CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

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. • 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/Reference/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 small-scale project activity

A.1 Title of the small-scale project activity:

Title: Wood Improved Domestic Stoves, Shimoni, Kenya
Version: 1.1
Completion date: 23/12/2010

A.2. Description of the small-scale project activity:

General project description as perceived at the stakeholder stage

This project will involve the distribution of energy efficient stoves in the Shimoni community, in Kenya, This community is one of the poorest in the region being also largely overpopulated, with most of its people suffering from unemployment, poor health and poverty. The lifestyles of the locals within this community often impact negatively on the environment, as for instance regarding deforestation. These stoves will utilise the efficient rocket technology. They will be manufactured, distributed and installed by local people under the training and supervision of co2b-Kenya. Initial testing has shown these stoves to be more than 50% more efficient than traditional models as well as it reduces the indoor smoke about 80%. These stoves will be using less firewood and emitting less smoke.

Since the time of this description the project has advanced being able to provide further detail on its description at the validation stage as follows:

Background to and purpose of project

In Kenya 70% of the national energy supply is met through use of biomass fuels, with 90% of this demand coming from the domestic sector.[*] Traditional cooking involves the use of a 3-stone fire, which amongst other shortfalls is only able to produce 10% thermal efficiency.[†] Combined with a population growth rate of 2.7%[‡] it is not surprising to find that between 1990 and 2005 Kenya lost forest coverage at a rate of 0.3-0.5%/year, with protected forest making up only 1.6% of land coverage by 2005.[§] This situation is not sustainable and Kenya's ability to meet future energy needs under a business-as-usual scenario is questionable, as highlighted by the Kenyan Ministry of Energy in a 2002 report.[**] The burning of significant quantities of non-renewable biomass also gives rise to large quantities of greenhouse gasses, contributing to anthropogenic climate change.

[*] "Kenya: Integrated assessment of the Energy Policy", UNEP, 2006 : http://www.unep.ch/etb/areas/pdf/Kenya%20ReportFINAL.pdf

[†] UNFCCC Methodology AMS-II-G http://cdm.unfccc.int/UserManagement/FileStorage/AUBHMWJVKFSY9D1380NOI5ET26ZQLG

[‡] "State of the world's forests 2009", FAO, 2009 : http://www.fao.org/docrep/011/i0350e/i0350e00.HTM

[§] "State of the world's forests 2009", FAO, 2009, "Kenya: Integrated assessment of the Energy Policy", UNEP, 2006

[**] "Study on Kenya's energy demand, supply and policy strategy for households, small scale industries and service establishments", Republic of Kenya Ministry of Energy, 2002. *File supplied to DoE by PP.*

Added to environmental pressures is the poor quality of life experienced by the rural poor, using traditional wood stoves which generate a large amount of smoke within the home due to poor combustion efficiencies. A WHO report concluded *'Indoor air pollution is a major environmental and public health hazard for many of the world's poorest, most vulnerable people.'* Biomass smoke has been linked to a range of health problems such as acute respiratory infections (ARI) in children, chronic obstructive lung diseases (such as chronic bronchitis and asthma), lung cancer and pregnancy-related outcomes. It is estimated that 4-5% of global deaths occur as a result of exposure to smoke particulates.[*]

The 'Shimoni Improved Cook Stove Project' will address these issues by construction of approximately 2,230 domestic wood-burning 'improved cook stoves' in households within the project area. Recipients will receive stoves free of charge and be directed in correct use of the stove by local community groups engaging with the project developers. Pilot studies have shown the stoves to reduce fuel consumption by at least 50%. This will result in an improved living environment for recipients and reduced pressure on local forests, with an anticipated reduction of 3,154 tonnes of wood being burnt annually as a result of the project.[†] By reducing fuel consumption, CO_2 emissions from combustion of non-renewable biomass will be correspondingly reduced.

As the stoves will be free, the project can expect to achieve high levels of market saturation in an area, allowing as many households as possible to benefit from the improved stove. The way in which a cook uses the stove is also a key influencing factor in the fuel savings made.[‡] It is expected therefore that by making such improved stoves commonplace within a community, and hence building strong local understanding of the technology, higher levels of fuel savings will be achieved.

Technology to be employed

Pilot studies have shown the large majority of households within the project area to be cooking for domestic purposes only, on three-stone fires using wood fuel. There is one main representative household cluster. For these reasons the project will initially employ a single model of wood-burning stove, which will be distributed for domestic use only. More advanced and efficient models of stove are currently under development and may be included in the project if available at the appropriate time. If this should occur the appropriate clustering would be organised.

The improved stoves (known as the Brick Rocket Stove or BRS) are a fixed construction of clay bricks and mortar, using a 'rocket' style design. This consists of a horizontal (combined) fuel and air intake, terminating in a firebox with a vertical outlet on which the cooking pot rests. Relative to the three stone fire, this type of stove allows higher combustion temperatures to be reached and improved fuel/air mixing, hence higher levels of combustion are achieved. This reduces the amount of smoke produced. There is no chimney as such, draft is created by the temperature difference between the low inlet and the outlet, and the hot combustion gasses pass out of the top directly onto the cooking pot in order to achieve high levels of thermal transfer. Despite the combustion gasses remaining in the house, the improved combustion efficiencies mean that smoke levels are dramatically reduced.

[*] "The health effects of indoor air pollution exposure in developing countries", WHO, 2002 : http://whqlibdoc.who.int/hq/2002/WHO_SDE_OEH_02.05.pdf

[†] Please refer to 'PDD supplementary information' spreadsheet, 'A42 Project size'

[‡] Page 10 "Solid fuel household cook stoves: characterisation of performance and emissions", Biomass and bioenergy 33 (2009) 294-305. http://www.pciaonline.org/files/Stoves_Paper_Final_Color_2.26.09.pdf

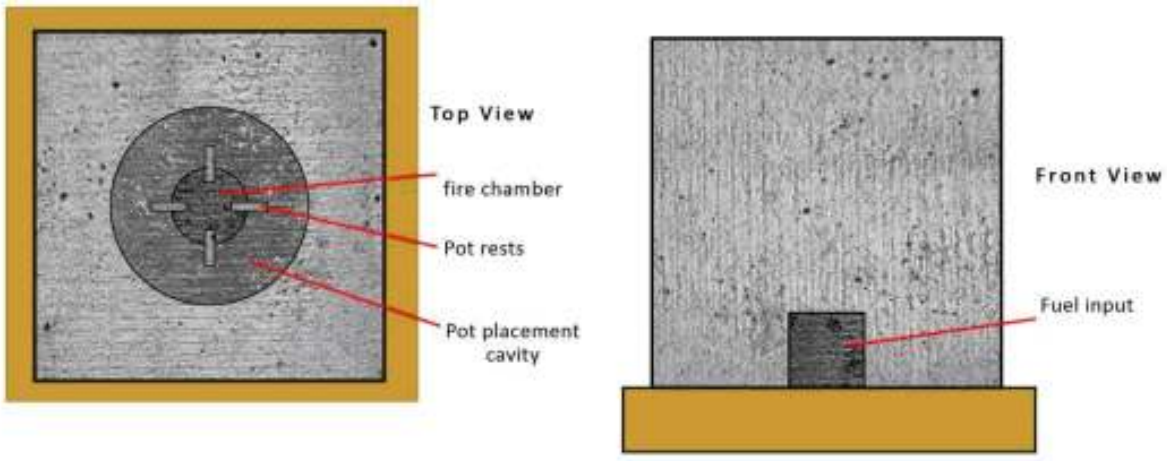


Image 1. Diagrammatic view of stove

The stove consists of an inner firebox constructed from well-fired fireclay bricks; these are used to prevent cracking of the chamber and are made locally where possible. The remaining bricks (~70%) are used to form an outer skin, these are exposed to lower temperatures and so need not be fired and can be made from locally dug clay dried in the sun.

Research into the environmental impact of small scale brick firing suggests that the greenhouse gas emissions generated as a result of this would be insignificant in relation to the reductions made over the lifespan of the stoves. Further details are discussed in section B.3.

Image 2. Photo of a pilot stove

The pilot project and development work have been funded by A3Carbon. Upon successful registration of the project it is expected that A3 Carbon Ltd will fund the implementation of the rest of the project. An

agreement at the time of will be issued in order to formalise the commitment; VER sales will constitute the only revenue stream. co2balance Kenya will manage the implementation of this project with the assistance of local stove contractor ReeCon. Long term monitoring and stove maintenance will be managed similarly by contract agreement as per the construction period.

100 Pilot stoves were built for a trial purpose before the 1st submission of the LSC report. Therefore, they will not be counted for crediting purposes. In country logistics did not allow to submit the report till a year after (Feb 2010) the LSC was hold, time when the necessary resources were put in place to ensure an adequate implementation. During the elapsed time other scopes of the project were advanced as for example reinforcement of community engagement, building the electronic database to track stoves individually, further internal training on project implementation, etc. Construction of the rest of stoves will not take place till successful registration of the project.

Planned construction/operation schedule*

Date	Stoves constructed in period	Total stoves operational	Total stoves CLAIMING ERs
Feb 2010	100	100	0
Jan 2011	2,134	2,234	2,134
2012	0	2,234	2,134
2013	0	2,234	2,134
2014	0	2,234	2,134
2015	0	2,234	2,134
2016	0	2,234	2,134
2017	0	2,234	2,134

Sustainability

As well as reducing greenhouse gas emissions this project will contribute to sustainability and millennium development goals in a number of ways including:

- Reducing householders exposure to health damaging biomass smoke
- Reducing pressure on local woodland and hence biodiversity
- Improved livelihood of the poor
- Increased rate of technology transfer

A detailed discussion of the impact of the project on sustainable development can be found in the accompanying Gold Standard Passport.

A.3. Project participants:

Name of Party involved (*)	Private entity project	Kindly indicate if the Party

* Details supplied to DoE in Excel file "PDD supplementary data Shimoni"

((host) indicates a host Party)	participants	involved wishes to be considered as a project participant (Yes/No)
Kenya (host)	N/A	No
United Kingdom	co2balance UK	No

The project is voluntary and as such official endorsement from the Parties is not required, the Kenyan DNA (NEMA) is however, aware of the project. NEMA were invited to the local stakeholder's meeting and also engaged to confirm the EIA non-requirement status of the project. Confirmation of the non-EIA requirement is available at validation.

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

A.4.1.1. Host Party(ies):

Republic of Kenya

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

The activities will take place within the Coast Province of Kenya.

A.4.1.3. City/Town/Community etc:

The project activity will take place within the Shimoni community.

