THE GOLD STANDARD:
Project Design Document for Gold Standard Voluntary Offset projects

(GS-VER-PDD)

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Explanatory information on how to complete the PDD and how to obtain Gold Standard registration can be found in the project developer's manual available on the Gold Standard website.

This template of the PDD is applicable for micro-, small- and large-scale projects. Note that the shaded boxes present information on the Gold Standard VER project development procedures. Project developers should delete these shaded boxes when preparing their PDD.

a. VOLUNTARY OFFSET PROJECTS

PROJECT DESIGN DOCUMENT FORM (GS-VER-PDD)
Version 01 - in effect as of: January 2006)

CONTENTS

SECTION A. General description of project activity

A.1 Title of the project activity

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Title: Integrated Biomass Energy Conservation Project - Malawi.
Version: 6
Date: 2nd of November 2012

A.2. Description of the project activity

Malawi is over dependent on woodfuel,[1] which accounts for 93% of the country's aggregate energy use.[2] Deforestation is not only resulting in increased scarcity of woodfuel for energy but it is also causing many other environmental problems, which directly increase socio-economic vulnerability, such as increased soil erosion, river siltation, increased vulnerability to flooding, the sinking of the water table and reduced natural habitat for biodiversity. It is estimated that in Malawi, 90 percent of household and industrial energy requirements are met from forests.[3]

Tobacco is Malawi's main export[4] and an important cash crop for smallholder farmers. Smallholder tobacco producers that farm areas of around 1 hectare of land[5] use fuelwood as a fuel to 'flue-cure'[6] tobacco leaves in inefficient conventional barns. Although improved barn technologies are available, their use is mainly restricted to large-scale estates. Smallholder tobacco growers do not operate their own fuelwood plantations due to scarcity of land. One study stated that tobacco induced deforestation in Africa is probably most serious in Malawi.[7]

The project reduces greenhouse gas emissions from non-renewable biomass fuel by dissemination of improved household and institutional cook-stoves and fuel-efficient rocket barns to replace existing inefficient curing barns. The project is based on research and development in the stoves and barns by the Programme for Biomass Energy Conservation (ProBEC) in Malawi. A company that promotes fuel-efficient technologies called Hestian Rural Innovation Development was founded on the basis of this pilot work in 2008.

This project disseminates four types of improved cook-stoves and improved tobacco-curing barns or 'rocket barns'.

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1 Woodfuel is used to mean all fuels originating from woody biomass, including charcoal, in distinction from firewood or fuelwood, which are understood to mean the wood in its original composition.

2 National Energy Policy, 2003.

3 Chipompha, N.W.S., Belo, W.S. & Mjojo, D.P.K. *Deforestation in Malawi, its nature, causes and corrective methods*. Forestry Department, Lilongwe, Malawi (1993).

4 Tobacco is the main export crop accounting for over 70.0 per cent of total export earnings. (Source: Malawi Growth and Development Strategy "From Poverty to Prosperity 2006-2011', GoM, 2007).

5 Ninety-five per cent of rural households in Malawi have 1 hectare or less and the average in the Southern Region is just 0.4 ha (National Forestry Programme, 2001).

6 *Flue-cured* tobacco is strung onto tobacco sticks, which are hung from tier-poles in curing barns. These barns have flues which run from externally fed furnaces, heat-curing the tobacco without exposing it to smoke, slowly raising the temperature over the course of the curing. Hence, flue-cured tobacco is not naturally cured by air or sun, but artificially by external energy sources. Tobacco is cured to obtain the characteristic taste, aroma and colour, and to preserve it for storage, transport and processing.

7 Geist, H. "How tobacco farming contributes to tropical deforestation". Paper presented at the Tobacco Deliberation Group Meeting, National Committee for International Cooperation and Sustainable Development, Utrecht, 29 October 1997.

(see Table A.2 1, A.2 2 and A.2 3):

a. Improved fuel-efficient portable ceramic stoves *(Chitetezo mbaula* – the "protective stove"*),*
b. Improved fuel-efficient fixed *esperanza* stoves,
c. Improved fuel-efficient rocket barns for curing agricultural produce
d. Institutional Stoves
e. Urban Cook Stoves

				
Portable ceramic stove	Fixed *esperanza* stove	Rocket Barn	Institutional Cook Stove	Urban Cook Stove

The improved stoves reduce fuel consumption by improved combustion and improve heat transfer. The stoves raise the cooking pot to the hottest point above the flame. The fixed stove, institutional cook stove and the urban cook stove have elbow-jointed combustion chambers that increase combustion efficiency.

The 'rocket barn' reduces fuel consumption by introduction of a double chimney that uses 'waste heat' to increase convective flow through the tobacco and barn structure for improved heat transfer systems, which ensure equal heat distribution with improved air-flow minimising the risk of barn fires. The rocket barn has a twofold increase in heat exchanger surface area compared to the conventional barn and has an improved, extended, and durable "*venturi"* furnace. The term 'rocket barn' was chosen for the improved barns as the combustion chambers of the barns are based on the well-proven rocket technology for improved cook-stoves.

Tests were conducted in 2008 and 2009 to measure the fuel savings introduced by the improved devices, with the following results:

- The improved portable ceramic stove reduced wood consumption in sampled households by 39% on average, in some cases saving more than 50% of fuel used previously,
- The fixed esperanza stove reduced wood consumption by 48% on average in the sampled households,
- The improved rocket barns reduced fuel-use by 63% on average in sampled farms,

During the second round stakeholder consultation, feedback was received suggesting that the project incorporate:

(a) efficient cook stoves sized for cooking at institutions such as schools, colleges, prisons and hospitals (Institutional Cook Stoves); and

(b) efficient cook stoves that are appropriate for urban and peri-urban areas and that allow for more efficient cooking with charcoal and/or a mix of charcoal and wood (Urban Cook Stoves).

As a result of this feedback the project intends to incorporate Institutional Cook Stoves (ICS) and Urban Cook Stoves (UCS). Tests will be conducted in 2009/2010 to measure the fuel savings introduced by the ICS and UCS.

The ICS and UCS are expected to apply proven 'rocket' technology by introduction of an insulated combustion chamber, increasing combustion efficiency and retaining heat while also raising the cooking pot to the hottest point above the flame. Both stoves will further increase heat transfer by having the cooking pot rest within a skirt.

The improved stoves and barns significantly reduce fuel consumption and greenhouse gas emissions. They simultaneously provide ancillary benefits to users and families in the form of reduced exposure to indoor air pollution (in the case of stoves), relief from high fuel costs; less time hand-gathering domestic fuel-wood and reduced burden for farmers to transport wood over distances that are increasing. Public benefits of the devices promoted come in the form of reduced pressure on Malawi's natural resources.

Fixed esperanza stove are targeted at rural households in Malawi and initially households that already have access to micro-finance; Portable ceramic stove are targeted at rural food-insecure households and, Rocket Barns are targeted at smallholder tobacco farmers that have access to micro-finance and are farming approximately 1 hectare of tobacco. The institutional stoves are targeted at institutions that regularly cook for large groups of people, such as schools, health centres, prisons, barracks etc. Urban cook stoves are targeted at the urban and peri-urban households.

The Project is being implemented in all three Regions of Malawi: Southern, Central and Northern. The project disseminates both fixed stoves and barns in the Central, Southern and Northern regions and concentrates portable ceramic stove dissemination in one district of the Southern Region. Institutional and urban cookstoves will be disseminated throughout Malawi. Improved portable ceramic stoves are marketed at a village level in collaboration with local and traditional authorities, while the fixed stoves, urban cook-stoves and rocket barns are disseminated in collaboration with micro-finance institutions and agro-industries. Institutional cook stoves may be disseminated through school feeding programmes and *via* national institutions.

Since 2007, plans were made to access the carbon market to finance the project to overcome various constraints so that sales could be increased dramatically through training specialised building teams and production groups, marketing and promotion, technical development and improved after sales services. From July 2008, using carbon finance advances and monies expected to be recouped from carbon finance, the expansion was implemented, operational capacity was improved, the company HRID was incorporated, quality assurance systems were devised, user manuals were developed and technical design of the devices were improved to achieve the high levels of efficiency listed above.

Table A.2 1, A.2 2 and A.2 3 project the expected volume of improved stoves and barns throughout the project period. Table A.2 3 calculates operational barn years on the assumption that barns are built before the start of each curing season, which runs from January to April each year. Operational stove years are calculated based on the amount of time that the stoves are in use. An improved stove, for example, working for six months qualifies as ½ operational barn year.

Table A.2 1 assumes that the fixed esperanza stoves have a 5-year working life, the portable ceramic stoves have a working life of at least 2 years while the rocket barns have a working life of ten years or more. These assumptions are not made by the monitoring protocol, which requires that actual usage drop off rates are measured during project operation.

In order to assure conservativeness, emission reduction calculations are made only for one stove per household (many households will have more than one improved stove) and the average values of one stove are multiplied by the projected number of operational stove years. For barns, initially only the smallest size barns (250 stick capacity) are being disseminated. Rocket barns with greater capacity (e.g. 260 and 300 stick), that use the same technology and fuel, will be included in the small barn cluster as this gives a conservative result when quantitative test results for fuel savings of small barns are applied to larger barns.

Carbon finance creates a strong incentive for quality assurance and customer service to ensure user awareness, proper use and continuity of emissions reductions. Quality expectations are being established amongst end-users and efficient cooking and curing is becoming more sought after. The quality assurance system extends the working life times of the stoves and barns and maintains performance levels by providing subsidised or free damage repairs and maintenance for the devices. The figures presented on Table A.2 1, A.2 2 and A.2 3 are targets that can be reached by making the technologies affordable and by building customer loyalty through quality customer service.

Table A.2 1 Projected Annual Sales and Operational Improved Fixed Esperanza (FES) Stove Years

Project Year	Calendar Year	Sales Fixed Stoves	Expiries	No. of users by year end	Projected Operational Stove Years (Cumulative)
1	Q4-08 to Q4-09	0	0	0	0
2	Q4-09 to Q4-10	1,524	0	1,524	762
3	Q4-10 to Q4-11	0	0	1,524	2,134
4	Q4-11 to Q4-12	0	0	1,524	2,926
5	Q4-12 to Q4-13	1,524	1,524	1,524	2,341
6	Q4-13 to Q4-14	0	0	1,524	2,787
7	Q4-14 to Q4-15	0	0	1,524	2,891
	Totals	**3,048**			**13,841**

Table A.2 2 Projected Annual Sales and Operational Improved Portable Ceramic Stove Years

Project Year	Calendar Year	Sales PCS	Expiries	No. of users by year end	Projected Operational Stove Years (Cumulative)
1	Q4-2008 to Q4-09	1,829	0	1,829	915
2	Q4-09 to Q4-10	5,526	0	7,355	4,592
3	Q4-10 to Q4-11	1,493	0	8,848	6,631
4	Q4-11 to Q4-12	2,000	0	10,848	8,078
5	Q4-12 to Q4-13	750	0	11,598	9,053
6	Q4-13 to Q4-14	750	1,829	12,348	9,653
7	Q4-14 to Q4-15	750	5,526	13,098	10,253
	Totals	**13,098**	**7,355**		**49,176**

Table A.2 3 Projected Annual Builds and Operational Rocket Barn Years

Project Year	Calendar Year	RBs (built before curing season)	Expiries	Barns built in time for curing season	Projected Operational Barn Years (Cumulative)
1	Q4-08 to Q4-09	153	0	153	159
2	Q4-09 to Q4-10	588	0	741	759
3	Q4-10 to Q4-11	0	0	741	721
4	Q4-11 to Q4-12	0	0	741	685
5	Q4-12 to Q4-13	0	0	741	651
6	Q4-13 to Q4-14	0	0	741	618
7	Q4-14 to Q4-15	0	0	741	587
	Totals	**741**			**4,180**

Table A.2 4 Projected Annual Sales and Operational Institutional Cook Stove Years

Project Year	Calendar Year	Sales Institutional Cook Stoves	Expiries	Number of users by year end	Projected Operational Stove Years (Cumulative)
1	Q4-08 to Q4-09	0	0	0	0
2	Q4-09 to Q4-10	1	0	1	1
3	Q4-10 to Q4-11	0	0	0	1
4	Q4-11 to Q4-12	0	0	0	1
5	Q4-12 to Q4-13	0	0	0	1
6	Q4-13 to Q4-14	0	0	0	1
7	Q4-14 to Q4-15	0	0	0	1
	Totals	**1**	**0**	**1**	**6**

Table A.2 4 Projected Annual Sales and Operational Urban Cook Stove Years

Project Year	Calendar Year	Sales Urban Cook Stoves	Expiries	Number of users by year end	Projected Operational Stove Years (Cumulative)
1	Q4-08 to Q4-09	0	0	0	0
2	Q4-09 to Q4-10	51	0	51	25.5
3	Q4-10 to Q4-11	0	0	0	66.3
4	Q4-11 to Q4-12	0	0	0	48
5	Q4-12 to Q4-13	0	0	0	0
6	Q4-13 to Q4-14	0	0	0	0
7	Q4-14 to Q4-15	0	0	0	0
	Totals	**51**	**0**	**51**	**139.8**

The sustainability analysis assesses the project in terms of environmental and sustainable development impact. The project complements and is consistent with the priority actions of Malawi's National Adaptation Programme of Action (NAPA) and can strengthen livelihoods in rural communities that are highly vulnerable to climate change. The relevant indicators are:

1. Air pollution: Reduced exposure to indoor air pollution, which is linked to many different diseases, including, tuberculosis, asthma, cardiovascular and ocular diseases, peri-natal health outcomes and acute and chronic respiratory diseases which is a major killer of children under age of 5 in the world.[8] Indoor air pollution disproportionately affects women and children who spend most time near the

[8] It is estimated that in 2002 in Malawi,12,240 deaths of children less than 5 years old from acute lower respiratory infections were attributable to solid fuel use (Indoor Air Pollution, National Burden of Disease Estimates, WHO, 2007). Initial tests in Dowa and Ntchisi Districts showed that a follow-up kitchen test resulted in a 55% decrease in average one-hour concentrations of particulate matter during cooking time in the kitchen, attributable to improved cook stoves, better ventilated kitchens and improved firewood management. Follow-up PM levels, however, were still higher than critical concentration values stipulated by the WHO, 1999.

domestic hearth. What about indoor air pollution in tobacco barns?[9]

2. Water quality and quantity: River siltation from soil erosion is mitigated due to reduction in tree felling.

3. Soil condition: soil quality at a community level is enhanced due to reduced soil erosion from the reduction in tree felling.[10]

4. Biodiversity is conserved through the project by reducing pressure on remaining forest reserves and by mitigation of alteration and destruction of natural habitat *via* reduced tree felling.

5. Quality of employment: Project staff is covered by MASM (Medical Aid Society of Malawi) health insurance. All staff and sub-contracted personnel are trained on new skills. To date, staff has been trained in business, accountancy, finance, management, participatory video making and Geographic Information Systems. Salaries and labour conditions are competitive and above average.

6. Livelihood of the poor: The resilience of livelihoods will be improved through reduced household and farm expense (reduced woodfuel purchases, which in turn reduces increasingly expensive transport of fuel-wood from further distances). The project also has the potential to improve food security through improving kitchen fuel security. The improved stoves are safer as they protect women and children from scalds and burns, as the stoves' body shields the fire to contain the heat. Woman and girls walk shorter distances and spend less time gathering firewood for cooking and heating. Benefits of the Rocket Barn include fuel and transport savings, yield increase *via* weight gain, quality gain of whole crop, reduced curing time and reduced maintenance costs.

7. Access to affordable and clean energy services: The project's geographically broad dissemination plan improves access to locally produced / assembled affordable technologies that significantly reduce the use of woodfuel (purchased &/or gathered) for cooking & curing.

8. Skills and human capacity: positive change in the number of jobs and positions for women, a change in female earned income, and empowerment to women as a result of women-specific training for stove production and kitchen and fuelwood management.

9. Quantitative employment and income generation: Demand for improved stoves and barns generate sustainable livelihoods and income generating opportunities at a village level around Malawi, particularly for women. To date 20 staff and over 80 specialised builders, metalworkers and carpenters have been contracted to build rocket barns and fixed stoves. There are also 11 production groups for portable ceramic stoves, which generate "off-farm" income for approximately 200 people, many of whom are women. There are also 60 village based stove promoters that receive a stipend for monitoring tasks and earn a steady income from sales of stoves. As the rate of dissemination increases, the project is likely to generate more employment and income.

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[9] The Rocket Barn is designed so that no smoke enters the inside of the barn – the heat generated in the furnace from burning wood passes through a sealed flue fire-box until it exits through the double-chimney – smoke would contaminate the tobacco leaves and should not be emitted inside. Once the curing process begins the person attending the cure very rarely enters the barn. Smoke is emitted from the furnace door once lit, but once the furnace fire is burning the smoke travels through the flue and out the chimney.

[10] Extensive land use, including the wanton cutting down of trees has resulted in severe land degradation and soil erosion, leading to siltation of rivers seriously affecting hydro-electric power generation, human health and fisheries (Adapted from Malawi's NAPA, 2006). By reducing tree-felling soil erosion can be reversed.

10. Balance of payments: The project facilitates direct foreign investment of private funds in multiple regions of Malawi in improved technologies.

11. Technological transfer and technological self-reliance: Appropriate technological transfer e.g. south-south, rural–rural transfer. The project facilitates transfer and adoption of appropriate locally designed and tested "made in Malawi" technologies. Technologies do not involve exotic parts or tools and promote self-reliance. The project's approach can be replicated in other countries, where there is an estimated wood deficit or prospective wood deficit situations (see Figure A.2).

