Monitoring report form
(Version 05.1)

Complete this form in accordance with the Attachment "Instructions for filling out the monitoring report form" at the end of this form.

MONITORING REPORT		
Title of the project activity	Aberdares Improved Cook Stoves	
UNFCCC reference number of the project activity	GS883	
Version number of the monitoring report	Version 8.4	
Completion date of the monitoring report	04/10/2017	
Monitoring period number and duration of this monitoring period	Monitoring Period 4: 01/04/2014–31/03/2016 [24 months]	
Project participant(s)	CO2balance UK	
Host Party	Kenya	
Sectoral scope(s)	Sectoral Scope: 1, 3 Domestic Energy Demand	
Selected methodology(ies)	Domestic Energy Efficiency – Methodology for improved cook-stoves and kitchen regimes V.02	
Selected standardized baseline(s)	n/a	
Estimated amount of GHG emission reductions or net GHG removals by sinks for this monitoring period in the registered PDD	147,666 tCO_2e	
Total amount of GHG emission reductions or net GHG removals by sinks achieved in this monitoring period	GHG emission reductions or net GHG removals by sinks reported up to 31 December 2012	GHG emission reductions or net GHG removals by sinks reported from 1 January 2013 onwards
	0	27,679

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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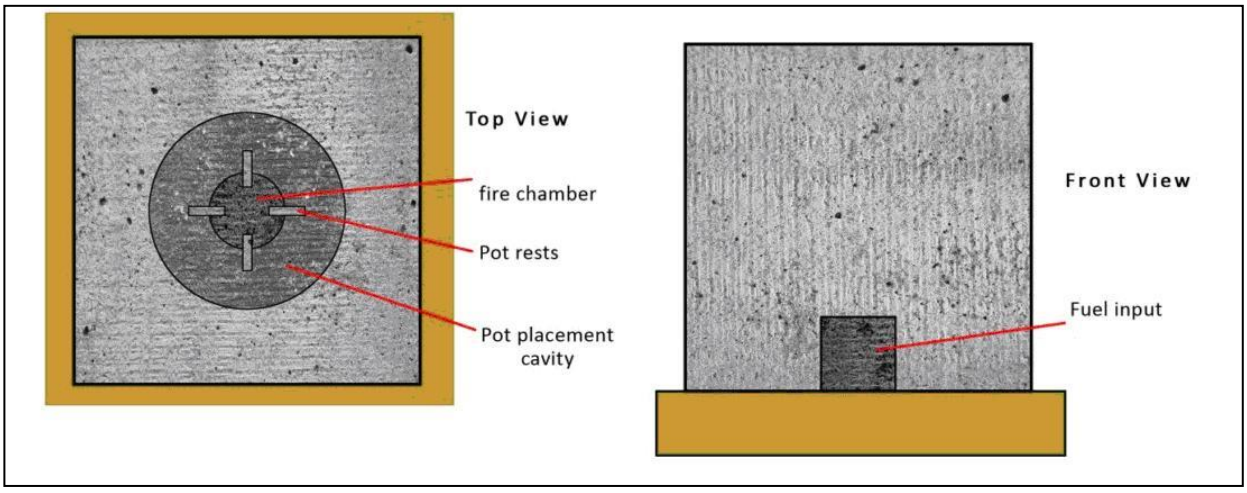
The 'Aberdares Improved Cook Stove project' will address issues of deforestation, greenhouse gas (GHG) emissions and indoor air pollution by the distribution of domestic wood-burning improved cook stoves in households within the project area. Pilot studies indicated that our stove reduces fuel consumption by at least 50%. This will result in an improved living environment for recipients and reduced pressure on local forests, with a reduction of wood being burnt annually as a result of the project. By reducing fuel consumption, carbon dioxide emissions from the combustion of non-renewable biomass will be correspondingly reduced.

The improved stoves (known as the Carbon Zero Kenya or CZK stove) are a fixed construction of an inner ceramic liner surrounded by clay bricks and mortar, using a 'rocket' style design. This consists of a horizontal (combined) fuel and air intake, terminating in a firebox with a vertical outlet on which the cooking pot rests. Relative to the three stone fire, this type of stove allows higher combustion temperatures to be reached and improved fuel/air mixing, hence higher levels of combustion are achieved. This reduces the amount of smoke produced. There is no chimney, however, a draft is created by the temperature difference between the low inlet and the outlet, and the hot combustion gasses pass out of the top directly onto the cooking pot in order to achieve high levels of thermal transfer



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In total 10,000 stoves have been installed since the beginning of the project, all of which were installed during the first monitoring period. Beneficiaries received stoves free of charge and were directed in correct use of the stove by local community groups engaging with the project developers. The improved cook stoves significantly reduce fuel consumption, by approximately 50%, resulting in an improved living environment for recipients and reduced pressure on local forests, with approximately tonnes of wood fuel saved in this monitoring period. By reducing fuel consumption, CO_2 emissions from combustion of non-renewable biomass have correspondingly been reduced by tCO_2/y.

A.2. Location of project activity

>>

[a] Host Party: Republic of Kenya

[b] Region/State/Province: Central Province

[c] City/Town/Community: District: Lari District

Divisions: Lari and Gatamaiyu

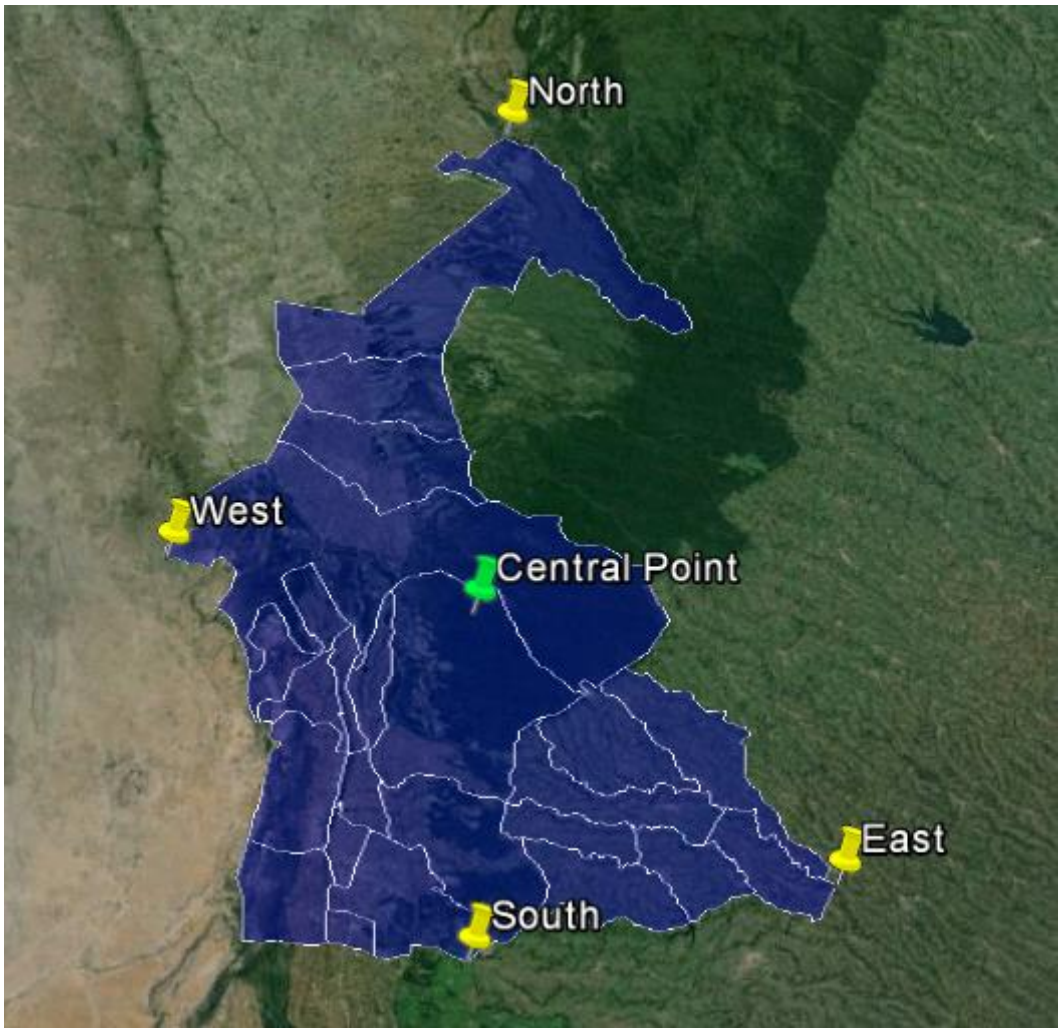
Lari Division	
Location	**Kamae**
Sub location	Kamae Kamukombini
Location	**Kinale**
Sub location	Kinale Mukeu
Location	**Kijabe**
Sub location	Bathi Magina Mbauini Kijabe
Location	**Gitithia**
Sub location	Gitithia Nyambari
Location	**Lari**
Sub location	Lari Scheme Githirioni
Location	**Kirenga**
Sub location	Kirenga Gituamba Kambaa Escarpment

Gatamaiyu Division	
Location	**Gatamaiyu**
Sub location	Kagwe Kamuchege
Location	**Nyanduma**
Sub location	Nyanduma Gachoire
Location	**Kamburu**
Sub location	Kamburu Kagaa Matimbei

[d] Physical/Geographic location:

The Aberdares Range, in the central province of Kenya forms part of the Great Rift Valley and reaches a maximum altitude of 4,000m above sea level. The area is characterized by a diverse range of ecosystems including montane humid forest, sub montane forest, bamboo forests and moorland. Most households in the area are dependent on wood fuel to meet their household energy needs and most frequently use 3-stone fires for cooking.