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :

The community boundary for the project has been defined by a co-ordinate quadrant as follows on the image below. Following the passport, a random point within the boundary limit as for reference regarding location purposes has been set to be:

Central point for reference	**Coordinates**
Latitude	04° 38' 40.36" S
Longitude	39° 22' 53.15" E

Table 1. Random coordinates within for the project boundary.

These boundaries are shown on the map below.

Furthermore, each stove is marked with a unique identification number which corresponds to detailed information stored in the project proponents' database; this includes household occupants and GPS co-ordinates.

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

According the GSv2.1 toolkit the project falls into the End-use Energy Efficiency Improvement category as it is the purpose the reduction in the amount of energy required for delivering or producing non-energy physical goods or services.

Project type eligibility is covered under "improved distributed heating and cooking devices".

A.4.3 Estimated amount of emission reductions over the chosen crediting period: [*]

Year	Estimation of annual emissions reductions in tonnes CO_2e
2011	4,453
2012	5,000
2013	5,000
2014	5,000
2015	5,000
2016	5,000
2017	5,000
Total estimated reductions (tonnes CO_2e)	34,453
Total number of crediting years	7
Annual average of the estimated reductions over the crediting period	4,922

A.4.4. Public funding of the small-scale project activity:

There is no public or ODA funding for this project activity, all revenue for the project will be derived from the sales of VERs.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

The proposed micro-scale project activity is not a debundled component of a larger-scale project activity as there is no registered micro-scale project activity or application to register another micro scale project activity:

- With the same project participants;

[*] Details supplied to DoE in Excel file "PDD supplementary data Shimoni"

- In the same project category and technology/measure; and
- Registered in the two previous years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

The project proponent is developing a number of similar projects within the host country, however none of these conflict with the debundling requirements.

SECTION B. Application of a baseline and monitoring methodology

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

The micro-scale project activity falls within the 'Energy Efficiency – Domestic' category and will utilise the Gold Standard 'Methodology for improved cook-stoves and kitchen regimes V.02'. This is the most up to date version of the methodology at the time of submission.

B.2 Justification of the choice of the project category:

The chosen methodology is applicable to the project, which is introducing improved cook-stoves and practices to households within Kenya by replacing inefficient wood fires with higher efficiency wood-stoves and training householders in their use. The project boundary will be defined by each individual household, and the project area by accurate GPS co-ordinates. The improved stoves have been tested and shown to have a nominal continuous useful output of 6.2kW*.

The project fulfils all of the qualifying conditions set out in the methodology:

- Low-emission cook-stoves and regimes replace relatively high-emissions baseline scenarios.
- The project boundary can be clearly identified, and the stoves counted in the project are not included in another voluntary market or CDM project (i.e. no double-counting takes place)
- The project is located in a single country
- The improved cook-stoves do not number more than ten per kitchen and have a continuous useful energy outputs of less than 50kW (defined as total energy delivered usefully from start to end of operation divided by time of operation)

The project will be classified as micro scale under as defined in the Gold Standard toolkit as "Any eligible project, reduction < 5,000 tCO_2 equivalent per annum for each year of the crediting period".

B.3. Description of the project boundary:

The project boundary is specified in the methodology.

* Calculated from KPT results, assuming 6hrs daily use.

a. The project boundary is defined as the domestic kitchens in which each stove is installed, recorded.
b. The target area as defined by GPS quadrants for each community in section A.4.1.4.
c. The Fuel Collection Area has been defined based on the information gathered by the Kitchen Surveys. The results analysis* showed that the majority of households collect their fuel from the local area, spending on average 4 hrs/day and covering 2 km.

Greenhouse gasses included in the project and baseline are as tabulated below.

	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

	Source	Gas	Included?	Justification/Explanation
Project	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 baseline and its development:

The project baseline has been developed in line with the chosen methodology as follows.

1. Determine customer groups "or clusters"

Step 1.1: Establish a pilot distribution record (PDR).

A small number (~100) of pilot stoves were built in the project area for the purposes of carrying out surveys and tests required for baseline development. A PDR containing the names and addresses/locations of the stove beneficiaries was created and stored in the project developer's database.

Step 1.2: Provisionally assess fuel types, fuel mix, and kitchen regimes.

Provisional assessments made by local staff established that exclusively domestic cooking in the project areas is carried out using fire wood fuel gathered from local forests or purchased from firewood sellers.

Step 1.3: Analyze renewability fraction of wood-fuels.

An assessment was made by C4 EcoSolutions (Pty) Ltd of the renewability fraction of wood fuel in Kenya.

* For full details see annex 3.

Step 1.4: Divide pilot distribution record (PDR) into major groups or clusters.
No major cluster distinctions were identified at this stage and hence the PDR was not split.

Step 1.5: Carry out a qualitative survey (Kitchen Survey – KS)
Kitchen Surveys were carried out as directed by an independent consultant German Garcia Ibanez[*] (GGI) and as described in the report 'Baseline monitoring report on the rocket stoves'[†]. The random selection of survey participants was made from the project developer's database using a standard programming language function; this process was documented for each selection for validation purposes. The results of the surveys were assessed by GGI and identified only one cluster for this project, pilot stove users were then selected for Kitchen Performance Tests. The KS report recommended that a cross sectional data collection study be carried out rather than paired sampling for this project.

Step 1.6: Refine demarcation of clusters and populate Project Database
As the project database is simply the distribution record re-organised for the calculation of emission reductions and at this stage only one cluster has been identified, the two records are currently the same. This will be monitored over the course of the project and adjusted for any results of surveys or introductions of new cook stove models.

2. Calculate baseline emissions

Step 2.1: Estimate expected variation and improvement in emission reductions
An appropriate statistical analysis was carried out by GGI and is documented in the 'baseline monitoring report on the rocket stoves'.

Step 2.2: Specify the units of emission reduction or fuel consumption
The units of emission reduction selected were tCO_2e/stove/year.

Step 2.3: Make quantitative measurements (Kitchen Performance Tests)
Kitchen Performance Tests were carried out as specified and documented in the 'baseline monitoring report on the rocket stoves.

Step 2.4: Calculate baseline
As a cross-sectional KPT was recommended the statistically significant results produced were in terms of average fuel saving per stove per year. For this reason the baseline and project emissions calculations have been slightly modified[‡] and are documented in PDD section B.6.3.

Leakage
As specified in the chosen methodology the following sources of leakage have been assessed for this project.

a) Some users of the efficient stoves respond to the fuel savings associated with higher efficiency stoves by increasing consumption of fuels with GHG emission characteristics by retaining some use of

[*] Germán García Ibáñez – Independent consultant, tel: (+34) 696 284 281; email: ibanez.gg@gmail.com

[†] See annex 3.

[‡] As allowed by the methodology – Page 19, section 7.

inefficient stoves, to the extent that project emissions are higher than those calculated from the assumption that cooking energy is constant. This is sometimes referred to as the 'rebound' effect.

This is accounted for by the design of the monitoring KPT and KS, as they will include the relevant questions to assess "residual" use of the baseline stove.

b) The project activity stimulates increased use of a high emission fuel either for cooking or for other purposes outside the project boundary (as would be the case for example if efficient cooking stimulated an increase in NRB consumption - possibly because the NRB fuel becomes cheaper due to the project activity).

Householders targeted by the project are exclusively wood fuel users who predominantly collect fuel for free. As the fuel in question is not part of an economic market, reduction in pressure on the NRB is unlikely to result in increased use of the fuel outside of the project area. In any case the NRB fraction will be monitored and used to inform of any changes in the future.

c) By virtue of promotion and marketing of a new model and type of stove with high efficiency, the project stimulates substitution of a cooking fuel or stove type with relatively high emissions by households who commonly using a cooking fuel or stove type with relatively lower emissions, in cases where such a trend is not eligible as an evolving baseline.

All stove recipients cook on 3 stone fires, in which case the only scenario producing this leakage would be a recipient reducing use of renewable fuels such as crop residues. This will be captured through monitoring KS and KPTs.

d) The project population compensates for loss of the space heating effect of inefficient cook-stoves by adopting some other form of heating or by retaining some use of inefficient stoves.

This is not expected in coastal areas as the covered by this project due to the template climate they enjoy. However, any leakage of this type will be detected by the pertinent kitchen surveys and if found to be the case, the leakage will be re-assessed to include the appropriate correction factor.

e) The traditional stoves displaced are re-used outside the boundary in a manner suggesting more usage than would have occurred in the absence of the project.

In all cases the traditional stoves replaced are three rocks; these have no market value and are not a product as such. There is nothing limiting the use of three stone cooking across the country (technology is lowest, price is zero), which is why this cooking method is so widespread. This leakage source can therefore be discounted.

However, the project proponent is instituting a mechanism to encourage removal of the traditional stoves by communicating the project idea and the benefits of the new stove to the end-users when the new stove is implemented in the household. Usage rates of both technologies will be monitored periodically through the kitchen surveys.

f) Significant emissions from transportation or construction involved in the project activity, including emissions associated with production/transport of the efficient stoves themselves, or

production/transport of project fuels (for example briquette manufacture and supply may be energy-intensive).

An assessment of project construction emissions has been made and is detailed in annex 3. The majority of bricks that make up a stove (70%) are dug & sun dried locally in order to minimise emissions, some energy is used in firing and transportation of the remaining bricks as assessed in annex 3, the potential impact of other construction materials used is detailed also.

g) The non-renewable biomass saved under the project activity is used by non-project households/users who previously used renewable energy sources.

There is no evidence to suggest significant (if any) use of renewable energy for cooking in the project region as found in the Kitchen Surveys. As solar ovens are not available, renewable energy use for cooking would likely be use of animal dung or crop residues which will be used due to ease of availability/proximity to the home rather than due to a shortage of wood fuel.

h) The non-renewable biomass saved under the project activity is used to justify the baseline of other project activities.

To the best knowledge of the project proponent there are at present no similar projects registered under the GS[*] or CDM[†] within the project area, this source of leakage is therefore avoided. The proponent is developing similar projects within the same host country however these are all being carefully developed in order to avoid any conflicting issues.

Risks a), c) & d) are subsumed by the KPT

Thus the total leakage factor applied is **0.0754tCO_2/stove for the first year of the project only**.

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 small-scale CDM project activity:

There has not been a previous announcement that the project activity would go ahead without the Gold Standard. The project activity is financed upfront for future Gold Standard VERs as the only source of funding and so the project activity could not go ahead without VER revenues.

Additionality is demonstrated using the UNFCCC Tool for the demonstration and assessment of additionality (Version 05.2[‡]) which shows that the project would not be possible without VER revenues.

Step 1: Identification of alternative to the project activity consistent with current laws and regulations.