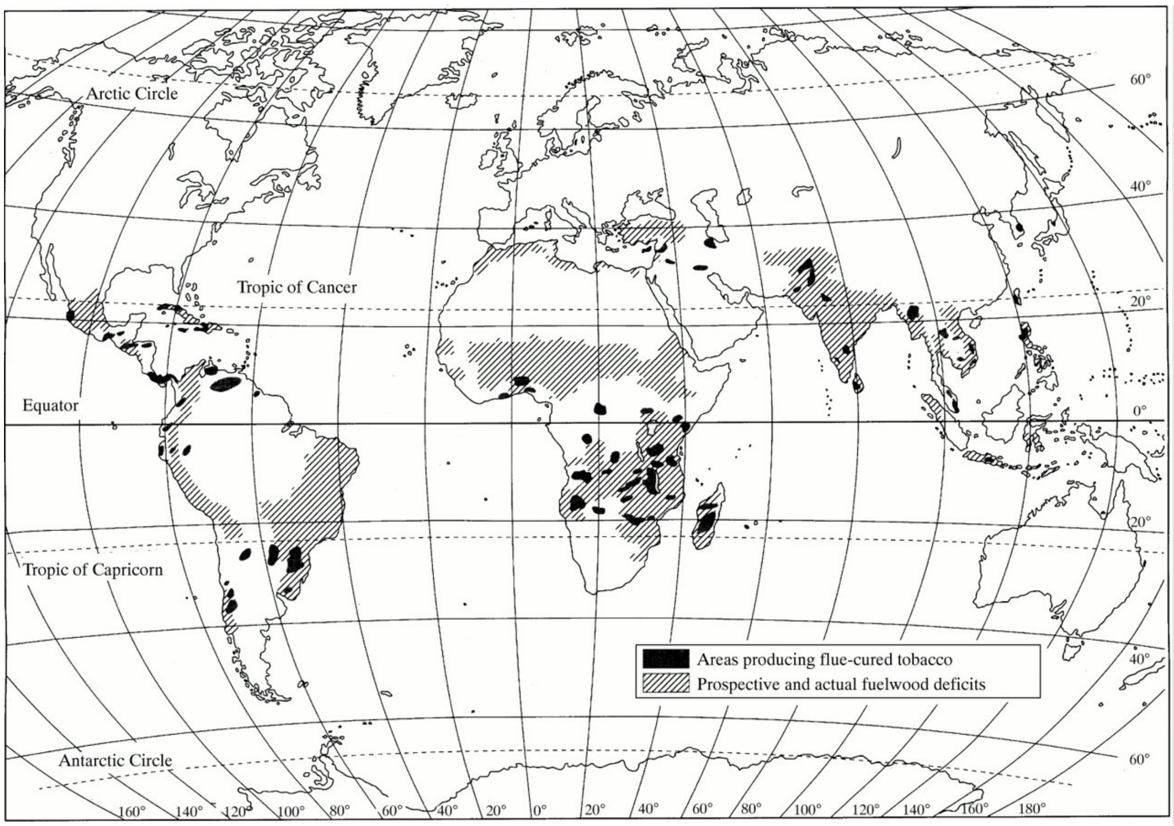

Figure A.2 In many countries where flue-cured tobacco is grown, fuelwood demand is not sustainable. Fraser (1986)[11]

No negative indicators arise from the project activities and an overall score is achieved as follows:

Component Indicators	**Matrix Score (-2 to 2)**
Local/Regional/global environment	
Air quality (emissions other than GHGs)	1

[11] Fraser, A. I. (1986): The use of wood by the tobacco industry and the ecological implications. - International Forestry Science Consultancy: Edinburgh.

Water quality and quantity	1
Other pollutants (including, where relevant, toxicity, radioactivity, POPs, stratospheric ozone layer depleting gases)	0
Soil condition (quality and quantity)	0
Biodiversity (species and habitat conservation)	1
Sub-total	**3**
Social sustainability and development	
Employment (including job quality, fulfilment of labour standards)	1
Livelihood of the poor (including poverty alleviation, distributional equity, and access to essential services)	1
Access to energy services	1
Human and institutional capacity (including empowerment, education, involvement, gender)	1
Sub-total	**4**
Economic and technological development	
Employment (numbers)	1
Balance of Payments (sustainability)	1
Technological self-reliance (including project replicability, hard currency liability, skills development, institutional capacity, technology transfer)	1
Sub-total	**3**
TOTAL	**10**

Box A.2 1 Sustainable Development Assessment Matrix

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)**
The project is voluntary: no Kyoto party participates	Hestian Innovation Ltd.	The Project is voluntary: no Kyoto party participates.

A.4. Technical description of the project activity:

<u>A.4.1. Location of the project activity:</u>

The project operates in all three regions of Malawi, namely Northern, Central and Southern Regions (initially in the Districts of Balaka, Dowa, Kasungu, Mzimba, and Ntchisi).

Malawi does not have a quantitative reduction target under the Kyoto Protocol.

A.4.1.1. Host Party (ies):

The project is voluntary and therefore is not hosted or invested in by a Party to the Kyoto Protocol.

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

All regions of Malawi, Southern Africa.

A.4.1.3. City/Town/Community etc:

Malawi. Improved stoves and rocket barns are disseminated in all three Regions of Malawi.
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A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

Hestian Rural Innovation Development is the implementing the dissemination of the stoves and barns and conducts the project from its offices in Lilongwe:

Contact Person(s):	Mr. Conor Fox hestianrural@gmail.com
Address:	Area 9 Plot Number 428, P.O. Box 1306, Lilongwe, Malawi. Phone: +265(0) 1 971 397, +265(0) 995 469 484

<u>A.4.2. Size of the project:</u>

Small Scale
Demonstration of Small Scale Limit:
15.6GJ/tonne wood * 1000MJ/GJ/3.6MJ/kWh/100,000kWh/GWh
= 0.00043GWh/tonne wood

So 180GWh/year = 41,500 tonnes of wood savings per year

The project can save up to 41,500 tonnes of wood per year and qualify for small scale status.

<u>A.4.3. Category(ies) of project activity:</u>

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".

<u>A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:</u>

The project reduces the amount of greenhouse gases (GHGs) emitted from firewood as cooking and curing fuels, by introducing widespread use of improved cook-stoves and rocket barns which replace existing less efficient devices.

It was agreed in 2008, that only through the incentive of carbon finance can (i) the dissemination targets be reached and (ii) the appropriate use and maintenance of the devices be ensured.

The project has not previously been announced for implementation without seeking carbon finance within the last 3 years.

The UNFCCC "tool for the demonstration and assessment of additionality" (Version 05.2), to show that the implementation of the project activity would not be possible without carbon finance, requires that 4 steps be taken to investigate whether or not the reduction would be obtained in the absence of project activity. Taking these 4 steps in turn:

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

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

- Project activity implemented without carbon finance
- Continuation of current situation: Firewood from non-renewable sources would continue to supply thermal energy for the users (baseline scenario).
- Designing a project achieving the same result using different methods. For example, energy is delivered to households and farms through liquid fossil fuels such as LPG or through electricity.

Dissemination of improved stoves and barns is expensive. Carbon finance, which allows for predictable revenue streams and is not subject to 'alternating preferences' of grant-givers, is the only realistic source of finance to ensure that (i) significant targets are met and (ii) quality assurance over time is guaranteed.

Other realistic and credible scenarios that deliver out puts and services with similar quality:

a) There is no evidence in Malawi that householders or institutions are making a shift towards LPG for cooking and curing. LPG is too expensive for households and family farms that currently use woodfuel.

b) It is unlikely that many Malawians will move towards cooking and curing with electricity in the short to medium term future. First and foremost the national grid only reaches 4% of the population in Malawi[12](and only 0.5%[13] of rural households have access to electricity)[14]. Secondly the cost of electrical appliances and of safe electrical connection is too high and thirdly the supplies are unreliable due to load shedding.

Of the three alternatives the continuation of the current situation is the most feasible in practical terms, and it is in compliance with national regulations and standards. This project is therefore not non-additional on single compliance grounds. The project goes 'beyond compliance' as legislation that requires the use of efficient cook-stoves and barns does not exist in Malawi and is not expected to be introduced during the project period.

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12 National Energy Policy, 2003.

13 National Energy Policy, 2003.

14 The Government of Malawi has set out the objective of increasing the number of households with access to electricity to 10% by 2010, to 30% by 2020 and 40% by 2050 (National Energy Plan, 2003). Due to low returns and few incentives for private investors for rural electrification, it is likely that the bulk of increased electricity capacity will serve urban populations. The Welfare Monitoring Survey undertaken by the National Statistics Office covering about 19,000 households from all districts of the country revealed that only 2% of Malawians use electricity for cooking and that the electrification rate of households in rural areas, where about 80% of the population live, still remains at less than 1% (The Nation, 03/09/09).

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

Woody biomass as a fuel is legal. Existing conventional technologies are the norm and are not illegal. There are not any existing standards on efficiency or emission factors of wood burning technologies.

Step 2: Investment analysis. Instead of an investment analysis, a barrier analysis is conducted.

Step 3: Barrier analysis.

No project activity of this type and scope is currently operational in Malawi. Without the incentive of carbon finance the project would neither be economically viable nor attainable. Although short-term finance has been made available in the past and was sufficient to develop the technologies and to motivate a pilot programme to design and develop prototypes in Malawi, this external finance was not available as needed for 2008 and beyond, and were it available would be inadequate in quantity to achieve the projected level of improved stove and 'rocket barn' dissemination.

Fixed esperanza stoves are paid through micro-finance, which is guaranteed by other actors such as agro-industries. Portable ceramic stoves are paid for in cash at a village level. Rocket Barns are paid for through guaranteed micro-finance (duration 2 years). Urban cook stoves and institutional cook stoves can be paid for through cash and micro-finance. Carbon finance facilitates training for production, marketing and user-training and creates incentives for dissemination targets, after-sales service and monitoring.

It is clear that to transform the cooking and curing reality in Malawi, finance and incentives are necessary to train staff and to develop skill sets, and to invest in capacity building, user-training, an after-sales and customer support strategy, a quality control system, and other such requirements. Revenue from building improved efficiency stoves and rocket barns at affordable market prices would be inadequate to address the barriers faced.

- *Investment barriers* Private capital is not readily available from domestic or international capital markets due to real or perceived risks associated with investment in the country where the project activity is being implemented.

  This is demonstrated by the following:

  - Foreign direct investment net inflows to Malawi for [2010] were reported at only $ 60,447,137[15];

  - Malawi is estimated to be the 8th poorest country in the world[16].

  - The World Bank has ranked Malawi 132nd of 183 in its 'Ease of Doing Business' rankings[17]

  - Malawi was ranked 162nd of 179 in the 2008 UNDP Human Development Index.

15 http://data.worldbank.org/indicator/BX.KLT.DINV.CD.WD?order=wbapi_data_value_2009+wbapi_data_value+wbapi_data_value-last&sort=asc&cid=GPD_53.

16 On a GDP per capita basis. https://www.cia.gov/library/publications/the-world-factbook/rankorder/2004rank.html.

17 http://www.doingbusiness.org/Rankings.

- Financing possibilities inside Malawi are limited with commercial interest rates of 20-30%[18].

- It is understood that Malawi has not been rated by any of the major credit rating agencies (Standard & Poor's, Moody's, Fitch).

- *Cost barrier.* In the absence of the project activity, the potential customers would choose the cheaper alternative of continued use of conventional cooking and curing methods, with much higher emissions, as they have limited access to finance and cannot afford the higher price of either:
  - Modern fossil-fuel stoves and barns and the associated fossil-fuels,
  - Stoves and barns with increased efficiency, sold at a price reflecting the full cost of disseminating these (e.g. training, monitoring, quality control, logistics, marketing etc.) without carbon finance assistance,
  - Alternatives (solar-powered electric stoves and barns, electric stoves and barns etc.).

  Malawi is estimated to be the 8th poorest country in the world in terms of GDP per capita[19] and very little cash is available for non-essential expenses.

  The fact that in Malawi, 91% of rural households use 3-stone stoves for domestic cooking and heating[20] is evidence of the effect of the cost barrier. The Kitchen surveys revealed that 100% of the households interviewed used wood as a fuel.

  Please see Annex 4 for a discussion of and specific examples of "alternatives undertaken and operated by private entities". To our knowledge these similar activities have "only been implemented with grants" (please see Annex 4 for further details).

- *Technology barrier.* A key obstacle preventing the proposed activity from taking place without the project, is an inability to access improved technologies. This is largely due to a lack of awareness amongst potential purchasers and users, as to benefits of the improved technologies. Another major obstacle to dissemination, in the absence of the project, is that many potential users are located in remote areas, very distant from main roads and principal trading centres. The fact that 91% of rural households in Malawi use 3-stone stoves for domestic cooking and heating[21] is evidence of the effect of the technology barrier. "Lack of infrastructure for implementation and logistics for maintenance" of various technologies is discussed in specific detail in Annex 4.

  Skilled and/or properly trained labour to operate and maintain the technology is scarce in Malawi. Education expenditure countrywide is estimated at only 4.2% of GDP (ranking 101st in the world)[22]. This leads to an unacceptably high risk of device disrepair and malfunctioning and underperformance.

- *Prevailing practice.* Habitual use of three-stone fires and conventional barns imposes a very strong influence on the baseline scenario, resulting in the continued use of conventional, inefficient

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18 Reserve Bank of Malawi: http://www.rbm.mw/data/findata/index.asp?content=cbir.

19 https://www.cia.gov/library/publications/the-world-factbook/rankorder/2004rank.html.

20 National Energy Policy, 2003.

21 National Energy Policy, 2003.

22 https://www.cia.gov/library/publications/the-world-factbook/geos/mi.html

technologies. 91% of rural households in Malawi use 3-stone stoves for domestic cooking and heating.[23] Kitchen surveys revealed that 90% (Dowa and Ntchisi) and 91% (Balaka) of households in the baseline still cooked on three-stone fires.

- *Barriers such as institutional, limited information, managerial resources, organisational capacity, financial resources, capacity to absorb new technologies.* The widespread introduction of improved technologies into the market requires considerable input in the form of business development capacity, financial investment, management skills, technical training and new technology absorption capacity. All these resources are scarce in the project region, a situation that poses a severe obstacle to introduction of improved stoves and barns.

Step 4: Common practice analysis.

In Malawi, 91% of rural households use 3-stone stoves for domestic cooking and heating[24] that are not fuel efficient, produce much smoke and are the source of many injuries and accidents. Kitchen surveys revealed that 90% (Dowa and Ntchisi) and 91% (Balaka) of households in the baseline still cooked on three-stone fires. The Kitchen surveys also revealed that 100% of the households interviewed used wood as a fuel. The barn surveys revealed that 100% of smallholders used wood as fuel in conventional barns. Similarly, curing barns used by smallholders are fuelled 100% with firewood.

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

There is not any other improved barn project in Malawi. ProBEC is promoting the Rocket Barn in other Southern African Countries. In Tanzania, 18 Rocket Barns were constructed in 2007, 56 in 2008 and 15 by November 2009. A smaller number of barns have been constructed in Zambia.[25] This volume is only a small fraction of the 800+ Rocket Barns that have been constructed to date as part of the Integrated Biomass Energy Conservation Project and a quality assurance and post-sales service has not been established in other countries.

Many improved stoves projects have been conducted in Malawi with support from Government, International Organisations and Non-Governmental Organisations (NGOs). The most successful programme to date has been ProBEC (a Southern Africa Development Community programme that is being implemented in Malawi under the Department of Energy Affairs in collaboration with GTZ), which began in 1999 and is due to phase out in 2010.

Since at least the 1980s there have been efforts to disseminate an improved mud-stove that potentially shares many of the characteristics of the portable ceramic stove and the esperanza stove and is similarly made of materials available at a village-level in Malawi. However, without accurate tools and proper training, local producers are not in a position to produce a standardised stove to exact specifications, resulting in what is called design drift and highly uncertain emissions reductions potential.

The Portable Ceramic Stoves, promoted by the Project, has also been promoted by NGOs in Malawi. In general, ProBEC has provided technical assistance and the NGOs have supported community based organisations.[26] It is not

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23 National Energy Policy, 2003.

24 National Energy Policy, 2003.

25 Information provided by the Monitoring and Evaluation Officer, GTZ ProBEC.

26 Organisations such as Concern Universal, GOAL Malawi, Ripple Africa, Total Landcare, Emmanuel International, CPAR Malawi and CADECOM have partnered ProBEC in disseminating portable ceramic stoves.

evident if quality assurance and monitoring of these initiatives will be guaranteed in the future. As ongoing facilitation activities such as training and quality control are expensive it is unlikely that these activities will continue in the event that the project or programmes funding comes to an end (typically every 2-3 years).

The Esperanza Stove is the most popular fixed household stove option in Malawi. To date it has been mainly disseminated in the houses of tea estate employees in Mulanje District, in southern Malawi. Again a systematic quality assurance and post-sales service is not guaranteed.

Metal fixed household rocket stoves have also been commercially disseminated in Malawi. Due to the high cost of imported steel to Malawi, a land-locked country, its dissemination has been limited and post sales services of perishable insulative combustion chambers is not readily available and hence the emission reductions potential over-time is uncertain.

For charcoal users in urban and peri-urban Malawi, a local version of the Kenyan Jico charcoal stove is popular, presumably due to its affordability and availability in urban markets (see annex 4 for more details). The stove is often made from recycled metal and its lifespan can be a short as 6-months. Its non-standardised design and uncertain emission reductions potential due to its limited lifespan make it an unlikely candidate in Malawi for up-scale. Currently the stove is disseminated by metalworkers, usually based in urban markets.

In terms of cleaner cooing fuels, ethanol seems to have most potential for household use in Malawi (see annex 4). The Blue-wave stove has been developed in Malawi and is designed to be fuelled by ethanol (see annex 4), but is currently is not available for sale. Another stove, the Gel-fuel stove has ceased to be disseminated in Malawi (see annex 4).

Institutional cook-stoves have been widely disseminated in Malawi, mainly through school-feeding programmes and through institutions such as secondary schools, barracks, prisons etc. The stoves have impressive fuelwood reduction potential but as of yet are not systematically monitored and repairs and maintenance is often not guaranteed. In many schools there are not enough stoves to cover the demand and in some cases the stoves were abandoned as number of different sized pots are used. In some cases the improved institutional stoves are reported to be rarely used and the reasons given are due to end of funding for an intervention or reluctance on behalf of the cooks to use the stoves. A survey of 549 stoves in use in 2007 found that 46% of the stoves were damaged. [27] The stoves are either a portable metal stove or a fixed brick stove with internal metal liners and generally have a 50-200 litre capacity. To date there is limited systematic follow-up support service to guarantee performance quality and the emission reductions of the stove.

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

Electricity is probably the cleanest and least costly form of cooking in Malawi, (see annex 4), but despite a rural electrification programme supported by the Department of Energy, only 2% of Malawians (both rural and urban) use electricity for cooking.[28]

Please refer to Annex 4 for descriptions of stoves, curing barns and fuels relevant to Malawi.

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27 De Gabrielle, J. and Msukwa, A. *Impact of the Institutional Rocket Stoves in School Kitchens*, ProBEC, 2007.

28 The Welfare Monitoring Survey undertaken by the National Statistics Office covering about 19,000 households from all districts of the country revealed that only 2% of Malawians use electricity for cooking and that the electrification rate of households in rural areas, where about 80% of the population live, still remains at less than 1% (The Nation, 03/09/09).

In an assessment of clean cooking fuels in Sub-Saharan Africa,[29] the failure of clean cooking fuels to attain wide-spread use is attributed to a number of market barriers including:

- Clean cooking fuels are prohibitively expensive,
- High price of compatible stoves,
- Many consumers are hesitant to adopt a new technology, and
- Under-developed infrastructure prevents these fuels (and stoves) from being made available in many local marketplaces.

In Malawi, the major barrier preventing a significant amount of households to use cleaner modren fuels is the price of fuels where the cost per MJ of energy from clean fuels compared to biomass fuels is higher by a factor of 3 to 10. The affordability and accessibility of stove alternatives is also limited.

Experience to date with respect to development and dissemination of efficient stoves or rocket barns, or alternatives achieving the same or better reduction of GHG emissions, has resulted in very little change in the prevailing practice. The evidence has been that the barriers listed have prevented and currently prevent widespread or countrywide uptake of efficient stoves and barns.

The carbon funding proposed here is highly directionalised, by way of building specialised local capacity for widespread market dissemination of specific technologies that have been tried and tested in Malawi, and by way of establishing high quality end-user training and follow-up with quality control systems and provision of after-sales services, to remove the barriers described above in a sustainable way.

