MONITORING REPORT

Integrated Biomass Energy Conservation Project, Malawi

Monitoring Period: 24th November, 2008 – 1st October, 2010

CONTENTS

ANNEX

1. General project activity information

1.1. Title of the project activity:

Integrated Biomass Energy Conservation Project Malawi.

1.2. Gold Standard registration number:

GS 613

1.3. Short description of the project activity:

The project reduces greenhouse gas emissions from non-renewable biomass fuel by dissemination of improved cook-stoves and fuel-efficient rocket barns to replace existing inefficient stoves and curing barns.

This Monitoring Report applies only to three of the five afore-mentioned technologies, namely: (1) Portable Ceramic Stoves; (2) Fixed Esperanza Stoves; and (3) Rocket Barns.

				
(1) Portable ceramic stove	(2) Fixed *esperanza* stove	(3) Rocket Barn	(4) Institutional Cook Stove	(5) Urban Cook Stove

The project activity involves progressive installation of four types of improved cook stoves and improved tobacco curing 'rocket barns' in all the three regions of Malawi i.e. Northern, Southern and Central regions. Kitchen Tests and Kitchen Surveys have been conducted for fuel-efficient Portable Ceramic Stoves, Fixed Esperanza Stoves and Rocket Barns.

Urban Cook Stoves (UCS) and Institutional Cook Stoves (ICS) have been included in the project activity based on feedback received during local stakeholder consultation. Kitchen Surveys and Kitchen Tests have not been completed yet for UCS and ICS clusters but will completed in the future.

This Monitoring Report covers only:

(1) Portable Ceramic Stoves;
(2) Fixed Esperanza Stoves; and
(3) Rocket Barns

Benefits of this projects include reduced exposure to indoor air pollution as well as 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.

1.4. Monitoring period:

This report includes VERs generated during the period from 24 November, 2008 – 1 October, 2010.

1.5. Methodology applied to the project activity (incl. version number):

a. Baseline methodology:

Gold Standard Methodology for Improved Cook-Stoves and Kitchen Regimes

b. Monitoring Methodology:

Gold Standard Methodology for Improved Cook-Stoves and Kitchen Regimes

1.6. Status of implementation including time table for major project parts:

The project activity has disseminated 7,429 Portable Ceramic Stoves (PCS), 1,524 Fixed Esperanza Stoves (FES), and 845 Rocket Barns (RB) during the monitoring period with a calculated GHG offset of 22,625 tons generated during the monitoring period.

In parallel with sales of stoves and barns, a rigorous monitoring of the project activity has been ongoing per schedule below:

Date	Activity	Purpose
24th of November, 2008 – 1st of October 2010	Sales recording	Establish sales database to track number of devices sold and determine clusters for kitchen / barn surveys
January – April 2008 January – April 2009	Baseline Barn Performance Tests	Determine baseline firewood savings
August – September 2009	Baseline Barn Survey	Determine baseline clusters
August 2009	Non-Renewable Biomass Baseline Study	Determine percentage of non- renewable biomass
(see box below)	Baseline Kitchen Performance Tests Baseline Kitchen Surveys	Determine baseline firewood savings and clusters
8-19 March 2010 (PCS) 15-16 September 2010 (PCS)	Kitchen Surveys (PCS)	Determine if clusters are still representative
29-30 July 2010	Kitchen Surveys (FES)	Determine if clusters are

		still representative
3 August – 28 September 2009	Barn Surveys (RB)	Determine if clusters are still representative

Baseline Kitchen Performance Tests Baseline Kitchen Surveys		
Monitoring activity:	**Baseline:**	**Follow-up:**
PCS Survey	11th to 14th March 2009	27th April to 1st May 2009
PCS Test	11th to 14th March 2009	27th April to 1st May 2009
FES Survey	2nd to 5th September 2009	7th and 10th October 2009
FES Test	2nd to 5th September 2009	7th and 10th October 2009
RB Survey	January to April 2008	2nd to 17th September 2009
RB Test	3rd February to 12th April 2008	2nd February to 4th April 2009

1.7. Intended deviations or revisions to the registered PDD:

None

1.8. Intended deviations or revisions to the registered monitoring plan:

None.

1.9. Changes since last verification:

NA. This is first verification.