[*] https://gs1.apx.com/myModule/rpt/myrpt.asp

[†] http://cdm.unfccc.int/Projects/projsearch.html

[‡] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v5.2.pdf

Sub-step 1a: define alternatives to the project activity:

Alternative 1: Stoves are built and distributed by a stove builder without registering as a Gold Standard VER project.

Under this alternative scenario the project would proceed as laid out in this document. This would result in the biomass savings, improved livelihoods and other contributions to sustainable development identified. In order for this to remain financially viable the stove recipients would have to pay the cost price of the stove.

Alternative 2: Energy is provided to households by fossil fuel stoves such as LPG.

Under this alternative scenario the project would distribute fossil fuel stoves, likely resulting in lower GHG emissions reductions but higher improvement in air pollution (depending on the technology employed) and sustainable development.

Alternative 3: Continuation of the current situation – use of traditional cooking with 3-stone fireplaces.

Without the intervention of the project and use of carbon finance it is unlikely that the status quo will change, as discussed in step 3 below.

Sub-step 1b: Consistency with mandatory laws and regulatory

The alternatives identified in Sub-step 1a above are in compliance with the mandatory laws and regulations in Kenya.

There is no general law against the extraction of fuel wood from forests in Kenya. These only exist for protected areas, where some problems with illegal harvest of wood for a variety of purposes exist due to poor enforcement.[*] Alternative scenarios 1 & 2 would likely reduce pressures on forests, whereas scenario 3 naturally represents no change.

Step 2: Investment Analysis

The Investment Analysis has not been applied for this project; a Barrier Analysis is conducted in Step 3 below.

Step 3: Barrier Analysis

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

(a) Investment barriers

Alternative 1
As identified in sub-step 1a, in order to scale up the proposed project without VER revenues a source of government or private funding would be required.

[*] http://siteresources.worldbank.org/EXTFORESTS/Resources/985784-1217874560960/FLEGKenya.pdf

Government funding
This is discussed in step 4 below.

Private funding
Envisaging that it would be possible for a stove builder to develop a much lower cost stove, such that a market should exist for it, the potential for a business to be established has been assessed.

A study by the World Bank found that 53% of small business in Kenya identified access to finance as a major business constraint, ranking this as the second largest obstacle, 83% of small businesses rely on internal funding/returns for investment.[*] The up-front costs required to develop and market such a stove would be significant, and until a significant reduction in costs could be proven, there would be no market. Given this financial case for such a business it is unlikely that a source of funding could be found. This presents a second clear barrier to alternative 1.

Alternative 2
The same barriers exist for alternative 2 as alternative 1.

Alternative 3
As 3 stone stoves do not require manufacturing and retailing there are no investment barriers to alternative scenario 3.

(b) Technological barriers *Inter alia*

Alternative 1
Equipment: The rocket stove technology to be utilised is not new, however its use in the area is not widespread, with householders typically using inefficient three stone fires.[†]

Skilled labour: In addition there is a lack of an adequately trained local workforce capable of constructing and maintaining stoves at present. There is no clear development of a market that would drive such capacity to be built due to the financial barriers stated above.

Alternative 2
LPG stoves and fuels are relatively readily available in Kenya, costs are high however there are no technological barriers to alternative scenario 2.

Alternative 3
The three stone fires represent low technology and are easily fabricated by any individual in any region. As such there are no technological barriers to this alternative.

(c) Barriers due to prevailing practice *inter alia*

[*] http://www.enterprisesurveys.org/CustomQuery/Country.aspx?economyid=101&year=2007&characteristic=size

[†] http://www.hedon.info/RocketMudStovesInKenya

Habitual use of traditional stoves imposes a very strong influence on the baseline scenario, resulting in continuation of use of traditional three stone fires. There have been some efforts to introduce improved cook-stoves in Kenya in urban areas, mainly limited to urban dwelling charcoal users. In the defined area this project is the first of its kind.

(d) Financial barriers

Alternative 1
Under this alternative scenario the project would be implemented as per the proposed activity and thus would incur the same build costs. However, without registration through the Gold Standard or other carbon financing mechanism this would have to be funded in another manner, either by sales or charitable donations.

A brief assessment of the ability of householders to fund their own stove has been made: According to the International Fund for Agricultural Development (IFAD) 53% of Kenya's rural population live below the poverty line.[*] The average income in Kenya is KES4,000 – KES4,250 per month[†,‡] (~€40), and for the rural poor 83% of the household budget is spent on food[§].

A Ministry of Energy study found the cost of firewood to stand between 77KSh/tonne and 1,200KSh/tonne. Also, at the national level, many householders are able to purchase a monthly permit to remove firewood at a cost of KES39/month[**] or for free from the local area. Thus the four options were analysed individually: if buying fuel at low price estimate, if buying fuel at high price estimate, if own collection of fuel paying permit and if own collection of fuel not paying permit.

Calculations have been made to assess the ability of households in the target area to purchase a rocket stove at the cost price of KES3600 (breakdown cost available in the supplementary excel sheet info file) based on the data tabulated below for the three possible situations stated above plus the free collection option, which would be the best scenario economically.

[*] http://www.ruralpovertyportal.org/web/guest/country/home/tags/kenya
http://www.fao.org/fileadmin/templates/ess/documents/food_security_statistics/country_profiles/eng/Kenya_E.pdf

[†] http://www.soko-kenya.com/SOKO_Proposal.pdf

[‡] http://www.unicef.org/infobycountry/kenya_statistics.html

[§] "Kenya: Integrated assessment of the Energy Policy", UNEP, 2006 :
http://www.unep.ch/etb/areas/pdf/Kenya%20ReportFINAL.pdf

[**] "study on Kenya's energy demand, supply and policy strategy for households, small scale industries and service establishments", Republic of Kenya Ministry of Energy, 2002

Average income (KES/month)	4,250
Average income (KES/year)	51,000
Proportion of income spent on food (%)	83%
Fuel price 1 = low estimation (KES/tonne)	77
Fuel price 2 = high estimation (KES/tonne)	1,200
Permit cost (KES/month)	39
Permit cost (KES/year)	468
Cost of rocket stove (KES)	3,600

Table showing initial data used to assess the study below.

Therefore, for the three possible scenarios stated above plus the free collection option, which would be the best scenario economically, the different fuel costs to calculate the average household income remaining after meeting the basic needs of fuel and food were projected. The cost of a rocket stove as a proportion of this remaining income was then calculated and is shown in the table below. Each scenario was assessed independently:

Fuel use (t/hh/year)	*3.60*
If buys fuel: low estim	43%
If buys fuel: high estim	82%
If collects: paying permit	44%
If collects: free collection	41%

Table showing cost of rocket stove as % of annual HH income after purchasing food and fuel.

The results show that, based in the fuel use determined in the baseline study, even in the most conservative scenarios householders wishing to purchase a stove would have to save at least 41% of their remaining income for a year (calculations available in the supplementary excel info file). This does not take into account any of the other costs of living such as clothing and schooling, it seems most likely then that the majority of householders would not be able to independently purchase a rocket stove.

Alternatively the project could rely on charitable donations, however this would only be possible for a small scale and sporadically when donor funding is available.

This alternative is likely to be more costly than the proposed activity.

Alternative 2

The distribution of LPG stoves as an alternative technology to the proposed rocket stoves (alternative 2) has been assessed also. The table below* shows the calculated fuel cost for a household to purchase firewood at the three prices discussed above and LPG at current prices.

Fuel	**Fuel cost (KSh/HH/year)**

* Details supplied to DoE in Excel file "PDD supplementary data Shimoni"

If buys fuel: low estim	277
If buys fuel: high estim	4,323
If collects: paying permit	468
If collects: free collection	0
LPG (in 6kg canisters)	19,815

Even if stoves were distributed freely, householders would not be able to purchase sufficient fuel to meet their energy needs; hence there is a financial barrier to alternative 2.

Alternative 3
There is no financial barrier to alternative scenario 3.

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

(a) The investment barrier identified would prevent alternative scenarios 1 & 2 from occurring but would not have an impact on alternative scenario 3.

(b) The technological barriers identified would prevent alternative scenario 1 from occurring as the technology requires development, there are however no technological barriers preventing alternative scenarios 2 & 3 from occurring.

(c) The prevailing practice barrier identified would prevent the alternative scenarios 1 & 2 occurring due to the high level of marketing that would be required to change prevailing practice.

(d) The financial barrier would prevent both alternative scenarios 1 & 2 from occurring due to lack of viable business models.

In conclusion alternative 3 is the only viable scenario in the absence of VER revenues.

Step4: Common practice analysis

Sub-step 4a: Analyze other activities similar to the proposed project activity:

Improved cook stoves started to appear in Kenya in 1981 following the UN 'Conference on New and Renewable Sources of Energy'

Upesi Stoves
The Upesi project started in 1995, it was supported by Intermediate Technology Development Group (ITDG) the aim was to commercialise the Upesi stove in Western Kenya. This stove had been developed in collaboration with GTZ 9 years previously: Potters were trained in the production of the liner and it was distributed by Ministry of Agriculture employees, price (~120KES) and distribution were subsidised by GTZ in order to make distribution viable in rural areas. After 8 years the support was withdrawn and so the project did not continue on any significant scale[*]

[*] http://www.hedon.info/TheUpesiRuralStovesProject

The stove is a simple fired clay liner (see image) which can be either used on its own or built into the ground to improve efficiency and durability. Original testing* showed up to 43% wood savings and an expected life of around 4 years.

Upesi liner*

After 5 years the Upesi project had trained a number of people in marketing as well as production of the liner, it was estimated that 16,000 had been distributed.

The Rural Stoves West Kenya (RSWK) project (building the mandeleo/upesi/jiko Kisasa stoves†), was a project working with the Ministry of Agriculture through the Home Economics Officers, the interest being that through the reduced pressure on non-renewable biomass - rate of deforestation was reduced which was of interest to the Ministry of Agriculture. When funding (1990 - 1995) from the Ministry of Agriculture dropped off, the level of production decreased as the subsidies, in the form of free transport for the stoves and controlled prices were removed and the poorer purchasers were unable to afford higher prices.