Conclusion:
The distinctions set out here between other activities and the Project Activity are so great that the project is additional.

A.4.4.1. Estimated amount of emission reductions over the crediting period:

Years	Annual estimation of emission reductions in tonnes of CO_2e
1	4,792
2	39,204
3	59,078
4	77,630
5	77,500
6	77,500
7	77,500
Total emission reductions (tonnes of CO_2e)	413,204
Total number of crediting years (first crediting period)	7

[29] Market Barriers to Clean Cooking Fuels in Sub-Saharan Africa: A Review of Literature; *An SEI Working Paper of* Nicolai Schlag and Fiona Zuzarte Working Paper, Stockholm Environment Institute, April 2008; A Review of the Household Energy Programme for Cooking – GHA/UNDP/00051634

Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	59,029

The table presents the project operational stove years and emission reductions (ERs) from November 2008 through to November 2015. The largest amount of VERs to be generated per year during crediting period 1 are estimated to be 77,630 which in Malawi is equivalent to savings of 41,491 tonnes of wood, which is within the small scale threshold.

SECTION B. Application of a baseline methodology

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

GS 613 is now following the Gold Standard Methodology for *Technologies and Practices to Displace Decentralised Thermal Energy Consumption (11/04/2011)* , which includes measures that significantly reduce consumption of non-renewable biomass. This methodology covers both the baseline and monitoring requirements for such a project.

The methodology applied also draws upon the Tool for the Demonstration and Assessment of Additionality; Version 05

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

Gold Standard Methodology for Technologies and Practices to Displace Decentralised Thermal Energy Consumption (11/04/2011) is applicable to the proposed project, because the following conditions apply:

- Low-emission cook-stoves and low-emission tobacco curing barns replace high-emission baseline scenarios: Improved cook stoves replace 3-stone fireplaces and rocket barns replace inefficient tobacco barns.
- The project boundary can be clearly identified, and the stoves and rocket barns 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, the place of the tobacco barns and the place of fuel collection, production, and transport in Malawi.
- The project is located in a single country: The project is located in Malawi.
- The improved cook-stoves do not number more than ten per kitchen/household and each have continuous useful energy outputs of less than 50kW: The project activity is to provide one stove per kitchen for domestic use (cooking). The number of rocket barns per farmer depends on the size of production. A one hectare farmer can have 1-2 Rocket Barns and larger farmers may have more. The project activity is to provide not more than 10 rocket barns per farmer for tobacco curing. The urban cook stove promoted by the project has useful energy output of 1.8 to 7.5 kw,[30] the portable ceramic stove has a KW output of 0.64 kW.[31] The fixed esperanza stove has an estimated KW output of 10 kW; the Rocket Barn has an estimated KW output of 30 kW and the Institutional Cook Stove has an estimated kW output of 25 kW.

The methodology includes provision for a large amount of small, distributed heating and cooking low-emission devices and kitchen / barn management regimes that replace relatively high-emission baseline scenarios. Improved biomass stoves are included as applicable technologies as are measures that reduce consumption of non-renewable biomass or other greenhouse emitting fuels. Tobacco curing barns, although not applied for cooking, are biomass fired and reduce non-renewable biomass consumption. The stoves and barns will be introduced to householders and smallholding farmers within a distinct geographical area through the project. The shift to low emission regimes will occur in a progressive increase over the project years in adoption of improved stoves and barns. The baseline technologies are inefficient stoves and barns that are fuelled with woody biomass.

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30 Megen Power Ltd. "Technical Evaluation of Stove Designs, WVA: Energy-efficient Wood Stoves Pilot Programme in Ethiopia" page 13.

31 Ethio Resource Group, *Feasibility study for the use of ethanol as a household cooking fuel in Malawi.* Consultancy for UNDP Growing Sustainable Business for Poverty Reduction Programme, Lilongwe, 2007 (page 58).

The country of Malawi as a whole is also defined as the Fuel Collection Area. There is clear evidence that the harvest of woody biomass for cooking and curing fuel is not balanced by the mean annual increment or re-growth in the supply area.[32]

The methodology is suitable for a project with a large supply area where very likely other entities may seek to quantify the non-renewing portion of the biomass consumption they save. By assessing non-renewability status in a fractional manner, the methodology assures that all projects in the same area are capped equally and there is no risk of double counting.

The methodology requires that surveys and quantitative measurements be carried out in households and farms of end-users. Since the fuel consumption reductions arising from the project will be sensitive to locally determined factors the application of a methodology requiring measurements in samples of households, as opposed to one dependent on lab testing of fuel efficiency, is appropriate.

As recommended, the Project proponents include the CO_2, CH_4 and N_2O greenhouse gases, and assess on whether or not their measurement or estimation is feasible or their quantitative impact is significant for the project and baseline.

B.2.	**Description of how the methodology is applied in the context of the project activity:**

In the context of this project, the basic assumptions of the methodology are that the green-house gas reductions arising from adoption of the devices disseminated by the project can be determined conservatively as follows:

- Emission factors for wood combustion are the same in the case of baseline devices and project devices, and the most recent IPCC default values for these wood as a fuel are appropriate
- The emission reductions resulting from dissemination of the devices are conservatively assessed, as prescribed by the methodology, by applying a rigorous statistical analysis to the results of fuel-consumption sampling (Kitchen Tests and Barn Tests) in households and farms using a specific model of the devices under a particular set of conditions.

Surveys and tests were complemented with an extensive review of the pertinent literature.

The previous methodology – Gold Standard Methodology for Improved Cookstoves and Kitchen Regimes V.01 was initially applied in the course of 2008 and 2009, through the development of:

- Improved cook-stove Kitchen Surveys and Kitchen Tests in rural villages in Central and Southern Malawi in 2008 and 2009.
- Barn surveys and barn tests with smallholder farmers in Central and Northern Malawi in 2008 and 2009.

The GS Methodology for Technologies and Practices to Displace Decentralised Thermal Energy Consumption is now applied by the Project.

For both stoves and barns, surveys and tests to estimate and quantify baseline conditions were conducted by comparing old and new device conditions in the same houses / farms, to minimise variability due to external factors other than the installation of the new device.

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[32] State of the Environment Report (2001), Chapter 4; Forestry Outlook Studies in Africa (2001), page 17; National Forestry Programme (2001) Page 2; Gowela, Julio P. and Masamba, Chris R. (2002) *State of Forest and Tree Genetic Resources in Malawi*. Page 7.

The project applies a fixed baseline approach. Improved stoves and barns are adopted progressively through the project period. The project applies a fixed baseline approach for the following reasons:

- The technologies on their own can only partially achieve potential efficiency improvements and emission reductions. Improved end-use and kitchen / barn and firewood management, for example, is gradual and requires considerable investment, but significantly contributes to emission reductions. Application of an evolving baseline can cancel out gradual emission reductions resulting from (costly) project activities that improve baseline kitchen and barn regimes. In other words, baseline conditions that are changing as a result of project activities (awareness raising and user-training) would reduce the emission reductions accruable to project activities, should an evolving baseline be applied.
- For Rocket Barns, 'early adopters' willing to try-out new technologies and curing process are a sub-set of all end-users. Evidence demonstrates that the performance of such people (many have received user training and have been the target of awareness raising campaigns) using conventional technologies significantly improves over time as a result of project activities.
- For stove users in the project area, poverty related under cooking is a reality. By applying a fixed baseline, any increase in usefully delivered energy (i.e. cooking energy utilised) for improved stove end-users is likely to result in conservative emission reduction estimations.
- NRB fraction is unlikely to reduce over the project period, implying more conservative ER estimations.

B.2.1 **Determine customer groups or project "clusters"**

Throughout the application of the methodology the project population (all end-users) can be divided into groups or clusters, that distinguish the characteristics, which determine the emissions reductions of each cluster.

Of the 4 types of stoves promoted by the project, the portable ceramic stove is targeted at low-income rural households and the fixed esperanza stove is initially targeted at rural households with access to micro-finance. The institutional stove is targeted at institutions and the urban cook stove is targeted at urban and peri-urban households.

The rocket barns promoted by the project target smallholder tobacco farmers. Initially, only 250 stick rocket barns are being promoted. Rocket barns with greater capacity (e.g. 270 stick and 300 stick rocket barns), that use the same technology and fuel, will be included in the smaller barn cluster as this gives a conservative result when quantitative test results for fuel savings of small barns are applied to larger barns. Larger barns (e.g. 500 stick and above) may be introduced later as a new cluster.

The surveys revealed that (i) all rural households use wood fuel for cooking[33] and (ii) all smallholder flue-cure tobacco producers use wood in conventional barns for curing. There is not any evidence of significant simultaneous use of renewable energy fuels, crop residue, or any other ancillary fuel type.[34] There is no evidence of trends toward significant mixing in the baseline.

Both types of stove-users and barn users are homogenous enough to qualify for sampling of fuel consumption savings as single clusters that all use wood as fuel and replace less efficient technologies:

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[33] The rural household energy survey conducted with 300 households in Balaka, Southern Malawi revealed that for the baseline 2.7% of households used charcoal as a fuel and this decreased to 0.3% for the follow-up survey. 100% of households for both the baseline and follow-up survey used wood as a fuel.

[34] In the surveys and tests carried out in Balaka Southern Malawi in 2009, only 2% of respondents used maize cobs and only 0.3% of respondents used crop stalks as a fuel.

a. Portable ceramic stoves,
b. Fixed esperanza stoves and
c. Rocket Barn
d. Institutional Stoves
e. Urban Cook Stoves

For the surveys, stove and barn users are each surveyed by a home visit. The purpose and sample sizes are as defined in the methodology, primarily to ensure that the clusters are homogenous and appropriate exclusions can be made, such that Kitchen Tests and Barn Tests will be representative and their results statistically significant.

For the portable ceramic stoves, 300 households have been tested and surveyed in Balaka, Southern Malawi in 2009. Subsequently to this an initial survey of fixed esperanza stove users was conducted with 108 households in the Districts of Dowa and Ntchisi,. Surveys and tests commence prior to installation of new improved device.

For the barns, 40 farmers were tested and surveyed in Dowa, Ntchisi, Kasungu and Mzimba in Central and Northern Malawi during 2008. The pilot sales were recorded at the same time to surveys and tests. The specific method used for these tests is described in the test report in Annex 2.

As mentioned in Section A.2 above, ICS and UCS are expected to be clusters d. and e. respectively.

B.2.2 Analysis of renewability status of biomass fuels.

The methodology for analysis of biomass renewability has been applied in the course of 2008. The details of this analysis and its results are given in this section, below.

B.2.2.1 Quantify non-renewable biomass

(a) Establish supply area and mean annual increment

Supply Area:

Wood-fuels marketed in Malawi are transported over long distances, implying that the collection areas are widespread and the country as a whole should be seen as the Fuel Collection Area or Reachable Collection Area for woodfuel. Since improved cook-stoves and rocket barns disseminated by the project will extend all three Regions of the Malawi, the entire country is considered the Fuel Collection Area or supply area.

Until recently “free” woodfuel was available easily and cheaply from indigenous woodlands, on lands of estates or in neighbouring customary land.[35] Kitchen Surveys conducted in Central and Southern Malawi indicated that more time is spent and greater distances travelled by householders to source woodfuel in recent years. The Barn Surveys indicate that fuel costs for smallholder farmers are increasing. It has been noted that only 15% of the large tobacco estates are self sufficient in wood while over 50% of estates cannot supply even half of their own requirements.[36] As confirmed by the Barn Surveys, smallholder farmers are not self-sufficient in renewable wood, do not operate their own fuelwood plantations due to scarcity of land and source wood fuel from Malawi’s Total Forestry Area.

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35 Adapted from page 47 National Forestry Programme (2001)

36 Page 47, National Forestry Programme, 2001

In 1993, Malawi's Forestry Area with tree cover greater than 20% was estimated to be **2,642,800** hectares, of which 95% were indigenous forests.[37] The extent of Malawi's indigenous and plantation forest was reduced by 57% between 1972 and 1992 with subsequent annual rates of deforestation of 3.4%, 2.4% and 2.7% in the Northern, Central and Southern Regions of the country, respectively, with a national average deforestation rate of 2.8% p.a. (Forestry Department, quoted in FOSA).[38]

(b) Quantify non-renewable biomass

Mean Annual Increment (MAI) or Annual wood-fuel increment:

The sum of mean annual increments of the wood species, or "re-growth" is calculated from the Mean Annual Increment (MAI) of the various forest categories. Using estimates of MAI of 0.85 m^3/ha for customary land and private forests; 1.3 m^3/ha for public forests, 14 m^3/ha for public and private plantations and between 0.1 and 0.5 m^3/ha for agricultural and public lands, the annual accessible MAI available is **3.796** million m^3 for Malawi.[39] These figures correspond to estimates of MAI of 0.8 m^3/ha for customary land; 1 m^3/ha for forest reserves and between 10 and 17 m^3/ha for plantations, with an estimated forest cover of 2.709 million hectares the annual wood-fuel increment is 4.1 million m^3 for Malawi.[40] However the later report assumes that 100% of public forests are accessible which is unrealistic. Both figures are conservative compared to estimates of The Forestry Outlook Survey of Malawi (2001) estimated wood supply to be as low as 3.7 million m^3.[41] Potentially sustainable supply is estimated to be as high as 7-8 million m^3 from current sources,[42] if among other things, sustainable yield from industrial plantations was not under-utilised and the MAI of public parks and reserves was 100% accessible. The project uses a conservative MAI of **3.796 million** m^3 for Malawi.

MAI = **3.796 million** m^3

Estimated the Harvest (H) of wood-fuels derived from supply area:

The harvest of wood is the volume of wood extracted per year. There are a number of official documents that have estimated the total harvest of wood in Malawi. The national trend of woodfuel consumption over time is increasing.[43] Over the period of 7 years (1983 - 1990), wood consumption increased from 8.5 million tons to about 12 million tons per year (16.6 million m^3), an increase of about 41 %. The Forestry Outlook Survey of Malawi (2001) estimated wood demand to be 14.5 million m^3 while the National Forestry Programme (2001) estimated aggregate annual

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37 Ministry of Forestry and Natural Resources, Forestry Department (1993) Forest Resources Mapping and Biomass Assessment for Malawi. Satellitbild, Kiruna, Sweden and Department of Forestry, Lilongwe, Malawi.

38 Forestry Outlook Studies in Africa, Country Report - Malawi, FAO, 2001.
http://www.fao.org/docrep/004/ab585e/AB585E00.HTM

39 Sourced from the Ministry of Forestry and Natural Resources as presented in Bunderson W.T. and Hayes I.M., (1995); *Agricultural and environmental sustainability in Malawi,* Paper to Conference for Sustainable Agriculture for Africa, Abidjan, Cote d'Ivoire.

40 Gowela, Julio P. and Masamba, Chris R. (2002) *State of Forest and Tree Genetic Resources in Malawi*. Prepared for the Second Regional Training Workshop on Forest Genetic Resources for Eastern and Southern African Countries 6-10 December 1999, Nairobi, Kenya; and updated for the SADC Regional Workshop on forest and tree genetic resources, 5-9 June 2000, Arusha, Tanzania. Forest Genetic Resources Working Papers, Working Paper FGR/27E. Forest Resources Development Service, Forest Resources Division. FAO, Rome (unpublished).

41 Forestry Outlook Studies in Africa, Country Report - Malawi, FAO, 2001.

42 National Forestry Programme, 2001

43 Forestry Outlook Studies in Africa, Country Report - Malawi, FAO, 2001.

consumption of forest products to be 15 million m^3. These figures correspond to other results using BEST ESTIMATES[44] per capita woodfuel consumption in Malawi of 1.410 m^3 and the population is estimated to be 10 million in 1998 (National Statistics Office, 2000) with population growth rates of between 2% to 3.3% p.a.

H = 14.5 million m^3

To summarise, the information collected so far can be used to quantify non-renewing wood in the collection area. This quantity is the excess harvest over and above the sustainable harvest of renewing wood, or annual increment. The total harvest we have seen is, conservatively, assumed to be **14.5 million m^3/yr** and the increment is **3.796 million m^3/yr**. The quantity of non-renewing biomass NRB is the difference, **10.704** million m^3/yr**.**

Non-renewing biomass (NRB) or excess harvest over and above re-growth, is the amount of woody biomass removed with attendant CO2 emissions which are not absorbed by re-growth.

NRB = H – MAI = 10.704 million m^3/yr**.**

The fraction of extracted woody biomass that is non-renewable is denoted as Xnrb. If a quantity of woody biomass supplied from fuel collection area A is used as a fuel in cook-stoves or rocket barns, the fraction Xnrb is assumed to be non-renewable with CO2 emissions that are not reabsorbed by re-growth:

Estimated Xnrb = (NRB/H) = 73.82%

As of June 15, 2012, the Department of Environmental Affairs (Designated National Authority) of Malawi accepted the UNFCCC's proposed default value for the fraction of non-renewable biomass with key values as follows:

Extent of forest (ha) = 3,237,000
Growth rate of biomass (t/ha-yr) = 2.65
Mean annual increment (t/yr) = 8,562,674
Annual change in living forest biomass (t/yr) = (2,000,000)
Total annual biomass removals (t/yr) = 10,562,674
Protected areas extent of forest (ha) = 757,000
Biomass growth in protected areas (t/yr) (DRB) = 2,002,454
Total annual removals – protected area growth (t/yr) (NRB) = 8,560,220

fNRB = NRB/(NRB+DRB) = 81%

To calculate emissions reductions, the estimated non-renewable component of wood-fuel in Malawi is applied to the consumption of biomass by the project population in both the baseline and project scenarios (since the project activity does not yet make any significant impact on either the harvest or increment quantities).[45]

(c) Maintain conservativeness

Deforestation in Malawi due to clearance for agriculture and human settlement has the effect of reducing the

44 Country Table A.BE.1, Per Capita Woodfuel Consumption according to BEST ESTIMATES Appendix 2.2.4 in *The role of wood energy in Africa*. Working Paper FOPW/99/3. FAO 1999.

45 In the first 7 years of the project, the planned dissemination of improved cook stoves and rocket barns will reduce wood consumption by approximately 120,000 m^3 each year. Although the project contributes in reversing the non-renewability of biomass it will not significantly impact wood availability in Malawi.

increment since the standing stock is shrinking (also due to the consumption of non-renewing wood). With longer drier periods and uncertain rainfall in Malawi due to climate change, the productivity of standing stock is due to decline while forests are likely to be prone to increased incidences of fire.

Demand for wood, represented by the harvest, has been growing rapidly in previous years and is expected to continue to grow through the project period. Malawi's economy is growing,[46] reflected in woodfuel demand increasing and rising demand for construction timber. Also, in a country with four times more people per square kilometre than Sub-Saharan Africa as a whole, of whom four fifths depend on agriculture, population growth, estimated at between 2% to 3.3% p.a., puts increasing pressure on Malawi's natural resources. Urban population growth rate is estimated to be at 6.7% per annum[47] and this has a significant impact on the rate of deforestation. Furthermore, the harvest is often under-estimated and under-reported, thus, the value of Xnrb is likely to be higher than estimated above.[48]

The scenario in Malawi must therefore be seen in terms of an increasing harvest of wood and a decreasing value of maximum sustainable yield giving an increasing shortfall or a worsening non-renewable biomass condition. The figures quoted from recent studies reflect conditions in the past few years, and many of them need to be updated to reflect the likelihood that the non-renewable quantity at the start of the project is greater than estimated in this document. Equally, as the project progresses, trends are likely be toward an increased non-renewable component of wood-fuels rather than decreased, although the project will have the effect of mitigating these trends.

