate in project scenario p during year y |
| Source of data: | Annual usage survey |
| Monitoring frequency | Annually |
| QA/QC procedures: | Transparent data analysis and reporting (see Monitoring Plan below for more specific QA/QC) |
| Any comment: | A single usage parameter is weighted to be representative of the quantity of project technologies of each age being credited in a given project scenario |

| **Data / Parameter:** | $N_{p,y}$ |
|---|---|
| Data unit: | Project technologies credited (units) |
| Description: | Technologies in the project database for project scenario p through year y |
| Source of data: | Total sales record |
| Monitoring frequency | Continuous |
| QA/QC procedures: | Transparent data analysis and reporting (see Monitoring Plan below for more specific QA/QC). |
| Any comment: | The total sales record is divided based on project scenario to create the project database |

| **Data / Parameter:** | $LE_{p,y}$ |
|---|---|
| Data unit: | t_CO2eq per year |
| Description: | Leakage in project scenario p during year y |
| Source of data: | Baseline and monitoring surveys |
| Monitoring frequency | Every two years (i.e. every other year) |

| | |
|---|---|
| QA/QC procedures to be applied: | Transparent data analysis and reporting (see Monitoring Plan below for more specific QA/QC). |
| Any comment: | Aggregate leakage can be assessed for multiple project scenarios |

| **Data / Parameter:** | Similar Cook Stove Project Activities in the Project Area |
|---|---|
| Data unit: | Number of projects and/or extent of overlap |
| Description: | List of similar cook stove projects and an assessment of how (e.g. target population, cook stove type, etc.) and to what degree overlap occurs |
| Source of data: | Various sources (e.g. GS registry, physical evidence on ground, etc.) |
| Monitoring frequency | Every year |
| QA/QC procedures to be applied: | NA |
| Any comment: | |

*Sustainable Development Indicators monitored (copied from Gold Standard Passport):*

| | | |
|---|---|---|
| No | | 1 |
| Indicator | | Air Quality |
| Mitigation measure | | na |
| *Repeat for each parameter* | | |
| Chosen parameter | | *# of positive comments from users of stoves about improvements in indoor air quality since use of stove in Kitchen/Monitoring Survey (Question #15 in Annex 3 of Monitoring Manual)* |
| Current situation of parameter | | Considerable indoor exposure to cooking smoke |
| Future target for parameter | | Expect participants to respond that indoor air quality has improved over baseline (3-stone). |
| Way of monitoring | How | Questionnaire at households according to appropriate sampling methodologies (see Management of Monitoring below). This questionnaire (Annex 3 of Monitoring Manual) has a question (#15) which will be summarized and analyzed annually just prior to verification. |
| | When | Annually |
| | By who | Eco2librium Research/Monitoring Coordinator |

| | | |
|---|---|---|
| No | | 3 |
| Indicator | | Soil Condition |
| Mitigation measure | | Rotation and planting of stabilizing plants |
| *Repeat for each parameter* | | |
| Chosen parameter | | Occurrence of rotation and area planted with stabilizing plants. |
| Current situation of parameter | | Certain areas of unstabilized soil exist where clay is harvested near streams for making liners. |
| Future target for parameter | | Through mitigation of rotating extraction sites (which minimizes impact) and planting natural grasses in extraction sites, we expect more area of stabilized soil in regions where soil was unstabilized due to extraction. |
| Way of monitoring | How | Observation and measurement of area. |

| | | |
|---|---|---|
| | | NEMA guidelines including their recommendations for mitigation measures will be followed. |
| | When | Annually |
| | By who | Eco2librium Research/Monitoring Coordinator |

| | | |
|---|---|---|
| No | | 7 |
| Indicator | | Livelihoods of the poor |
| Mitigation measure | | na |
| *Repeat for each parameter* | | |
| Chosen parameter | | *Amount of time (in frequency of trips per week) for fuelwood collection per household* |
| Current situation of parameter | | Currently people with 3-stone fires make an average of 2.3 trips per week collecting wood for cooking (Baseline Survey 2010/2011). |
| Future target for parameter | | Expect average time spent collecting wood per week to decrease. |
| Way of monitoring | How | Kitchen/Monitoring Survey at households according to sampling methodology described below (Management of Monitoring), completed prior to verification. This survey has a question (see Monitoring Manual, Annex 3, question #11) which asks stove users how much time they spend collecting wood per week. This question will be summarized and analyzed yearly. |
| | When | Annually |
| | By who | Eco2librium Research/Monitoring Coordinator |