* Photo taken from http://www.hedon.info/TheUpesiRuralStovesProject

† Rural Stoves West Kenya: http://practicalaction.org/?id=t4sl_casestudy_stoves

Built-in Upesi/Mandeleo stove[*]

Similar observations have been made regarding the Kuni Mbili, promoted by KENGO, the wood fuel version of the KCJ which is subsidised and often sold at cost or less than cost[†]. This is currently considered acceptable as the stove is still in demonstration, but when subsidies are removed the success of the Kuni Mbili commercialisation is in question. There are only 20,000 of these stoves in operation in Kenya at present.[‡]

Kuni Mbili[§]

The Kenyan Ceramic Jiko, was first pioneered two decades ago and has broken into the urban market, however over this time stove quality has deteriorated as price competition has led producers to cut costs

[*] Taken from http://www.pisces.or.ke/pubs/pdfs/PISCES_Kenya_Report_2010.pdf

[†] Kuni Mbili http://www.hedon.info/CookingStovesForCommercialSustainableProductionAndDisseminationInAfrica

[‡] http://www.hedon.info/CookingStovesForCommercialSustainableProductionAndDisseminationInAfrica

[§] Taken from http://www.bioenergylists.org/stovesdoc/Ezzati/Home%20Page%20of%20Majid%20Ezzati.htm

in response to competition[*]. Improved Kenyan stoves tested in1980s consumes 30-50% less charcoal than conventional ones, today this is 24%. Consumers not necessarily aware of drop in efficiency but a notice the decline in appearance and robustness.

The Private Sector Development in Agriculture (PDSA) stove project was carried out by GTZ on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ). The objective of this project was to distribute ~180,000 ICS by 12/2008 within rural and urban households in a number of districts of Kenya, including Kisumu. The project focussed on commercialising a number of stove technologies, dometic ICS were; the existing Jiko Kisasa (formally mandeleo/upesi) liner, Jiko Kisasa built in & a new model, the rocket mud stoves.

Two pot rocket stove[†]

It is reported[*] that by Dec 2007, 24 individuals were involved in the production of fixed Jiko Kisasa stoves and 220 trained in constructing rocket stoves.

Sub-step 4b: Discuss any similar Options that are occurring:

A recent assessment of the PDSA project[‡] showed that no poor households had the more expensive rocket stove (similar quality to the proposed activities technology) and that low income households such as those targeted by the proposed activity had only 16% of ICS despite making up half the population. It was also found that the lowest number of households utilising ICS was in the area where the proposed

[*] DFID http://povertystoves.energyprojects.net/

[†] Taken from http://www.gtz.de/de/dokumente/en-kenya-results-assessment-stoves-2009.pdf

[‡] Pg 35 http://www.gtz.de/de/dokumente/en-kenya-results-assessment-stoves-2009.pdf

activity will be developed.[*] Surveying showed that the main reasons for people not owning an ICS (in order of responses) were cost, no interest & don't know where to buy them[†]. Clearly the proposed activity addresses these issues.

It is easy to see that although a number of similar improved cook stove dissemination activities have been observed in Kenya, all have been subsidised by external funding and have not lead to widespread common use of improved cook stoves in rural Kenya. The repeated efforts at commercialisation suggest that they have not been successful despite subsidising stoves. The distinction between these and the proposed activity is that stoves are given for free and in the poorest rural communities, thus reaching those unlikely even to buy a subsidised stove. On top of this the stove quality will be higher due to the more stringent QA procedures that can be put in place with a project building many stoves in a short period and a small geographical area.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

All stoves will be constructed at the start of the project and so the project proponent has elected to use a fixed baseline as allowed by the chosen methodology.

Due to the use of a cross sectional study and the requirement for a T-test, the exact equations given in the methodology were not used however the method and calculated results are not altered. This is approved by the methodology (page 19, penultimate paragraph); "*It is legitimate to derive emission reduction values on a per Unit basis directly from the KT tests, and modify the mode of calculation of project emission reductions (and of baseline and project emissions) accordingly, in cases where this results in the most transparent and clear mode of calculation, and where this is consistent with the calculations above*".

Changes made are demonstrated below.

Original calculations from methodology:

[*] Pg 36 http://www.gtz.de/de/dokumente/en-kenya-results-assessment-stoves-2009.pdf

[†] Pg 52 http://www.gtz.de/de/dokumente/en-kenya-results-assessment-stoves-2009.pdf

$$ER_y = \sum BE_{i,y} - \sum PE_{i,y} - \sum LE_{i,y} \quad \text{……Eqn ER.1a}$$

Where:

ER_y = Emissions reductions in total project population in year y (tCO_2e/yr)
$BE_{i,y}$ = Baseline emissions of cluster i in year y (tCO_2e/yr)
$PE_{i,y}$ = Project emissions of cluster i in year y (tCO_2e/yr)
$LE_{i,y}$ = Leakage of cluster i in year y (tCO_2e/yr)

Within each cluster emissions are calculated thus:

$$BE_{i,y} = N_{i,y} \times BE_y \quad \text{……Eqn ER.1b}$$
$$PE_{i,y} = N_{i,y} \times PE_y \quad \text{……Eqn ER.1c}$$

Where:

$N_{i,y}$ = the number of Units in cluster i

$$BE_y = X_{nrb,bl,y} \times B_{bl,y} \times EF_{bl,bio,CO2} + \sum (AF_{bl,i,y} \times EF_{af,CO2,i})$$
$$+\sum(\text{Non-CO2 emissions during cooking})$$
$$+\sum(\text{GHG emissions during production of the fuels}) \quad \text{……Eqn B.1a}$$

Where:

BE_y = baseline emissions in year y (in tonnes CO_2e per year) specific to cluster and Unit chosen

$X_{nrb,bl,y}$ = the non-renewable fraction of the woody biomass harvested in the project collection area in year y in the baseline scenario

$B_{bl,y}$ = the mass of woody biomass consumed during cooking in the baseline in year y (tonnes/year)

$EF_{bl,bio,co2}$ = the CO_2 emission factor for use of the biomass fuel in the baseline scenario in tonnes CO_2 per tonne fuel

$AF_{bl,i,y}$ = The mass of alternative fuel i in the baseline in year y in accordance with trends projected throughout the project period, in tonnes. This mass can be set to zero in cases where the KPT is appropriately designed to subsume alternative fuels (approach 3).

$EF_{af,co2,i}$ = The CO_2 emission factor for use of the alternative fuel i in the baseline in tonnes of CO_2 per tonne fuel.

Non-CO_2 emissions during cooking

$$= \sum (B_{bl,y} \times EF_{bl,bio,non-co2,i}) + \sum (AF_{bl,i,y} \times EF_{af,i,non-co2\_gas\_i}) \quad \text{……Eqn B.1b}$$

GHG emissions during production of the fuels

$$= X_{nrb} \times B_{bl,y} \times EF_{bio,prod,co2}$$
$$+ \sum (AF_{bl,i,y} \times EF_{af,prod,co2,i})$$
$$+ \sum (B_{bl,y} \times EF_{bio,prod,non-co2\_gas\_i})$$
$$+ \sum (AF_{bl,i,y} \times EF_{af,i,prod,non-co2\_gas\_i}) \quad \text{……Eqn B.1c}$$

Where:
$EF_{bl,bio,non\text{-}co2,i}$ = Emission factor for GHG gas i in the baseline scenario in units of tonnes gas per tonne wood-fuel

$EF_{af,non\text{-}co2\ gas\ i}$ = Non-CO_2 emission factor during cooking for alternative fuel i for GHG gas i in tonnes gas per tonnes fuel

$EF_{bio,prod,co2}$ = CO_2 emission factor for wood-fuel during production in tonnes gas per tonnes fuel

$EF_{af,prod,co2,i}$ = CO_2 emission factor for fuel I during production in tonnes gas per tonnes fuel

$EF_{bio,prod,non\text{-}co2\ gas\ i}$ = Non-CO_2 emission factor for wood-fuel during production in tonnes gas per tonne fuel

$EF_{af,prod,non\text{-}co2\ gas\ i}$ = Non-CO_2 emission factor for alternative fuel i for GHG gas i during production in tonnes gas per tonnes fuel

$$PE_y = X_{nrb,pj,y} \times B_{pj,y} \times EF_{pj,bio,CO2} + \sum (AF_{pj,i,y} \times EF_{af,CO2,i})$$
$$+\sum(\text{Non-}CO_2 \text{ emissions during cooking})$$

+∑(GHG emissions during production of the fuels) ……Eqn P.1a

Where:

BE_y = project emissions in year y (in tonnes CO_2e per year) specific to cluster and Unit chosen

$X_{nrb,pj,y}$ = the non-renewable fraction of the woody biomass harvested in the project collection area in year y in the project scenario

$B_{pj,y}$ = the mass of woody biomass consumed during cooking in the project each year (tonnes/year)

$AF_{pj,i,y}$ = The mass of alternative fuel i in the project in year y in accordance with trends projected throughout the project period, in tonnes. This mass can be set to zero in cases where the KT is appropriately designed to subsume alternative fuels (approach 3).

Non-CO_2 emissions during cooking

$$= \sum (B_{pj,y} \times EF_{pj,bio,non-co2,i}) + \sum (AF_{pj,i,y} \times EF_{af,i,non-co2\_gas\_i}) \text{ ……Eqn P.1b}$$

GHG emissions during production of the fuels

$$= X_{nrb} \times B_{pj,y} \times EF_{bio,prod,co2} + \sum (AF_{pj,i,y} \times EF_{af,prod,co2,i}) + \sum (B_{pj,y} \times EF_{bio,prod,non-co2\_gas\_i}) + \sum (AF_{pj,i,y} \times EF_{af,i,prod,non-co2\_gas\_i}) \text{ ……Eqn B.1c}$$

Calculations used in this project

As the KPT was appropriately designed to subsume all alternative fuels, $AF_{bl,i,y}$ and $AF_{pj,i,y}$ were set to zero. For the reasons set out in B.6.2 $EF_{bio,prod,co2}$ and $EF_{bio,prod,non\text{-}co2\ gas\ i}$ were also set to zero.