B.2.3 Net leakage

The baseline surveys and tests for both stoves and barns investigated the following risks of leakage:(as required by the methodology):

a. Some users of the efficient devices respond to the fuel savings associated with higher- efficiency devices by increasing consumption of fuels with GHG emission characteristics, 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.
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).
c. By virtue of promotion and marketing of a new model and type of device with high efficiency, the project might stimulate substitution of a cooking / curing fuel or device type with relatively high emissions by households who commonly using a cooking / curing fuel or device type with relatively lower emissions, in cases where such a trend is not eligible as an evolving baseline.
d. The project population might compensate for loss of the space heating effect of inefficient devices by adopting some other form of heating or by retaining some use of inefficient devices.
e. The traditional devices displaced might be re-used outside the boundary in a manner suggesting more usage than would have occurred in the absence of the project.
f. Significant emissions from transportation or construction involved in the project activity might occur, including emissions associated with production/transport of the efficient devices themselves, or production/transport of project fuels.

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46 Malawi's economy is predicted to grow at over 8% in 2009, GDP Growth Forecasts 2009, Economist Intelligence Unit, The Economist, 2008. http://www.economist.com/markets/indicators/displaystory.cfm?story_id=12818136

47 Government of Malawi (2001) State of Environment Report, Department of Environmental Affairs.

48 Global Forest Resource Assessment, FAO, 2005.

Observations made to date indicate no evidence of contingency (a) occurring over the extensive period of the pilot program as any shift of pressure on the resource is, at this stage, insignificant in scale. Scarcity of wood is increasing making access, for both stove and barn users, more timely and effortful. There is also evidence from the Kitchen Test (KT) and Kitchen Survey (KS) in Balaka that some of the few who were using charcoal during the baseline shifted to use of wood fuel with lower net GHG emissions. Also, end-users of barns are already purchasing wood and reduction in wood requirements is a direct cost saving.

In the case of (b) it is clear that there is 'negative leakage' from improved cook stoves as neighbours of the project's customers adopt cleaner more efficient technologies, as promoted by the project, resulting in reduced use of higher emission technologies (i.e. three-stone fire). The improved rocket barn technology on its own would not increase flue-cured production (which is a fuel intensive activity) by more than would have been the case in the absence of the project. Flue-cure farming has been increasing for some years, irrespective of improved flue-curing technologies, and its increased production is a strategic goal for Malawi, under its Growth and Development Strategy.[49] The rocket barn makes the increasing production cleaner, but is only part of a greater investment required in a switch to flue-cure farming and cannot be considered responsible for stimulating increased use of NRB.

Equally it was concluded there was no evidence of risk of (c), (d), (e), (f).

For contingency (d) there was no evidence of compensation for loss of the space heating effect of inefficient technologies. Barns are not used for space heating aside from curing. The KTs have not been conducted during the cooler months of June, July and August and have not been conducted in highland areas so that the fuel savings used for calculating emissions reductions are likely to be conservative. Retention of some use of inefficient stoves is captured in the KTs.

In the case of (f) it was confirmed that, overall, reductions in transport emission would occur (so giving rise to a surplus) as reduced fire-wood consumption by households and farmers results in reduced fire-wood transport emissions. This effect results in 'negative leakage' but is not taken into account in order to ensure conservativeness. There is no risk of leakage from the construction of stoves or barns. For example, portable ceramic stoves are fired using firewood, however the amount of fuel used for firing a single stove (2kgs of wood)[50] is negligible compared to the wood savings for a single stove with a 2-year life (at least 1,759 kgs of wood). Similarly, bricks to construct new and/or retro-fit rocket barns are fired using firewood but the emissions from firing is not significant compared to emission reductions over the 10 year life of the barn. In any case, conventional barns that would be used in the absence of the project require bricks to be burnt for annual maintenance.

During the project itself, all the above leakage risks will be monitored and re-evaluated.

There is no evidence of risks (a), (b), (c), (d), (e) and (f); hence a 0% overall leakage factor is adopted.

Table B2 – Emission Reduction by Greenhouse Gas

From all devices combined:

Year	CO2	Non-CO2	Total	Leakage	Net GHG reductions

[49] Malawi Growth and Development Strategy, from Poverty to Prosperity 2006-2011, Key Strategy, page 17.

[50] In Kaphuka Village of Dedza District ,240 kgs of wood were used to fire 121 portable ceramic stoves, which equates to approximately 2kgs of wood per stove for firing.

1	3,625	1,167	4,792	0	4,792
2	29,660	9,544	39,204	0	39,204
3	44,696	14,382	59,078	0	59,078
4	58,731	18,899	77,630	0	77,630
5	58,633	18,867	77,500	0	77,500
6	58,633	18,867	77,500	0	77,500
7	58,633	18,867	77,500		
Total	312,611	100,593	413,204	0	413,204
Yearly average	44,659	14,370	59,029	0	59,029

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered VER project activity:

The Kitchen Tests for stoves deliver data specific on firewood consumption per stove-year for both the portable ceramic stove and for the fixed esperanza stove and for barns, Barn Tests deliver data specific to fuel consumption per kg of cured tobacco (which is then combined with averaged kgs cured per barn per year).

In tests and surveys conducted by the project, paired samples are taken, that is, pre- and post installation consumption is compared in the same houses and farms. As conditions indicate daily repetition of a set pattern, the three-day minimum of sampling has been applied for stoves. For barns, cures (lasting 4-9 days) are monitored at the start and finish of the cure. Pre-installation and post-installation conditions for all surveys are the same.

For the kitchen tests, the weight of fuel wood from the stockpiles was calculated by use of spring-dial hoist scales of 100 kg with a capacity and a precision of 0.5 kg on households' wood stockpiles within the 72-hour period. Samples of wood and maize cobs used for fuel by each household were obtained for determination of moisture content. To measure moisture content a VOLTCRAFT FM–100 with a capacity to measure moisture content up to 44% at an accuracy of 1% was used.

For the barn tests, measurement of fuel consumption is done through a combination of physical fuel-use measurements of "stacked cubic metres" and analysing accounting records of fuel-use before and after implementation of the rocket barns. Tobacco farmers usually specify their wood use in cubic metres.[51] Wood of one metre long by one metre wide by one metre high gives a total volume of one (stacked) cubic metre (stm^3). Due to irregular gaps and air spaces, only approximately 60–70% of the volume is made up of solid wood.[52] FAO[53] proposes a basic conversion factor for wood density of 725 kg/m^3, so that the weight of wood in one stack will range from approximately 435kg to 507.5kg. This translates into a mean stacking factor of 471.25(kg) or 0.47 (tonnes)[54]

Fuel mass is converted to GHG emissions using emission factors. Actual baseline and project conditions use the same IPCC default emission factors. Theses emission factors, the non-renewable biomass fraction (calculated in

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51 To convert stacked wood (expressed in cubic metres) into solid wood (expressed in kilogram), a conversion factor can be used for every type of tree species. Such conversion figures are hardly available (Lowore et al. 1994) and if not available, the specification in kg is speculative.

52 Geist, H. J. "Global assessment of deforestation related to tobacco farming" *Tobacco Control*, 8, 18-28, 1999.

53 Interactive Wood Energy Statistics, i-WESTAT, FAO, 2005

54 *Adapted from* Fraser AI. The use of wood by the tobacco industry and the ecological implications. Edinburgh: International Forest Science Consultancy, 1986.

B2.2) and quantitative measurements from Kitchen Tests (KTs) and Barn Tests (BTs) for each customer group are used to calculate emission reductions. The data from the tests is statistically analysed to determine at a 90% confidence level a range of values within which the mean difference between baseline firewood consumption and project firewood consumption lies, with respect to the population of interest. The lower bound of the confidence interval represents the value of firewood consumption which should be used for all sales for the cluster in question, with 90% confidence that it will be exceeded in reality. These values are then converted into emissions reductions using default emission factors and the non-renewable biomass factor.

The unit of emission reduction for stoves is the kitchen year, that is the emission reductions from a combination of devices and practices providing the meals for an average family throughout the year. For barns the unit of emission reduction is the barn year, that is the emission reductions from curing tobacco from one barn for one year (i.e. one season).

For the portable ceramic stove cluster, 300 households were tested over 3-day (72 hour) periods for baseline and follow-up tests in Traditional Authority Msamala of Balaka District in Southern Malawi. Of these households, only 252 provided complete data sets for both the baseline and follow-up tests. The tests ,demonstrated that baseline fuel consumption was on average 2.561 tonnes of fuelwood p.a.
Quantity of fuel that was consumed in the project scenario for PCS in year 0 (when the PCS were first disseminated) was 1.566 tonnes per household per year.

Quantity of fuel that was consumed in the project scenario for PCS in year 2 (2 years after the project PCS were first disseminated) was 1.813 tonnes per household per year.

Please see Annex 5 for calculation of VERs using suppressed demand approach .

Portable ceramic stoves	t/(year*stove)	Sample size: 252
Mean before	2.561	
Mean after	1.566	
Mean change	0.955	
Standard deviation change	0.454	
Upper 90%-confidence limit for the mean change	1.111	112.6% of mean
Lower 90%-confidence limit for the mean change	0.880	88.4% of mean

For the fixed esperanza stove cluster, 108 households were tested over 3-day (72 hour) periods for baseline and follow-up tests in Districts of Dowa and Ntchisi in Central Malawi . Of these households, only 71 provided complete data sets for both the baseline and follow-up tests. The tests demonstrated ,baseline fuel consumption to be on average 3.362 tonnes of woodfuel p.a.

Please see Annex 5 for calculation of VERs using suppressed demand approach .

Fixed Esperanza stoves	t/(year*stove)	Sample size: 71
Mean before	3.362	
Mean after	1.748	
Mean change	1.614	
Standard deviation change	1.651	
Upper 90%-confidence limit for the mean change	1.941	120.3% of mean
Lower 90%-confidence limit for the mean change	1.288	79.8% of mean

For the rocket barn cluster, a Barn Test and Survey were conducted for a sample of 37 smallholder flue-curing tobacco producers using conventional barns during the curing season of 2008 (January to April) and 33 smallholder flue-curing tobacco producers using Rocket Barns during the curing season of 2009 (January to April). comparing their conventional fuel consumption with improved Barn consumption in the districts of Dowa, Kasungu, Ntchisi and Mzimba.

Rocket Barns	kg_wood / kg_tobacco	101 Cures from Conventional Barn; 128 Cures from Rocket Barn
Mean before (Conventional Barn)	11.9554	
Mean after (Rocket Barn)	4.2608	
Mean change	7.69466	
Upper 90%-confidence limit for the mean change	8.66353	107.3% of mean
Lower 90%-confidence limit for the mean change	6.7258	87.4% of mean

The barn tests show that average conventional barn consumption is 11.96 kgs of wood per kg of cured tobacco. Flue–cure tobacco producers using the rocket barns for the same purpose and thermal load (curing tobacco of the same type, volume and size) were found to reduce their consumption by and average of 7.7 tonnes per tonne of tobacco cured. From the analysis of tobacco sales in the Auction Floors the average output per Rocket Barn was calculated conservatively at 1,315 kg of cured tobacco per barn.

This average fuel saving per Rocket Barn per year corresponds to a greenhouse gas emissions reduction of 18.941 tonnes of CO2e, given the biomass source for firewood is 81% non-renewable.

For the Institutional Cook Stoves 31 institutions were surveyed and testestd using the KPT approach. At 90% confidence level, the range of the men was within 30% as required under the metholdology.

Institutional Cook Stoves	tonnes_wood / 10,000 meals cooked	31 Institutions tested KPT approach
Mean before	3.60462	
Mean after	0.85449	
Mean change	2.75013	
Upper 90%-confidence limit for the mean change	3.57	129.77% of mean
Lower 90%-confidence limit for the mean change	1.93	70.23% of mean

For Urabn Cook Stoves 90 households were surveyd and tested using the KPT approach using paired samples. At 90% confidence level, the range of the men was within 30% as required under the metholdology.

Urban Cook Stoves - Mthandizi	t/(year*stove)	Sample size: 90
Mean before	2.887954	
Mean after	1.174212	
Mean change	1.713742	
Standard deviation change	2.06165	
Upper 90%-confidence limit for the mean change	2.074956	121% of mean

Lower 90%-confidence limit for the mean change	1.352527	79% of mean

The breakdowns of CO2 emission reductions made during curing are detailed in section E.

Table B.2 presents emission reductions calculated based on Kitchen Tests and Barn Tests as detailed in Annex 2 and in accordance with the methodology.

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

The project boundary is defined by the kitchens and barns used by the project population (i.e. customers of devices being disseminated by the project); this is distinct to the Reachable Fuel Collection Area, which is the geographical area of Malawi where fuelwood can reasonably be expected to be collected throughout the period of the project.

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 place of the tobacco curing barn
- The place of fuel collection, production and transport, located in the fuel collection area.

b. Target Area:
The target area is defined as the country of Malawi

c. Fuel Collection Area:
This Area is defined as the country of Malawi

The following emission sources are included or excluded from the project boundary:

	Source	Gas	Included?	Justification / Explanation
Baseline	Cooking / curing, 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 / curing, 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.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity(ies) determining the baseline:

For portable ceramic cook-stoves, the baseline survey and KT was conducted with 300 households in 68 villages in

Msamala Traditional Authority, Balaka District, Southern Malawi between the 11th and 14th of March and was followed up between the 27th of April and 4th May 2009. The enumeration team comprised of 71 members of which 60 were Concern Universal village based promoters and 11 field facilitators under the supervision of Amulike Msukwa of Development Technical Assistance Services (DeTAS) and Elizabeth Banda (Clioma).

For the fixed esperanza stoves, a baseline survey and KT was conducted with 108 households in the Districts of Dowa and Ntchisi, Central Malawi between 2nd to 5th of September[55] and 7th to 10th of October 2009. The enumeration team comprised of 14 enumerators under the supervision of Amulike Msukwa.

For the rocket barns, the initial baseline study was conducted with 37 farmers in the districts of Dowa, Ntchisi and Kasungu in Central Malawi between the 3rd of February and the 12th of April 2008. The enumeration team comprised of 6 enumerators contracted by Programme for Biomass Energy Conservation (ProBEC) under the supervision of biomass energy consultant, Peter Scott. In 2009, a follow-up survey was conducted with 33 farmers in the Districts of Dowa, Ntchisi, Kasungu and Mzimba in Central and Northern Malawi between 2nd of February and the 4th of April 2009. The enumeration team comprised 5 enumerators contracted by ProBEC.

The non-renewability of woodfuel was analysed by the project coordinator in August 2009.

The baseline survey was completed on the 24/08/2009.

(See Annex 2 for detailed baseline information).

55 Pre-testing training of enumerators was carried out in Kandamanja Village, Sub-Traditional Authority Mponela, Dowa District on the 1st of September, 2009.

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity: 24th of November 2008 (or was it earlier, initial stakeholder meeting, ?)

C.1.2. Expected operational lifetime of the project activity: 21 years 0 months

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

The crediting period is renewable

C.2.1. Renewable crediting period 7 years

C.2.1.1. Starting date of the first crediting period: 24/11/08

C.2.1.2. Length of the first crediting period: 7 years 0 months

C.2.2. Fixed crediting period: NA

C.2.2.1. Starting date: NA

>>

C.2.2.2. Length: NA

SECTION D. Application of a monitoring methodology and plan

Data monitored and required for verification and issuance are to be kept for two years after the end of the crediting period or the last issuance of VERs for this project activity, whatever occurs later.

D.1. Name and reference of approved monitoring methodology applied to the project activity:

The monitoring protocol is included within the methodology *Technologies and Practices to Displace Decentralised Thermal Energy Consumption (11/04/2011)*, approved by the Gold Standard Foundation, which includes measures that significantly reduce consumption of non-renewable biomass.

Please refer to the revised Monitoring Plan in Annex 3.

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

The methodology is specifically designed to match the project conditions. As mentioned above, improved biomass stoves are included as applicable technologies as are measures that reduce consumption of non-renewable biomass or other greenhouse emitting fuels. Tobacco curing barns, although not applied for cooking, are biomass fired and reduce non-renewable biomass consumption.

Monitoring will be conducted according to the prescribed approach in the methodology and as detailed below.

The monitoring methodology is applicable as;
- A Total Sales Record, a Detailed Customer Database, and a Project Database are maintained continuously,
- Periodically Kitchen Surveys, Barn Surveys, Kitchen Tests and Barn Tests are conducted to measure or estimate parameter values and review and revise the cluster lists held in the Project Database.

Maintenance of a Total Sales Record.
The Project Coordinator collates a composite electronic **Total Sales Record** and keeps paper records also.

The **Total Sales Record** will comprise the following data:

- Date of Sale (based on delivery/installation or completion of construction of stove or rocket barn)
- Model/type: Esperanza stove / portable ceramic stove / rocket barn (New or retrofitted)
- Number of devices purchased
- ID number of the device
- Name and telephone number (if available)
  - Required for all bulk purchasers i.e. retailers and rocket barn users
  - Domestic end-users: as many as possible
- Address
  - Required for all bulk purchasers i.e. retailers and rocket barn users
  - Domestic end-users: as many as possible
- Geographic Positioning System for rocket barns

The **Sales Record** information is collected using the following methods:

Sales volumes are measured for each cluster option.

For portable ceramic stoves, village based stove promoters retail stoves directly to end-users and record sales and user training on a daily basis, which is collated into a detailed customer database that tracks the chain of transactions between the user and the producer. Monthly monitoring reports include information on random visits to end-users' homes.

For fixed esperanza stoves, village based stove promoters cause the construction of the stoves and record all sales to end-users and the training that they have received in a detailed customer database. Sales are recorded at field and office level.

For the rocket barns, potential customers are screened for credit-worthiness and once approved construction begins. On completion of construction of the barn, the end-user certifies that the barn has been completed to specifications as detailed in the user-manual (which is written in vernacular languages and contains a one-year guarantee for the barn structure). Certification results in issuance of an invoice.

The project database is the sales records re-organised, and contains distinct lists for each cluster.

Detailed Customer Database

The Detailed Customer Database is filled with the results of the Kitchen and Barn Surveys (both project and monitoring) and monitoring Kitchen Tests and Barn Tests.

Project database
The Project Database contains:

- Description of the outcome of the newest Kitchen Surveys and Kitchen Tests regarding clustering and emission reduction calculation for the newest available definitions of clusters,
- List for each cluster containing all device users from the Total Sales Record belonging to this cluster,
- List of all device users not being part of any cluster.