| | | |
|---|---|---|
| No | | 8 |
| Indicator | | Access to clean and affordable energy |
| Mitigation measure | | na |
| *Repeat for each parameter* | | |
| Chosen parameter | | *Number of people using energy efficient cooking methods* |
| Current situation of parameter | | Reports show that the majority of households in area use the three-stone method. |
| Future target for parameter | | Project will put about 100,000 new energy efficient stoves into households. |
| Way of monitoring | How | Sales records |
| | When | Annually |
| | By who | Eco2librium Research/Monitoring Coordinator and Project Manager |

| | |
|---|---|
| No | 9 |
| Indicator | Human/institutional capacity |
| Mitigation measure | na |
| *Repeat for each parameter* | |
| Chosen parameter | *Number of women in area receiving a training and income for stoves.* |
| Current situation of parameter | Women are generally not trained in this region but those that are |

| | | |
|---|---|---|
| | | often lack the capacity to apply training towards generating an income. |
| Future target for parameter | | Project is expected to train and generate income for approximately 30 women. |
| Way of monitoring | How | Project financial records (e.g. payment receipts) and summaries/minutes of training sessions will be summarized for every year of project crediting period. These can show income to women as well as number of women receiving capacity building or skill training. |
| | When | Annually |
| | By who | Eco2librium Research/Monitoring Coordinator |

| | | |
|---|---|---|
| No | | 10 |
| Indicator | | Quantitative Employment and Income Generation |
| Mitigation measure | | na |
| *Repeat for each parameter* | | |
| Chosen parameter | | *Number of people receiving an income.* |
| Current situation of parameter | | Currently, no people are receiving an income from project activities. |
| Future target for parameter | | Project will provide income to approximately 100 people directly for project crediting period. |
| Way of monitoring | How | Project financial records (e.g. payment receipts) will be summarized annually for project crediting period to include the number of people receiving income each year |
| | When | Annually |
| | By who | Eco2librium Research/Monitoring Coordinator |
| Chosen parameter | | *Number of people receiving an income in excess of what they were earning prior to project.* |
| Current situation of parameter | | Currently, no people are receiving an income from project |
| Future target for parameter | | Project will provide income to approximately 100 people in amounts that was more than they earned prior to project. |
| Way of monitoring | How | Project financial records (e.g. payment receipts) will be summarized annually for project crediting period and compared with signed statements from those receiving income about amounts of their previous earnings. |
| | When | Annually |
| | By who | Eco2librium Research/Monitoring Coordinator |

### B.7.2. Description of the monitoring plan:

>> The applied methodology requests the following continuous, annual, and periodic monitoring activities which are described briefly below. For more details, please refer to document titled: "Monitoring Manual."

**A. Total Sales Record**

The following data are recorded for all sold stoves;

- Date of Sale (we use *Date of Installation*)
- Geographic area of sale (includes village, GPS coordinates, and larger political boundaries)
- Model/type of stoves sold
- Quantity of stoves sold
- ID number of stove
- Cluster inclusion
- Name, telephone number, and address - where possible (i.e. some end users to not have phones and there are no number/street name addresses in this area)
- Mode of use: all stoves are domestic
- We also record the following –
    - a unique household ID number (because some houses have more than one stove ID)
    - Scott's club number (another way to cross reference) and this number is used for random drawings for incentive award program
    - Seller and installer names – a means of keeping track of information

**B. Project database**

The project database is derived from the Total Sales Record with project technologies differentiated by different project scenarios. The differentiation of the project database into sections is based on the results of the applicable monitoring studies for each project scenario, in order that ER calculations can be conducted appropriately section by section.

**C. Ongoing Monitoring Studies**

Ongoing monitoring studies are conducted for each project scenario following verification of the associated initial project studies. These monitoring studies investigate and define parameters that could not be determined at the time of the initial project studies or that change with time.

**a) Monitoring survey –** completed annually, beginning 1 year after project registration:
The monitoring survey investigates changes over time in a project scenario, by surveying end users with project technologies, on an annual basis. It provides critical information on year-to-year trends in end user characteristics such as technology use, fuel consumption and seasonal variations, as well as SD indicators

**b) Usage Survey -** Completed annually or in all cases on time for any request of issuance:
The usage survey provides a single usage parameter that is weighted based on drop off rates that are representative of the age distribution for project technologies in the total sales record. A usage parameter must be established to account for drop off rates as project technologies age and are replaced.