For the purposes of this project the boundaries have been defined as the political boundary to include all sub-locations as illustrated below. The central point (shown with a pin on the map is at 0°21'42.42"S
37°44'31.26"E.



GPS coordinates:		
	Lat	**Long**
E	1° 1'46.04"S	36°48'24.74"E
S	1° 3'53.08"S	36°40'24.25"E
W	0°55'22.99"S	36°33'19.72"E
N	0°45'21.81"S	36°40'20.31"E

The stoves have been individually tracked using GPS co-ordinates to ensure they fall within the project boundary. In some instances, Carbon Transfer Forms (CTFs) have been collected but GPS coordinates are missing. Work is still ongoing to update the Distribution Record with these details but based on guidance from the Gold Standard credits can be claimed for these stoves. Furthermore, each stove is marked with a unique identification number that will be uploaded and kept on the electronic database; this includes household occupants and GPS co-ordinates. That will allow the individual tracking of each stove to avoid double counting and boundary issues.

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate whether the Party involved wishes to be considered as project participant (yes/no)
Party A (host) Kenya	N/A	No
Party B United Kingdom	CO2balance UK	No
…	…	

A.4. Reference of applied methodology and standardized baseline

>>

The small-scale project activity falls within the Energy Efficiency – Domestic category and utilises the Gold Standard 'Methodology for improved cook-stoves and kitchen regimes V.02' It also applies the guidance of the UNFCC CDM 'Tool for demonstration and assessment of additionality (version 05.2.1)' as required by the above methodology.

A.5. Crediting period of project activity

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The type and length of crediting period applied to this project is 7 years, twice renewable, which started at 01/12/2010. This Monitoring Report covers the period 01/04/2014 to 31/03/2016 (24 Months).

A.6. Contact information of responsible persons/entities

>> See Appendix 1

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

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

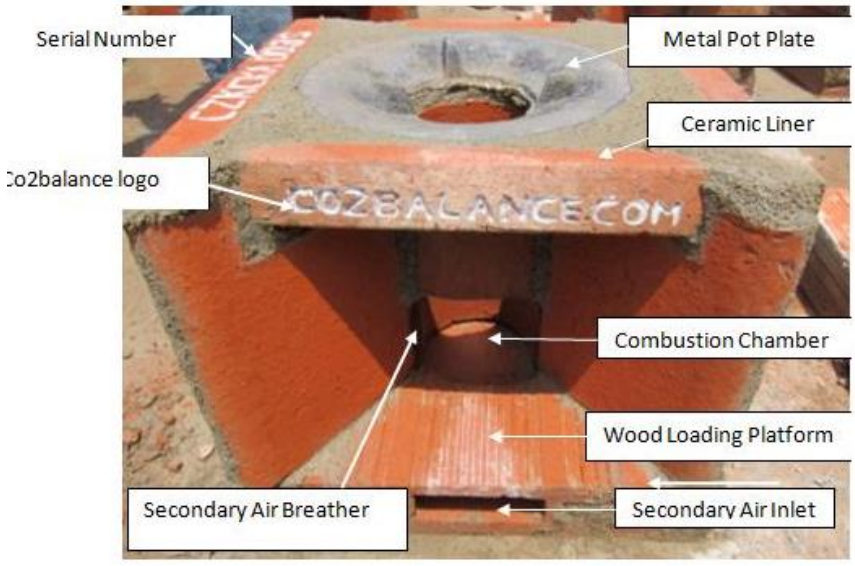
Added to environmental pressures is the poor quality of life experienced by the rural poor, using traditional wood stoves which generate a large amount of smoke within the home due to poor combustion efficiencies. A WHO report concluded 'Indoor air pollution is a major environmental and public health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

The 'Aberdares Improved Cook Stove project' has started to address these issues by the construction of the first 9,311 of approximately 23,033 domestic wood-burning 'improved cook stoves' in households within the project area. However, data collection and uploading is still occurring for some of these stoves and only 6,620 stoves will be credited in this monitoring period. To date no further CTFs have been located since the last monitoring period and therefore the number of crediting stoves has remained the same. Furthermore, no additional stoves have been distributed in the project area since the end of the last monitoring period, as resources have had to be relocated to a different project area, however, it is hoped that construction will restart in the next monitoring period.

Pilot studies and subsequent monitoring have shown the large majority of households within the project area to be cooking for domestic purposes only, on three-stone fires using wood fuel. This has resulted in one main representative household cluster. For these reasons the project employed a single model of wood-burning stove, which was distributed for domestic use only.

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

The stove consists of an inner firebox being a standardised fired-ceramic liner, made locally where possible; a grey cast iron plate that is specifically shaped for optimum efficiency; an open front ease of viewing whilst operating the fire; a secondary air intake to assist with the fire starting, maximising air flow during combustion and keeping the wood on a brick loading platform; and the outer skin of fired bricks. It is a high performance, ergonomically designed cook stove that was designed with both the builder and the user in mind.



co2balance UK Ltd have constructed 10,000 improved stoves in the project area to date (between 2010 and 2011). Of these we currently have records for 9,311 stoves in the Distribution Record, meaning that the location of 689 stoves is currently unknown. As all stoves are serialised and uniquely identifiable co2balance UK Ltd staffs have been instructed to attempt to locate them while conducting surveys in the project area as part of their daily activities. As these stoves are found the

household details are collected and a CTF completed allowing them to be credited as part of the project. This therefore means the number of recorded and crediting stoves between monitoring periods may increase without additional stoves being constructed in the project area (up to a maximum of 10,000). In addition to this there has been a lag in data collection and upload which means that not every stove in the Distribution Record has a CTF. As per GS guidance the project proponent is not allowed to claim credits for these stoves. In total 1,365 stoves do not currently have CTFs and have been removed from emission reduction calculations resulting in 7924 crediting stoves. A further 1,328 were conservatively removed during this monitoring period where the GPS coordinates showed the stove locations to be in close proximity, to avoid the possibility of two stoves crediting for one household. This left 6,620 crediting stoves for Monitoring Period 4.

	Monitoring Period 1 (01/12/2010 – 31/03/2012)	**Monitoring Period 2 (01/04/2012 – 31/03/2013)**	**Monitoring Period 3 (01/04/2013 – 31/03/2014)**	**Monitoring Period 4 (01/04/2014 – 31/03/2016)**
Total Stoves Recorded	9245	9311	9311	9311
Total Stoves Crediting	7773	6,620	6,620	6,620

Since installation it has been found that a number of stove beneficiaries have 'modified' their stoves. This modification usually involves altering the vent or liner with the presumed aim of increasing the opening allowing more varied sizes of wood to be used in the stove. Prior to the last verification, a survey of households in the project area was undertaken to determine the proportion of modified to unmodified stoves during which 2801 households were visited. It was found that 446 (16%) were modified and the remaining 2355 (84%) had not been. As the modified stoves showed slightly reduced emissions reductions through the KPT result, the wood savings has been weighted according to the proportion of modified or damaged stoves.