Continuous repetition of Kitchen and Barn Surveys

- Annual monitoring surveys for each stove cluster are surveyed. For tobacco curing there is only one season and thus barn surveys of at least 25 farmers (i.e. customers) will be conducted once a year (i.e. every 12 months).
- The same guidelines and questions for Kitchen Surveys and Barn Surveys are followed as described in the baseline section (B). In case new issues arise they can be included in the Kitchen Surveys or Barn Surveys,
- Results of the Kitchen Surveys and Barn Surveys will be included in the Detailed Customer Database and in the Monitoring Reports.

The data collected will be:

- Usage: Whether device (ICS or RB) is still in use or not; if not, what has replaced it,
- Telephone number and/or address,
- Type of device used by customer previously,
- Application of device (any other uses),
- Fuel mix used typically through the year: specify different types of fuel used and fractions,
- Source of fuel (purchased or hand-collected).

Additional survey questions in the KS and BS will inform leakage considerations.

Other periodic monitoring tasks:

- Net Leakage factors (discussed above) will be surveyed, and an investigation made into the possibility of new leakage and surplus effects, every second year,
- A Usage Survey will be undertaken for Total Sales made in the first year of the project, to establish the fraction of end-users who are no longer using the devices over time. The sample size will be as defined for the KS and BS. The approach will be to randomly sample from users having begun to use their devices in the first year of the project. Reported every second year,
- Stove-age KTs and rocket barn BTs will be undertaken for Total Sales made in the first year for each cluster, to measure emission reduction performance in successive years of devices of Age x years, Age y years,

and so on. A linear extrapolation is applied to all devices of intermediate age and extended age, when calculating overall project GHG reductions.

- New stove KTs and new rocket barn BTs will take place for new models and designs if they become available and when they have been in use for one year, and will be repeated annually,
- In addition, the wider social and economic impact of the project will be investigated every 2 years and an assessment made of its contribution, positive or otherwise, to sustainable development in the area.

Note, a fixed baseline is assessed to be conservative and is applied for renewability status of wood-fuel used by each cluster (NRB fraction) for the

D.2. 1. OPTION 1: Monitoring of the emissions in the project scenario and the baseline scenario

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID #	Data variable	Source of data	Data unit	Measured (m), calculated (c) estimated (e)	Recording Frequency	Proportion of data to be monitored	How will the data be archived? (Electronic/ paper)	Comment
1	*Stove Sales*	*Sales Records*	*Number of stoves by type and size*	*M*	*Daily – recorded daily in the field and later entered into sales record and database in office*	*All sales*	*Electronic and paper*	
2	*Rocket barns*	*Total Build Records*	*Number of rocket barns by type and size*	*M*	*Daily - recorded daily in the field and later entered into sales record and database in office*	*All total Builds*	*Paper and electronic*	
3	*Mass Fuel Consumption*	*KTs and BTs*	*Mass fuel per year*	*M*	*Annual*	*Measurement of sample of cluster population*	*Electronic and paper*	*Fuel consumption of improved stove and barn*
4	*Clustering definitions*	*Monitoring KS and BS*	*As specified above*	*E*	*Annual for BS and Every 6 months KS*	*Sample*	*Biannual monitoring reports*	*To ensure representative KTs and BTs*
5	*Usage factor*	*Usage KS and BS*	*% Operational*	*M, E*	*Annual*	*Sample*	*Electronic and paper*	
6	*Age factor*	*KT and BT*	*Mass fuel per year*	*M*	*Every 2 years*	*Sample*	*Electronic and paper*	
7	*New stove*	*New stove KT*	*Mass fuel*	*M*	*Baseline*	*Sample*	*Electronic and*	*Fuel*

	and barn performance	*and new barn BT*	*per year*		*and follow-up survey, subsequently every 2 years*		*paper*	*consumption of new improved stove and new improved barn*
8	*Non-renewability of woody biomass fuel in the project in year y*	*Study*	*Fraction*	*C / E*	*Fixed baseline for first crediting period*	*100%*	*Electronic and paper*	

D.2.1.2. Data to be collected in order to monitor project performance on the most sensitive sustainable development indicators:

No sustainable development indicators were found critical during Stakeholder Consultation and Sustainable Development Assessment but the following are monitored for reflection given the need to assess every two years the social and environmental impact of the project

Sustainable Development Indicator	Data type	Data variable	Uncertainty levels	Data unit	Measured (m), calculated (c) or estimated (e)
SD 1) Air quality	*Survey*	*Air pollutants (CO, particulates)*	*Low*	*Survey observations*	*Estimated through home interviews and observations as to inside/outside cooking*
SD 2) Livelihood of the poor	*Survey*	*Financial impact*	*Low*	*MK (Malawi Kwacha)*	*Estimated through surveys*
SD 3) Employment	*Survey*	*Numbers*	*Low*	*Employees*	*Direct employees; producers and retailers of improved cook stoves and specialised builders, metal-workers and carpenters of rocket barns*
SD 4) Human and Institutional capacity	*Survey*	*Numbers*	*Low*	*Trainees, employees*	*Attendance of women-specific training, number of jobs and positions for women;* *Awareness raising??*

D.2.1.3. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO2 equivalent).

When applying the not monitored variables as set out in part B, then within each cluster the emissions are calculated thus:
PEi,y,z = Ni,y * PEy * Age,z

Where
Ni,y = the number of Units in cluster I (100% working)
Ni,y = sold stoves, x * Usage,x,z

D.2.1.4. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived:

The project has chosen a fixed baseline and hence there is no reason to monitor baseline anthropogenic emissions by sources.

D.2.1.5. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO2 equ.)

Please see Section E

D. 2.2. OPTION 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

Not applied

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equivalent):

D.2.3. Treatment of leakage in the monitoring plan

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

As explained in B.2., there is no leakage expected from any source. To assess if the dissemination of efficient stoves and barns has a source of leakage, a survey is conducted via the KS and BS, which are monitored at least every 2 years.

ID #	Data variable	Source of data	Data unit	Measured (m), calculated (c) estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
11	*All leakage risks*	*KS and BS*		*e*	*Every 2 years*		*Electronic and paper*	

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equivalent).

Qualitative assessment through quarterly kitchen survey and barn survey visits throughout the project period.

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equivalent).

$ER_y = \Sigma BE_{i,y} – \Sigma PE_{i,y} – \Sigma LE_{i,y}$

See annex 2,

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored

The project coordinator ensures quality control in the monitoring activities. The project coordinator and/or a third party consultant(s) are responsible for the periodic KSs, KTs, BSs, BTs, Leakage investigation, and spot-checks (including field observations of retailer and construction activities) to confirm the absence of double counting in any form. The project coordinator ensures that Detailed Customer Database and Project Database are up to date and the latter is representative of the most recent definition of clusters. Sales Records are crosschecked with the sales record of retailers/contractors and with production / construction records (materials, purchasers, staff numbers). Reports on the methods used for such crosschecks and their findings are included in the monitoring reports available to the verifier.

Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Data Variable	Uncertainty level of data (High/ Medium/ Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
Table 2.2.1 (1)	*Stove Sales*	Low	The project participant is best capable of collecting this data because he knows the technology best. An internal monitoring quality standard and 3rd party expert views from local NGOs & experts are used to guarantee the quality.

Table 2.2.1 (2)	*Rocket barns*	Low	The project participant is best capable of collecting this data because he knows the technology best. An internal monitoring quality standard and 3rd party expert views from local NGOs & experts are used to guarantee the quality.
Table 2.2.1 (3)	*Project Fuel Consumption*	*Low*	The project participant is best capable of collecting this data because he knows the technology best. An internal monitoring quality standard and 3rd party expert views from local NGOs & experts are used to guarantee the quality.
Table 2.2.1 (4)	*Clustering definitions*	*Low*	The project participant is best capable of collecting this data because he knows the technology best. An internal monitoring quality standard and 3rd party expert views from local NGOs & experts are used to guarantee the quality.
Table 2.2.1 (5)	*Usage factor*	*Low*	The project participant is best capable of collecting this data because he knows the technology best. An internal monitoring quality standard and 3rd party expert views from local NGOs & experts are used to guarantee the quality.
Table 2.2.1 (6)	*Age factor*	*Low*	The project participant is best capable of collecting this data because he knows the technology best. An internal monitoring quality standard and 3rd party expert views from local NGOs & experts are used to guarantee the quality.
Table 2.2.1 (7)	*New stove and barn performance*	*Low*	The project participant is best capable of collecting this data because he knows the technology best. An internal monitoring quality standard and 3rd party expert views from local NGOs & experts are used to guarantee the quality.
Table 2.2.1 (8)	*Non-renewability of woody biomass fuel in the project in year y*	*Low*	Third party studies are used to calculate this data
Table 2.2.1 (9)	*Non-renewable woody biomass fuel in the baseline in year y*	*Low*	Third party studies are used to calculate this data
Table 2.2.1 (10)	*Baseline fuel consumption*	*Low*	The project participant is best capable of collecting this data because he knows the technology best. An internal monitoring quality standard and 3rd party expert views from local NGOs & experts are used to guarantee the quality.
Table 2.2.1 (11)	*All leakage risks*	Low	The project participant is best capable of collecting this data because he knows the technology best. An internal monitoring quality standard and 3rd party expert views from local NGOs & experts are used to guarantee the quality.
SD 1	Air quality	Low	Surveys
SD 2)	Livelihood of the poor	Low	Surveys
SD 3)	Employment	Low	The project participant records used, no uncertainty applies
SD 4)	Human and Institutional capacity	Low	The project participant records used, no uncertainty applies

D.4. Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

The Project Coordinator will schedule and implement the monitoring activities described and tabulated above, and summarise results in the form of monitoring reports.

For the monitoring of the emission reductions a detailed monitoring plan exists. Quality controls are conducted both internally by the project coordinator and externally with advice from local experts (NGOs, government, university).

Specialised staff is employed by the project with specific responsibility for monitoring. The staff is trained at the beginning and works with a monitoring manual. If needed, the manual is updated and the staff is re-trained.

All data will be kept electronically for a period of 2 years after the end of the crediting period.

D.5 Name of person/entity determining the monitoring methodology:

The monitoring methodology is as prescribed in the GS Methodology for *Technologies and Practices to Displace Decentralised Thermal Energy Consumption* under the Gold Standard Foundation prepared by Hestian Innovation.

SECTION E. Estimation of GHG emissions by sources

Formulae from methodology and the rationale behind the values applied for parameters are presented in Annex 2.

E.1. Estimate of GHG emissions by sources:

For improved cook stoves please see annex 5 for justification of a common conservative approach for 3 technologies and for calculations of emission reductions.

For improved Cook Stoves:

Description	*Abbreviation*	*Value*	
Thermal efficiency new stove		31%	(Conservative est'n)
Thermal efficiency in year 0-1	Eff,pcs,0-1	26%	
Thermal efficiency in year 1-2	Eff,pcs,1-2	21%	
Thermal efficiency in year 2-3	Eff,pcs,2-3	22%	
CO2 emission factor from use of biomass	EF,wood,CO2	1.75	tCO2/ t_biomass
Non-CO2 emission factor from use of biomass	EF,wood,non-CO2	0.46	tCO2/ t_biomass
Non Renewable Biomass Factor	fNRB	0.81	fNRB
Emission factor of baseline and project fuels	EFwood	1.871	tCO2eq / t_biomass
Suppressed demand based on aproach 2			
Monitored consumption of fuels	$B_{p,y}$	1.690	tonnes of wood p.a.
Baseline wood use	$B_{b,y}$	5.237	
Efficiency of the baseline technology	Effb,y	10%	
Efficiency of the project technology	Effp,y	31%	(Conservative est'n)
Baseline Emissions (per household)		9.797	tCO2 eq / HH / year
Project Emissions (per household)		3.160	tCO2 eq / HH / year
Emission Reductions (per household)		6.637	tCO2 eq / HH / year

For Rocket Barns:

Description	*Abbreviation*	*Value*	
Average output per RB		1.315	tons / output per year
Baseline efficiency	$B_{b,y}$	11.96	kgs wood / kg output
Project efficiency in year 0-1	$B_{p,y}$	4.26	kgs wood / kg output
Baseline efficiency		15.73	kgs wood / RB p.a.
Project efficiency in year 0-1	Eff,rb,0-1	5.60	kgs wood / RB p.a.
CO2 emission factor from use of biomass	EF,wood,CO2	1.747	tCO2/ t_biomass
Non-CO2 emission factor from use of biomass	EF,wood,non-CO2	0.455	tCO2/ t_biomass
Non Renewable Biomass Factor	fNRB	0.810	fNRB
Emission factor of baseline and project fuels	EFwood	1.871	tCO2eq / t_biomass
Baseline emissions		29.42 0	tCO2eq/year
Project emissions		10.47	tCO2eq/year

		9	
Emissions reductions at 100% usage and performance		18.94 1	tCO2eq/year

For Institutional Stoves:

Description	*Abbreviation*	*Value*	
Baseline Efficiency	$B_{b,y}$	3.605	tonnes / 10,000 meals / year
Project efficicency	$B_{p,y}$	0.854	tonnes / 10,000 meals / year
CO2 emission factor from use of biomass	EF,wood,CO2	1.75	tCO2/ t_biomass
Non-CO2 emission factor from use of biomass	EF,wood,non-CO2	0.46	tCO2/ t_biomass
Non Renewable Biomass Factor	fNRB	0.81	fNRB
Emission factor of baseline and project fuels	EFwood	1.871	tCO2eq / t_biomass
Baseline Emissions (per 10,000 meals)		6.743	tCO2 eq / 10,000 meals / year
Project Emissions (per 10,000 meals)		1.598	tCO2 eq / 10,000 meals / year
Emission Reductions (per 10,000 meals) 100% usage and performance		5.144	tCO2 eq / 10,000 meals / year

In the case of ICS and UCS, the Kitchen Tests and Kitchen Surveys have been presented for the verification of Monitoring Period 01/10/2010 to 01/10/2011.

E.2. Estimated leakage:

This is estimated to be zero for all clusters as detailed in section B.2.

E.3. The sum of E.1 and E.2 representing the project activity emissions:

As E.2 is estimated to be zero, the project activity emissions are those presented in E.1.

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

See E.1 and E.6

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

$ER_y = \Sigma BE_{i,y} - \Sigma PE_{i,y} - \Sigma LE_{i,y}$
$= \Sigma BE_{i,y}$ – Project Activity Emissions

See E.1 and E.6

E.6. Table providing values obtained when applying formulae above:

Year	Estimation of basline activity emission (tonnes CO_2e)	Estimation of project activity emission (tonnes CO_2e)	Estimation of leakage (tonnes CO_2e)	Estimation of emission reductions (tonnes CO_2e)
1	7,074	2,282	0	4,792
2	57,874	18,669	0	39,204
3	87,213	28,132	0	59,078
4	114,600	36,967	0	77,630
5	114,408	36,905	0	77,500
6	114,408	36,905	0	77,500
7	114,408	36,905	0	77,500
Total	609,985	196,764	0	413,204

SECTION F. Environmental impacts

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

No adverse environmental impacts will take place as a result of the project activity. Questions in this regard (specify questions) were answered to the satisfaction of authorities attending the stakeholder consultation in November 2008.

The Department of Environmental Affairs, which is the Designated National Authority for Malawi, revised the Project's documentation and visited one of the Project's sites in November 2009. With these observations and information, the Department expressed in writing its full support of the Project as a way of supporting Malawi Government's global commitment to climate change mitigation.

F.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:

An Environmental Impact Assessment (EIA) is not needed because it is neither required by the Gold Standard procedures nor by the host country.

SECTION G. Stakeholders' comments

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

The stakeholder consultation was held in 2 parts. The first took place at the Crossroads Hotel in Lilongwe on Friday, November 14th, 2008 and the second (a field visit to a working farm) took place at a farm in Chamama, Kasungu on Wednesday, November 19th, 2008. The first part was attended by representatives from government, environmental and civil society organizations, academia and the private sector. There were 39 participants at the first part of the stakeholder consultation. The second part of the stakeholder consultation was attended by some of the participants of the first part and a significant number of farmers (with an attendance of 68).

Stakeholder comments were invited and compiled with the assistance of guidance from the Gold Standard Toolkit (section 2.6 and Annex J). A number of presentations on the project were made, followed by a questions /comments round and a blind sustainable development exercise (each as more fully described in the (uploaded) GS 613 Stakeholder Consultation report).

The project was, overall, very well received by the stakeholders.

G.2. Summary of the comments received:

The primary recommendations made by the stakeholders were:

1. That the implementation of the project will be spread from the pilot areas to the rest of the country.

2. With a view to minimizing negative impact on Soil Condition (from clay collection), the project could actively promote: (1) the collection of clay from above-ground piles of earth; (2) where not possible, the minimisation of pit depths; and (3) the rapid replacement of clay removed from pits with biodegradable household and agricultural wastes.

3. A small number of participants had a divergent view on the definition of biodiversity. This was discussed at length in open forum across the group. The vast majority of participants did not agree with the notion of the project having a negative impact on biodiversity. However it was stated that biodiversity could be improved by: (a) promoting the governmental policy which encourages tobacco farmers to use part of their farm land for planting trees; (b) collaborating with NGOs like the one which promotes briquettes as an alternative to wood fuels in order to further reduce the use of wood fuels; (c) ensuring that many people have access to the stoves.

4. That the project avoids taking too long to be implemented because of the lengthy process involved for carbon financing.

5. That the project has a lot of personnel on the ground to monitor performances.

6. That the community be educated and encouraged to use the new technologies devices provided by the project instead of conventional technologies.

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

The project has accommodated the recommendations in the following ways:

1. GS613 is a small scale project. However, the whole country will be gradually reached with both stoves and rocket barns for rural areas where firewood is the main source of fuel through VPAs under the separate African Biomass Energy Conservation micro-scale Programme of Activities..

2. The project will actively promote: (1) the collection of clay from aboveground piles of earth; (2) where not possible, the minimisation of pit depths; and (3) the rapid replacement of clay removed from pits with biodegradable household and agricultural wastes.

3. The project will (a) promote the governmental policy which encourages tobacco farmers to use part of their farm land for planting trees; (b) collaborate with NGOs to further reduce the use of wood fuels; (c) ensure that many people have access to the stoves.

4. The project has will endeavour to avoid implementation delays and has distributed significant numbers to date.

5. The project includes a comprehensive monitoring regime (please see Section D) involving in excess of 70 personnel.

6. The project includes a comprehensive education program whereby all end-users receive training on the usage and benefits (to end-users) of the new technologies (please see Section D).

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

BASELINE INFORMATION

The parameters table below summarises the results of the KS, RBS, KT and RBT findings as to clustering and the emission reductions per unit of each cluster.

The KS and RBS recommended that the project calculate emission reductions for devices according to the following clusters:

a. Sales of portable ceramic stoves
b. Sales of fixed esperanza stoves
c. Sales of Rocket Barns
d. Sales of institutional cook stoves
e. Sales of urban cook stoves

Clusters (a), (b) and (e) comprise wood-burning domestic stoves. A KT in 2009 in Balaka indicated an initial wood saving of 0.955 tonnes of wood for the portable ceramic stove and is the result of a comprehensive KT carried out with 300 rural households. A KT in 2009 in Dowa and Ntchisi indicated a wood saving of 1.614 tonnes of wood per year for the fixed esperanza stove and is the result of a comprehensive KT carried out with 108 rural households. Calculations of wood saving for the urban cook stove are based on initial baseline and follow up KT conducted in Lilongwe in 2010 and further KT in 2011 among 90 households which show savings of 1.714 tonnes of wood per year. Calculations of emission reductions are presented in Annex 5.

