Spark Fund: Improving the performance of locally manufactured biomass cook stoves in Kenya

oject Report

GVEP International

Global Alliance for Clean Cookstoves

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Executive summary

Overview

In June 2013, GVEP International was awarded a grant from the Spark Fund to improve the performance and quality of locally manufactured efficient cookstoves in Kenya. The project titled, '*Improving the Performance of Locally Manufactured Biomass Cookstoves',* was designed to introduce to the market cookstove models with superior fuel use and emissions properties relative to models currently being produced by local manufacturers, as well as prove to producers the market viability of high quality performing stoves. In addition, entrepreneurs would receive capacity building to improve their technical, business and market skills. Lastly, the project was to establish a seed fund for producers to enable them expand their businesses, and assist business in accessing carbon markets. The project was initially planned to run for 12 months from July 2013 to June 2014 but was extended for 3 months and ended in September 2014 having run for 15 months. GVEP international was expected to continue providing support and tracking of progress to the enterprises supported by Spark Fund under a co-funding arrangement until June 2015 when the final project report would be put together for GACC. This final project report provides an overview of the implemented activities. For each activity, the lessons learnt, challenges encountered and recommendations for further action have been discussed.

Design process

The project worked with 12 enterprises drawn from Central and Kisumu regions of Kenya. Out of the 12, 4 enterprises (33.3%) are female owned. The first activity was to develop stove designs with enhanced performance properties. Kenya Stoves Works, a stove Design and Manufacture Company was contracted to support the design process. *Kenya Ceramic Jiko (KCJ)* and *Jiko Kisasa portable* were then selected as the baseline charcoal and wood stoves respectively against which improvements on the new designs would be benchmarked. The design aim was not to 're-invent the wheel' but to work with what is already popular on the market to address the performance constraints while retaining all their positive attributes that have made them popular with end-users.

The design process was intense and lengthy, characterized by numerous iterations in a bid to balance the often competing parameters of usability, performance and cost. Finally, fairly improved wood and charcoal versions were adopted. The wood and charcoal designs' thermal efficiencies are in the range of 27-33% and 34-35% respectively. The stoves were also tested under real cooking conditions and found to save 33% and 15% of daily wood and charcoal use respectively. At a retail price of KES 2000 ($≈23) for the wood stove and KES 1500 ($ ≈17) for the charcoal stove, the stoves are fairly affordable.

The biggest challenge in the design phase related to striking the best compromise between usability and thermal efficiency for wood stove design. End-users often require a stove which can accommodate big pieces of wood to allow time for other chores as the food cooks. On the other hand, large combustion chambers, especially when made of clay, end up negating thermal efficiency. The second challenge was lack of a testing facility that could provide emissions test results at short turnaround times, rendering it impossible to correctly optimize emissions at the prototyping stage. As a result the new designs have been characterized by high CO emissions, higher than that emitted by baseline stoves. The third challenge was presented by clay liners. Clay is cheap, high in strength and long lasting. However, in terms of efficency, clay has high thermal mass which erodes thermal efficiency. The project settled for thin-walled liners to mitigate against the challenge. Clay liners also take a fairly long time to cure and the process is weather sensitive (a minimum of 21 days when the weather is dry and longer during wet seasons). Every time a new prototype was developed, at least a month of dead time had to elapse to allow moulding, curing and firing the liners. This slowed the pace of the design process.

The report documents a number of lessons drawn from the design activity. Amongst these lessons is the pivotal role of a well-equipped testing facility that can punctually generate test results and the need to accord projects with a stove design component enough time so as to factor in the uncertainities around performance optimization processes (we recommend 1 year minimum for design work).

To further enhance the perfomance, there are a number of modifications required to contain the high CO levels, further optimize the diameter of wood stove's combustion chamber, explore alternative cheaper insulation materials, further optimize the thickness of clay liners and explore the possibilty of integrating secondary air. GVEP welcomes support from the Alliance to facilitate this work.

Marketing

The new stoves, branded *Jiko Smarts,* have been introduced in the market and the reception is good - at end of June 2015, a total of **4,469** stoves had been produced and **3,153** sold. Following the end of project in September last year, GVEP continued supporting the enterprises to expand *Jiko Smart's* market share through the larger CARE2 program. This has mainly been through market development activities (MDAs) and business linkages with downstream value chain players. Through the business linkages, a total of **32** retailers are now actively buying *Jiko Smart* from the producers and stocking them at their outlets. GVEP has also adopted a more result-oriented marketing-support model for *Jiko Smart* which places greater emphasis on exploration of niche markets through organized groups such as flower farms, sugar factories, tea estates, and women groups, Savings and Credit Societies (SACCOs) and Financial Services Associations (FSAs).