B.2. Post-registration changes

B.2.1. Temporary deviations from registered monitoring plan, applied methodology or applied standardized baseline

The PDD mentions that age tests would be performed in 3rd party direction and assessment. The monitoring studies for this monitoring period were not assessed by a third party. This is not a requirement of the methodology, but at the time of validation, the understanding was that the project as a whole and its survey results will go through a DOE assessment. Hence, PP included this point in the parameter, but did not intend to conduct annual monitoring under 3rd party assessment, except the DOE assessment. In this the fourth periodic verification PP followed the same approach as in the three previous monitoring periods.

B.2.2. Corrections

>> There have been no corrections to project information or parameters fixed at Validation in this monitoring period.

B.2.3. Changes to start date of crediting period

>> There has been no change to the start date of the crediting period during this monitoring period.

B.2.4. Inclusion of a monitoring plan to the registered PDD that was not included at registration

>> N/A

B.2.5. Permanent changes from registered monitoring plan, applied methodology or applied standardized baseline

>> There have been no permanent changes from the registered monitoring plan or applied methodologies during this monitoring period.

B.2.6. Changes to project design of registered project activity

>> There have been no changes to the project design of the project activity during this monitoring period.

B.2.7. Types of changes specific to afforestation or reforestation project activity

>> This section is not applicable to this project type.

SECTION C. Description of monitoring system

>> The survey process is summarised by the flow diagram below, which shows the origin and transfer of data and the employee responsible for each phase. Items that are highlighted in red indicate a quality control point, which may be an actual process itself – or indicated by the manager or coordinator responsible for internal quality control. To aid in the comprehension of the flow diagram, the roles and responsibilities of each employee involved in the process are summarised below:

- **UK Projects Manager** - Programme management, UK Staff Training, Internal Quality Control, Defining Job Descriptions
- **UK Carbon Projects Developer** - Defining Parameters, Completion of Monitoring Plan, Coordinating Project Monitoring, Data quality check, Monitoring Analysis and Calculation, Training Host Country Staff, Producing Training Literature
- **Monitoring Coordinator** - Coordinating Monitoring Programme, Data quality check, Reporting Data to UK, Employee Training, Scanning Originals, Archiving Originals
- **Head Community Project Officer** - Leading Monitoring Operations, Training Data Collection Team, Operational Quality Control, Transferring Data to Soft Copy
- **Data Collection Team** - Gathering Field data (hard copy)

Co2balance Monitoring Procedure

1. Maintenance of pilot & Total Distribution Record (TDR)

Accurate distribution records have been kept and stored both electronically and in paper format Stove builders created paper records for each stove built (of the type shown below); these were then transferred to a computer system belonging to the project proponents and the original documentation stored in the local office (Kenya).

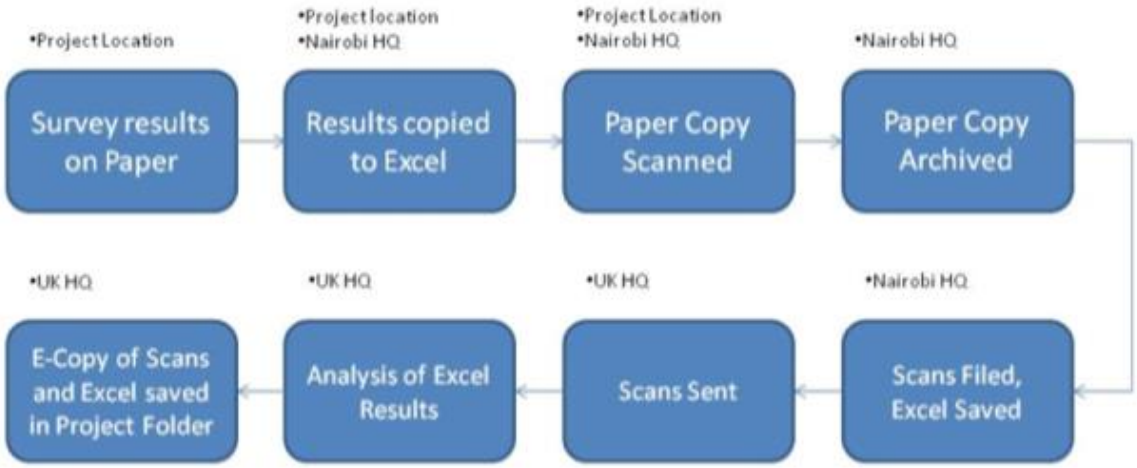
Distribution Record Information	Source Document	Hard/Soft Copy	Entity Responsible For Collection
Stove serial number	Builders Form	Hard Copy	Contractor
Project region	Builders Form	Hard Copy	Contractor
Stove Construction Company Name	Builders Form	Hard Copy	Contractor
Name of builder's trainer (Training entity is co2balance)	Builders Form	Hard Copy	Contractor
Stove building date	Builders Form	Hard Copy	Contractor
Resident's name	Builders Form	Hard Copy	Contractor
Resident address (where possible)	Builders Form	Hard Copy	Contractor
Resident phone number (where possible)	Builders Form	Hard Copy	Contractor
Stove Model	Photo	Soft Copy	co2balance
Mode of use (domestic in all cases)	Data collectors form	Hard Copy	co2balance
Type of fuel used	Data collectors form	Hard Copy	co2balance
Pilot stove (Y/N)	Data collectors form	Hard Copy	co2balance
GPS Coordinates	Photo	Soft Copy	co2balance

1. Data Management and Storage

The results of all Kitchen Surveys (KS's), Monitoring Kitchen Surveys (MKS), Usage Surveys, Project Technology Days, and Kitchen Performance Tests (KPT's) are collated in excel spreadsheets and stored on a central server in an electronic format.

The documentation procedure that co2balance UK has devised ensures a minimum chance of original data being lost – all original copies of our project documentation are retained in our Nairobi HQ (rather than being posted to the UK). The diagram below summarises the processes involved and the locations where data is stored at each stage in its transfer from the field to the UK office.

Co2balance Documentation Procedure



All surveys are administered by trained co2balance UK staff (occasionally supplemented from a pool of casuals that work closely with a co2balance UK lead), local to the area and conversant in the local dialects to ensure that responses are consistent and not biased by any regional language barriers. Field staff are provided with an English and Swahili version of the questionnaire to ensure the greatest possible standardisation of responses. It is important when conducting the survey to explain its purpose to the respondent and to assure them that the answers to surveys are analysed as a group and that no individual names are used in this analysis.

When selecting households for the survey the UK office will select beneficiaries that have received a stove in the previous three months first and then from the remained if this number was not sufficient. The households are then grouped based on Stove Model, Mode of Use (domestic/institutional) and Fuel Type to determine clusters. Using a web based number generator the desired amount of random numbers is generated per cluster and added to the spreadsheet. This column is then sorted into ascending/descending order and the first 90 households per cluster chosen as the sample. From this sample the survey teams should choose households to survey.

Data collected during an MKS contains the following type of data:

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

All surveyors used the same standardised questionnaires and answer sheets. The answer sheets completed in the field were returned to the Kenya office for transcribing into an excel spreadsheet. Once completed this was returned to the UK office for analysis.

3. Updating of Project Results

The conclusions drawn from MKS's and KPT's are continuously added to the central server and are used to inform cluster changes and changes in emissions reductions (if any). Emission reductions calculations have been documented here as well.

4. Calculation of emissions reductions

Emissions reductions are calculated according to the 'Gold Standard Energy Efficiency – Domestic Methodology for improved cook-stoves and kitchen regimes V.02' using the results of the fixed and Monitored parameters; KS's and KPT's, NRB, leakage, (stove models, if required) and usage survey.