Cluster (c) comprises wood-burning rocket barn. A survey was conducted together with a rocket barn test in 2008 sampling 37 farmers burning wood and using the rocket barn and conventional barns.

A further survey and test were conducted in 2009 sampling 33 farmers burning wood and using the rocket barn. A statistical analysis of the results found at 90% confidence level that rocket barn saved at least 6.72 kgs of wood per kg of cured tobacco as compared to the conventional barns in 2008 (as our baseline). For the purposes of estimating emission reductions per rocket barn, the emission reduced per kg of produce cured is multiplied by the average number of kgs cured per rocket barn per year as observed in the 2008 baseline sample. The BTs indicated an emission saving of 18.941 tCO2e / rocket barn-year.

Cluster (d) comprises wood-burning institutional stoves. Kitchen Surveys and Tests conducted in between September 2010 and Septemberr 2011 among 31 institutions found that the institutional cook stove saved at least 2.750 tonnes of wood each year per 10,000 meals cooked as compared to the traditional method of preparing the meals – an emission reduction of 5.144 tCO2e / 10,000 meals / year at full usage and performance. The emission reduction per 10,000 meals per year is multiplied by the number of meals cooked per stove per year.

Formulae Applied:

The emission reductions per device that can be claimed under Gold Standard for reduced emissions from the use of NRB, as defined as Approach 1 in the methodology, are calculated using the following equation:

$$BE_y = X_{nrb,bl,y} . B_{bl,y} . EF_{bl.bio,co2} + \sum(AF_{bl,l,y} . EF_{af,co2,i})$$
$$+ \sum(\text{Non-}CO_2 \text{ emissions during cooking})$$
$$+ \sum(\text{GHG emissions during production of the fuels})$$

Where:

BE_y = baseline emissions in year y (in tonnes CO2e 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 / curing in the baseline in year y (tonnes/year).

$EF_{bl.bio,co2}$ = the CO2 emission factor for use of the biomass fuel in the baseline scenario in tonnes CO2 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 KT is appropriately designed to subsume alternative fuels (approach 3).

$EF_{af,co2,i}$ = The CO2 emission factor for use of the alternative fuel i in the baseline in tonnes of CO2 per tonne fuel

Non-CO2 emissions during cooking
$$= \sum(B_{bl,y} . EF_{bl.bio,non\text{-}co2,i}) + \sum(AF_{bl,i,y} . EF_{af,i,non\text{-}co2,\ gas\ i})$$

$$\text{GHG emissions during production of the fuels} = X_{nrb} . B_{bl,y} . EF_{bio,prod,co2}$$
$$+ \sum(AF_{bl,i,y} . EF_{af,prod,co2,i})$$
$$+ \sum(B_{bl,y} . EF_{bio,prod,co2,gas\ i})$$
$$+ \sum(AF_{bl,i,y} . EF_{af,i,prod,non\text{-}co2,gas\ i})$$

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

$EF_{af,i,non\text{-}co2,\ gas\ i}$ = Non-CO2 Emission factor during cooking for alternative fuel i for GHG gas i in tonnes gas per tonnes fuel

$EF_{bio,prod,co2}$ = CO2 Emission factor for wood-fuel during production in tonnes gas per tonnes fuel

$EF_{af,prod,co2,i}$ = CO2 Emission factor for fuel i during production in tonnes gas per tonnes fuel

$EF_{bio,prod,co2,gas\ i}$ = Non-CO2 Emission factor for wood-fuel during production in tonnes gas per tonne fuel

$EF_{af,i,prod,non-co2,gas\ i}$ = Non-CO2 Emission factor alternative fuel i for GHG gas i during production in tonnes gas per tonnes fuel

Project Emissions:

$$PE_y = X_{nrb,pj,y} . B_{pj,y} . EF_{bio,co2} + \sum(AF_{pj,i,y} . EF_{af,co2,i})$$
$$+\sum(\text{Non-}CO_2 \text{ emissions during cooking / curing})$$
$$+\sum(\text{GHG emissions during production of the fuels})$$

Where (noting that parameters common to baseline equations are not repeated):

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

PE_y = project emissions in year y (in tonnes of Co2e per year) specific to cluster and Unit chosen

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

Non-CO2 emissions during cooking / curing

$$= \sum(B_{pj,y} . EF_{pj.bio,non-co2,i}) + \sum(AF_{pj,i,y} . EF_{af,i,non-co2,\ gas\ i})$$

GHG emissions during production of the fuels = $X_{nrb} . B_{pj,y} . EF_{bio,prod,co2}$

$$+ \sum(AF_{pj,i,y} . EF_{af,prod,co2,i})$$
$$+ \sum(B_{pj,y} . EF_{bio,prod,co2,gas\ i})$$
$$+ \sum(AF_{pj,i,y} . EF_{af,i,prod,non-co2,gas\ i})$$

Parameters Table:

Data / Parameter:	EFbl.bio,co2
Data unit:	tCO2/t_biomass
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 1.2/1.4
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:	EFpj.bio,co2
Data unit:	tCO2/t_biomass
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 1.2/1.4
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:	EFbl.bio,non-co2
Data unit:	tCO2/t_biomass
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 2.9 in Volume 2: Energy
Value applied:	0.4554 tCO2/t wood (=(1.224 tCO2/TJ * 0.0156 TJ/ t * 21) + (0.01125 tCO2/TJ * 0.0156 TJ/ t * 310))
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 The following GWP100 are applied: 21 for CH4, 310 for N20
Any comment	Both defaults are within a range and the mean of the range is taken as the default. Technical references are from studies in developing country contexts and are more up-to-date than other default values.

Data / Parameter:	EFpj.bio,non-co2
Data unit:	tCO2/t_biomass
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 2.9 in Volume 2: Energy
Value applied:	0.4554 tCO2/t wood (=(1.224 tCO2/TJ * 0.0156 TJ/ t * 21) + (0.01125 tCO2/TJ * 0.0156 TJ/ t * 310))
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 The following GWP100 are applied: 21 for CH4, 310 for N20
Any comment	Both defaults are within a range and the mean of the range is taken as the default. Technical references are from studies in developing country contexts and are more up-to-date than other default values.

1) Fixed 'esperanza' Stove	**Parameter**	**Value**	**Units**	**Source**
Fractional Non-Renewability (constant for baseline and project conditions)	X_{nrb}	0.81	Fraction	UNFCCC default value
Consumption of wood (baseline)	B_{bl}	5.237	t_wood/stove-yr	Pending baseline study

per household per year *as per suppressed demand approach 2* (see Annex 5).				
CO2 emission factor wood	$EF_{bio,co2}$	1.7472	tCO2/t_wood	Product of NCV wood (IPCC 2006 GL default 15.6MJ/kg) and CO2 emission factor (energy basis) for wood (IPCC 2006 GL default 112 tCO2/TJ) x 10^{-3}
Mass alternative fuel	AF_{bl}	NA		
CO2 emission factor alternative fuel	$EF_{af,co2}$	NA		
Project consumption wood (project) per household per year	B_{pj}	1.690	t_wood/stove-yr	Pending baseline study
Non-CO2 emission factor wood	$EF_{bl.bio,non\text{-}co2,i}$	0.4554	tCO2e/t_wood	NCVwood (IPCC 2006 GL default 15.6MJ/kg) EF for CH4 average of EF ID 118531 EF for N2O average of EF ID 118539 100 year GWP from IPCC SAR IPCC (21 CH4 and 310 for N2O)
Non-CO2 emission factor alt fuel	$EF_{af,non\text{-}co2}$	N/A		
Mass alternative fuel (project)	$AF_{pi,}$	N/A		
Leakage of portable stoves in year y	$LE_{fixed\ esp\ stove,\ y}$	0.00	Fraction	

2) Portable Ceramic Stove	Parameter	Value	Units	Source
Fractional Non-Renewability (constant for baseline and project conditions)	X_{nrb}	0.81	Fraction	UNFCCC default value
Consumption of wood (baseline) per household per year as per suppressed demand approach 2 (see Annex 5).	B_{bl}	5.237	t_wood/stove-yr	Baseline Study Project-Specific
CO2 emission factor wood	$EF_{bio,co2}$	1.7472	tCO2/t_wood	Product of NCVwood (IPCC 2006 GL default 15.6MJ/kg) and CO2 emission factor (energy basis) for wood (IPCC 2006 GL default 112 tCO2/TJ) x 10^{-3}
Mass alternative fuel	$AF_{pi,}$	NA		
CO2 emission factor alternative fuel	$EF_{af,co2,i}$	NA		
Project consumption wood (project) per household per year as per suppressed demand approach 2 (see Annex 5).	B_{pj}	1.690	t_wood/stove-yr	Baseline Study Project-Specific
Non-CO2 emission factor wood	$EF_{bl.bio,non\text{-}co2,i}$	0.4554	tCO2e/t_wood	As per Ref A above
Non-CO2 emission factor alt fuel	$EF_{af,non\text{-}co2}$	N/A		
Mass alternative fuel (project)	$AF_{pi,}$	N/A		

Leakage of portable stoves in year y	$LE_{portable\ stove,\ y}$	0.00	Fraction	

3) Rocket Barn	Parameter	Value	Units	Source
Fractional Non-Renewability (constant for baseline and project conditions)	X_{nrb}	0.81	Fraction	UNFCCC default value
Average (lower bound confidence interval) consumption of wood (baseline) per cured kg	B_{bl}	10.81	kg_wood/kg-cured	Baseline Study Project-Specific
CO2 emission factor wood	$EF_{bio,co2}$	1.7472	tCO2/t_wood	Product of NCVwood (IPCC 2006 GL default 15.6MJ/kg) and CO2 emission factor (energy basis) for wood (IPCC 2006 GL default 112 tCO2/TJ) x 10^{-3}
Mass alternative fuel	AF_{bl}	NA		
CO2 emission factor alternative fuel	$EF_{af,co2,i}$	NA		
Lower level average consumption wood (project) per cured kg	B_{pj}	3.98	kg_wood/kg-cured	Baseline Study Project-Specific
Kg wood saved per cured kg		6.83	kgs wood / kg cured produce	Baseline Study Project-Specific
Average (lower bound confidence interval) kgs cured per rocket barn (baseline)		1,164	kgs / year	Baseline Study Project-Specific
Non-CO2 emission factor wood	$EF_{bl.bio,non\text{-}co2,i}$	0.4554	tCO2e/t_wood	As per Ref A above
Non-CO2 emission factor alt fuel	$EF_{af,non\text{-}co2}$	N/A		
Mass alternative fuel (project)	$AF_{pi,}$	N/A		
Leakage of portable stoves in year y	$LE_{RB,\ y}$	0.00	Fraction	

As indicated above, in the case of Institutional Cook Stove and Urban Cook Stove, the Kitchen Tests and Kitchen Surveys have been presented in Monitoring Report 01/10/2010 to 01/10/2011 for verification.

Annex 3 (Revised)

REVISED MONITORING PLAN FOR GS 613

The revised monitoring plan for GS613 acts in accordance with Gold Standard methodology *"Technologies and Practices to Displace Decentralised Thermal Energy Consumption (11/04/2011)"* and replaces the project's initial monitoring plan that followed an earlier Gold Standard methodology *"Improved Cook-stoves and Kitchen Regimes V.01"*.

1. **Total Sales Record**

A total sales record and a project database are maintained continuously. Records are backed up electronically.

The required data are:

- Date of sale or conservative assessment of as to date of installation an commence of use of technology.
- Geographic area of sale
- Model / type of project technology sold
- Quantity of project technologies sold
- Name and telephone number (if available) and address
    1. Required for all bulk purchasers, i.e. retailers and industrial users
    2. All end-users except where this is justified as not feasible (e.g. sales in market stalls, or shops where the retailer cannot reasonably be expected to collect customers names and addresses during busy times).
- Mode of use: domestic, commercial other
    1. As many as commensurate with representative sampling.

2. **Project Database**

The project database is derived from the total sales record (or dissemination record in the case of non-commercial distribution) 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. Technologies aged beyond their useful life-time, as established in the usage survey, are removed from the project database and no longer credited.

3. **Ongoing monitoring studies**

For each project scenario a monitoring survey and usage survey is conducted annually, while a leakage assessment is carried out every two years.

3.1 **Monitoring survey**

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.

End-users for a given project scenario are selected using representative sampling techniques to ensure adequate representation of users with technologies of different ages. Common sampling approaches such as clustered random sampling are allowed and geographic distribution should be factored into selection criteria. End-users can be surveyed at any time(s) throughout the year with care taken to collect information pertaining to seasonal variations in technology and fuel use patterns.

Sampling procedure is covered in sample plan below.

The monitoring survey is only conducted with end-users representative of the project scenario and currently using the project technology. Monitoring surveys can be conducted with usage survey participants that are currently using the project technology.

3.2 Usage survey

Completed annually or more frequently and 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.

To ensure conservativeness, participants in the usage survey with technologies in the first year of use (age_{0-1}) must have technologies that have been in use on average longer than 0.5 years. For technologies in the second year of use (age_{1-2}), the usage survey must be conducted with technologies that have been in use on average at least 1.5 years, and so on.

A usage parameter must be established to account for the drop off rates as project technologies age and are replaced. Prior to a verification, a usage parameter is required that is weighted to be representative of the quantity of project technologies of each age being credited in a given scenario. For example, if only technologies in the first year of use (age_{0-1}) are being credited, a usage parameter must be established through a usage survey for technologies age_{0-1}. If an equal number of technologies in the first year of use (age_{0-1}) and the second year of use (age_{1-2}) are credited a usage parameter is required that is weighted to be equally representative of drop off rates for technologies (age_{0-1}) and (age_{1-2}).

As noted in the sample plan below, the minimum total sample size is 100, with at least 30 samples for project technologies of each year being credited. The majority of interviews in a usage survey must be conducted in person and include expert observation by the interviewer with the kitchen in question, while the remainder may be conducted via telephone by the same interviewers on condition that the in-kitchen observational interviews are first conducted and analysed such that typical circumstances are well understood by the telephone interviewers.

The usage parameter must be applied when calculating the quantity of fuel consumed in the project scenario p during year y ($B_{p,y}$). Unless proven otherwise, it should be assumed that any drop off in the use of the project technology is replaced by fuel consumption in the applicable baseline scenario. The usage survey will establish a useful lifetime for the technologies after which they are removed from the project database and no longer credited. The corresponding household may of course then acquire a new improved stove in which case emission reductions will be claimable under another technology vintage.

3.3 Project FT update

The PFT update is an extension of the project PTF and provides a fuel consumption assessment representative of the project technologies currently in use, every two years. Hence the PFT 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.

As baseline fuel and project fuel are the same (i.e. woody biomass) in GS613, baseline and project FT data is analysed in combination to estimate annual average ERs or fuel savings per unit.

3.4 Baseline FT Update

A fixed baseline is maintained and hence the BFT will not be updated for the remainder of the current crediting period.

3.5 Leakage assessment

Completed every other year, starting on time for the first verification.

3.6 Non-renewable biomass assessment update

The non-renewable biomass fraction is fixed based on the results of the NRB assessment. Over the course of the project, renewability may be re-examined by conducting a new NRB assessment.

4 Data and parameters to be monitored

Data / Parameter	$fNRB_{i,y}$
Unit	Fraction non-renewability
Description	Non-renewability status of woody biomass fuel in scenario i during year y
Source of data	Applicable NRB assessment
Monitoring frequency	Fixed by baseline study for a given crediting period, updated if necessary
QA/QC procedures	Transparent data analysis and reporting
Additional comment	As applicable, NRB assessment may be used for multiple scenarios

Data / Parameter	$P_{p,y}$
Unit	Kg / household-day (for household stoves) Kg / adult adjusted meal (for institutional stoves) Kg / kg of output (for Rocket Barns)
Description	Quantity of fuel that is consumed in project scenario p during year y
Source of data	Total sales record, project FT, project FT updates, and any applicable adjustment factors.
Monitoring frequency	Updated every 2 years, or more frequently
QA/QC procedures	Transparent data analysis and reporting
Any comment	A single project fuel consumption parameter is weighted to be representative for the quantity of project technologies of each age being credited in a given project scenario

Data / Parameter	$U_{p,y}$
Unit	Percentage
Description	Usage rate in project scenario p during year y
Source of data	Annual usage survey

Monitoring frequency	Annual or more frequently, in all cases on time for any request for issuance
QA/QC procedures	Transparent data analysis and reporting
Any comment	A single usage parameter is weighted to be representative of project technologies of each age being credited in a given project scenario

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

Data / Parameter	$LE_{p,y}$
Unit	tCO_2e per year
Description	Leakage in project scenario p during year y
Source of data	Baseline and monitoring surveys
Monitoring frequency	Every 2 years
QA/QC procedures	Transparent data analysis and reporting
Any comment	Aggregate leakage can be assessed for multiple project scenarios, if appropriate

5 Data and parameters not monitored over the crediting period

Data / Parameter	$EF_{b, CO2}$ and $EF_{p, CO2}$
Unit	tCO_2 / t_wood
Description	CO_2 emission factor arising from use of fuels in baseline and project scenarios
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Tables 1.2/1.4
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	EF in baseline and project have the same value as the project reduces use of the same fuel.

Data / Parameter	$EF_{b, nonCO2}$ and $EF_{p, nonCO2}$
Unit	tCO_2 / t_wood
Description	Non-CO_2 emission factor arising from use of fuels in baseline and project scenarios
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Table 2.9 in Volume 2: Energy
Value applied:	0.4554 tCO2/t wood (=(1.224 tCO2/TJ * 0.0156 TJ/ t * 21) + (0.01125 tCO2/TJ * 0.0156 TJ/ t * 310))
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. The following GWP100 are applied: 21 for CH4, 310 for N20.
Any comment	Both defaults are within a range and the mean of the range is taken as the default. Technical references are from studies in developing country contexts and are more up-to-date than other default values. EF in baseline and project have the same value as the project reduces use of the same fuel.

Note: CO_2 and nonCO_2 emissions factors for charcoal are estimated by researching a conservative wood to charcoal production ratio (from IPCC) and by multiplying this value by the pertinent EF for wood.

To calculate the amount of wood biomass equivalent from the amount of consumed charcoal the IPCC default value[56] is used: "if no local information is available, 6 kg of wood input per kg of charcoal may be used as default (FAO, 1990)." The charcoal used in Lilongwe is produced in simple earth kilns without observing standards; therefore no exact value is available and the use of the following default value is applied for charcoal use among *Mthandizi* or Urban Cook Stove users in the baseline and project[57]:

mbiomass of wood / mcharcoal = 6 units biomass of wood/ unit charcoal

6 Quality assurance and Quality Control

The project will maintain accurate and transparent record keeping.