GVEP has also partnered with The Adventure Project to implement a 12-month stove project aimed at increasing uptake of *Jiko Smart* in Kenyan households through market activation initiatives to create demand, and training of more producers to strengthen supply.

While appreciating that all these initiatives have raised awareness about *Jiko Smart,* increased its market presence and will help accelerate the adoption rate, it is also acknowledged that the efforts are far from creating the level of demand that would translate into large scale adoption. Effective stove marketing calls for elaborate wherewithal which most micro-enterprises unfortunately lack. More demand needs to be created and the supply strengthened further before the *Jiko Smart* initiative can stand on its own. Even as GVEP continues to engage other partners, the Alliance should consider further partnership to support more marketing work.

Seed grant

The seed grant was aimed at capacity building the enterprises with support that could enable them fully incorporate *Jiko Smart* into their product mix as well as enhance their overall production capacities. The initial plan was to have 60-40 cost-sharing arrangement whereby 60% of the support items would be financed through the grant with the enterprises contributing the remaining 40%. However, In August 2014, one and a half months to the closure of the project in September, it was realized that there was lack of adequate *Jiko Smart* stocks to support implementation of the marketing strategy. It was hence decided to procure materials, fully financed through the seed grant, for distribution to 10 entrepreneurs to enable them produce a sizeable batch. Compensation for labor costs incurred was also paid to incentivize the enterprises to prioritize this work. This was the first phase of disbursement.

By the end of the project in September 2014, disbursement of the second phase was yet to commence. Although the plan was to disburse the remaining grant amount within two months, the process encountered long delays that were neither predicted nor anticipated. The entrepreneurs kept on requesting for more time to mobilize funds for the 40% obligation. By end of 2014, only one enterprise had paid 40% matching amount for a firing kiln. By February 2015, only 4 more enterprises had paid the 40% contribution for water tanks and workshop expansion materials.

In April 2015, it was decided to re-appraise the enterprises with a view to ascertaining the underlying factors behind the long delays in raising the matching amounts. The appraisal revealed that none of the entrepreneurs was likely to raise funds any time soon. The reasons cited ranged from tied-up capital to cash-flow constraints to more pressing obligations like school fees. With this feedback and in light of the need to conclude the process, it was decided to disburse the remaining seed grant without the 40% matching contribution from the entrepreneurs. It was feared that the process risked dragging on endlessly.

Several lessons learnt have been discussed in detail in this report. One of the lessons is that when implementing projects with a seed grant component, the activity should be slotted at the beginning so as to allow for sufficient time to cover the complexities and delays likely to be encountered. With the Spark fund, the activity was slotted towards the end. Preliminary anecdotal feedback suggest that the support items awarded are boosting production capacities, however more time will be needed before actual impact over the long-term can be determined.

Carbon feasibility study

The study to assess the feasibility of *Jiko Smart* producers accessing carbon finance markets showed that *Jiko Smart cookstoves* have considerable offsetting potential particularly when majority of sales are to customers using non-improved models like 3 stone fire and metal charcoal stove. The most suitable project framework is the Gold Standard Micro-Program of Activities applying Technologies and Practices to Displace Decentralized Thermal Energy Consumption (TPDDTEC) methodology. Owing to the relatively low sales forecasts, each group of enterprises from Kisumu and Central clusters could form aggregated bodies which would comprise the micro-programs under the program. Micro-program framework has flexibility advantage which can allow admission, at a later date, of entrepreneurs from other clusters producing *Jiko Smart* to be incorporated into an existing carbon project as new micro-programs.

It is acknowledged that owing to the huge initial financial outlays and the elaborate technical capacity required to set-up and run a carbon finance project, the current regime of micro-enterprises cannot afford to initiate and implement such a project on their own. Whilst GVEP has been on the look-out for opportunities which can empower *Jiko Smart* enterprises exploit the identified carbon financing opportunities, we do welcome support of the Alliance and its wide network of partners in pursuit of carbon finance prospects on behalf of stove enterprises.