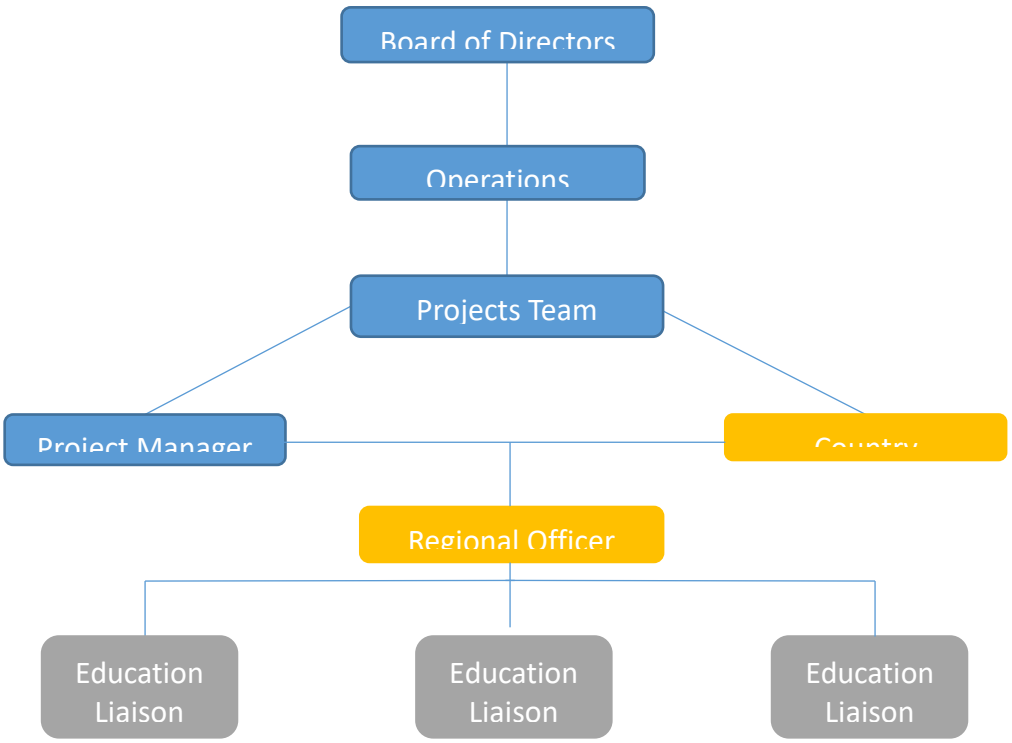
Periodic monitoring tasks

The periodic tasks are as follows:

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

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

The organogram below provides an overview of the Aberdares project organizational structure.



SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

(Copy this table for each piece of data and parameter)

Data/parameter:	N_y
Unit	Number
Description	Number of stoves in year
Source of data	Total distribution record
Value(s) applied)	6,620
Choice of data or measurement methods and procedures	N/A
Purpose of data	Calculation of emissions reductions
Additional comments	As outlined in section B.1. less stoves were distributed than the ex-ante estimate and not all distributed stoves are crediting (No CTFs). Hence the value is lower than that which is given in the registered PDD.

Data/parameter:	$EF_{bl.bio,co2}$
Unit	$tCO_2/t\_biomass$
Description	CO_2 emission factor arising from use of wood-fuel in baseline scenario
Source of data	Calculated from IPCC defaults
Value(s) applied)	1.7472
Choice of data or measurement methods and procedures	N/A
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data/parameter:	$EF_{pj.bio,co2}$
Unit	$tCO_2/t\_biomass$
Description	CO2 emission factor arising from use of wood-fuel in project scenario
Source of data	Calculated from IPCC defaults
Value(s) applied)	1.7472
Choice of data or measurement methods and procedures	N/A
Purpose of data	Calculation of project emissions
Additional comments	Value updated to post 2012 IPCC defaults

Data/parameter:	$EF_{bl.bio,non-co2}$
Unit	$tCO_2/t\_biomass$
Description	Non-CO_2 emission factor arising from use of wood-fuel in baseline scenario
Source of data	Calculated from IPCC defaults – refer to 'PDD supplementary data Aberdares v.02'.
Value(s) applied)	0.1355952
Choice of data or measurement methods and procedures	N/A
Purpose of data	Calculation of baseline emissions
Additional comments	Value updated to post 2012 IPCC defaults

Data/parameter:	$EF_{pj.bio,nonco2}$
Unit	$tCO_2/t\_biomass$
Description	Non CO_2 emission factor arising from use of wood-fuel in project scenario
Source of data	Calculated from IPCC defaults – refer to 'PDD supplementary data Aberdares v.02'.
Value(s) applied)	0.1355952
Choice of data or measurement methods and procedures	N/A
Purpose of data	Calculation of baseline emissions
Additional comments	Value updated to post 2012 IPCC defaults

Data/parameter:	$X_{nrb,bl,y}$
Unit	Fractional non-renewability
Description	Non-renewability status of woody biomass fuel scenario i during year y
Source of data	Report compiled by Anthony Mills (PhD) and Diane Southey (MSc) C4 EcoSolutions (Pty) Ltd., Cape Town, South Africa
Value(s) applied)	0.95
Choice of data or measurement methods and procedures	N/A
Purpose of data	ER calculation
Additional comments	The PDD states that the NRB will be monitored biennually and is therefore also included under the monitored parameters. The original NRB study was reviewed by co2balance UK Ltd in correspondence with the PDD. See Supplementary Data 'NRB Review'. The population and available biomass figures were updated and questions pertaining to woodfuel availability in the project area from the MKSs were examined in order to determine whether the NRB figure may have changed. No indication was found that the f NRB has decreased, hence the fraction remains at 0.95 as stated by the original C4EcoSystem report.

Data/parameter:	$EF_{bio,prod,co2}$
Unit	$tCO_2/t\_fuelf94$
Description	CO_2 emission factor arising from production of wood-fuel
Source of data	IPCC defaults or project-relevant measurement reports
Value(s) applied)	N/A
Choice of data or measurement methods and procedures	N/A
Purpose of data	Calculation of emissions
Additional comments	As revealed in the baseline Kitchen Surveys fuel is harvested and transported manually (walking and/or donkey cart) by each individual household and so does not generate any production related CO_2 emissions.

Data/parameter:	$EF_{bio,prod,non-co2}$
Unit	$tCO_2/t\_biomass$
Description	Non-CO2 emission factor arising from production of wood-fuel
Source of data	IPCC defaults or project-relevant measurement reports
Value(s) applied)	N/A

Choice of data or measurement methods and procedures	N/A
Purpose of data	Calculation of emissions
Additional comments	As revealed in the baseline Kitchen Surveys fuel is harvested and transported manually (walking and/or by donkey cart) by each individual household and so does not result in any transport related production CO2 emissions.

Data/parameter:	$EF_{af,co2}$
Unit	tCO_2/t_fuel
Description	CO2 emission factor arising from use of alternative fuel
Source of data	N/A
Value(s) applied)	N/A
Choice of data or measurement methods and procedures	N/A
Purpose of data	N/A
Additional comments	The Kitchen Survey identified some alternative fuel use by project beneficiaries however the KPT only measures consumption of the primary fuel, therefore any secondary fuel is treated as zero.

Data/parameter:	$EF_{af,\ non\text{-}co2}$
Unit	tCO_2/t_fuel
Description	Non-CO2 emission factor arising from use of alternative fuel
Source of data	N/A
Value(s) applied)	N/A
Choice of data or measurement methods and procedures	N/A
Purpose of data	N/A
Additional comments	The Kitchen Survey identified some alternative fuel use by project beneficiaries however the KPT only measures consumption of the primary fuel, therefore any secondary fuel is treated as zero.

Data/parameter:	$EF_{af,prod,co2}$
Unit	tCO_2/t_fuel
Description	CO2 emission factor arising from production of alternative fuel
Source of data	N/A
Value(s) applied)	N/A
Choice of data or measurement methods and procedures	N/A
Purpose of data	N/A
Additional comments	The Kitchen Survey identified some alternative fuel use by project beneficiaries however the KPT only measures consumption of the primary fuel, therefore any secondary fuel is treated as zero.

Data/parameter:	$EF_{af,prod,non\text{-}co2}$
Unit	tCO_2/t_fuel
Description	Non-CO2 emission factor arising from production of alternative fuel
Source of data	N/A

Value(s) applied)	N/A
Choice of data or measurement methods and procedures	N/A
Purpose of data	N/A
Additional comments	The Kitchen Survey identified some alternative fuel use by project beneficiaries however the KPT only measures consumption of the primary fuel, therefore any secondary fuel is treated as zero.

Data/parameter:	$AF_{bl,i,y}$
Unit	t_fuel/unit-year
Description	The mass of alternative fuel i combusted in the baseline year
Source of data	Baseline Kitchen Surveys
Value(s) applied)	0
Choice of data or measurement methods and procedures	N/A
Purpose of data	Calculation of emissions
Additional comments	The Kitchen Survey identified some alternative fuel use by project beneficiaries however the KPT only measures consumption of the primary fuel, therefore any secondary fuel is treated as zero.

Data/parameter:	$X_{re,bl,y}$
Unit	Fraction
Description	Woody biomass combustion avoided due to renewable energy fuels form in baseline year (i.e. solar cookers, agricultural residues, etc)
Source of data	Baseline Kitchen Surveys
Value(s) applied)	0
Choice of data or measurement methods and procedures	N/A
Purpose of data	N/A
Additional comments	Baseline Kitchen Surveys show that there is a certain degree of fuel and stove type mixing in the project area. In response to this the KPT was appropriately designed to measure fuel consumption of the primary fuel only, while the households involved are carrying on a degree of typical fuel and stove-type mixing during the KPT itself. Therefore, any secondary fuel is treated as zero in both the baseline and the project scenarios.