1.10. Person(s) responsible for the preparation and submission of the monitoring report:

Conor Fox,
C/o Hestian Rural Innovation Development,
Area 9 Plot Number 428
P.O. Box 1306, Lilongwe
Tel: +265 995 469 484
Email: hestianrural@gmail.com

2. Key monitoring activities

(according to the monitoring plan for the monitoring period stated in A.4.).

2.1. Monitoring equipment:

2.1.1. Table providing information on the equipment used

The following instrument is used to weigh the amount of wood used by households / farms before and after acquiring an improved device promoted by the project:

Equipment	Manufacturer	Type	Uncertainty
Weighing scales (spring dial hoist	Generic - Globe Universal	100 kg capacity	Precision of 0.5 kg

scale)	(available in many hardware stores in Malawi)		
Moisture meter	Voltcraft FM-100	Capacity to measure moisture content up to 44%	Accuracy of 1%.

2.1.2. **Involvement of Third Parties:**

Monitoring is being performed Hestian Rural Innovation Development.

2.2. Data collection (accumulated data for the whole monitoring period):

2.2.1. **List of fixed default values:**

Data	Description	Value	Source
$EF_{bl.bio,co2}$	CO2 emission factor arising from use of wood- fuel in baseline scenario	1.747 tCO2/t_biomass	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Tables 1.2/1.4
$EF_{pj.bio,co2}$	CO2 emission factor arising from use of wood-fuel in project scenario	1.747 tCO2/t_biomass	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Tables 1.2/1.4
$EF_{bl.bio,non-co2}$	Non-CO2 emission factor arising from use of wood- fuel in baseline scenario	0.455 tCO2/t_biomass	CH4 and N2O: IPCC 2006 GL for emission factors and NCVs, IPCC SAR 1996 for GWPs.
$EF_{pj.bio,non-co2}$	Non-CO2 emission factor arising from use of wood- fuel in baseline scenario	0.455 tCO2/t_biomass	CH4 and N2O: IPCC 2006 GL for emission factors and NCVs, IPCC SAR 1996 for GWPs.

2.2.2. **List of variables:**

Data	Description	Source of data	Conducted	Value	Monitoring Frequency
Xnrb,bl,y Xnrb,pj,y	Non-renewability status of woody biomass fuel in year y in baseline and project scenario	2009 Baseline Study (section B.2.2 in PDD)	August 2009	73%	Conditions are unchanging during the project period, the project proponent established a single baseline fixed in time (the pre-project situation) of the type *"fixed baseline"*. As soon as a more actual official credible value is publicly available for the Republic of Malawi, this factor will be adopted by the project.
Leakage	Potential GHG emissions outside project boundary caused by project activity	Baseline and Project Scenario Study (section B.2.3 in PDD)	2008-2010 (i.e. during Project and PDD establishment and development		Every two years
Bbl,y	Mass of woody biomass combusted in the baseline in year y	Measurements of sample or whole of cluster population in baseline studies	11-14 March 2009 (PCS) 2-5 September 2009 (FES) 3 February – 12 April 2008 (RB)	2.26 tonnes / HH-year (PCS) 2.68 tonnes / HH-year (FES) 13.74 tonnes / Barn - year (RB)	Conditions are unchanging during the project period, the project proponent established a single baseline fixed in time (the pre-project situation) of the type *"fixed baseline"*.
Bpj,,y	Mass of woody biomass combusted	Baseline and Project Scenario Study (B.3	27 April – 1 May 2009 (PCS)	1.38 tonnes / HH-year (PCS)	Every two years

	in the project in year y	in PDD)	7-10 October 2009 (FES) 2 February – 4 April 2009 (RB)	1.39 tonnes / HH-year (FES) 4.90 tonnes / Barn - year (RB)	
Usage in year y	Percentage of stoves of age x remaining in use in year y	Survey			Every two years
Age	Adjustment to values of Bpj,,y and AFpj,i,y for stoves of age x	Survey			Every two years
New Stove	Adjustment to values of Bpj,,y and AFpj,i,y for new stove models	Measurements of sample or whole of cluster population			Every two years
Stove Sales	Number of stoves / barns sold by project activity	Sales Record by Hestian Rural Innovation Development	From 24/11/2008 to 01/10/2010	7,075 PCS 1,524 FES 845 RB	Quarterly
Eligibility of Project database for KPT / BPT sampling (KS / BS)	analysis of kitchen surveys results to determine whether new clusters (and therefore new KPTs / BPTs) are required	Kitchen and Barn Surveys	Dates as indicated above. In section 1.6.	Clusters are still representative	Six monthly