**c) Project FT Update -** Completed every other year, or more frequently:
The PFT update is an extension of the project PFT and provides a fuel consumption assessment representative of project technologies currently in use every two years. Hence the PPT update accounts for changes in the project scenario over time as project technologies age and new customers are added, also as new models and designs are introduced. It is legitimate to apply an Age Test instead of a PFT, to project technologies which remain materially the same year after year.

**d) Baseline FT Update:**

This monitoring study is omitted since a fixed baseline is applied.

**e) Leakage Assessment -** Completed every other year, starting on time for the first verification

**f) Non-Renewable Biomass Assessment Update:**
The non-renewable biomass fraction is fixed based on the results of the NRB assessment. Over the course of a project activity the project proponent may at any time choose to re- examine renewability by conducting a new NRB assessment.

**Management of Monitoring Activities:**
Monitoring will occur through a Monitoring/Research Coordinator (with staff) hired full time by project. This person and staff will receive oversight and guidance from the Field Director. This person and staff, in collaboration with Operations Coordinator, will coordinate all data collection specifically regarding continuous measures (e.g. total sales records)). This person and staff will also coordinate independently the collection of all annual (e.g. Usage survey) and periodic measures (e.g. Aging stove data). All data will be gathered in hard copy in the field by the Monitoring Coordinator and staff. MC will then input data into digital files. This will be checked for QC/QA by the Field Director with "spot" checks using hard copies in comparison with digital. All data will be archived as hard copies in ECO2-Kenya field office and in digital achives in ECO2 Headquarters Executive Director and with ECO2-Kenya Field Director. For more details, see supporting document titled: "Monitoring Manual."

Summary of data collected and timeframe:

| **Data Item** | **Description** | **Timeframe of Data Collection** | **Responsible entity** |
|---|---|---|---|
| Sales record<br>Project Database (modified sales record based upon monitoring of variables) | (See above)<br>Includes date, land location, GPS location, mode of use, stove serial number, number of stoves purchased, name and contact info, sales ID number for all stove "sales" | Daily and Monthly | - Operations Coordinator will collect/compile data daily according to sales<br><br>- Monitor Coordinator/ will provide back up data collection and analysis on a monthly basis |
| Monitoring Survey | Survey questionnaire on random sample (100 total minimum: minimum 30 for each stove age) from households with "purchased" stoves clustered in time | Annually (starting after first verification) | - Monitor Coordinator/ |

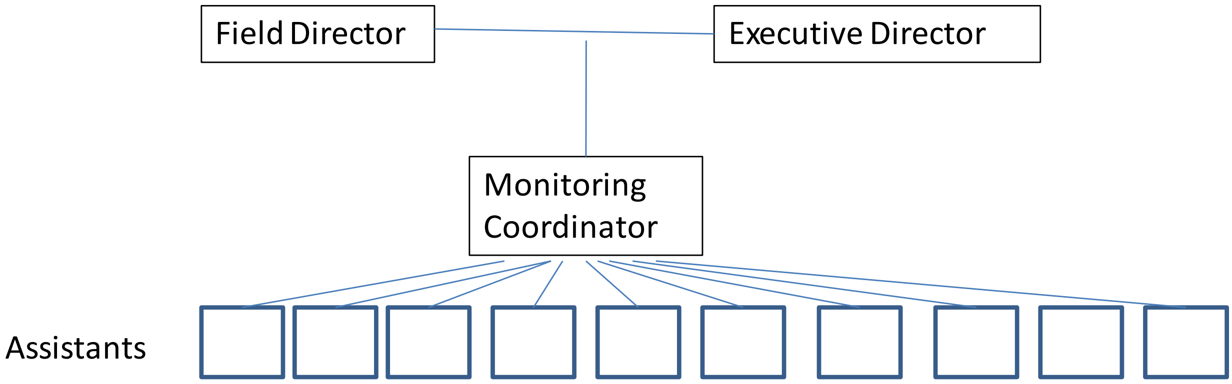
| | | | |
|---|---|---|---|
| | period (i.e. age of stove). Also includes fuel mix ratios, fuel prices, cooking frequency. | | |
| Usage Survey | Usage survey for stoves sold to assess the drop-off rate with minimum total sample size of 100 with at least 30 samples for project technologies of each age being credited. | Annually (after first verification, *anytime during year but prior to issuance)<br><br>*samples must have stove for at least ½ year for each stove age. | - Monitor Coordinator |
| Leakage | Relevant surveys and monitoring survey with analysis of emissions resulting from project identified and assessment on potential new sources | On time for first verification and then . . .<br><br>Every 2 years (bi-annually)<br>-after first verification | - Monitor Coordinator |
| FT Update/Aging Stove KT | Quantitative tests with surveys (with samples sizes needed to obtain 90% confidence intervals within 30% of the mean) to estimate fuel reduction performance as it varies with stove age and used to potentially extrapolate to extended years | Every 2 years (bi-annually)<br>-after first verification | - Monitor Coordinator |
| Social, Environmental and Economic Indicators (those with “+” and “-“ in SDM) | Includes:<br>- air quality<br>- quality of employment<br>- livelihood of poor<br>- access to clean | Every year | - Monitor Coordinator/ |