Data/parameter:	$X_{af,bl,y}$
Unit	Fraction
Description	Woody biomass combustion avoided due to alternative fuels in baseline
Source of data	Baseline Kitchen Surveys
Value(s) applied)	0
Choice of data or measurement methods and procedures	N/A

Purpose of data	Calculation of emissions
Additional comments	Baseline Kitchen Surveys show that there is a certain degree of fuel and stove type mixing in the project area. In response to this the KPT was appropriately designed to measure fuel consumption of the primary fuel only, while the households involved are carrying on a degree of typical fuel and stove-type mixing during the KPT itself. Therefore, any secondary fuel is treated as zero in both the baseline and the project scenarios.

D.2. Data and parameters monitored

Data/parameter:	$AF_{pj,i,y}$
Unit	t_fuel/unit-year
Description	Mass of alternative fuel i combusted in the project in year y
Measured/calculated/default	Measured
Source of data	Monitoring Kitchen Surveys
Value(s) of monitored parameter	N/A
Monitoring equipment	Surveys
Measuring/reading/recording frequency:	Quarterly
Calculation method (if applicable):	N/A
QA/QC procedures:	Full training is provided to survey staff
Purpose of data:	
Additional comments:	Baseline Kitchen Surveys show that there is a certain degree of fuel and stove type mixing in the project area. In response to this the KPT was appropriately designed to measure fuel consumption of the primary fuel only, while the households involved are carrying on a degree of typical fuel and stove-type mixing during the KPT itself. Therefore, any secondary fuel is treated as zero in both the baseline and the project scenarios. MKS have confirmed this scenario and continue to monitor it for significant change.

Data/parameter:	$X_{af,pj,y}$
Unit	Fraction
Description	Woody biomass combustion avoided due to alternative fuels in year y in project
Measured/calculated/default	Measured
Source of data	Monitoring Kitchen Surveys
Value(s) of monitored parameter	0
Monitoring equipment	Survey
Measuring/reading/recording frequency:	Quarterly
Calculation method (if applicable):	N/A
QA/QC procedures:	Kitchen Surveying will be overseen by co2balance UK Ltd field staff.
Purpose of data:	

Additional comments:	Baseline Kitchen Surveys show that there is a certain degree of fuel and stove type mixing in the project area. In response to this the KPT was appropriately designed to measure fuel consumption of the primary fuel only, while the households involved are carrying on a degree of typical fuel and stove-type mixing during the KPT itself. Therefore, any secondary fuel is treated as zero in both the baseline and the project scenarios. MKS have confirmed this scenario and continue to monitor it for significant change. **NOTE: As approach 1 in the methodology has been chosen this parameter is not in fact relevant for calculation of ERs. However it is included in the PDD and will therefore be included in the Monitoring Report.**

Data/parameter:	$X_{re,pj,y}$
Unit	Fraction
Description	Woody biomass combustion avoided due to renewable energy form in year y in project
Measured/calculated/default	Measured
Source of data	Monitoring Kitchen Survey
Value(s) of monitored parameter	0
Monitoring equipment	Survey
Measuring/reading/recording frequency:	Quarterly
Calculation method (if applicable):	N/A
QA/QC procedures:	Kitchen Surveying will be overseen by co2balance UK Ltd field staff
Purpose of data:	
Additional comments:	Baseline Kitchen Surveys show that there is a certain degree of fuel and stove type mixing in the project area. In response to this the KPT was appropriately designed to measure fuel consumption of the primary fuel only, while the households involved are carrying on a degree of typical fuel and stove-type mixing during the KPT itself. Therefore, any secondary fuel is treated as zero in both the baseline and the project scenarios. MKS have confirmed this scenario and continue to monitor it for significant change. **NOTE: As approach 1 in the methodology has been chosen this parameter is not in fact relevant for calculation of ERs. However, it is included in the PDD and will therefore be included in the Monitoring Report.**

The previous three data parameters [AFpj,i,y / Xre,pj,y / Xaf,pj,y] are associated with alternative fuel types and can all be explained using the same justifications.

Data from the Baseline Kitchen Survey (Figures 1 and 2) shows that there is a certain degree of fuel and stove type mixing in the project area. In response to this the KPT was appropriately designed following the third form to calculate the baseline (refer to page 12 of the methodology). So, the KPT measures fuel consumption of the primary fuel only, while the households involved are carrying on a degree of typical fuel and stove-type mixing and/or typical use of RE forms during the KPT itself. Therefore, any secondary fuel is treated as zero in both the baseline and the project scenarios. Hence, all alternative fuels, AFbl,i,y and AFpj,i,y were set to zero.

Figure1: Stove use prior to installation of CZ stove: Dry season

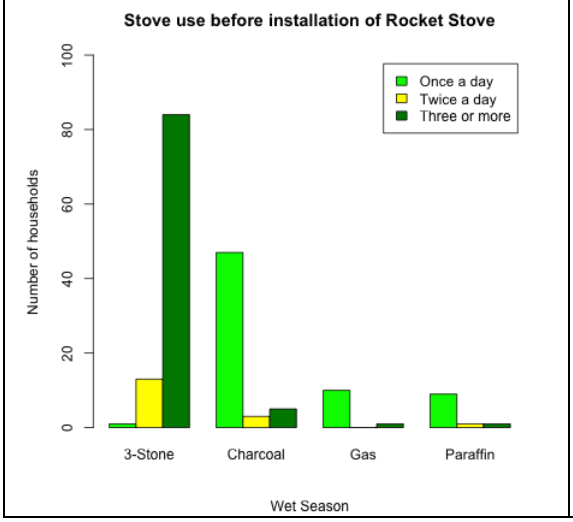


Figure 2: Stove use prior to installation of CZ stove: Wet season

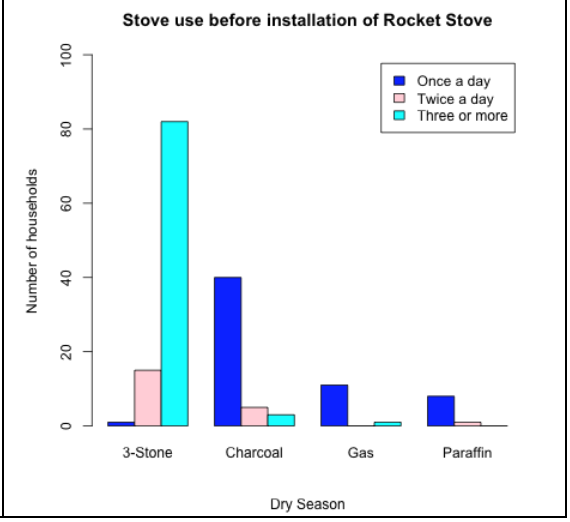


Table A below indicates that since the adoption of the improved CZK stove the occurrence of other fuel and stove use has remained relatively consistent with the baseline level. This is especially true for charcoal. As charcoal is a much more emissions intensive fuel source than wood, it was conservatively assumed that any net emissions benefit to reduced charcoal usage as a result of this project is 0.

Q40 - What type of fuel do you use for cooking?							
Survey	n	Wood	Gas	Charcoal	Paraffin/Kerosene	Other	Husks
KS	100	99	0	1	0	0	0
MKS 12	45	45	0	0	0	0	0
MKS 13	44	44	0	0	0	0	0
MKS 14	45	44	0	1	0	0	0
MKS 15	43	40	0	3	0	0	0
MKS 16	41	41	0	0	0	0	0
MKS 17	45	45	0	0	0	0	0
MKS 18	45	45	0	0	0	0	0
MKS 19	45	45	0	0	0	0	0
MKS 20	45	45	0	0	0	0	0

Data/parameter:	Age
Unit	Fraction
Description	Adjustment to values of Bpj,,y and AFpj,i,y for stoves of age x As the improved stoves were distributed within one year of the start of the crediting period and are expected to last the lifetime of the project, age wise sampling is not necessary.
Measured/calculated/default	Measured .
Source of data	Aging Stove KPT
Value(s) of monitored parameter	The stoves show no sign of depreciation in efficiency: The monitored value was 1.11. In order to achieve conservative results, the value was multiplied by the lower bound fuel savings between project and baseline scenario.