Sustainable Development Variables (Gold Standard Requirement)

Sustainable Development Indicator	**Data type**	**Data variable**	**Data unit**	**Value**
Air quality	Survey and/or PM concentrations	Air pollutants (CO, particulates)	Survey observations and /or indoor air pollution	See 2.27
Livelihood of the poor	Survey	Financial impact	MK (Malawi Kwacha) saved per year	See 2.27

Employment	Survey	Numbers – job creation	Jobs / year	See 2.27
Human and Institutional capacity	Survey	Numbers	Trainees, employees with new skills	See 2.27

2.2.3. **Data concerning GHG emissions by sources of the project activity:**

Data	**Value**	**Source**	**Frequency of collection**
Stove sales	PCS – 7,429 FES – 1,524 RB – 845 Total	Sales Records (from November 24 2008 to October 1 2010)	Monthly
Average yearly household / barn consumption of wood	1.566 tonnes/HH-year (PCS cluster) 1.748 tonnes/HH-year (FES cluster) 5.60 tonnes / barn-year (4.2608 x 1,315 kgs) (RB cluster)	2009 Baseline KPT Study	Every 2 years

2.2.4. **Data concerning GHG emissions by sources of the baseline:**

Data	**Value**	**Source**	**Frequency of Collection**
Non-Renewable Biomass Baseline (wood)	73%	2008 Baseline Study	Constant for baseline and project conditions.

Data	**Value**	**Source**	**Frequency of Collection**
Average yearly household / barn consumption of wood	2.561 tonnes/HH-year (PCS cluster) 3.362 tonnes/HH-year (FES cluster) 15.72 tonnes / barn-year (11.9554 x 1,315 kgs) (RB cluster)	2009 Baseline KPT Study	Conditions are unchanging during the project period, the project proponent established a single baseline fixed in time (the pre-project situation) of the type *"fixed baseline"*.

2.2.5. **Data concerning leakage:**

No significant sources of leakage were identified at this point in the project, but future offset calculations will be adjusted accordingly if possible sources of leakage are later identified. The following possible sources of leakage will continue to be monitored in future Kitchen Surveys (KS), Barn Surveys (BS), Kitchen Performance Tests (KPT) and Barn Performance Tests (BPT):

- Increased use of non-renewing biomass as a result of savings in woodfuel use. Evidence from the baseline kitchen surveys and tests dmonstrates increased scarcity of wood, increases in woodfuel prices; so that savings in wood results in a favourable cost and

labour saving.

- Users of efficient stoves or barns replace lower emissions technology than the improved stove. For example, switching from inefficient fuelwood to efficient charcoal can yield an increase in overall emissions in some cases. There is evidence from the baseline Kitchen Surveys and Tests for the portable ceramic stove in Balaka that some of the few rural households that were using charcoal during the baseline shifted to use of wood fuel with lower net GHG emissions.

- Improved stove users compensate for loss of the space heating effect of inefficient cook-stoves by adopting some other form of heating, such as open fires, or by retaining some use of inefficient stoves.

- The traditional or conventional stoves and barns replaced by the improved stoves and barns are re-used by the same families or other families in a manner suggesting increased consumption of woodfuel beyond the baseline demand level.

- Manufacture, distribution, or use of the improved stoves gives rise to new emissions associated with transport or manufacturing. An analysis presented in the baseline Barn Survey demonstrates that this effect for rocket barns is more than compensated for by reduction in transport emissions due to decreases in woodfuel use.

2.2.6. **Data concerning environmental impacts:**

- Air quality
Indoor air pollution is assessed qualitatively in the Kitchen Survey (KS) and the Barn Survey (BS)

2.2.7. **Monitoring Results for Gold Standard Sustainability Indicators (Gold Standard Requirement)**