All supporting documentation and records for the Project must be easily accessible for spot checking and cross-referencing by a third party.

[56] IPCC: Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual

[57] In an earth-mound kiln, the most common method of making charcoal in Sub-Saharan Africa, between 5 and 10 tons of wood is needed to make 1 ton of charcoal - a mass based conversion efficiency of 10 to 20%. (Source: Bailis, R.: Wood in Household Energy Use. Encyclopedia of Energy, Vol. 6, page 515 Amsterdam: Elsevier 2004). This corresponds to a factor mbiomass /mcharcoal in the range of 5 to 10. Kammen and Lee use the factor 8 in table 1, page 4, to calculate the wood equivalent (Source: Kammen D. M., Lew D. J.: Review of Technologies for the Production and Use of Charcoal. University of California, Berkley, and National Renewable Energy Laboratory, Golden, Colorado; March 1, 2005).

Contact information in the total sales record must allow a project auditor to easily contact and visit end-users. An auditor must also be able to cross reference pertinent project documentation, which includes archives such as production records (e.g. material purchases, internal logs), financial accounts and sales records, as well as wholesale customer invoices, observations of retailer activities and sales performance.

7 Suppressed Demand

The baseline scenarios for domestic cook stoves (PCS, FES and UCS), although fixed over the first crediting period, have been revised to take into account an ex-post assessment of suppressed demand, where the level of thermal energy consumption corresponds not with a pre-project situation but with a project level of satisfied demand.

The approach and findings are presented in detail in Annex 5.

8 Performance Field Tests ad Calculation of Emission Reductions

Institutional Cook Stoves and Urban Cook Stoves were included in GS613's registered PDD but the baseline and follow-up surveys and tests were not completed for the first verification but are to be included from the second verification.

The project's baseline fuel and project fuel are the same and statistical analysis is conducted with respect to fuel savings per unit.

The project will apply two options for the statistical analysis. In all cases sample sizes must be greater than 20:

I. 90/30 rule. When the sample sizes are large enough to satisfy the "90/30 rule," i.e. the endpoints of the 90% confidence interval lie within +/- 30% of the estimated mean, overall emission reductions can be calculated on the basis of the estimated MEAN annual emission reduction per unit of the MEAN fuel annual savings per unit.

II. 90% confidence rule. When the sample sizes are such that the "90/30 rule" is not complied with, the emission or fuel saving result is not the mean (or average) test result, but a lower value i.e. the LOWER BOUND of the one-sided 90%

9 <u>The formulae used for ER calculations of barns and institutional cook stoves are:</u>

$ERy = \sum BE_{b,y} - \sum PE_{p,y} - \sum LE_{p,y}$

Where:

ERy = Emission reduction for total project activity in year y ($tCO2e/yr$)

BEp,y = Baseline emissions for baseline scenario b in year y ($tCO2e/yr$)

PEb,y = Project emissions for project scenario p in year y ($tCO2e/yr$)

LEp,y = Leakage for project scenario p in year y ($tCO2e/yr$)

Baseline emissions calculations are conducted as follows:

$BEb,y = Bb,y * ((fNRB,y * EFb,fuel,CO2) + EFb,fuel,non\text{-}CO2) * NCVb,fuel$

Where:

$BE_{b,y}$	Emissions for baseline scenario b during the year y in tCO_2e
$B_{b,y}$	Quantity of fuel consumed in baseline scenario b during year y in tonnes
$f_{NRB,y}$	Fraction of biomass used during year y for the considered scenario that can be established as non-renewable biomass
$NCV_{b,fuel}$	Net calorific value of the fuel that is substitutes or reduced
$EF_{b,fuel,CO2}$	CO_2 emission factor of the fuel that is substituted or reduced 112 tCO_2/TJ for Word / Word waste, or the IPCC default value of other relevant fuel
$EF_{b,fuel,non\text{-}CO2}$	Non-CO_2 emission factor of the fuel that is substituted or reduced

$B_{b,y} = N_{p,y} * P_{b,y}$

Where

$N_{p,y}$	Project technology-days in project database for project scenario p through year y
$P_{b,y}$	Specific fuel consumption for an individual technology in baseline scenario b during year y converted to tons / day

Project emission calculations are conducted as follows:

$PE_{p,y} = B_{p,y} * ((f_{NRB,y} * EF_{p,fuel,CO2}) + EF_{p,fuel,nonCO2}) * NCV_{p,fuel}$

Where

$PE_{p,y}$	Emissions for Project scenario p during year y in tCO_2e
$B_{p,y}$	Quantity of fuel consumed in Project scenario p during year y, in tons, and as derived from the statistical analysis conducted on the data collected during the Project performance field tests
$f_{NRB,y}$	Fraction of biomass used during the year y that can be established as non-renewable biomass
$NCV_{p,fuel}$	Net calorific value of the project fuel
$EF_{p,fuel,CO2}$	CO_2 emission factor for the project fuel. This is equal to the baseline fuel EF in projects which use the same fuel, 112 tCO_2/TJ for wood / wood waste or the IPCC default value of other relevant fuel
$EF_{p,fuel,nonCO2}$	Non-CO_2 emission factor of the project fuel. This is equal to the baseline fuel EF in projects which use the same fuel.

$B_{p,y} = N_{p,y} * ((P_{p,y} * U_{p,y}) = (P_{b,y}, * (1 – U_{p,y})))$

Where

$N_{p,y}$	Project technology-days in the project database for project scenario p through year y
$P_{p,y}$	Specific fuel consumption for an individual technology in project scenario p during year y converted to tons / day
$P_{b,y}$,	Specific fuel consumption for an individual technology in baseline scenario b during year y converted to tons/day

Up,y	Cumulative usage rate for technologies in project scenario p during year y, based on cumulative installation rate and drop-off rate.

For instances where suppressed demand is applied to domestic cook stoves:

Suppressed demand will be applied exclusively to household stoves where biomass is used in the project and baseline exclusively. If kerosene or other fossil fuels are used these are unlikely to be material and are ignored on the basis of conservatism.

BEb,y = Bpj,y * ((fNRB,y * EFb,fuel,CO2) + EFb,fuel,nonCO2)) * Eff p, y / Eff b, y

PEp,y = Bpj,y * ((fNRB,y * EFp,fuel,CO2) + EFp,fuel,nonCO2)

Where:

Effp,y	Efficiency of the project technology and fuel combination. This will be tested using simple test water boiling tests of stoves in a representative sample of project cook stoves at the same frequency as biomass usage is monitored. The efficiency is recorded as a percentage of the amount of useful energy divided by the delivered energy.
Effb,y	Efficiency of the baseline technology and fuel combination. This will be either tested using a simple test water boiling tests in a representative sample of baseline cook stoves at the same frequency as biomass usage is monitored. Alternatively a 10% default can be used as per the GS methodology. The efficiency is recorded as a percentage of the amount of useful energy divided by the delivered energy.
Bpj,y	Biomass utilised by project cook stoves on an annual basis in tonnes bone dry biomass per year. The average usage in the sample is multiplied by the total number of stoves in the project taking account the amount of time the stove has been in use. The units are in tonnes dry biomass/year.

10 Sampling Plan

10.1 Objective:

To meet requirements and follow guidelines from Gold Standard methodology *"Technologies and Practices to Displace Decentralised Thermal Energy Consumption (11/04/2011)"* so that (a) unbiased and (b) reliable estimates of mean (i) wood savings ($P_{p,b,y}$) , (ii) cumulative usage rates ($U_{p,y}$) , and (iii) stove performance over time are used in the calculations of greenhouse gas emission reductions ($ER_{b,p,y,CO2}$).

It is assumed that the total number of devices disseminated is documented in the total sales record and hence sampling is not required for $N_{p,y}$ (cumulative number of technology days / years).

10.2 Field measurement objectives and data to be collected:

Usage surveys are conducted at least annually for each technology / device to find out if the device (e.g. stove) is still in use at the time of the survey or not. Manipulation of findings can estimate life-span of device.

A complementary monitoring survey, also conducted at least annually, explores behaviour trends of the end-user in relation to technology use, fuel use and their socio-economic implications and can be used to corroborate fuel savings estimations.

FTs are conducted at least every 2 years to see how the devices perform over time. For ICS and RBs KPTs (or BPTs) are conducted to assess device performance. With the inclusion of suppressed demand for domestic stove users, KPTs estimate the project consumption of wood, while water boiling tests, that follow PCIA guidelines, assess evolution of device performance.

ERs from ICS are based on number of adult adjusted meals. Infant, children and light meals are adjusted to normalise meals into "adult adjusted meals" and remain unchanged for the crediting period.

UCS users made some use of charcoal in the baseline. A default wood equivalent of 6:1 for charcoal is applied and remains unchanged for the crediting period as detailed in the section x *data and parameters not monitored over the crediting period*

10.3 **Target population and sampling frame:**

This target population or potential end-users in Malawi is largely homogeneous (e.g. only 2% of Malawians cook with electricity and the rest, with few exceptions, cook with biomass). Rural households tend to cook with firewood on open fires (9 out of 10 rural households cook with open fires)[58] that they collect themselves while urban households tend to use wood and charcoal that they normally purchase. It is necessary to compare fuel savings and usage among rural and urban using the same device to assess if there are notable behavioural differences that should be reflected in ER estimations.

10.4 **Sample Method:**

Wherever possible simple random sampling is used to obtain a representative estimate.

As GS613 reaches more people and the project population expands and becomes more geographically dispersed simple random sampling becomes prohibitively expensive. Being a landlocked country with limited transport infrastructure, transport and logistics are a major cost of information gathering in Malawi.

Area sampling or geographic cluster sampling presents greater economy by treating several respondents with a local area as a cluster. For example, instead of simply randomly sampling the entire population only geographic representative clusters are sampled. The geographic areas to be sampled should vary over time to minimise potential bias.

If the project uses another method than Simple Random Sampling for Field Performance Tests, the statistical analysis will be carried out by a statistician whose curriculum vitae and contact details will be provided as part of the project documentation submitted for review. For monitoring / usage survey other sampling method as provided in *"General Guidelines for Sampling and Surveys for Small-Scale CDM Project Activities"* may be applied.

10.5 **Desired precision / expected variance and sample size:**

For statistical analysis of emission or fuel saving the 90/30 rule is used and in cases where it is not satisfied the lower bound of the one-sided 90% confidence interval is applied.

The guidelines set out by the methodology for minimum sample size are as follows:

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58 National Energy Policy, 2003.

Group size 300: Minimum sample size 30 or population size, whichever is smaller
Group size 300 to 1,000: Minimum sample size 10% of group size,
Group size >1,000 Minimum size 100

GS613 employs oversampling by approximately 20% more than the minimum sample sizes above (e.g. at least 120 samples for group size of >1,000 end-users are randomly selected for annual usage and monitoring surveys). This is done not only to compensate for attrition, outliers or non response associated with the sample but also for the reason that in the event the required reliability is not achieved additional sampling efforts would be required to determine parameter value.

10.6 **Procedures for administering data collection and minimizing non-sampling errors:**
Data collection is conducted by project field staff under the supervision of the appropriate project manager. Figure 1 below is used to illustrate the hierarchy of information for the portable ceramic stoves (PCS), for example. The Project Coordinator plans the monitoring activities, which are periodically communicated to the appropriate project manager, who in turn delegates to sub-manager who supervises data collection by field facilitators who, collect the data themselves or get assistance from trained data collectors who also act as stove promoters.

GS 613 Organigarm (example of PCS hierarchy)

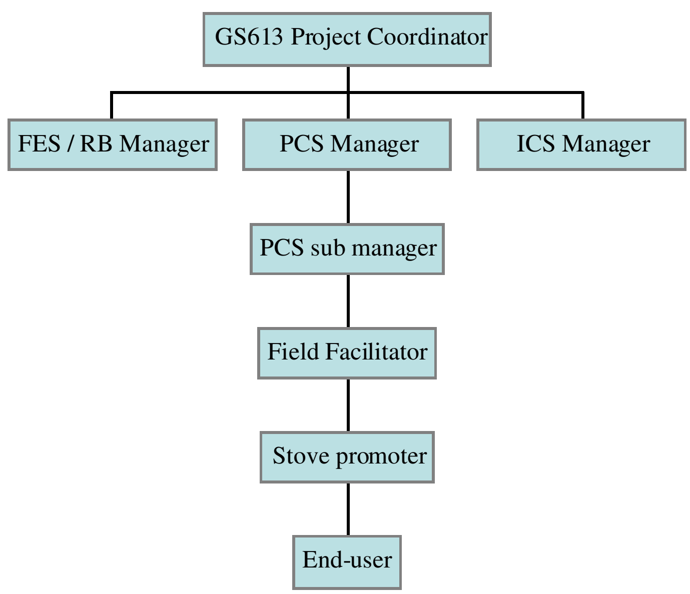

Figure 1 Organisational chart for PCS element of GS613

Questionnaires and data collection formats evolve based on feedback to improve understanding of end-user behaviour, and are updated prior to data collection. Questions are designed to effectively generate desired information and are tested by data collectors. Data collection is performed in local vernacular language (e.g. Chichewa) so care is taken to frame the questions in English in such a way as it is easy to translate and the meaning is not lost. Most of the field personnel have now much experience in data collection and any new personnel are trained and supervised. Data collectors are trained on calibration in cases where of monitoring equipment is used (e.g. digital weighing scales for

FTs or thermometers for WBTs). Once data is collected on paper it is analysed by the project manager and data collectors are asked to explain discrepancies and / or missing data. The data in hard copies is then sent to central location where it is input and digitally analysed and a draft report is produced. Should assistance be required on statistical analysis qualified statisticians or researchers, normally from University of Malawi, are consulted and asked for advice. Reports are finalised and filed for presentation to DoE for verification.

10.7 **Implementation:**

Implementation schedule is outlined in Annex 6 and illustrates how this monitoring plan conforms with *"Technologies and Practices to Displace Decentralised Thermal Energy Consumption (11/04/2011)."*

Data collection procedure and responsibility as described in 10.6 above. CVs of third part analysts or statisticians, who do not have any conflict of interest with the project, are filed for presentation to DoEs on request.

Annex 4
STOVES, CURING BARNS AND FUELS RELEVANT TO MALAWI

Types of Stoves in Malawi

Mud-stoves are improved stoves made of a mix of local materials such as anthill clay and *dambo* or river sand. They can reduce woodfuel consumption, improve safety and stability of pots and can reduce the negative effects of strong winds. Whether they work efficiently in rural situations is uncertain, as the stove may not be made to design unless a lot of resources are dedicated to training stove builders and monitoring quality. Due to the threat of design drift where the stove is not standardised and the limited durability of the stove, this design is unlikely to be suitable for a large up-scale. As householders often build the mud-stoves themselves the monetary cost for materials is low unless a metal chimney is used.

Details of the **Portable Ceramic Stove** *(Chitetezo Mbaula)* are provided in A.2. The stove retails at MK250 to MK700 (US$1.80 to US5).

The **Kenyan Jico** Improved Charcoal Stove was developed in Kenya and has been adapted in Malawi. The stove has a metal cladding with a ceramic thermal liner that helps increase efficiency compared to the traditional all metal charcoal stove. This stove uses charcoal as a source of fuel that is lit with ignited wood in a 5-10 minute starting process. The stove tends to last for one year, due to the metal used being recycled and low grade, while the ceramic liners lasted for six months although this varied depending on quality and usage.[59] The stove price depends on size but retails at MK270 to MK1,000 (US$2 to US7).

The **Bluewave (SuperBlu)** Stove is an ethanol-burning stove developed by Bluewave Ltd in Malawi. It is specially developed to burn in an economic and safe way whereby once the ethanol reaches boiling point, the fuel vaporizes and passes over a copper catalyst at 400° C. Hydrogenation takes place as the ethanol reacts to form acetaldehyde and hydrogen gas. The starting process takes under 5 minutes depending on the fuel levels in the tank. The stove is at a prototype stage and it is difficult to assess the final unit cost. Bluewave has aimed to price the stove at approximately US$10 or MK 1,4000.

The **Gel Fuel** Stove sits in a basic metal frame with a simple 'can' structure and regulator. Gel fuel, the source of fuel for the stove, is poured into the can through the middle of the regulator and lit with matches. The gel fuel burns with a blue flame that is turned off by placing a lid over the regulator. Modern gel fuel stoves have dial regulators like normal stoves that can regulate temperatures and put out the fire. The Gel-fuel stove was originally marketed in Lilongwe as a package including a stove and two litre bottles of gel-fuel for MK1,000 (US$7).

Plant oil stoves, such as the Bosch-Siemens PROTOS plant oil stove that is being tested by ProBEC in Tanzania, can use straight plant oils as a fuel are reported to have produced good results but purity of oil seems to play a crucial role. In Malawi there is currently limited production of oils, such as Jatropha, and their access is limited particularly in rural areas. The cost and availability of the stove is also likely to be a challenge.
A wide range of **electric stoves** is available in trading centres and towns retailing from MK3,500 (US$25). **Paraffin stoves** retail at approximately MK2,000 to MK3,000 (US$14 – 21) . **LPG** two-plate stove retails at MK12,000 to MK27,000 (US$86 – 193) and the cylinder costs MK19,321 (US$138) before tax.

Types of Curing Barns in Malawi

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[59] "Bio-Ethanol as a Household Cooking Fuel: A Mini Pilot Study of the SuperBlu Stove in Peri-Urban Malawi", J. Robinson, October 2006.

Although improved barn technologies are available, their use is mainly restricted to large-scale estates. Smallholders do not normally have the necessary capital to invest in other new technologies.

The **conventional barn** is the oldest curing technology in Malawi that is the standard barn for smallholders. Its furnace has a horizontal feed chamber: Because tending a barn is time consuming, users often prefer to over feed the furnace with wood to 'save' labour. The barn is normally built by the farmer with burnt bricks, mud, thatch and metal materials for flues. It is popular amongst smallholder farmers as it is the barn they have used and known. The barn is normally maintained every year. Curing times is approximately 7 days. The barn can cost the farmer an estimated MK85,000 (US$600).

Details of the **Rocket Barn** are provided in A.2. of the PDD. Curing times can be as low as 4 days. The market price is currently at MK140,000 (US$1,000), which includes a one-year warranty on the barn structure and subsidised maintenance and repairs.

Venturi Solar Barn has a fan-assisted furnace to improve combustion. The barn is not currently commercially disseminated and expertise on design is not widely available. The barn including solar powered fans costs approximately MK350,000 (US$2,500).

Chongololo Barn is designed for large-scale estates. A duct from one fire source, normally fuelled with coal, connects seven barns. Since the duct is long, the Chongololo uses fans, which are placed along the duct to evenly distribute the heat to the entire barn. The fans require a constant electricity supply that is often provided by diesel generators. For the Chongololo, it is difficult to monitor the heat and as such it is equipped with thermometers and thermostats. The Chongololo barn has about 7 days turn around period and has the start up capital can be in the excess of MK 5,000,000 (US$35,000).

Types of Fuel in Malawi

According to the 2005 Malawi Integrated Household Survey, the overwhelming majority of Malawians (98.1%) use biomass fuels for cooking. Fuelwood is the most important cooking fuel in Malawi (89%) followed by charcoal (6.8%). Only 1.7% and 0.3% of the population uses electricity and paraffin respectively.