Monitoring equipment	Training provided for all field staff as well as calibration / replacement of equipment when necessary as per EB 61, Annex 21 .
Measuring/reading/recording frequency:	Biennially
Calculation method (if applicable):	"The mean fuel use of the aging stoves is to be ratio-ed to the mean fuel use of the stoves as measured in the baseline study; this ratio is then multiplied by the lower bound of the baseline fuel savings to yield the fuel savings of the aging stoves." (GS Methodology: Section III, 1.B.4., p. 25)
QA/QC procedures:	Training provided for all field staff as well as calibration of equipment
Purpose of data:	Calculation of project emissions. To adjust for a change in fuel use from baseline to the aging stoves and yield the fuel savings of the aging stoves.
Additional comments:	

Data/parameter:	Leakage
Unit	t_CO2e per year
Description	Potential GHG emissions outside project boundary caused by project activity
Measured/calculated/default	Calculated if necessary
Source of data	Kitchen surveys supported by desk-based research.
Value(s) of monitored parameter	L3=0
Monitoring equipment	Surveys
Measuring/reading/recording frequency:	Biennually
Calculation method (if applicable):	See Section E.3
QA/QC procedures:	N.A
Purpose of data:	Calculation of Leakage. To account for tCO_2 that occur during the crediting period as a result of the project activity.
Additional comments:	Applied during years in which stoves are constructed; however, this will be reviewed biennially.

Data/parameter:	$X_{nrb,pj,y}$
Unit	Fractional non-renewability
Description	Non-renewability status of woody biomass fuel scenario i during year y
Measured/calculated/default	Calculated
Source of data	Report compiled by Anthony Mills (PhD) and Diane Southey (MSc) C4 EcoSolutions (Pty) Ltd., Cape Town, South Africa
Value(s) of monitored parameter	0.95
Monitoring equipment	N.A
Measuring/reading/recording frequency:	According to the methodology, the project proponent can choose to renew the NRB at any time as per Gold Standard Rules. In the case of this project the PDD states that the NRB is reviewed biennially.
Calculation method (if applicable):	Average fuel use per household
QA/QC procedures:	N.A
Purpose of data:	Calculation of baseline and project emissions.

Additional comments:	The PDD states that the NRB will be monitored biennually and is therefore also included under the monitored parameters. The original NRB study was reviewed by co2balance UK Ltd in correspondence with the PDD. See Supplementary Data 'NRB Review'. The population and available biomass figures were updated and questions pertaining to woodfuel availability in the project area from the MKSs were examined in order to determine whether the NRB figure may have changed. No indication was found that the f NRB has decreased, hence the fraction remains at 0.95 as stated by the original C4EcoSystem report.

Data/parameter:	$B_{bl,y}$
Unit	t_biomass/stove/year
Description	Mass of woody biomass that is combusted in the baseline in year y
Measured/calculated/default	Measured
Source of data	Kitchen Performance Tests
Value(s) of monitored parameter	3.97
Monitoring equipment	The Field Test will utilise digital weighing scales accurate to 2 decimal places (from kg).
Measuring/reading/recording frequency:	Biennially – if Monitoring Kitchen Survey suggests any significant changes in patterns
Calculation method (if applicable):	Average fuel use per household
QA/QC procedures:	New scales are purchased for each KPT and therefore no calibration is required.
Purpose of data:	Calculation of baseline emissions.
Additional comments:	Figure remains relevant until MKS suggests significant change in fuel use patterns as outlined on p.17, 18 or until the crediting period ends. Due to small sample size of original third party approved baseline KPTs, and with permission from the Gold Standard, a revised baseline KPT was conducted by co2balance UK Ltd field staff and verified by ERM during first verification, this was conducted in August 2012 which is the figure presented here

Data/parameter:	$B_{pl,y}$
Unit	t_biomass/stove/year
Description	Mass of woody biomass that is combusted in the project in year y
Measured/calculated/default	Measured
Source of data	Kitchen Performance Tests (ER_Calculation_Sheet > Tab: Intact Stove KPT)
Value(s) of monitored parameter	2. 26
Monitoring equipment	The FT will utilise digital weighing scales accurate to 2dp.
Measuring/reading/recording frequency:	Biennially
Calculation method (if applicable):	Average fuel use per household
QA/QC procedures:	The scales are calibrated prior to each use by measuring against a known weight. The KPT was conducted on two random samples, of both modified and unmodified stoves, each containing 43 households. Thus KPTs were conducted on a total of 86 households
Purpose of data:	Calculation of project emissions.

Additional comments:	Due to small sample size of original third party approved baseline KPTs, and with permission from the Gold Standard, a revised baseline KPT was conducted by co2balance UK Ltd field staff and verified by ERM during first verification this was conducted in August 2012 which is the figure presented here. The figure presented is the lower bound project fuel use.

Data/parameter:	New Stove
Unit	Fraction
Description	Adjustment to values of (Bbl,y – Bpj,,y) and AFpj,i,y for new stove models. This parameter was defined as such in the registered PDD. As no new stove designs were introduced since the start of the project, it is, however, not applicable for this project.
Measured/calculated/default	Measured
Source of data	New Stove KPT
Value(s) of monitored parameter	n/a
Monitoring equipment	Digital scales – accurate to 2 decimal places.
Measuring/reading/recording frequency:	When new stove designs are introduced and then biennially after that
Calculation method (if applicable):	N/A
QA/QC procedures:	Training provided for all field staff as well as calibration / replacement of equipment when necessary as per EB 61, Annex 211. 3rd party direction and assessment of study.
Purpose of data:	Calculation of project emissions.
Additional comments:	At launch of new model and not less than biennially.

Data/Parameter	Usage in year y
Unit	Fraction
Description	Percentage of stoves of age x remaining in use in year y. As the improved stoves were distributed within one year of the start of the crediting period and are expected to last the lifetime of the project, age wise sampling is not necessary.
Measured/Calculated /Default	Measured
Source of data	Usage Survey
Value(s) of monitored parameter	0.68
Monitoring equipment	Survey
Measuring/Reading/ Recording frequency	Biennially
Calculation method (if applicable)	N/A
QA/QC procedures	Random selection of households and full training provided to staff
Purpose of data	Calculation of project emissions.
Additional comment	Surveyed in June/July 2014 and valid for 2 years.

[1] http://cdm.unfccc.int/Reference/Guidclarif/ssc/methSSC_guid06.pdf

Sustainability Indicators:

No		1
Indicator		Air Quality
Mitigation measure		None
Repeat for each parameter		
Chosen parameter 1.1		Total suspended particulate matter (TSPM) – measured indirectly by wood consumption
Current situation of parameter		As determined by research and field staff, traditional cooking methods produce large amounts of TSPM. It is not justifiable to measure this quantitatively but it will be measured qualitatively as described below.
Estimation of baseline situation of parameter		The baseline is determined by the current situation.
Future target for parameter		The project aims to reduce wood consumption and hence make a reduction in the defined parameter.
Way of monitoring	How	Kitchen Performance Tests & Kitchen Surveys
	When	Bi-annually and quarterly, respectively
	By who	Expert surveying team
Chosen parameter 1.2		Respirable suspended particulate matter (RSPM) – measured indirectly by wood consumption
Current situation of parameter		As determined by research (see table above) and field staff, traditional cooking methods produce large amounts of RSPM. It is not justifiable to measure this quantitatively but it will be measured qualitatively as described below.
Estimation of baseline situation of parameter		The baseline is determined by the current situation.
Future target for parameter		The project aims to reduce wood consumption and hence make a reduction in the defined parameter.
Way of monitoring	How	Kitchen Performance Tests & Kitchen Surveys
	When	Biennually and quarterly, respectively
	By who	Expert surveying team

Wood use has been reduced from the baseline scenario of 10.89 to an average of 5.27 kg/hh/day. Coupled with this is the response from 99% of stove users that they have experienced reduced smoke levels since using the stove. In light of these results, we score this indicator positively.

No		2
Indicator		Quality of employment
Mitigation measure		None
Repeat for each parameter		
Chosen parameter 2.1		Number of training workshops organised, number of attendees.
Current situation of parameter		3
Estimation of baseline situation of parameter		As defined by current situation.
Future target for parameter		3
Way of monitoring	How	Stove contractor records – collated
	When	Continuously
	By who	Project developer

As defined above, the parameter 'Quality of Employment' is measured by the number of training events organised. Considering that no new stoves are being produced or distributed, employment is focused on monitoring and maintenance. Given substantial experience of existing staff, the number of trainings has been reduced in comparison to the start of the project as detailed in the GS Passport. The agenda of the training included: A company-wide training event was held on the 26th and 27th of February 2015.