| | | | |
|---|---|---|---|
| | and cheap energy<br>- human capacity<br>- income generation | | |

**Feasibility:**

ECO2 has been monitoring project activities according to the tasks outlined above for six years. The staff is adequate thus far. ECO2's Executive Director and Field Director have doctorates in fields related to data collection, analysis, and storage. They have considerable experience managing large numbers of staff in data collection, organization, analysis, and storage.

How the monitoring plan is being implemented:




Field Director and Executive Director design monitoring plan and specific studies/surveys according to GS methodology and experience, and train Monitoring Coordinator (MC) and assistants. MC uses between 5-20 assistants, depending on monitoring task, to collect the appropriate a. MC is full time employee and assistants are contractual and paid by task completed. MC uses motorcycle and assistants either walk or use bicycles (monitoring is organized by region and assistants are hired according to region based upon where they live). Data is collected by field data sheets and questionnaires. This is then inputed by MC into digital versions and delivered to FD. According the methodology applied, we have completed all monitoring activities (according to the standards) needed prior to verification (e.g. baseline studies, performance tests). In addition, we are continuously monitoring project households for alternative fuel uses, wood use patterns, leakage, quality, and complete switch from baseline to project. For more information, please see "Monitoring Manual." See table above for a summary of activities, when they occur and by whom.

**Schedules**

*Sales Record*. OC collects sales information from territory managers via text messaging or written hard copie.. OC collates all hard copy PSA and delivers to MC. MC inputs data digitally and delivers to FD. Operations Director spot checks using PSA and prepares annual reports.

*Monitoring Survey*. MC, with 5-20 assistants (depending on need) visit a minimum of 100 total households (with minimum of 30 households within each scenario and age cluster), randomly chosen from appropriate sales record, to administer interviews with households that have received a Upesi stove. Occurs over a 1-2 month period with attention to assessing seasonal variations. Assistants fill out hard copy questionnaires and deliver to MC. MC inputs responses into database and delivers to FD. FD checks data with spot checks using hard copies for accuracy. Executive Director checks data and spot checks using hard copies, then analyzes data and prepares report.

*Usage Survey*. MC, with 5-20 assistants (depending on need), visits a minimum of 30 households per scenario (one pot and two pot) and age cluster during a 2 month period just prior to verification to interview households and ascertain usage visually. Each assistant can visit about 3-5 households per day. *Usage survey may be subsumed within Monitoring Survey. Assistants fill out hard copy questionnaires and deliver to MC. MC inputs responses into database and delivers to FD. FD checks data with spot checks using hard copies for accuracy. Executive Director checks data and spot checks using hard copies, then analyzes data and prepares report.

*Leakage*. MC, in cooperation with Executive Director, will assess leakage every two years during a two month period. This will include using Monitoring Survey data (which asks questions about charcoal use and other fuels for cooking or saved wood for other purposes), reanalysis of emissions from transportation and production of stoves, and reassessment of fNRB impact. First leakage assessment will occur on time for first verification. Executive Director checks data and spot checks using hard copies, then analyzes data and prepares report.

*Project Field Performance Update Tests/Aging stove efficiency*. Completed every two years over a 2-3 month period by MC and assistants prior to verification/issuance. At least 30 households for each scenario and age are visited each 2-3 times over a 3 day period.. Assistants fill out hard copy questionnaires and deliver to MC. MC inputs responses into database and delivers to FD. FD checks data with spot checks using hard copies for accuracy. Executive Director checks data and spot checks using hard copies, then analyzes data and prepares report.