In rural areas the dependence on **biomass fuels** is almost universal (99.6%). Biomass fuels are also dominant in urban areas although to a slightly lesser degree (87.3%). Almost 70% of the woody biomass is used in the household sector (58% rural and 12% urban) while the remaining 30% is absorbed by services and industries such as tobacco processing, tea estates, brick making, fish smoking, etc. In rural Malawi, almost all households collect firewood and cook on three-stone fires. In urban areas, wood is scarcer and many households buy wood and charcoal to fuel stoves. It is estimated that approximately 7 kgs of firewood is used to fire 1kg of charcoal.[60] In urban areas where firewood and charcoal are for sale, firewood is less expensive per kg (Price kg of wood = MK 9.11 (US$0.07) Vrs. Price of kg of charcoal MK16.40 (bulk) or MK21.40 (small quantities)), although charcoal is has a higher energy content, is easier to transport and is viewed as more convenient by urban consumers. Over the years prices of cooking fuels have increased significantly at much higher rate than increases in income.[61]

Malawi is the second country in Africa after Zimbabwe to start blending **ethanol** with gasoline. Since the establishment of ETHCO in 1982, Malawi has been producing an annual production of ethanol of between 10-20

60 Ibid

61 Feasibility study for the use of ethanol as a household cooking fuel in Malawi, UNDP Malawi, November 2007.

million litres depending on availability of sugar molasses and requirement of ethanol for petrol blending. Gasoline blending is not compulsory in Malawi although 95% of gasoline consumed in Malawi is blended with ethanol. Initial blending ratio was 20% but has since reduced to 10% with unleaded gasoline. The surplus is used in the local industries or exported. Ethanol can also be made from various biomass feed stocks including cassava and sweet sorghum. Ethanol has been used as a fuel for domestic heating and cooking in Malawi but the fuel is relatively more expensive and is difficult to procure. Ethanol can be converted into Gel-fuel, which has a higher viscosity, making it easier to handle and a safer alternative. In Malawi, a gel fuel factory was set up near Lilongwe with the capacity to produce 1,000 ltr / day. Unfortunately production was halted in 2005 due to increase in the price of ethanol and changes to tax and duty exemption that made the fuel unaffordable to most, costing in excess of MK200 including VAT (US$1.42).

Electricity is a clean and efficient source of energy supply. Malawi generates the vast majority of is electricity from hydropower stations on the Shire River (94%)[62] and the remaining (6%) is generated from diesel-powered thermal plants. Electricity is highly subsidized such that it is the cheapest cooking fuel in the country for those who are connected. However, only 2% of households currently cook with electricity as access to the grid is limited. Another barrier to access electricity is the relatively high cost to install electricity properly so that it is safe to use.

Malawi imports all its petroleum requirements, which constitute 8.8% of Malawi total imports. **Paraffin** or kerosene is a petroleum based fuel and is the main source for lighting for 81% of households. Use of paraffin for cooking is not very common with only 1.2% of urban household's customer base. Initially, paraffin was subsidized so as to encourage use of paraffin over wood fuel but this has since ceased following abuse in the form of smuggling of paraffin to neighbouring countries. Although cleaner than biomass fuels, there are numerous hazards associated with kerosene because of its toxicity and flammability.

Jatropha oil is extracted from the seeds of the jatropha plant. It is currently being produced in Malawi and is used in some rural areas as a fuel for lighting. Current technologies for plant-oil stoves do not limit emissions enough to make jatropha an attractive alternative as a cooking fuel.[63]

Biogas is a clean cooking fuel that is produced through the anaerobic digestion of various organic wastes. Modern biogas digesters designed to produce energy for a household can function on the waste of four humans, or one to two cows. In Tanzania, which had an ambitious programme to disseminate biogas technology in the 1980s , only 200 digesters were operating as of 1991.[64] In Malawi there is potential to use biogas as a clean cooking fuel but currently there are only a small number of biogas users.

Liquefied Petroleum Gas (LPG) is a mixture of propane ad butane. It has a high energy density and can be burned very efficiently and emits few pollutants but releases GHGs into the atmosphere. Its use as a cooking fuel in Africa varies significantly across national borders and is highly dependent on government policy. In Senegal, for example LPG is the principal fuel for 37% of its population, including 71% of urban households.[65] In Malawi, the cost of

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62 Malawi's hydropower has a potential of powering about 1670 MW.

63 Market Barriers to Clean Cooking Fuels in Sub-Saharan Africa: A Review of Literature; *An SEI Working Paper of* Nicolai Schlag and Fiona Zuzarte Working Paper, Stockholm Environment Institute, April 2008; A Review of the Household Energy Programme for Cooking – GHA/UNDP/00051634

64 Low-cost bio-digesters for zero grazing smallholder dairy farmers in Tanzania. Livestock research for rural development, 11(2). Rutamu, I (1999).

65 ANSD (Agence Nationale de la Statistique et de la démographie) , 2006. Résultants du troisième recensement général de la population et de l'habitat (2002) Rapport National de présentation.

cooking with LPG is higher than all existing fuels in the market and also higher than liquid ethanol. The gap will further widen with the expected price rise for LPG.

Category	Type of Fuel	Type of Stove	Cost of Stove (MK)	Cost (MK) per MJ of energy
Traditional	Firewood	Portable ceramic stove	250 - 700 MK	3.0 MK
		Fixed esperanza stove	2,800 – 3,500 MK	
Intermediate	Charcoal	Kenyan Jico	250-1,000 MK	3.6 MK
	Paraffin	Paraffin Stove	2,000 + MK	9.0 MK
Modern	Ethanol / Gel-fuel	Ethanol Stove / Gel-fuel stove	600 + MK	12.6 MK
	LPG	LPG Stove	12,000 +	13.6 MK
	Electricity	Electric Stove	3,500 + MK	1.6 MK

Table: Comparison of fuels, stoves and their respective prices in fuel categories as grouped by the World Energy Council.[66]

66 Cost per MJ is taken from *Feasibility study for the use of ethanol as a household cooking fuel in Malawi*, UNDP Malawi, November 2007.

Annex 5
SUPPRESSED DEMAND

Approach to the inclusion of Suppressed Demand (SD) in the calculation of emissions reductions attributable to efficient biomass cook stoves in Malawi (as approved by GS TAC)

For Hestian Innovation for the evaluation and selection of an appropriate approach to dealing with SD in their project (GS613).

The consultancy was for the inclusion of the SD in the verification of emissions reductions for cook stoves and other efficient thermal energy services between October 2010 and October 2011. The inclusion is being considered exclusively for the cook stove interventions in this verification. The introduction of CDM Suppressed Demand Standard (July 2011) and exploration of the treatment of approaches to SD by the Gold Standard Foundation (GS) allows for proposals that may interpret how to include SD in carbon accounting.

The following is a proposal on how the GS613 Malawi project can be verified using a deviation from the original PDD which was developed using the first version of the GS methodology which later included an annex on how to account for SD. This annex is included as an annex to this document and its interpretation is the substance of this document.

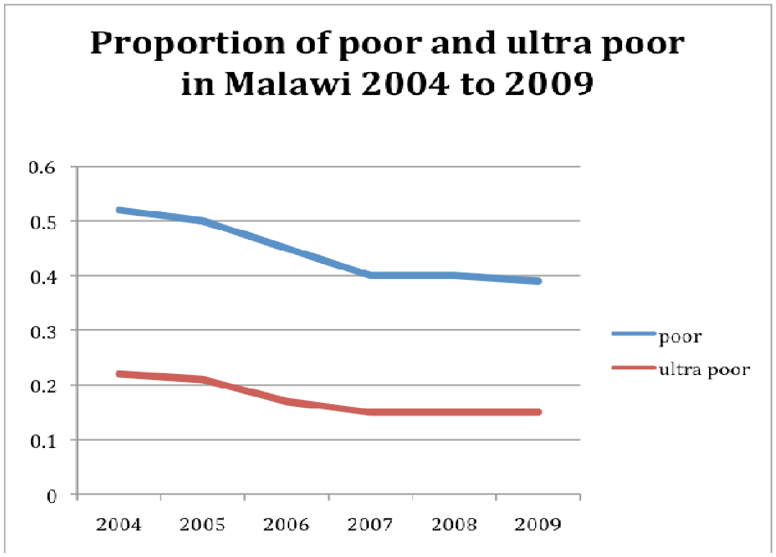
The first draft of the verification report follows the PDD and does not include SD. Two approaches to the inclusion of SD are considered, these include:

b. The interpretation of SD by using a Minimum (MSL) or Sufficient Service Level (SSL); or
c. The inclusion of SD using an ex-post approach based on the useful service level reached by the project.

The monitored annual tonnages of wood per household per year are as follows:

1. Pre project consumption (April 2009) 2.561 tonnes
2. Initial post project follow-up (April 2009) 1.566 tonnes
3. 2-year post project follow-up (April 2011) 1.813 tonnes

Approach 1: MSL or SSL
The MSL is included in the CDM SD Standard and is not controversial in its application to the indigent whose livelihoods are not improving. However, statistics show that in Malawi (the 8th poorest country in the world) livelihoods are improving albeit from a low base. Statistics (ref. Welfare Monitoring Report 2009, National Statistics Office) show decreases in the “poor” and “very poor”. See figure below.



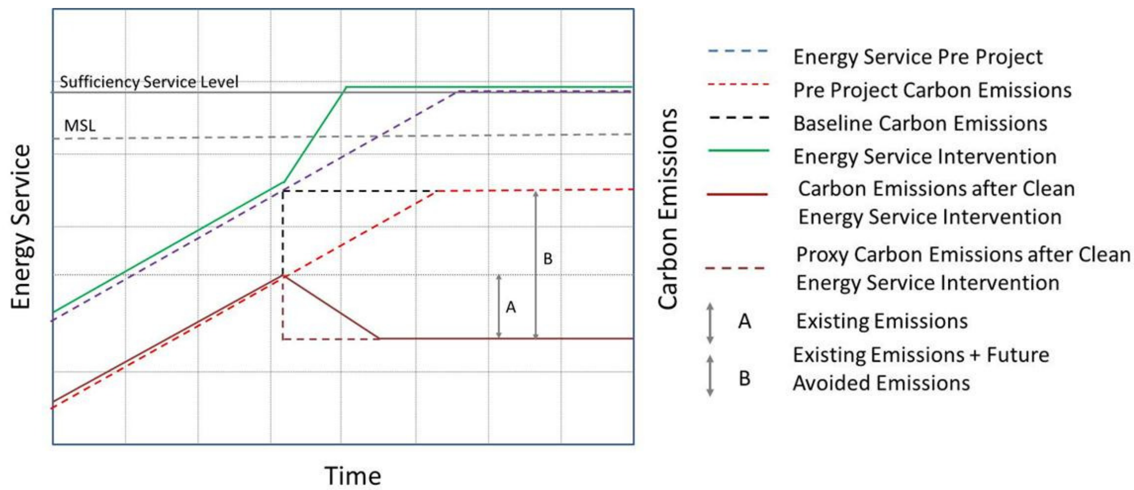
With poverty decreasing or conversely livelihoods increasing, the use of sufficiency level may be applied, but the question would be how to locate this level in the absence of an international or national set level for sufficiency? Proxies could include a basket of commodities describing the minimum quantities of goods and services required for life in urban areas of the country.

If the SSL approach were to be used the level of service could be applied from the commencement of the project to each efficient cook stove. Application of this approach would dramatically reduce monitoring from estimation of the consumption of fuels in a statistically relevant sample to monitoring whether the cook stoves are being used or not within a statistically relevant sample.

The calculation of emissions reductions (ER) would be the emissions from the baseline (BL) less those from the project (P) calculated using the efficiencies of the technologies and fuels utilized in the baseline and project multiplied by the emissions factors of the fuels at the SSL less any leakage (L). SSL in this case would be "useful" Megajoules of energy. Emissions factors (EF) of the baseline and project fuel are required in the calculations.

ER = SSL/efficiency of BL tech*EF BL fuels – SSL/efficiency of P* EF P fuels - L

The figure below describes the approach.



A Malawi institution called the Centre for Social Concern publishes a monthly "Basic Needs Basket" of various household requirements[67]. The basket applies to four urban areas and the most recent figures were for July 2011. As yet there is not a rural basic needs basket. But if the urban quantity of charcoal is utilized as a MSL proxy for rural areas, the monthly 100kgs of charcoal[68] could be equated to a quantity of biomass. The calculation would be as follows:

= 1200kgs charcoal/year * 29.5MJ/kg charcoal/15.6MJ/kg wood = 2269kgs bone dry wood/year
or, at 12% average moisture content[69]
= 2269kgs/0.88 = 2579kgs wood/year

The approach while simple (once MSLs or SSLs) are determined it is yet to be fully agreed to by the GS, and as such constitutes some risk, and may be appropriate to subsequent verifications once the GS has agreed.

Approach 2: Ex-post evaluation of emissions reductions
Very simply the approach would be to calculate the amount of fuel required to provide the project level of service (PLS) using the baseline technologies, fuels and behavioural measures less emissions from the project and any identified leakage. The GS allows for this approach in version 3 of the methodology where it is stated that:

> *In many developing countries the level of energy service is not sufficient to meet human development needs due to lack of financial means and/or access to modern energy infrastructure or resources. This concept is known as suppressed demand and is described in Annex 2. The methodology allows for a baseline scenario to be assessed in terms of suppressed demand, if evidence is provided that the project technology users, or a "cluster" of such users within the project population, are otherwise deprived of a*

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67 The Centre for Social Concern (CfSC) carries out research into the cost of living for people in Malawi. This is done every month through gathering information for the "Basic Needs Basket" (BNB) in Blantyre, Lilongwe, Mzuzu and Zomba. (ref: http://www.cfscmalawi.org/bnb_pub.html)

68 While most Malawians use wood for cooking, Charcoal is used extensively in urban areas. Electricity, which is included in the BNB, is used in some urban homes for cooking, but electricity has been excluded for this calculation on the basis of conservatism.

69 Moisture content reference to monitoring and protocol, Shell Foundation Household Energy and Health Programme protocols (Bailis & Smith, 2004).

> *reasonable level of human development (or humanely acceptable benchmark) in comparison to their peers and provided that there is likelihood of avoided future emissions as for example if the standard of living is increasing for some of the project population or their peers outside of the project boundary.* ***In such case, the level of thermal energy consumption in the baseline scenario will not correspond to the pre-project situation but to a satisfied demand level, which will be equal to or lower than the project level of satisfied demand****. (ref: GS Methodology "technologies and practices to displace decentralised thermal energy consumption", page 8.)*

The PLS is calculated for the least efficient of the three domestic stoves in the project, the portable ceramic stoves (PCS) others include the fixed esperanza stoves and urban cook stoves. The application of the approach to all stoves in the project using figures from the PCS is therefore conservative.

The PLS per cook stove is the amount of useful energy service calculated from the monitored consumption of fuels (PF) multiplied by the efficiency of the project stoves.

The emissions reduction calculation is as follows:

ER = (PF * (efficiency of P technology/efficiency of BL technology) * EF BL fuels) – (PF * EF P fuels) – leakage

Based on monitored data this calculation could be as follows (assuming BL of P fuels have the same EF). Note NRB = 0.81. Efficiency of 3 stone fires default 10%. Efficiency of efficient cook stoves is 31 using water boiling tests as performed in 2012 by the regional testing centre, Centre for Research in Energy and Energy Conservation, Makerere University, Uganda is used. EF biomass for GS613 is 1.871 tonnes CO2/tonne biomass, as in validated PDD[70] with more actual and credible NRB factor of 81%.

ER = (((1.566 + 1.813 tonnes biomass)/2)* (0.31 /0.1) * 1.871 tonnes CO2/ton biomass) – (1.566 +1.813 tonnes biomass)/2 * 1.871 tonnes CO2/ton biomass – leakage

ER = 6.637 tonnes CO2/annum (using 31% efficiency for the project technology)

This ex-post approach is currently a more comfortable interpretation of the SD approach in the GS methodology than the MSL or SSL approach, which still has to be endorsed implicitly by the GS. The major issue here is to verify the efficiencies of the technologies and to ensure that there is no wastage/take-back/rebound under the project. The IPCC values also apply to dry biomass.

The baseline level of biomass calculated using an ex-post approach is as follows:

BL wood use[71] = (1.566 + 1.813 tonnes biomass)/2 * 0.31 /0.1
= 5.237 tonnes wood per stove per year

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70 EF of biomass for both the project and baseline is equal to the EF of CO2 emissions by the non renewable biomass (NRB) factor plus the EF of non-CO2 emission; = (1.747*0.81)+(0.455) = 1.871.

71 Biomass usage comes from direct monitoring of a statistically relevant sample of stoves using the Kitchen Performance Test described in the methodology.

Annex 6
SAMPLING AND MONITORING SCHEDULE FOR GS 613 (TO BE UPDATED ANNUALLY)

Parameters	**PDD V.3 / passport V.4**	**Meth V1**	**Meth V3**	**Rev'd Mon Plan**	**Last done**
NRB	Fixed	Every 2 years	Fixed; updated if necessary (no update period specified) – GS accepts using CDM meth; gives option to switch to CDM	Meth V3	Proposed CDM SSC WG February 2012
Fuel consumption in baseline (P_{BY}) or $B_{BL,Y}$** to verify; baseline FT update	Fixed baseline	Every 2 years,	Updated every 2 years, except in cases where a fixed baseline is adopted	To change to meth 3	fixed baseline is adopted accepted
$B_{P,Y}$ or $P_{PY,}$ project FT update	Every 2 years	Every 2 years	Every 2 years	Meth 3	2011 (RB, PCS, UCS, IC 2012 (FES)
Usage (drop off rate) U_{PY} (project scenario)	Annual	Every 2 years	Annual or more frequently	Meth 3	2011 (PCS, RB), 2012 (F
Performance test/project fuel test	Every 2 years	Every 2 years	Every 2 years	Meth 3	2011 (PCS, RB) 2012
New stove performance	Every 2 years	Every 2 years	N/A		Only if new stove is introduced.
Stove sales	Continuous	Continuous	Continuous – put into database	Meth 3	
Kitchen survey / monitoring surveys	Every 6 months		Every year	Meth 3	2011 (RB, PCS, UCS, IC FES)
Gold Standard required monitoring of sustainable development indicators					
Air Quality	Yearly			Yearly	In time for verification of monitoring report 2
Water qual & quan	Yearly			Yearly	
Soil condition	Yearly			Yearly	
Biodiversity	Yearly			Yearly	
Quality of employment	Every 2 years			Every 2 years	
Livelihood of the poor	Yearly			Yearly	
Access to clean energy	Yearly			Yearly	
Human & instit. Cap	Every 2 years			Every 2 years	
Quantitative employm't & IGAs	Every 2 years			Every 2 years	
BoP & investments	Every 2 years			Every 2 years	
Tech transfer	Every 2 years			Every 2 years	
Leakage assessment					
Update parametres			Every 2 years	Every 2 years	MR 1