- Principles of planning and undertaking a Baseline Survey

- Planning, Team selection and understanding the objectives of undertaking MKS
- Measuring and tracking key indicators monitored during MKS
- Key elements and outlining principles in Usage survey data collection.
- Conducting Kitchen Performance Test and data validation
- Understanding a Water Boiling Test
- Practical performance of a WBT following the standard guidelines.
- Monitoring data management and screening

The PP is scoring the parameter positively as this is an improvement over the baseline situation of zero training events.

No		3
Indicator		Livelihood of the poor
Mitigation measure		None
Repeat for each parameter		
Chosen parameter		Wood consumption
Current situation of parameter		Wood consumption is known to be high amongst the project area population
Estimation of baseline situation of parameter		As defined by current situation
Future target for parameter		It is anticipated that wood consumption amongst stove beneficiaries will be reduced by at least 50%
Way of monitoring	How	Kitchen Performance Tests & Kitchen Surveys
	When	Biennially and quarterly, respectively
	By who	Expert surveying team

Wood use has been reduced from the baseline scenario of 10.89 to an average of 5.27 kg/hh/day; this is a reduction of 55.5%. As well as this, 99% of those surveyed in the MKS stated that they use less fuel since receiving the improved cook stove. Wood consumption serves an indicator for livelihood of the poor because it provides a proxy for the amount of time people spent collecting fuel.

Table B below shows that both distance walked to collect firewood and time spent on collection of firewood has been reduced by more than 50%. The Baseline Kitchen Survey (KS) indicated that households spent on average 192min in order to collect woodfuel, walking 3.37km per day.

The average collection time and distance observed from the last 8 MKS's in this Monitoring Period (MP Average) shows a reduction to 95min and 1.51km per household per day. This reduction significantly frees up people's capacity for other tasks of maintaining livelihoods or to pursue productive or recreational tasks. As such, we score this indicator positively.

MKS Q59 & Q60 Livelihood of the poor		
Survey	Collection Time (Mins)	Collection Distance (Kms)
KS	**192.00**	**3.37**
MKS 12	96.08	1.56
MKS 13	121.67	1.98
MKS 14	105.45	1.48
MKS 15	109.80	1.12
MKS 16	117.86	1.82
MKS 17	91.50	0.87
MKS 18	65.00	1.09
MKS 19	84.00	1.78
MKS 20	70.63	1.94
MP Average	**95.78**	**1.51**

Table B: Collection Time and Distance as indicated by the Monitoring Kitchen Surveys conducted in this Monitoring Period.

No		4
Indicator		Access to affordable and clean energy services
Mitigation measure		None
Repeat for each parameter		
Chosen parameter		Change in volume of traditional fuel consumption
Current situation of parameter		Traditional fuel consumption (wood) is known to be high amongst the project area population
Estimation of baseline situation of parameter		As defined by current situation
Future target for parameter		It is anticipated that wood consumption amongst stove beneficiaries will be reduced by at least 50%
Way of monitoring	How	Kitchen Performance Tests & Kitchen Surveys
	When	Biennially and quarterly, respectively
	By who	Expert surveying team

By distributing improved cook stoves for free this parameter is inherent in the project. At the end of this monitoring period a total of 6,620 crediting stoves had been constructed and distributed. Furthermore, as demonstrated earlier, the stove reduces wood consumption and therefore smoke generation. This parameter has been scored as positive.

No		5
Indicator		Quantitative employment and income generation
Mitigation measure		None
Repeat for each parameter		
Chosen parameter		Household income generated from employment generated by the project
Current situation of parameter		100,000Ksh
Estimation of baseline situation of parameter		As defined by current situation
Future target for parameter		4,145,000
Way of monitoring	How	Stove contractor/project developer records – collated
	When	Continuously
	By who	Project developer

As a result of the stove project new employment opportunities will emerge related to the different phases and scopes of the project. The number of employment opportunities created and their specifications have been recorded for this purpose. The direct parameter used to measure the indicator is household income generated from employment created by the project. As the project has moved from construction into the monitoring phase, the project helps to maintain 6 full time employees:

1. Project Development Coordinator
2. HR and Finance Coordinator
3. Construction Manager
4. Regional Coordinator for the Coastal region
5. 2x Community Project Officer

Income from direct employment generated through this project is just over KES 1,300,000.This figure is a significant improvement on the baseline situation and as a result we score this indicator positively.

Modified Stoves

Since installation it has been found that a number of stove beneficiaries have 'modified' their stoves. This modification usually involves altering the vent or liner with the presumed aim of increasing the opening allowing more varied sizes of wood to be used in the stove. Prior to the second verification, a survey of households in the project area was undertaken to determine the proportion of modified to unmodified stoves during which 2801 households were visited. It was found that 446 (16%) were modified and the remaining 2355 (84%) had not been. Compared to Monitoring Period 1 this was a significant change in percentage split, most probably due to an increase in sample size. A comparative KPT shows that there is a significant difference in the amount of woodfuel used between an unmodified stove (5.13) and a modified stove (6.02). This difference has been taken into account by calculating an adjusted KPT result. The percentage of each stove type (modified and unmodified) was multiplied by correlating KPT result and then summed to get a weighted average KPT.

The significant difference between the baseline and the project stove is due to the baseline assessment having been very conservative.

D.3. Implementation of sampling plan

>>

The parameters above have been monitored through a Random Sample Group (RSG). The size of the sample group has been selected to ensure the parameters measured satisfy 90/10 precision (90% confidence interval and 10% margin of error), according to the guidance: Draft General Guidelines On Sampling And Surveys (EB 37, Annex 27) and General Guidelines For Sampling And Surveys For CDM Project Activities and Programme of Activities Version 02 (EB 69 Annex 5). The individual participants were selected at random from the stove information database. A random number generator ranked the unique serial numbers of the stoves in the project, generating a RSG. The size of the RSG varied depending on the variance of the parameter being monitored. The RSG was reselected for every monitoring period to ensure the selection remains random.

Monitoring Kitchen Survey

The MKS has been designed to collect data on the following characteristics: household demographics, seasonality, socio-economic factors, cooking and fuel use habits as well as sustainable development parameters. As required by the applicable Gold Standard Methodology the MKS is conducted quarterly to capture any potential trends attributable to seasonality. The minimum sample size requirement of 25 households is exceeded with a typical survey capturing 40+ households; all interviews are conducted face-to-face in the respondents' home. Responses are analysed allowing population trends to be established and reported on. The minimum sample size requirements for Monitoring Kitchen Surveys as set out on page 22 of the methodology is 25 households or 10% of the cluster size if the cluster is less than 250.

Kitchen Performance Test- Ageing Stove

The 4 day KPT (3 full days or 72 hours monitored, requiring 4 days of visits) was considered to yield robust results. In order to collect data that is considered to be 'typical' the KPTs were carried out at a time when the level of fuel use was not unusual. To achieve a conservative estimate of the fuel consumption and GHG saving it is advantageous to carry out the KPT when fuel use is at the lower end of normal. For this reason, the KPTs were carried out mid-week when there were no festivals or key agricultural periods in the community (midweek means Monday to Friday). It was explained to all home owners that they must cook normally during the tests and use fuel only from a designated stock which had been pre-weighed by co2balance UK staff. The surveys were conducted by expert full time co2balance UK staff based in Kenya.

A sample size of 2 x 43 households was randomly selected to meet the requirements of the methodology. KPTs were checked for outliers to provide a more robust result. Statistical analysis showed that the confidence interval of average fuel use was less than 10% of the mean, therefore the mean value can be used. For full calculations, please see 'Aberdares ER sheet'

The results of the Ageing Stove KPT demonstrate that ageing of the stoves had no effect. In fact, fuel consumption has reduced. This is likely due to the continuing education surrounding the use of the stove and fuel management for beneficiaries, and the time that they have had to get accustomed to using the stove. ER calculations have been adjusted to account for this difference.

The comparison between unmodified and modified stoves, showed a significant difference and results have been adjusted accordingly as detailed in the 'ER Sheet'.

Usage Survey

The usage survey establishes the proportion of beneficiaries that use the improved stoves, a key parameter in the emission reduction calculations. As the improved stoves were distributed within one year of the start of the crediting period and are expected to last the lifetime of the project, age wise sampling is not necessary. Therefore, the annual usage survey has been conducted using a minimum sample size of 100. Surveys were conducted on random samples between 24/06/2014 and 03/07/2014 and showed that 68% can be considered users i.e. report that they currently use the stove and will continue to use.