*Sustainability Indicators*. Completed every year by MC and assistants with assistance from Executive Director. Involves a two month period to collate project records, summarize interviews with project contractors, analyze Monitoring surveys regarding indoor air quality perceptions, and site visits to clay extraction sites. Assistants fill out hard copy questionnaires and deliver to MC. MC inputs responses into database and delivers to. FD checks data with spot checks using hard copies for accuracy. Executive Director checks data and spot checks using hard copies, then analyzes data and prepares report.

**Quality Assurance and Quality Control:** All data gathering, organization, analysis, and reporting will follow guidelines to provide the highest levels of accuracy and transparency. With regards transparency, all hard copies, raw digital data, working datasheets, and digital analysis are available upon request to any third party (DOE or other) with appropriate directions to allow unencumbered evaluation. With regards accuracy, monitored data can lose quality (i.e. produce expected or unexpected variation) at several levels. ECO2 designs all stages of monitoring to reduce this loss and thus increase quality assurance and quality control of its data and conclusions. In general, all data is cross-referenced and is available at several levels for checking, including third party if need be. All raw data and analyzed data is available and organized to be readily transparent and evaluated to any third party. The table below summarizes the monitoring design related to QC/QA:

| Monitoring Stages (where quality can be reduced) | QC/QA strategy |
|---|---|

| | | |
|---|---|---|
| a. | Inconsistency in data collection by numerous staff members | All staff are trained in mass by Field Director (who has a Ph.D. in field related to data collection). This training involves four steps: (1) explanation of data and how it will be collected, (2) modelling of how data is to be collected, (3) checking and fine-tuning of mock data collection by FD, and (4) cross-referencing of data collection for internal consistency among staff in simulations.<br><br>In addition, all data collection parameters have clearly defined procedures. See "Monitoring Manual" |
| b. | Inaccuracy in data collection by staff members | All staff are trained in mass by Field Director (who has a Ph.D. in field related to data collection). This training involves four steps: (1) explanation of data and how it will be collected, (2) modelling of how data is to be collected, (3) checking and fine-tuning of mock data collection by FD, and (4) cross-referencing of data collection for internal consistency among staff in simulations.<br><br>In addition, all data collection parameters have clearly defined procedures. See "Monitoring Manual" |
| c. | Unrepresentative sample that does not reflect population of interest | To ensure that monitoring occurs in households that are representative, Random sampling will be done by Field Director and/or Executive Director using computer random sampling programs. If random sampling does not result in representative sample, then repeat procedure. |
| d. | Too much variation in sample that makes conclusions about population difficult | We will start with reasonable sample sizes and perform tests of variation. If variation is larger than 30%, then we increase sample size such that sample sizes produce variation within 30% of the mean at the 90% confidence interval. |
| e. | Questionnaire is not reliable | Questionnaires will be annually tested for reliability estimates using interview procedures. |
| f. | Questionnaire does not make sense to respondents | Questionnaires were written by Executive Director and then fine-tuned by Kenyan staff (FD and MC) and translated into local languages. Each questionnaire is then tested on sample subjects and further fine-tuned so that questions are interpreted according to intended meaning. |
| g. | Collected data not recorded completed and/or correctly | All field hard copy data sheets are reviewed by MC for incompleteness and/or mistakes. If such exists then MC sits with appropriate staff to reconcile. |

| | |
|---|---|
| | Once MC has done this, FD routinely checks a sample of hard copy data sheets for same. |
| h. Collected data not digitally inputed completely and/or correctly | All field hard copy data sheets are digitally copied into database by MC who checks for incompleteness and/or mistakes. If such exists then MC sits with appropriate staff to reconcile.<br><br>Once MC has done this, FD routinely checks a sample of hard copy data sheets to match with the digital for same. |
| i. Data has outliers (specific data points that don't fit within normal parameters) | Executive Director applies statistical software to check for outliers and then responds accordingly, either to remove from database or include. |

**B.8. Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies):**

>>

In Feb-March 2011, using the sales record, a baseline/kitchensurveywas conducted to assess the key variables suggested in the applied methodology "Technologies and Practice to Displace Decentralized Thermal Energy Consumption, 11/04/2011." This data collection was designed and coordinated by Dr. Mark Lung (Executive Director) and Dr. Anton Espira (Field Director). All data collection was done by Leonard Mahunga (Monitoring Coordinator) and assistants. See Kitchen Survey Report. Additional baseline surveys were conducted in expansion areas in 2014 and baseline surveys were conducted in main target area in 2017. These were managed in the same way.