Indicator	Data type	Data variable	Data unit	Value	Source
Air quality	Survey and/or PM concentrations	Air pollutants (CO, particulates)	Survey observations and /or indoor air pollution	Qualitative: Vast majority of survey respondents stated that there is less smoke from devices promoted by the project In the Kitchen Survey for PCS conducted in September 2010, 100% of respondents claim that the PCS produces less smoke. Quantitative: Air quality tests carried out in 2009 reveal a average reduction of 41% in PM concentrations for PCS users and 55% in PM concentrations for FES users.	Air Quality Excel, FES KS results excel, PCS KS results excel, RB BS results excel.
Livelihood of the poor	Survey	Financial impact	MK (Malawi Kwacha) saved per year	From the devices disseminated by the project to date: Savings of wood is valued at MK83.1 million p.a. Savings of labour in terms of both cooking / curing time savings and fuel collection savings is valued at MK40.8 million p.a. Improved income from RB is valued at MK56.7 million p.a. which is likely to have a multiplier effect in rural areas where RBs are located.	Livelihood of poor excel, FES KS results excel, PCS KS results excel, RB BS results excel.

Employment	Survey	Numbers – job creation	Jobs / year	The project is generating employment for 808 people (99% in rural areas, 69% women).	Employment and skills development excel.
Human and Institutional capacity	Survey	Numbers	Trainees, employees with new skills	384 (87% female) trained on ceramic stove production; 352 (61% female) trained on marketing, awareness raising and stove promotion; 33 tradespeople trained on RB, ICS and UCS construction techniques; 17 trained on FES construction, awareness raising and stove promotion; and 22 people work at a coordination level trained on various skills such as business, database management, geographic information systems, surveys and Kitchen / Barn performance tests.	Employment and skills development excel.

2.2.8. **Data concerning double counting**

The project continues to monitor any risks of double counting in this project, specifically determining whether any of the stoves sold as part of this project are counted in any other emission reduction projects. At this time, to the best of our knowledge there are no other greenhouse gas emission reduction projects in Malawi involving stoves or barns, and thus today no risk of double counting exists. However, the project developers continue to monitor whether any other projects exist. In such cases, the project developer will cross reference our total sales database and end user database with any other projects to ensure that there is no overlap. In addition, the project continues to use all legal documentation outlined in the PDD to ensure legal ownership over offsets, a step that further avoids double counting.

2.3. Data processing and archiving (incl. software used):

Sales records and results of kitchen surveys are first captured in paper form then compiled in a Microsoft Excel spreadsheet. Records will be kept for two years after the project activity is completed. Monitoring data is analyzed using Microsoft Excel and SPSS (Software Package for Social Sciences).

2.4. Special event log:

- Any special events which occurred should be listed here with date and details.

None since Validation Report issuance.

3. Quality assurance and quality control measures

3.1. Documented procedures and management plan:

3.1.1. **Roles and responsibilities:**

The Project Coordinator assists the project implementing body HRID and the specific project managers to maintain and make available accurate records. The Project Coordinator collates a composite electronic Total Sales record and HRID keeps back-up paper records. HRID's existing accounting and records system accurately tracks sales, inventories and supply and purchases. HRID maintains a full sales database in Excel of all sales that take place, listed according to the sales mechanism, date, device, type etc. Sales databases are cross-checked with production records and other data to ensure consistency and accuracy.

HRID have implemented a limited warranty system for the rocket barn and the esperanza stoves.

For the portable ceramic stoves, social marketing exercises are used to promote stove adoption, such as complementary seeds for drought resistant legumes that can also be used as a fuel.

End user information is collected through direct sales to end-users by retailers of agents of the project and is contained in warranty and / or emission reduction contract. This information is collated into an electronic database from which project monitoring can be conducted. The database and excel records are backed up and sent to the project coordinator for checking prior to using them as the basis for quarterly monitoring activities. Hard copies of ER contracts and warranty are filed as additional backup and for verification purposes.

Direct sales to end-users information is collected by HRID's agents, who are issued with contract forms in advance and submit the forms to the relevant project manager. The customers in the sales record for which phone numbers or addresses are available are used for survey sampling to support the periodic monitoring activities.

Monitoring tasks, such as six-monthly Kitchen Surveys, assessment of leakage and other such tasks are managed by the project managers in collaboration with the project coordinator, who are best capable of collecting this data because they know the technology and the en-users best.