SECTION E. Calculation of emission reductions or GHG removals by sinks

The project proponent has elected to use a fixed baseline, in-line with the chosen methodology. Each stove build date is individually recorded in the proponent's database and emission reductions calculated on an individual basis. A maximum one-month lead time is accounted for between construction and operation of the stove, this leads to a conservative assessment of the emission reductions made and accurate calculation of emission reductions under a progressive distribution scenario.

Kitchen Performance Tests are calculated according to the third form as described on page 12 of the methodology which states: The KT measures fuel consumption of the primary fuel only, while households involved are carrying on a degree of typical fuel and stove-type mixing and/or typical use of RE forms during the HT itself ("subsumed-fuel KT"). Where a secondary fuel or stove is subsumed, the quantity or fraction of secondary fuel or RE is treated as zero (AF and Xaf, Xre in the equations below) and the effect of fuel mixing is to reduce the saving made in primary fuel between baseline and project scenarios.

Following from this, 'approach 1' (pages 13 and 16 of the methodology) is used to calculate emissions reductions which is specific to each representative unit of each cluster and applies values of mass for each fuel in the mix. Calculations are therefore made on a per unit basis, resulting in an ER/stove/year figure which is applied to the number of stoves crediting based on the length of time each has been in operation.

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

Where:

ERy = Emissions reductions in total project population in year y (tCO_2/yr)
BEi,y = Baseline emissions of cluster i in year y (tCO_2/yr)
PEi,y = Project emissions of cluster i in year y (tCO_2/yr)
LEi,y = Leakage of cluster i in year y (tCO_2/yr)

Within each cluster emissions are calculated thus:

$$BE_{i,y} = N_{i,y} \times BE_y$$ ……Eqn ER.1b

$$PE_{i,y} = N_{i,y} \times PE_y$$ ……Eqn ER.1c

Where:

Ni,y = the number of Units in cluster i

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

>> Baseline emissions in tCO_2/stove/year are calculated as follows:

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

Where:

BEy = baseline emissions in year y (in tonnes CO2e per year) specific to cluster and Unit chosen

Xnrb,bl,y = the non-renewable fraction of the woody biomass harvested in the project collection area in year y in the baseline scenario

Bbl,y = the mass of woody biomass consumed during cooking in the baseline in year y (tonnes/year)

EFbl,bio,co2 = the CO2 emission factor for use of the biomass fuel in the baseline scenario in tonnes CO2 per tonne fuel

AFbl,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).

EFaf,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

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

GHG emissions during production of the fuels

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

Where:

EFbl,bio,non-co2,i = Emission factor for GHG gas i in the baseline scenario in units of tonnes gas per tonne wood-fuel

EFaf,non-co2 gas i = Non-CO2 emission factor during cooking for alternative fuel i for GHG gas i in tonnes gas per tonnes fuel

EFbio,prod,co2 = CO2 emission factor for wood-fuel during production in tonnes gas per tonnes fuel

EFaf,prod,co2,i = CO2 emission factor for fuel I during production in tonnes gas per tonnes fuel

EFbio,prod,non-co2 gas i = Non-CO2 emission factor for wood-fuel during production in tonnes gas per tonne fuel

EFaf,prod,non-co2 gas i = Non-CO2 emission factor for alternative fuel i for GHG gas i during production in tonnes gas per tonnes fuel

Baseline Emissions	
BEy	**7.14**
Xnrb,bl,y (fraction)	0.95
Bbl,y (t/HH/year)	3.97
EFbl,bio,CO2 (tco2/t_wood)	1.7472
AFbl,i,y (t/HH/year)	0
EFaf,CO2 (tco2/t_fuel)	0
Non-CO2 Emissions	0.538916139
EFbl,bio,non-co2 (tco2e/t_wood)	0.1355952
EFbio,CH4 (tco2e/t_wood)	0.117
EFbio,N2O (tco2e/t_wood)	0.0185952
EFaf,i,non-co2 gas (tco2e/t_fuel)	0
GHG Emissions During Production	0
EFbio,prod,co2 (tco2/t_wood)	0
EFaf,prod,co2 (tco2/t_fuel)	0
EFbio,prod,non-co2 gas (tco2e/t_wood)	0
EFaf,prod,non-co2 gas (tco2e/t_fuel)	0

E.2. Calculation of project emissions or actual net GHG removals by sinks

>> Project emissions in tCO_2/stove/year are calculated as follows:

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

+∑(Non-CO2 emissions during cooking)
+∑(GHG emissions during production of the fuels) ……Eqn P.1a

Where:

PEy = project emissions in year y (in tonnes CO2e per year) specific to cluster and Unit chosen

Xnrb,pj,y = the non-renewable fraction of the woody biomass harvested in the project collection area in year y in the project scenario

Bpj,y = the mass of woody biomass consumed during cooking in the project each year (tonnes/year)

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

Non-CO2 emissions during cooking

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

GHG emissions during production of the fuels

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

Project Emissions	
PEy	**4.06**
Xnrb,pj,y (fraction)	0.95
Bpj,y (t/HH/year)	2.26
EFpj,bio,CO2 (tco2/t_wood)	1.7472
AFpj,i,y (t/HH/year)	0
EFaf,CO2 (tco2/t_fuel)	0
Non-CO2 Emissions	0.30668106
EFpj,bio,non-co2 (tco2e/t_wood)	0.1355952
EFbio,CH4 (tco2e/t_wood)	0.117
EFbio,N2O (tco2e/t_wood)	0.0185952
EFaf,i,non-co2 gas (tco2e/t_fuel)	0
GHG Emissions During Production	0
EFbio,prod,co2 (tco2/t_wood)	0
EFaf,prod,co2 (tco2/t_fuel)	0
EFbio,prod,non-co2 gas (tco2e/t_wood)	0
EFaf,prod,non-co2 gas (tco2e/t_fuel)	0

E.3. Calculation of leakage

>> Leakage calculations originally completed at registration were determined on a per stove basis. The final leakage figure was then calculated based on the estimated number of stoves to be constructed in the project area. However stove construction in the project area has been paused and the leakage figure as calculated for this monitoring period has been calculated on the actual number of stoves built.

$$LE_2 = 0.01793 \times n$$
$$LE_2 = x$$
$$LE_{3,4..n} = 0$$
$$LE_2 = 0.01793 \times 0$$
$$LE2 = 0$$

E.4. Summary of calculation of emission reductions or net GHG removals by sinks

Item	Baseline emissions or baseline net GHG removals by sinks (t CO_2e)	Project emissions or actual net GHG removals by sinks (t CO_2e)	Leakage (t CO_2e)	GHG emission reductions or net GHG removals by sinks (t CO_2e) achieved in the monitoring period		
				Up to 31/12/2012	From 01/01/2013	Total amount
Total	94,464	53,760	0	0	**27,679**	**27,679***

*After usage rate adjustment (0.68) has been applied

Net ERs by Vintage		
Year	**Date**	**ERs (tCO2e/year)**
2014	01/04/2014 - 31/12/2014	10,380
2015	01/01/2015 - 31/12/2015	13,839
2016	01/01/2016- 31/03/2016	3,460
Net Total		**27,679**

E.5. Comparison of actual emission reductions or net GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO_2e)	147,666 tCO_2e	**27,679**

E.6. Remarks on difference from estimated value in registered PDD

>> The estimated value calculated in the PDD is different from the actual value calculated in this Monitoring Period due to the construction schedule. The total original number planned to be constructed in the first year was 23,033, the actual number constructed to date is 9,311 but due to missing CTFs and the potential duplicates conservatively removed, the number credited is 6,620. This has resulted in the final ER figure of this monitoring period.

Appendix 1. Contact information of project participants and responsible persons/entities

Project participant and/or responsible person/ entity	☒ Project participant ☒ Person/entity responsible for completing the CDM-MR-FORM
Organization name	CO2balance
Street/P.O. Box	
Building	Discovery House
City	Taunton
State/region	
Postcode	TA26BJ
Country	United Kingdom
Telephone	0044 1823 332233
Fax	
E-mail	Richard.Stone@co2balance.com
Website	www.co2balance.com
Contact person	Richard Stone
Title	Carbon Projects Developer
Salutation	
Last name	
Middle name	
First name	
Department	Projects Team
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	