The first Baseline and Project Field Performance Test, based upon methodologies in "Technologies and Practice to Displace Decentralized Thermal Energy Consumption, 11/04/2011" was completed in June 2011. (See Kitchen Test Report). Additional Baseline and Project Performance tests were done in 2013 and PFT updates were conducted in 2013, 2015/2016.

**Date of completion of the baseline section:**
21 July 2011, November 2014, June 2017

**Name of the responsible person/entities:**
Dr. Mark Lung, Eco2librium
Tobias Hoeck, myclimate – the Climate Protection Partnership

## SECTION C. Duration of the project activity / crediting period

### I. C.1. Duration of the project activity:

#### C.1.1. Starting date of the project activity:

>> 25 October 2010 (date of first upfront payment)

**C.1.2. Expected operational lifetime of the project activity:**

>> 21 years, 0 months

**C.2. Choice of the crediting period and related information:**

**C.2.1. Renewable crediting period:**

**C.2.1.1. Starting date of the first crediting period:**

>> 25 November 2010, or 2 years prior to Gold Standard registration, whichever occurs later.

**C.2.1.2. Length of the first crediting period:**

>> 7 years, 0 months

**C.2.2. Fixed crediting period:**

**C.2.2.1. Starting date:**

>>N.A.

**C.2.2.2. Length:**

>>N.A.

## SECTION D. Environmental impacts

>> The host country does not require an Environmental Impact Assessment for the proposed project activity.

**D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:**

>>N.A.

**D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:**

>>N.A.

## SECTION E. Stakeholders' comments

>> See Gold Standard Passport.

**E.1. Brief description how comments by local stakeholders have been invited and compiled:**

>> See Gold Standard Passport.

**E.2. Summary of the comments received:**

>> See Gold Standard Passport.

**E.3. Report on how due account was taken of any comments received:**

>> See Gold Standard Passport.

## Annex 1

## CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

| | |
|---|---|
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| Represented by: | Dr. Mark Lung |
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| | |
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## Annex 2

### INFORMATION REGARDING PUBLIC FUNDING

There is no public funding for project. See Gold Passport for ODA declaration.

## Annex 3

## Annex 4

## MONITORING INFORMATION

Monitoring is described under section B.7 in the PDD, and in the document titled: Monitoring Manual.

## Annex 5

References Cited

BLEHER, B., D. USTER, & T. BERGSDORF (2006). Assessment of threat status and management effectiveness in Kakamega Forest, Kenya. *Biodiversity and Conservation* **15**(4): 1159-1177.

DEBANN, L. (2003) Promotion of energy-saving technologies and alternatives to forest-derived fuelwood initiated through ICIPE's Intergrated Conservation Project of Kakamega Foreste, Kenya: Impact assessment, Final Report, ICIPE and Swiss Federal Institute of Techology.

Dose, H. 2007. Securing household income among small-scale farmers in Kakamega District: possibilities and limitations of diversification. GIGA (German Institute of Global and Area Studies) Research Programme: Working Paper, No. 41.Transformation in the process of Globalization, Hamburg.

GLENDAY, J. (2006). Carbon storage and emissions offset potential in an east African tropical rainforest. Forest Ecology and Management 235:72-83.

Governmental of Kenya. 2006. Population Estimates of Kenya Provinces and Districts. website - http://www.kenya.go.ke/.

GUTHIGU, P. AND J. MBURU. (2006) Local communities incentives for forst conservation: case of Kakamega Forest, Kenya. Paper presented at 11th Conference of the International Association for the Study of Common Property. Bali, Indonesia, 2006.

HABERMEHL, H. 1994. Microeconomic and macroeconomic benefits of household energy conservation measures in rural areas of Kenya. Deutsche Gesellschaft fur. Technische Zusammenarbeit (GTZ) GmbH. Household Energy Program (HEP). Germany.

I.C.I.P.E (African Insect Science for Food and Health ). Website: http://www.icipe.org/.Map of Kakamega Forest 2000.

IPCC. 2006. IPCC Guidelines for National Greenhouse Gas Inventories.