This leaves the following equations:

$$BE_y = X_{nrb,bl,y} \times B_{bl,y} \times EF_{bl,bio,CO2} + \sum (B_{bl,y} \times EF_{bl,bio,non-co2,i})$$

$$PE_y = X_{nrb,pj,y} \times B_{pj,y} \times EF_{pj,bio,CO2} + \sum (B_{pj,y} \times EF_{pj,bio,non-co2,i})$$

Since:

$$ER_y = \sum BE_{i,y} - \sum PE_{i,y} - \sum LE_{i,y}$$

As there is only one cluster this reduces to:

$$ER_y = \left(BE_y - PE_y - LE_y\right) \times N_y$$

Hence:

$$\begin{aligned} ER_y = & \\ & ((X_{nrb,bl,y} \times B_{bl,y} \times EF_{bl,bio,CO2} + \sum(B_{bl,y} \times EF_{bl,bio,non-co2,i})) \\ & -(X_{nrb,pj,y} \times B_{pj,y} \times EF_{pj,bio,CO2} + \sum(B_{pj,y} \times EF_{pj,bio,non-co2,i})) \\ & - LE_y) \\ & \times N_y \end{aligned}$$

Since in all cases:

$$X_{nrb,bl,y} = X_{nrb,pj,y}$$

And

$$EF_{bl,bio,CO2} = EF_{pj,bio,CO2}$$

And

$$EF_{bl,bio,non-co2,i} = EF_{pj,bio,non-co2,i}$$

The equation can be rearranged thus:

$$\begin{aligned} ER_y = & (\left(B_{bl,y} - B_{pj,y}\right) \times X_{nrb,y} \times EF_{bio,CO2} \\ & + \sum\left(B_{bl,y} - B_{pj,y}\right) \times EF_{bio,non-co2,i} \\ & - LE_y) \\ & \times N_y \end{aligned}$$

As this project is accounting for methane (CH_4) and Nitrous Oxide (N_2O) as well as CO_2, the final equation used was:

$$\begin{aligned} ER_y = & (\left(B_{bl,y} - B_{pj,y}\right) \times X_{nrb,y} \times EF_{bio,CO2} \\ & + \left(B_{bl,y} - B_{pj,y}\right) \times EF_{bio,CH4} \\ & + \left(B_{bl,y} - B_{pj,y}\right) \times EF_{bio,N2O} \\ & - LE_y) \\ & \times N_y \end{aligned}$$

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

The project proponent has elected to use a fixed baseline along the crediting period, in line with the chosen methodology, and hence the following parameters will be available at validation but not monitored.

Data / Parameter:	$EF_{bl.bio,co2}$
Data unit:	$tCO_2/t\_biomass$
Description:	CO_2 emission factor arising from use of wood-fuel in baseline scenario
Source of data used:	Calculated from IPCC defaults - 2006 IPCC Guidelines for National Greenhouse Gas Industries, Chapter 2, Stationary Combustion.
Value applied:	1.7472
Justification of the choice of data or description of measurement methods and procedures actually applied :	Deemed valid by methodology v2.
Any comment:	Refer to calculations excel sheet for further details.

Data / Parameter:	$EF_{pj.bio,co2}$
Data unit:	$tCO_2/t\_biomass$
Description:	CO_2 emission factor arising from use of wood-fuel in project scenario
Source of data used:	Calculated from IPCC defaults - 2006 IPCC Guidelines for National Greenhouse Gas Industries, Chapter 2, Stationary Combustion.
Value applied:	1.7472
Justification of the choice of data or description of measurement methods and procedures actually applied :	Deemed valid by methodology v2.
Any comment:	Refer to calculations excel sheet for further details.

Data / Parameter:	$EF_{af,co2}$
Data unit:	tCO_2/t_fuel
Description:	CO_2 emission factor arising from use of alternative fuel
Source of data used:	N/A
Value applied:	N/A
Justification of the choice of data or description of measurement methods and procedures actually applied :	The Kitchen Survey identified that no alternative fuels were used by project beneficiaries.
Any comment:	

Data / Parameter:	$EF_{bl.bio,non-co2}$
Data unit:	$tCO_2/t\_biomass$
Description:	Non-CO_2 emission factor arising from use of wood-fuel in baseline scenario
Source of data used:	Calculated from IPCC defaults - 2006 IPCC Guidelines for National Greenhouse Gas Industries, Chapter 2, Stationary Combustion.
Value applied:	0.0292
Justification of the choice of data or description of measurement methods and procedures actually applied :	Deemed valid by methodology v2.
Any comment:	Refer to calculations excel sheet for further details.

Data / Parameter:	$EF_{pj.bio,non-co2}$
Data unit:	$tCO_2/t\_biomass$
Description:	Non-CO_2 emission factor arising from use of wood-fuel in project scenario
Source of data used:	Calculated from IPCC defaults - 2006 IPCC Guidelines for National Greenhouse Gas Industries, Chapter 2, Stationary Combustion.
Value applied:	0.0292
Justification of the choice of data or description of measurement methods and procedures actually applied :	Deemed valid by methodology v2.
Any comment:	Refer to calculations excel sheet for further details.

Data / Parameter:	$EF_{af, non-co2}$
Data unit:	tCO_2/t_fuel
Description:	Non-CO_2 emission factor arising from use of alternative fuel
Source of data used:	N/A
Value applied:	N/A
Justification of the choice of data or description of measurement methods and procedures actually applied :	The Kitchen Surveys identified that no alternative fuels were used by project beneficiaries.
Any comment:	

Data / Parameter:	$EF_{bio,prod,co2}$
Data unit:	tCO_2/t_fuel
Description:	CO_2 emission factor arising from production of wood-fuel
Source of data used:	IPCC defaults or project-relevant measurement reports
Value applied:	0
Justification of the	As revealed in the baseline Kitchen Surveys (annex 3) fuel is harvested and

choice of data or description of measurement methods and procedures actually applied :	transported manually by each individual household and so does not generated any production related CO_2 emissions.
Any comment:	

Data / Parameter:	$EF_{af,prod,co2}$
Data unit:	tCO_2/t_fuel
Description:	Non-CO_2 emission factor arising from production of alternative fuel
Source of data used:	N/A
Value applied:	N/A
Justification of the choice of data or description of measurement methods and procedures actually applied :	The Baseline Kitchen Surveys identified that no alternative fuels were used by project beneficiaries.
Any comment:	

Data / Parameter:	$EF_{bio,prod,non-co2}$
Data unit:	$tCO_2/t\_biomass$
Description:	Non-CO_2 emission factor arising from production of wood-fuel
Source of data used:	IPCC defaults or project-relevant measurement reports
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	As revealed in the baseline Kitchen Surveys (annex 3) fuel is harvested and transported manually by each individual household and so does not result in any transport related production CO_2 emissions.
Any comment:	

Data / Parameter:	$EF_{af,prod,non-co2}$
Data unit:	tCO_2/t_fuel
Description:	Non-CO_2 emission factor arising from production of alternative fuel
Source of data used:	N/A
Value applied:	N/A
Justification of the choice of data or description of measurement methods and procedures actually applied :	The baseline Kitchen Surveys identified that no alternative fuels were used by project beneficiaries.
Any comment:	

Data / Parameter:	$X_{nrb,bl,y}$

Data unit:	Fraction
Description:	Non-renewability status of woody biomass fuel in year in baseline scenario
Source of data used:	Report compiled by C4 EcoSolutions (Pty) Ltd., Cape Town, South Africa
Value applied:	0.84
Justification of the choice of data or description of measurement methods and procedures actually applied :	Third party study following GS Methodology v2.
Any comment:	Refer to NRB study provided.

Data / Parameter:	$X_{nrb,pj,y}$
Data unit:	Fraction
Description:	Non-renewability status of woody biomass fuel in year in project scenario
Source of data used:	Report compiled by C4 EcoSolutions (Pty) Ltd., Cape Town, South Africa
Value applied:	0.84
Justification of the choice of data or description of measurement methods and procedures actually applied :	Third party study following GS Methodology v2.
Any comment:	Refer to NRB study provided.

Data / Parameter:	$X_{re,bl,y}$
Data unit:	Fraction
Description:	Woody biomass combustion avoided due to renewable energy form in baseline year
Source of data used:	Baseline Kitchen Survey
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	No renewable fuel use by project beneficiaries was identified by the baseline kitchen surveys, monitoring kitchen surveys will be used to identify any change in this situation.
Any comment:	

Data / Parameter:	$X_{af,bl,y}$
Data unit:	Fraction
Description:	Woody biomass combustion avoided due to alternative fuels in baseline
Source of data used:	Baseline Kitchen Surveys
Value applied:	0
Justification of the choice of data or description of	No renewable fuel use by project beneficiaries was identified by the baseline kitchen surveys, monitoring kitchen surveys will be used to identify any change in this situation.

measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	$EF_{af,prod,non-co2}$
Data unit:	tCO_2/t_fuel
Description:	Non-CO_2 emission factor arising from production of alternative fuel
Source of data used:	N/A
Value applied:	N/A
Justification of the choice of data or description of measurement methods and procedures actually applied :	The baseline Kitchen Surveys identified that no alternative fuels were used by project beneficiaries.
Any comment:	

Data / Parameter:	$(B_{bl,y} - B_{pj,y})$
Data unit:	t_biomass/stove/year
Description:	(Mass of woody biomass combusted in the baseline in year y – Mass of woody biomass combusted in the project in year y)
Source of data used:	Kitchen Performance Tests
Value applied	1.48
Justification of the choice of data or description of measurement methods and procedures actually applied :	Kitchen Surveys and Kitchen Performance tests as described in section B.4
Any comment:	Please refer to baseline report compiled by the third party.

Data / Parameter:	$AF_{bl,i,y}$
Data unit:	t_fuel/unit-year
Description:	The mass of alternative fuel i combusted in the baseline year
Source of data used:	Baseline Kitchen Surveys
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	No alternative fuel use by project beneficiaries was identified by the baseline kitchen surveys, monitoring kitchen surveys will be used to identify any change in this situation.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

As described in section B.6.1. the following equation has been used to calculate emissions.

$$ER_y = (\left(B_{bl,y} - B_{pj,y}\right) \times X_{nrb,y} \times EF_{bio,CO2} + \left(B_{bl,y} - B_{pj,y}\right) \times EF_{bio,CH4} + \left(B_{bl,y} - B_{pj,y}\right) \times EF_{bio,N2O} - LE_y) \times N_y$$

As discussed in section B.4 and the attached report, the results of the KPT were analysed to provide the average fuel saving per stove per year to the lower bound of 90% confidence interval. This was then used to calculate the ex-ante emissions reductions per stove-year.

	t/stove/year
Saving Adj. for lower bound of 90% confidence	**1.48**

Leakage has been assessed a one-off source identified that will be written off in year one as construction of stoves will complete within the first year. Following this zero leakage is anticipated for the following years.

The materials and quantities used to construct each stove* have been detailed along with CO_2 emission factors† identified for their production as available in the literature for the embodied carbon of materials. Emissions associated with material construction were therefore estimated to be 74 $kgCO_2$/stove. On the other hand, transportation of the materials is also assessed. Thus, bricks are produced locally, within 5km of each project area and materials are transported to site via pickup trucks. The emissions generated by this transport are 1.04 $kgCO_2$/stove.
The total leakage associated with transportation and construction has been assessed to be **0.0754tCO_2/stove**.

* As defined by the stove construction manual provided to contractors by the project proponent.