It is important to note that six-monthly kitchen surveys are not used directly in ER calculations, but instead serve to inform whether new clusters are required (which could in turn effect ER calculations) and monitor certain Gold Standard sustainability indicators. Surveys are organised by external 3rd party consultant(s) and HRID staff, and new enumerators are trained prior to conducting surveys and tests. Survey and test results are filed in paper at HRID office and are analysed using excel to compile reports. Biannual monitoring tasks according to the methodology are also organised by HRID and the project coordinator. The integrity of data is constantly cross-checked with other variables to ensure consistency and avoid mistakes.

3.1.2. **Trainings:**

HRID and external consultants recruited local enumerators during the baseline study and trained them to conduct Kitchen Surveys (KS), Barn Surveys (BS), Kitchen Performance Tests (KPTs) and Barn Performance Tests (BPTs). These enumerators perform the quarterly KS and report directly to the respective project manager. The Project Coordinator collates the information provided by the respective project managers.

HRID and it agents actively train new supervisors, ceramic artisans, specialised builders, metal workers and technicians to be employed by the project. To date, they have trained 786 new artisans in the skills needed to manufacture efficient stoves and barns. Training new workers takes 1-3 months, depending on the individual and the skills they are aiming to achieve.

HRID prefers to use local enumerators and artisans in different parts of the country because it decreases transport costs and employs local people, which is a benefit to the community and helps strengthen the project's local presence.

HRID and its agents also train end-users on proper use of the stove, as outlined in section 3.4. below on troubleshooting.

3.2. Involvement of Third Parties:

KFM consultants – External Auditor – Audited Project Database (as per attached Report)

Clioma Ltd. - sub-contracted to conduct KTs, KSs, BTs and BSs.

3.3. Internal audits and control measures:

The volume of devices sold is the basis to determining the emissions reductions. Respective project managers manage their sales records, project database and information on sustainable development indicators, and forward them to the project coordinator.

Specialized external auditors, KFM consultants have conducted an internal systems review on the project's Database (please see attached report). HRID and its agents are subjected to financial audits under Malawi law.

3.4. Troubleshooting procedures:

Troubleshooting procedures (as commonly understood) do not apply to this project.

The following measures improve the lifetimes of the technologies and help to maintain efficiency:

(1) HRID and its agents provide user-training to each and every end-user how (i) to operate the devices (i.e. user quality control) (ii) to improve kitchen / barn management and (iii) to improve firewood management. Producers and builders are trained on production techniques and design specifications.

(2) Stove users are encouraged to avoid leaving portable stoves out in the rain and protect fixed stoves from the elements. By protecting stoves, their life-span can be extended.

(3) End-users are trained on how to improve firewood management by drying and splitting, firewood before use, by not overloading the furnace or fire chamber with too much fuel and by extinguishing un-used firewood in sand that can be used for later.

(4) Kitchen and barn management is promoted to reduce exposure to smoke by encouraging improved kitchen ventilation and to improve cooking practices by using a lid while cooking, by soaking beans overnight, by using the hot stove after cooking to heat water for bathing etc.

(5) As part of Surveys, home visits are made as required by the methodology. During these visits, proper use of the stove and firewood and kitchen management is discussed. HRID and its agents also follow up with users through its extensive sales network. These visits serve to reinforce proper use principles outlined above.

(6) The project's decentralized production of stoves and barns facilitates after-sales services from producer / contractor to end-user. Some of the troubleshooting and quality assurance measures that are in place include:

- For the PCS, Quality controllers trained by field facilitators certify the quality of each ceramic stove produced and ascertain the validity of records of the producer groups. The production batch is recorded in the ceramic stove's serial number so that the performance of each batch is monitored.
- For the FES and RB, the end-user certifies by signature that the device has been built to specification to authorise payment. The RB includes a one year warranty and health check and the FES includes a 2 month waranty on the ceramic pot-rest.

4. Calculation of GHG emission reductions

4.1. The formulae used for ER calculations of stoves are:

$ERq = \sum BE_{i,q} - \sum PE_{i,q} - \sum LE_{i,q}$

Where:
ERq = Emission reduction in total project population in quarter q (tCO2e/qr)
BEi,q = Baseline emissions of cluster i in quarter q (tCO2e/qr) taking NRB fraction into account
PEi,q = Project emissions of cluster i in quarter q (tCO2e/qr) taking NRB fraction into account
LEi,q = Net Leakage of cluster i in quarter q (tCO2e/qr)

Within each cluster the emissions are calculated thus:

$BEi,q = \sum (Fbio,fuel,yr * (\%NRbio,fuel,yr * EFbio,fuel,CO2 + EFbio,fuel,non\text{-}CO2) * Dbio,fuel,yr)$
$+ \sum (Ffuel,yr * \%NRfuel,yr * (EFfuel,CO2 + EFfuel,non\text{-}CO2) * Dfuel,yr)$

$PEi,q = \sum(Fbio,fuel,yr * (\%NRbio,fuel,yr * EFbio,fuel,CO2 + EFbio,fuel,non\text{-}CO2) * Dbio,fuel,yr * (1 - Ubio,fuel,yr))$

$+ \sum(Ffuel,yr * \%NRfuel,yr * (EFfuel,CO2 + EFfuel,non\text{-}CO2) * Dfuel,yr * (1 - Ubio,fuel,yr))$

Biomass Fuels

Fbio,fuel,yr : Daily fuel savings (tonnes/day) for a given biomass fuel in a given year of usage (baseline, year 1, year 2, etc.) of the project cluster's improved cooking device or regime.

%NRbio,fuel,yr : Fractional non-renewability of biomass baseline for a given biomass fuel in a given year.

EFbio,fuel,CO2 : CO2 Emissions Factor (tCO2/t_fuel) for a given biomass fuel.

EFbio,fuel,non-CO2 : Non-CO2 Emissions Factor (tCO2e/t_fuel) for a given biomass fuel; includes all non-CO2 gases accounted.

Dbio,fuel,yr : Days (days) of fuel savings accounted for a given biomass fuel in a given year of usage (baseline, year 1, year 2, etc.) of the project cluster's improved cooking device or regime.

Ubio,fuel,yr : Annual fractional *drop-off* in the usage of the project cluster's improved cooking device or regime in a given year of usage (year 1, year 2, etc.). (Labeled 'CUM U1, 2, etc' in the excel carbon calculator).

Non-Biomass Fuels

Ffuel,yr : Daily fuel savings (tonnes/day) for a given non-biomass fuel in a given year of usage (baseline, year 1, year 2, etc.) of the project cluster's improved cooking device or regime.

%NRfuel,yr : Fractional non-renewability for a given non-biomass fuel in a given year. For fossil fuels the value will be 1, for renewables, 0.

EFfuel,CO2 : CO2 Emissions Factor (tCO2/t_fuel) for a given non-biomass fuel. This can include production and consumption.

EFfuel,non-CO2 : Non-CO2 Emissions Factor (tCO2e/t_fuel) for a given non-biomass fuel; includes all non-CO2 gases accounted. This can include production and

consumption.

A full list of monitored parameters, as outlined in the PDD, annex 2, is included below:

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.

4.2. Emission Reductions Calculations

The Emission Reduction (ER) Calculator calculates total emission reductions on a daily basis for each stove and on an (annual) seasonal basis for each rocket barn in the project database. The ER calculator is run separately for each device cluster defined for the project. A different file for each device accompanies this report:

- ER Calculation_PCS 241108 01102010.xls
- ER Calculation_FES 241108 011010.xls
- ER Calculation_RB.xls
- Summary ER Calculations

Stoves that are sold as replacement or additional (i.e. complementary stoves) are omitted from ER calculations to maintain conservativeness. The calculator for stoves accounts for the day that each stove is put into use and then calculates the usage of each stove for each day. It factors in the monitored annual drop-off in usage as stoves age, and other monitored parameters.[1] Stove usage is calculated in stove-years, the number of stove days the stove was used divided by 365 (days).

Barn usage is calculated in operational barn-years for barns built for the curing season, which runs from late January to April each year. Seasonal usage per barn is multiplied by the number of emission reductions per barn-year (tCO2eq/stove-year) calculated in the PDD to quantify total ERs per project year.

Barns built by the project prior to Novemebr 24 2008 but used for the first time in the 2009 curing season have not been included in the ER calculations.

The 'Assumptions' worksheet of each ER Calculation workbook states the 'Usage Rates', 'Fuel saving' and and 'emission reductions' (tCO2eq/device-year). Sales are listed in the 'Project Database' worksheet, which links as an input to each carbon calculator on the "ER Calculator" worksheet.