KIFCON. 1992. Kenya Indigenous Forest Conservation Programme (1992) Kakamega Forest Domestic Energy Survey. Forest Department, Nairobi. Kenya.

KIFCON 1994. Kenya Indigenous Forest Conservation Programme (1994) Kakamega Forest: The Official Guide. Forest Dept., Nairobi. Kenya.

Kituyi et al. 2001. Biofuel availability and domestic use patterns in Kenya. Biomass and Bioenergy 20(2): 71-82.

Kenya National Bureau of Statistics (KNBS) 2009. Republic of Kenya: 2009 Kenya Population and Housing Census.

KOKWARO, J.O. (1988) Conservation status of the Kakamega Forest in Kenya: the easternmost relic of the equatorial rainforests of Africa. Monogr. Syst. Bot. Misouri Bot. Garden 25:471-489.

BOETCHER, A., LUNG, M. AND GEHRING, T. 2008. An Assessment of Human Access and Forest Use Patterns in Kakamega Forest, Kenya: Implications for Management and Forestry-based Carbon Offset Projects. Working Paper, KFS.

LUNG. T. AND SCHAAB, G. 2006. Assessing fragmentation and disturbance of west Kenyan rainforests by means of remotely sensed time series data and landscape metrics. Afr J Ecology 44:491-506.

Mitchell, N. 2004. Exploitation and disturbance history of Kakamega Forest, western Kenya. BIOTA East Report #1.

Mitchell, N. and Schaab, G. 2008. Developing a disturbance index for five East African forests using GIS to analyze historical forest use as an important driver of current land use/cover. African Journal of Ecology 46: 572-584.

UNDP (United Nations Development Program) 2005. International Human Development Indicators – Kenya. Website - http://hdrstats.undp.org/en/countries/profiles/KEN.html.

UNEP (United Nations Environmental Program) 2006. Kenya: Integrated Assessment of the Energy Policy: with focus on transportation and household energy sectors. www.unep.ch/etb/areas/pdf/**Kenya**%20ReportFINAL.pdf

WASS, P. (1995). Kenya's Indigenous Forests: Status, Management, and Conservation. IUCN, Gland, Switzerland.

# Annex 6: Purchase and Sales Agreement

ECO2LIBRIUM
SUSTAINABLE SOLUTIONS

**Stoves for Life**

**Purchase and Sales Agreement**

**HOUSEHOLD ID NO.:**

**RECEIPT NO.:** ______ **SCOTT'S CLUB NO.:** ______

**INSTALLATION TYPE:** **NEW:** ☐ **ADDITIONAL:** ☐

**If ADDITIONAL, then please provide either of the following: HOUSEHOLD ID or OLD LINER NUMBER or SCOTT'S CLUB NUMBER**

**Buyer Name:** ______

**Buyer Contact:** ______ **Sub-Location:** ______

**Buyer Village:** ______ **Location:** ______

**GPS (E):** ______ **GPS (N):** ______

**Sold By:** ______ **Installation Date:** ______

**Installed By:** ______ **Number of Liners:** ______

**Liner ID Numbers:** ☐ ☐

**Supervisor Check (NAME):** ☐ **Liner Number Written on Door:** ☐

**Is the Buyer Satisfied:** **YES** **NO**

**ECO2 warranties the stove liner(s) listed herein and will repair or replace at no charge or at reduced charge any and all stove liners that can no longer function for their intended purpose.**

**I, the Buyer, hereby grant, convey and permanantly assign to ECO2LIBRIUM, LLC all emission reductions associated with the stoves described herein and as evidenced by the serial numbers first written above.**

**Buyer:** ______ **ECO2:** ______

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**ECO2LIBRIUM'S PLEDGE**

**Upon signing this Agreement, Buyer is hereby a member in good standing of Scott's Club. Members of Scott's Club who consistantly use the recently installed stove(s) for 2 years after the date of this Agreement shall be entitled to multiple benefits and gifts. The sale of carbon credits makes this possible. Buyer's use of the stoves described shall be confirmed and verified by periodic visits to Buyer's home by a monitoring coordinator or other verifier.**

**SCOTT'S CLUB NUMBER:** ☐

**LINER ID. NUMBERS:** ☐ ☐

**BUYER NAME:** ______

**BUYER SIGNATURE:** ______

**ECO2 SIGNATURE:** ______

***Please call ECO2 Stoves for Life at this number for any enquiries:***

**0735 294 663**

**ASANTE SANA**