† Data sources: http://people.bath.ac.uk/cj219/ &
http://practicalaction.org/practicalanswers/product_info.php?products_id=249

Hence:

$$LE_1 = 0.0754$$
$$LE_{2,3...n} = 0$$

The anticipated number of stoves to be constructed is:

$$N_1 = 2{,}134$$

So:

$$ER_1 = (1.48 \text{ x } 0.95 \text{ x } 1.7472 + 1.48 \text{ x } 0.009828 + 1.48 \text{ x } 0.01934 - 0.0754) \times 2{,}134$$

And:

$$ER_{2,3,...n} = (1.48 \text{ x } 0.95 \text{ x } 1.7472 + 1.48 \text{ x } 0.009828 + 1.48 \text{ x } 0.01934 - 0) \times 2{,}134$$

Hence:

$$ER_1 = 4{,}453\ tCO_2e$$

And:

$$ER_{2,3,...n} = 5{,}000\ tCO_2e$$

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

Year	Estimation of project activity emissions (tCO_2e)	Estimation of baseline emissions (tCO_2e)	Estimation of leakage (tCO_2e)	Estimation of overall emission reductions (tCO_2e)
2011	N/A	N/A	0.0754	4,453
2012	N/A	N/A	0.0000	5,000
2013	N/A	N/A	0.0000	5,000

* Details supplied to DoE in Excel file "PDD supplementary data Shimoni"

2014	N/A	N/A	0.0000	5,000
2015	N/A	N/A	0.0000	5,000
2016	N/A	N/A	0.0000	5,000
2017	N/A	N/A	0.0000	5,000
Total (tCO_2e)	-	-	**0.0754**	**34,453**

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

B.7.1 Data and parameters monitored:

(Copy this table for each data and parameter)

Data / Parameter:	$X_{nrb,pj,y}$
Data unit:	Fraction
Description:	Non-renewability of woody biomass fuel in year y in project scenario
Source of data used:	Desktop study
Value of data:	-
Description of measurement methods and procedures to be applied:	As deemed valid in the methodology v2.
QA/QC procedures to be applied:	Study commissioned to an independent third party.
Any comment:	Subject to bi-annual monitoring

Data / Parameter:	$X_{re,pj,y}$
Data unit:	Fraction
Description:	Woody biomass combustion avoided due to renewable energy form in year y in project
Source of data to be used:	Monitoring Kitchen Survey
Value of data	-
Description of measurement methods and procedures to be applied:	No renewable fuel use by project beneficiaries was identified by the initial kitchen surveys, monitoring kitchen surveys will be used to identify any change in this situation.
QA/QC procedures to be applied:	Kitchen Surveying will be overseen by an independent third party.
Any comment:	Subject to bi-annual monitoring

Data / Parameter:	$X_{af,pj,y}$
Data unit:	Fraction
Description:	Woody biomass combustion avoided due to alternative fuels in year y in project

Source of data to be used:	Monitoring Kitchen Surveys
Value of data	-
Description of measurement methods and procedures to be applied:	No alternative fuel use by project beneficiaries was identified by the initial kitchen surveys, monitoring kitchen surveys will be used to identify any change in this situation.
QA/QC procedures to be applied:	Kitchen Surveying will be overseen by an independent third party.
Any comment:	Subject to bi-annual monitoring

Data / Parameter:	Leakage
Data unit:	t_CO_2e per year
Description:	Potential GHG emissions outside project boundary caused by project activity
Source of data to be used:	Study
Value of data	0.0754
Description of measurement methods and procedures to be applied:	Kitchen Surveys supported by desk-based research.
QA/QC procedures to be applied:	Kitchen surveys are used to assess the leakage during the duration of the project.
Any comment:	Value stated is to be applied in year one only, no further leakage is anticipated.

Data / Parameter:	$(B_{bl,y} - B_{pj,y})$
Data unit:	t_biomass/stove/year
Description:	(Mass of woody biomass combusted in the baseline in year y – Mass of woody biomass combusted in the project in year y)
Source of data to be used:	Kitchen Performance Tests
Value of data	-
Description of measurement methods and procedures to be applied:	Kitchen Surveys and Kitchen Performance tests as described in section B.4
QA/QC procedures to be applied:	3rd party study and report
Any comment:	Subject to bi-annual monitoring

Data / Parameter:	$AF_{pj,i,y}$
Data unit:	t_fuel/unit-year
Description:	Mass of alternative fuel i combusted in the project in year y
Source of data to be used:	Monitoring Kitchen Surveys
Value of data	-
Description of	No alternative fuel use by project beneficiaries was identified by the initial

measurement methods and procedures to be applied:	kitchen surveys, monitoring kitchen surveys will be used to identify any change in this situation.
QA/QC procedures to be applied:	Kitchen Surveying will be overseen by an independent third party.
Any comment:	Subject to bi-annual monitoring

Data / Parameter:	Usage in year y
Data unit:	Fraction
Description:	Percentage of stoves of age x remaining in use in year y
Source of data to be used:	Kitchen Survey
Value of data	-
Description of measurement methods and procedures to be applied:	Monitoring kitchen surveys
QA/QC procedures to be applied:	3rd party study and report
Any comment:	Subject to bi-annual monitoring

Data / Parameter:	Age
Data unit:	Fraction
Description:	Adjustment to values of $B_{pj,,y}$ and $AF_{pj,i,y}$ for stoves of age x
Source of data to be used:	Aging stove KPT
Value of data	-
Description of measurement methods and procedures to be applied:	Aging stove KPT will be carried out as per expert third party direction.
QA/QC procedures to be applied:	3rd party direction and assessment of study.
Any comment:	Subject to bi-annual monitoring

Data / Parameter:	New Stove
Data unit:	Fraction
Description:	Adjustment to values of $(B_{bl,y} – B_{pj,,y})$ and $AF_{pj,i,y}$ for new stove models
Source of data to be used:	New stove KPT
Value of data	-
Description of measurement methods and procedures to be applied:	New stove KPT will be carried out as directed by expert third party.
QA/QC procedures to be applied:	3rd party direction and assessment of study.

Any comment:	Subject to bi-annual monitoring

B.7.2 Description of the monitoring plan:

The project proponents will supervise and assist stove contractors in generating the appropriate records during the construction phase of the project.

The monitoring tasks continually undertaken are:

1. Maintenance of pilot & Total Distribution Record (TDR)
Accurate distribution records will be kept and stored both electronically and in paper format. The stove builders will create paper records (of type shown below) for each stove built; these will then be transferred to a computer system belonging to the project proponents and the original documentation stored in the local office (Kenya).

- Stove serial number
- Stove Model
- Project region
- Mode of use (domestic in all cases)
- Contractor building stove
- Trainer of contractor
- Fuel used
- Pilot stove (Y/N)
- Date of construction
- GPS Coordinates
- Name of householder
- Resident address (where possible)
- Resident phone number (where possible)
- Carbon rights handover signed (Y/N)

2. Maintenance of a Detailed Customer Database (DCD)
A detailed customer database will be kept, containing the results of all Kitchen Surveys (KS's) and Kitchen Performance Tests (KPT's). Initially the baseline KS & KPT data will be entered; following this the results of monitoring KS's & monitoring KPT's will be added.

Monitoring KS's will be carried out for 25 randomly selected beneficiaries from the TDR, per cluster, every quarter. As the stoves will be constructed over a short period and no further stoves built, households will be selected from the TDR for monitoring KS's rather than the TDR for the previous quarter. The monitoring KS's will provide information regarding the ongoing relevance of KPT results (cluster changes, usage drop-off & aging stove performance drop-off, seasonal variations, fuel-mixing patterns) and sustainable development indicators.

KPT's will be carried out every two years to assess performance of aging stoves and to ensure emissions reductions claims made in monitoring reports remain accurate. KS's will be carried out face to face, with a max 50% by telephone.

Co2b prefers to record all SD monitoring indicators in a quarterly basis even though this is not required by the GS. This extra safety measure ensures that we carefully examine the stove performance. Less intensive monitoring procedures may be implemented in the future if early results are satisfactory.

Data collected during a KS contains the following type of data:

- General information - Name, address, telephone number etc
- Household socio-demographic information
- Cooking behaviour, fuel type & mix
- Sources of fuel, prices or labour input (person-hours, distances)

3. Updating of Project Database

A project database will be created, which divides the purchasers into groups according to the most recently defined clusters, derived from the TDR. The conclusions drawn from KS's and KPT's will also be recorded here relating to cluster changes and changes in emissions reductions (if any). Emission reductions calculations will be documented here also

4. Calculation of emissions reductions

Emissions reductions will be calculated using the results of the Monitoring KS's and KPT's, using updated values for NRB, leakage, usage, age, new stove models.

Periodic monitoring tasks

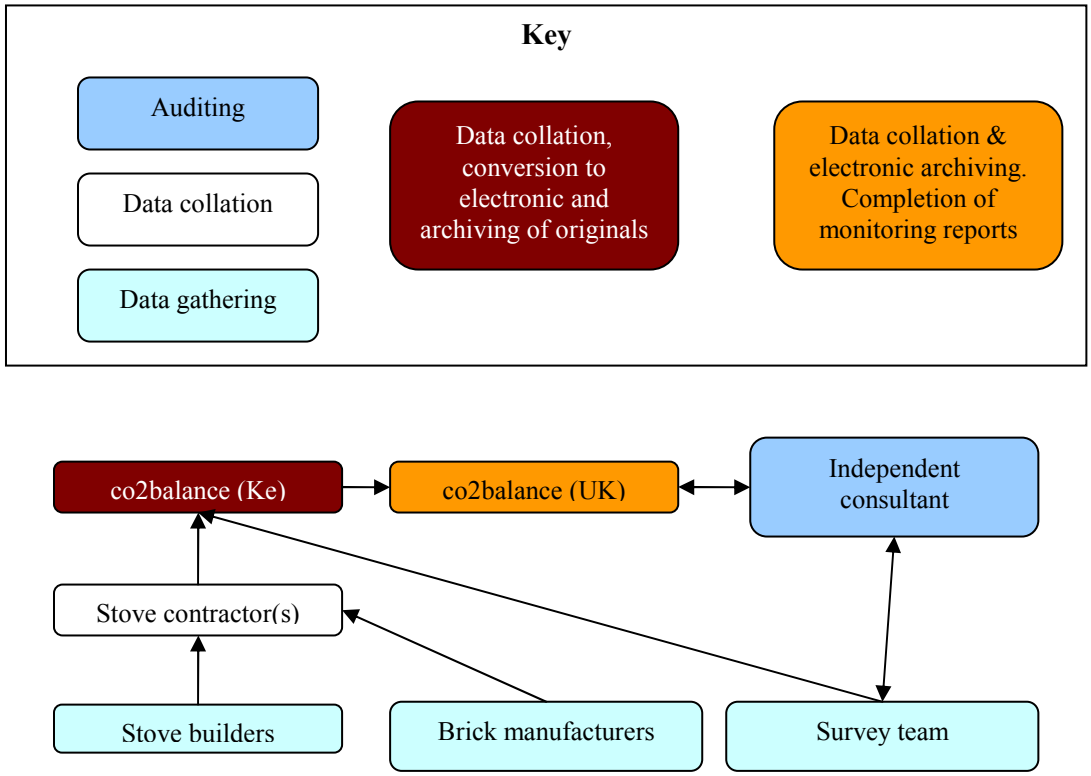
- NRB fraction assessed by literature review every two years
- Leakage estimates (identified in the PDD and possible new sources) will be surveyed every two years
- Drop-off in usages rates by beneficiaries in the first year will be surveyed every two years, random sampling as in the KS
- An aging stove KPT to assess performance of ageing stoves will be carried out every two years to assess any changes in performance of the project stoves
- A baseline monitoring KPT will be carried out every two years IF: The KS reveals that baseline parameters measured by the KPT's may have changed significantly.
- New stove KPT will be carried out for new models if launched
- Assessment of wider social and economic impact and contribution to local sustainable development of the project will be made every two years. This will be assessed through a study supported a desktop research, field work in the local area and all the information/documentation produced during the monitoring period as described above.