Stove quantities and the 'usage start dates' are linked from the 'usage record' worksheet to the 'Age 0-1' and 'Age 1-2' worksheets. These two 'Use' worksheets calculate usage on a daily basis for each day of the project period (x-axis) and for each usage start date and the corresponding stove quantity (y-axis). The 'Use' worksheets are separate to account for stove usage at different ages. Usage for all stoves aged 0-1 year, which are in the 1st year of use, is accounted in the 'Age 0-1' worksheet and usage for all stoves aged 1-2 years, which are in the their 2nd year of use, is accounted in the 'Age 1-2' worksheet.

Similarly, Rocket Barn quantities, that have been reported to office by the supervisor / manager as having been completed to specifications and ready in time for the curing season, and are linked with the sales and sales resume worksheets. These sales resume worksheet calculates usage on

[1] The full set of parameters is given in the monitoring tables below. Currently the only parameter value which has changed from values given in the PDD, is the utilisation factor; thus the calculator in its current form is limited to this single parameter.

a seasonal basis for each season of the project period (2009 and 2010 curing season) which is linked to the usage rates on the assumption worksheet.

Daily stove use (stove days) is calculated using Annual Usage Rates for stoves of different ages (Upj,yri)). The Annual Usage Rates are calculated to reflect annual usage drop-off from the Cumulaitve Usage Rates (CumUi) determined in the monitoring studies below. The Annual Usage rate (Upj,yri) is the average annual drop-off in usage. That rate is applied to all stoves equally over the full year they re of given age (Age 0-1, Age 1-2, etc.).

Calculating Annual Usage Rates (Upj,yri) from Cumulative Usage Rates (CumUi) is straightforward: If 100 of the 100 monitored stoves are still in use after one year, the Cumulative Usage Rate (CumU1) after one year is 100%. If 60 of the original 100 stoves are still in use after two years, the Cumulative Usage Rate (CumU2) after two years is 60%. The Annual Usage Rate (Upj,yr2) in year 2 is 80% ((100%+60%)/2).

Once daily stove usage (stove–days) is accounted in the 'Use' worksheets for stoves from each 'Uage Start Date', it is converted to stove years by dividing stove-days by 365. Stove-years of usage are aggregated on a quarterly basis in the 'ER Calculations' worksheet.

Finally, on the 'ER Calculations' worksheet, aggregate quarterly stove use (stove-years) is multiplied by the ERs per stove-year (tCO2eq/stove-year) to calculate total ERs on a quarterly basis. These values from the 'ER Calculations' workbook of each cluster are linked to the 'Summary ER Calculations' workbook where ERs from all clusters are combined and the verificaiton period is specified for crediting.

4.3. **Description and consideration of measurement uncertainties and error propagation:**

Due to the use of multiple conservative approaches, such as use of the lower 90% confidence interval for fuel savings, etc, the ERs calculated according to the above formulas significantly underestimate total greenhouse gas savings. Nonetheless, there is a large quantity of data in the form of sales records on which the project developer performs spot checks. The project developer periodically checks excel records against paper records to confirm consistency.

Specialized external auditors, KFM consultants, have conducted an internal systems review on the project's Database (please see attached).

Moreover, financial accounts, production records, retailers' records, retailer activity and observations made during monitoring surveys and tests are also checked to confirm consistency. If any deviation is identified, the sales records are changed accordingly. Any erroneous records that look not to be consistent with actual sales are eliminated from the database. QA/QC procedures are outlined in more detail in section D.3. of the registered PDD.

4.4. **GHG emission reductions (referring to B.2. of this document):**

4.4.1. Leakage:

As outlined in the PDD, there is no evidence that additional leakage is present beyond that which is already incorporated in the paired KPT approach to measuring fuels savings.

4.4.2. **Summary of the emissions reductions during the monitoring period:**

IBECP Malawi Offset Summary - 24 November, 2008 - 1 October 2010						
	Yr	Date	PCS	FES	RB	Vintage Totals
Offset generation (tonnes CO2e)	2008	24 Nov - 31 Dec	0	0	0	0
	2009	Quarter 1	734	0	2,361	8,451
		Quarter 2	244	0		
		Quarter 3	2,262	0	0	
		Quarter 4	1,801	1,049	0	
	2010	Quarter 1	374	1,416	11,434	14,174
		Quarter 2	574	0		
		Quarter 3	376	0	0	
		1 Oct - 23 Nov	0	0	0	
Total			**6,366**	**2,465**	**13,794**	**22,625**