Quality assurance

- Throughout the duration of the project an independent third party consultant (GGI) has been engaged to reinforce data gathering and monitoring tasks.

All data recorded will be stored by the project proponents for a minimum of two years after the end of the crediting period or the last issuance of VERs, whichever occurs later.

The diagram below shows the organisational responsibilities for the monitoring plan, arrows show the flow of monitoring information.



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

The baseline and monitoring methodology were completed 05/05/2010. co2balance is the project proponent and the responsible entity for the completion of the application of the baseline and monitoring methodology.

co2balance.com
1 Discovery House
Cook Way
Taunton
Somerset
TA2 6BJ
United Kingdom

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

>> 21 years.

C.1.1. Starting date of the project activity:

To date no construction has begun bar 100 pilot stoves being built for baseline pilot establishment. These stoves will be counted for crediting purposes from the starting date of the project activity. The start date of the project will be according to the construction start date which is planned to start on the 1st January 2011.

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

>>The initial operational lifespan of the improved stoves is expected to be 7 years, following this a review will be carried out to assess the feasibility of refurbishment in order to achieve another 7 years of operational life.

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

The project will use a 7 year renewable crediting period.

C.2.1. Renewable crediting period

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

>>01/01/2011

C.2.1.2. Length of the first crediting period:

>> 7 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>

C.2.2.2. Length:

>>

SECTION D. Environmental impacts

>>

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

The Designated National Authority of the host party has provided confirmation that the project does not require an Environmental Impact Assessment to be carried out. Proof letter available.

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

>>

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

The co-operation and understanding of local stakeholders is a key to the success for the project activity, with this in mind a face to face stakeholder meeting was held at the Shimoni Jungle Restaurant Conference Hall, Shimoni, Mombassa, 9AM 27th February 2009.

When inviting organisations and individuals to attend the stakeholder meeting, the project proponent thought it is best to expand the selection in order to avoid missing out any organisations or individuals that could have a key interest in the activity. A small group of diverse participants was chosen by their location, need, how affected they were by the traditional cooking methods and its consequences, their capacity to help address the issue and their motivation to make the project work. The main priority was to make certain that it was not only the visible, voluble and easy to access that were invited.

Some of the representatives included:

- Tanda Ventures
- Shimoni Mkwiro Dhow Tours
- Mkwiro Conservation
- Mkwiro Youth C Group
- Wasin Women's Group
- Mkwiro Women's Group
- Sineno Group – Majoren
- Community policing, etc.

Invitation methods included email, telephone and hand delivery. And, as many families would not have access to the local newspaper, women's groups and church groups were used to visit households in the area and personally invite these homesteads. It was important to deliver the invitations in the evening, when the men were also home, as this would motivate them to attend as well. Above 50% of the parties invited confirmed their attendance, which were considered to be acceptable, furthermore, some cases are also tracked by phone when the attendance is not confirmed. However, from the attendance list, it is clear that the group was certainly a well represented one. The proponent was successful in ensuring that all age groups were represented although in future it would be preferable to have more men present at the meeting in order to be more representative.

Stakeholders were encouraged to actively participate in the meeting, aiding in creating a sustainable development matrix and discussing how the sustainable development indicators identified could be monitored. At the end of the meeting all stakeholders were invited to fill out a feedback form.

E.2. Summary of the comments received:

Shown below is a selection of comments representative of those received at the end of the meeting.

Name	**Mbwana Kombo (feedback sheet 19)**
What is your impression of the meeting?	The poor people have learnt about the importance of protecting the environment.
What do you like about the project?	The reduction in the use of firewood.
What do you not like about the project?	Nothing
Signature	See Annex 2.

Name	**Kassim Hassan (feedback sheet 19)**
What is your impression of the meeting?	The meeting was open, peaceful and showed unity.
What do you like about the project?	The reduction in the use of firewood.
What do you not like about the project?	Nothing
Signature	See annex 2.

Name	**Tima Mwalimu (feedback sheet 5)**
What is your impression of the meeting?	The meeting was very nice and had a lot of meaning to me.
What do you like about the project?	I like the fact that the stoves are being built and that they are free.
What do you not like about the project?	There is nothing I don't like. Everything makes me happy.
Signature	See Annex 2.

Name	**Issa Angonga (feedback sheet 13)**
What is your impression of the meeting?	This meeting has educated us on the problems that come about like eye diseases from the smoke.
What do you like about the project?	I like this project because it will help eradicate poverty as the poor will be using less money on firewood.
What do you not like about the project?	What I don't like about the project is lies and the project being done.
Signature	See Annex 2.

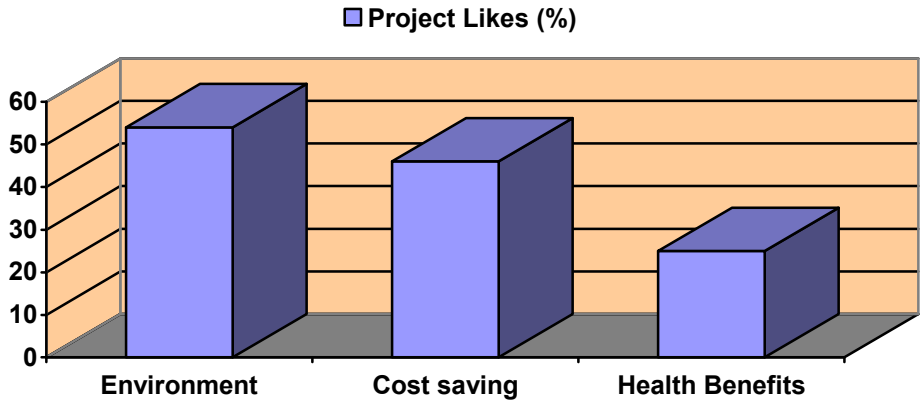
Name	**Msafiri Kingi (feedback sheet 22)**
What is your impression of the meeting?	In my opinion I was pleased will all that was discussed and the goals that were explained.
What do you like about the project?	What I like about the project is that it does not require any money from the people and that it will reduce sickness from smoke.
What do you not like about the project?	There is nothing I did not like.

Signature	See Annex 2.

The overall consensus was that the meeting was successful and informative. Participants felt that they were made fully aware of the project and its objectives, and that their questions were answered.

From the 24 feedback sheets received the comments regarding project likes were:

- 54% thought that the project would have enormous environmental benefits.
- 46% commented on the benefits of reduced fuel and the cost saving implications.
- 25% commented on the health benefits due to the smoke reduction.



With regard the dislikes of the project;
84% had no dislikes, was detailed as not applicable or left blank. The remaining comments were related to the project being limited just to a few people, hypothetical problems among the people in the community due to that fact, preconceived expectations that were clarified in the meeting and suggestion providing allowances for the meeting.

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

The only issue to take into account is the future approach of the businessmen on the boats to persuade them to offset their emissions in the near future and to plan the employment inclusion of the wood sellers affected by the decreased wood consumption due to the project. In the first case co2b will approach them informally at their usual business area to introduce to the "offsetting" concept to pursue a form of commitment. In the second case co2b will assess at a later stage of the project when all stoves are implemented to what extent the wood sellers are affected and will look into prioritising their employment inclusion in the project.

The proponent will look into benefit all the sub locations when at all possible.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Annex 3

BASELINE INFORMATION

See CO2balance online registry for NRB study.

See below details of baseline and its development.

Baseline monitoring report on the rocket stoves:

Shimoni Gold Standard project

for

co2balance Ltd.

5th May, 2010

prepared by Germán Garcia Ibáñez
Independent consultant

Introduction

Co2balance Ltd is developing a project that involves the free distribution of efficient wood stoves to households in Shimoni village (Kenya). In the absence of this project householders would cook primarily using traditional inefficient 3 stone fires.

In line of the Gold Standard recommendations for quality assurance and control, a third independent party (Germán García Ibáñez) has been involved to accomplish and reinforce the data collection tasks. A previous document has set out the process to collect the necessary data to calculate the GHG emission reduction of the project. The third independent party has checked the quality and consistency of the data sent by the co2balance however the data collection field work has been performed by co2balance and no field visits has been done by the third independent party.

The following presents the results of the data collection process.

Methods and approach

Qualitative survey (Kitchen Survey or KS)

The Kitchen Survey is designed to be developed in communities where improved stoves project are underway. The KS involves observations and questionnaires have been undertaken by an expert survey team visiting kitchens using the improved stoves. These results are used to develop a more precise understanding of how adoption of the improved cookstove effects fuel consumption and GHG emissions within each major cluster.

As the project is going to implement around 2,000 stoves in Shimoni village, 100 Kitchen Surveys were therefore administered in households within Shimoni.

The KSs were performed by a field team in March 2010 inside of the village were the pilot 100 rocket stoves have been built.

Make quantitative measurements (Kitchen Performance Test or KPT)

Kitchen Performance Test (KPT) was performed in 80 households in Shimoni by a field team in March 2010. The KPT was conducted over three full days, requiring daily households visits for four days, firewood were weighed daily using a large scale spring scale with 0.1 – 0.5 kg accuracy. The survey was also administered daily to record information about the number of people cooked for. The KPT was

performed using a cross sectional study in 40 households using the rocket stove from 2 months ago and in different 40 households using the traditional 3 stone stove.

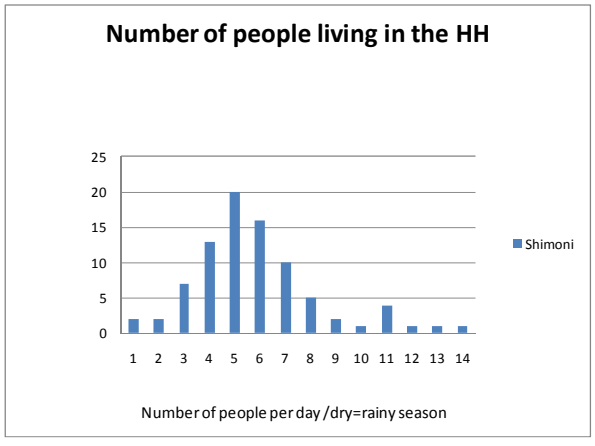
The households for the KPT on rocket stove users were selected using screening criteria based on the 100 Kitchen Surveys performed in Shimoni, so as to be representative of the typical efficient stove beneficiary. The three stone stove users KPT were performed on households with similar socioeconomic and demographic characteristics as the rocket stoves beneficiaries but who did not have rocket stoves.

Results

Kitchen Survey

The kitchen survey did not reveal any relevant differences in the dry and rainy seasons regarding the number of people cooked for, the number of meals cooked per day and the frequency of use of fuels. The KS has ratified that there are only firewood consumers and no clustering criterion can be identified.

Among the 100 Kitchen Surveys respondents in Shimoni rocket stoves beneficiaries, the number of people living in the household and the number of people cooked for in these household covered a wide range and it is showed in the next figure:



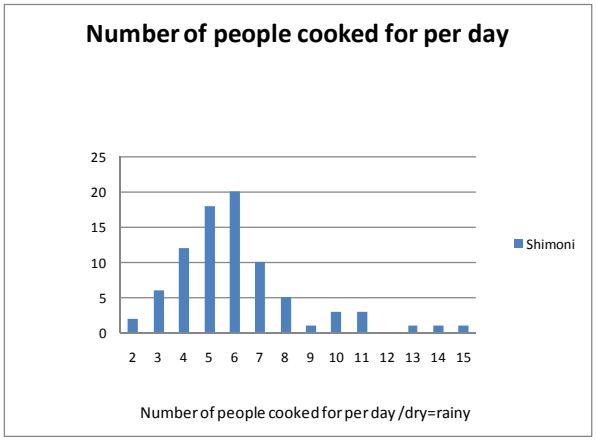


Figure 1: KS responses for the number of people living in the HH and the number of people being cooked for

The data in Figure 1 was used to create criteria for the KPT household selection process. In order to cover the typical range of people living in the household and to avoid outliners, households cooking for very

large numbers or households with very large number of people living in it (higher than 7), were excluded from the KPT. Also households with 2 or less people were excluded from the KPT selection.

The kitchen survey did not reveal any other significant clustering criterion, the households´ level of education and main source of income is shown in Figures 2 and 3 below:

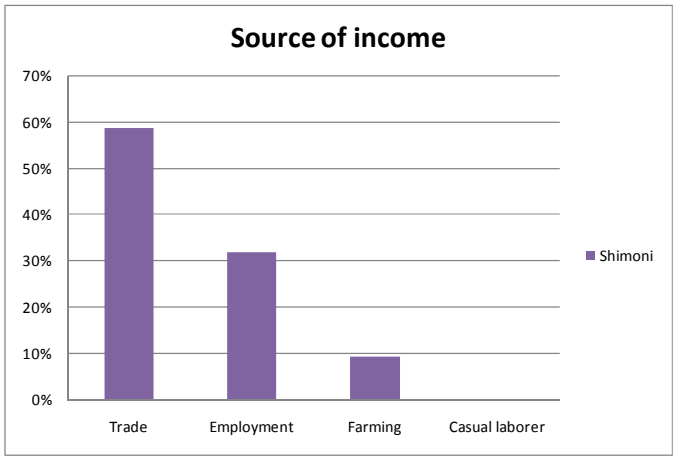


Figure 2: Kitchen Survey responses for the households´ main source of income

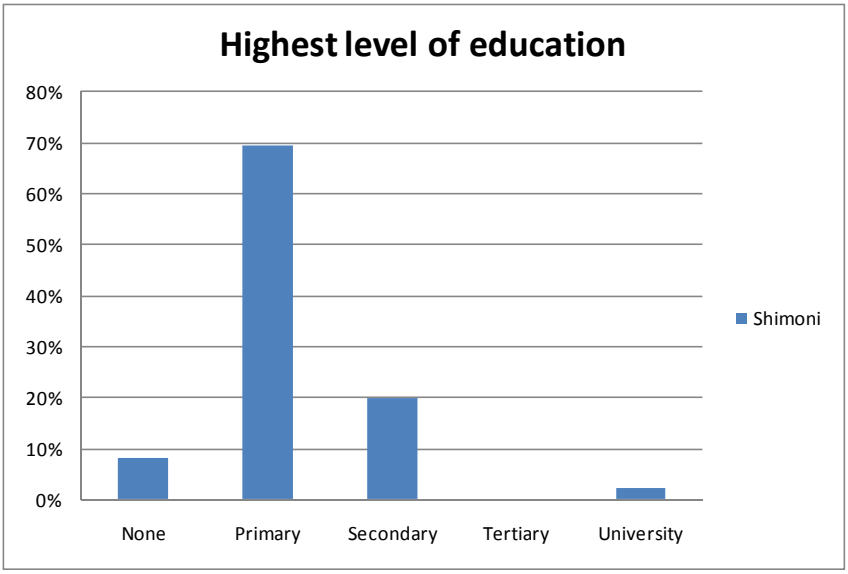


Figure 3: Kitchen Survey responses for the highest level of education

The resume of the average time spent to collect firewood and the average distance travelled per day is presented below[*]*:*

	Firewood collection	
	Average time spent to collect firewood per day	Average distance to collect firewood (km) per day
Shimoni	4h	2.3

Table 1: Time and distance spent per day in firewood collection

Kitchen Performance Test

Table 2 and 3 below summarizes the firewood use results of the 3 – day KPT in 40 households using the rocket stove and in 40[†] *households using the traditional three stone stove.*

	Number of households	Mean (kg / HH day)	Std. Deviation	Std. Error Mean	CV	Min sample size (90/10)
Firewood use in a 3 stone stove	29	9,87	1,76	0,33	18%	9
Firewood use in a rocket stove	40	5,07	1,93	0,31	38%	39

Table 2: KPT results

[*] 55% of the interviewers collect the wood

[†] Despite the fact that the survey team asked the household size before perform the KPT there were 11 households that were cooking for more than 8 people during the test day, to avoid outliners this 11 cases were deleted from calculations.

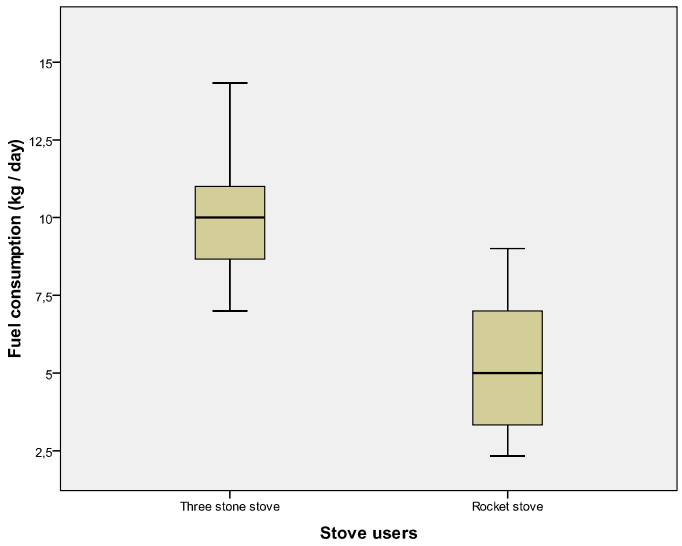


Figure 4: KPT graph results

				90% Confidence Interval		t-Test
	Firewood use in a 3 stone stove	**Firewood use in a rocket stove**	**Firewood savings (3 stone stove - rocket stove)**	**Lower**	**Upper**	**p - value**
Units	Kg / HH - day	Kg / HH - day	Kg / HH - day	Kg / HH - day	Kg / HH - day	
Number of households	29	40				
Results	9,87	5,07	4,81	4,05	5,56	6,132E-16

Table 3: Cross sectional KPT results and firewood savings

As the t-Test p-value in Table 2 above reveal, the households had significant firewood savings. Annual firewood savings from a three stone to a rocket stove switch results in ***1.48 tons of firewood per household per year****.*

Report prepared by Germán García Ibáñez

Leakage
Source f: Transportation and construction of stoves
An estimate of the CO_2 emissions generated in the construction of the stoves has been assessed for leakage purposes, the results found this form of leakage to be minimal. For the sake of remaining conservative however, this assessment has been included in the calculation of emissions reductions achieved.

The materials used to construct each stove* are detailed below, along with CO_2 emission factors† factors† identified in the available literature for the embodied carbon of materials.

Material	Quantity (units/stove)	Units		Quantity (kg)	EF (kgCO2/kg material)
Fired bricks	16	#	31%	57.6	0.25
Fire bricks	35	#	69%	126	0.25
Vermiculite	0.3	bag	-	7	0.52
Cement	0.5	bag	-	25	0.83
Sodium silicate	2	litre	-	2	1
Lime	0.3	bag	-	3.3	0.74
Sand	2	barrows	-	60	0.005

Emissions associated with material construction were therefore estimated to be 74 $kgCO_2$/stove.

Bricks are produced locally, within 5km of each project area and materials are transported to site via pickup trucks. The emissions generated by this transport have also been accounted for.

Journey distance (km)‡	10
Materials transported/stove (tonnes) § §	0.2809
Tonnekm/stove	2.81
EF (kgCO2/tkm)**	0.37
Transport emissions (kgCO2/stove)	**1.04**

The total leakage associated with transportation and construction has been assessed to be **0.0754tCO_2/stove**.

* As defined by the stove construction manual provided to contractors by the project proponent.

† Data sources: http://people.bath.ac.uk/cj219/ & http://practicalaction.org/practicalanswers/product_info.php?products_id=249

‡ As stated by project partners in host country

§ As stated by project partners in host country

** From Defra ghg factors 2009 Annex 7, diesel class III. Most conservative figure

Annex 4

MONITORING INFORMATION

See CO2balance online registry for monitoring process and forms.