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Acronyms, abbreviations & Symbols

GVEP	GVEP International
ASK	Agricultural Society of Kenya
BoP	Bottom of Pyramid
CARE2	Capital Access for Renewable Energy Enterprises
CO	Carbon Monoxide
CREEC	Center for Research in Energy and Energy Conservation
e-MSMEs	Energy Micro Small and Medium-size Enterprises
FGDs	Focus Group Discussions
FSA	Financial Services Associations
GACC	Global Alliance for Clean Cookstoves
HH	Household
ICS	Improved Cookstoves
IWA	International Workshop Agreement
KCJ	Kenyan Ceramic Jiko
KDA	K-Rep Development Agency
KES	Kenya Shillings
KINHBS	Kenya Integrated National household Budget Survey
KIRDI	Kenya Industrial Research and Development Institute
Lab	Laboratory
MDA	Market development activity
PDP	Pipeline Development Project
PDP3	A pipeline cook stove and Briquettes Development Project in Kenya
PEMS	Particulate Emissions Monitoring System
PPM	Parts per million
SA	Standard adult
Sacco	Savings and credit cooperative
Sida	Swedish International Development Cooperation Agency
TOR	Terms of Reference
UoN	University of Nairobi
WBT	Water Boiling Test
WHO	World Health Organization
MJd	Mega-joule delivered to the pot
Mg	Milligram
Kg	Kilogram
$	United States Dollar
g	grams
ug/m3	Micro-grams per cubic meter
MJ	Mega-joule
Min	Minute
L	Litre

1 Introduction

1.1 Project Overview

In June 2013, GVEP International was awarded a grant from the Spark Fund to improve the performance and quality of locally manufactured efficient cookstoves in Kenya. The grant was aimed at providing vital support to a number of high potential cookstove businesses in relation to technical capacity building, better product design, manufacturing practices and financial assistance for investing in necessary expansion activities. The Spark Fund is an initiative of the Global Alliance for Clean Cookstoves as part of their strategy to strengthen supply and enhance demand in the cookstove and fuels sector through innovation and tailored entrepreneurial capacity development.

The Spark Fund grant was co-funding a larger project, (CARE2) Capital Access for Renewable Energy Enterprises, funded by Sida (the Swedish International Development Cooperation Agency). In Kenya, the CARE2 component, known as PDP3, is supporting e-MSMEs in Improved Cookstove (ICS) and Briquette production to increase the quality and uptake of locally made domestic biomass stoves and biomass briquettes through capacity building, marketing and distribution and scaling up production for high potential local producers.

The Spark fund project was initially planned to run for a period of 12 months from July 2013 to June 2014. However, on request from the grantee, a 3 months no-cost extension was granted and the project ended in September 2014, having run for 15 months. This report provides an overview of activities implemented through the project with emphasis on accomplishments, lessons learnt, challenges experienced and recommendations for further action.

1.2 Project Rationale

As is discernible from the project title, "*Improving the Performance of Locally Manufactured Biomass Cookstoves*", the project was designed to introduce to the market cookstoves models with superior fuel use and emissions properties relative to models currently being produced by local manufacturers in Kenya. The main local models, with exception of a few such as KCJ & Uhai stoves, are only barely improved rendering them wasteful of fuel and highly polluting. Typically made of clay and light-gauge metal, these models are also known to lack in durability. They are however cheap (4-10 USD) and hence affordable by households in low income categories. The international brands on the other hand are highly efficient and clean but expensive (in the range of 30-40 USD). This has limited their affordability to households with high disposable incomes. The absence in the market of a design that occupies this middle ground between the local 'low-end' models and the international 'high-end' brands is what inspired this project. The aim was to develop stove models that are fairly improved and which can be availed to the end-users at fairly reasonable price.

In Kenya, biomass (wood, charcoal and agricultural residues) remains the pre-dominant source of cooking energy. Firewood is estimated to be used by 68.3% of all households, 80% of which are in rural areas. Charcoal ranks second in popularity with usage in 13.3% households, majority of which are in urban areas (KINHBS 2005/06). Even though displacement of biomass with modern fuels in Kenyan households is likely to increase as the economy flourishes and urbanization gathers pace, biomass is projected to remain the main source of cooking energy for many years to come (Kammen, 1995).

Rural households are particularly affected due to low-disposable incomes, freely available wood and high cost as well as poor distribution infrastructure for modern fuels (Barnes et al. 1994). Wide-spread reliance on traditional biomass sources coupled with use of inefficient cookstoves exacerbates deforestation and has negative impacts on health and quality of life. This underscores the need for development of more-efficient, affordable cookstoves with capacity to cut down on fuel use, reduce emissions, alleviate drudgery associated with foraging for fuel and generally improve the households' quality of life. The Spark Fund project was geared towards this outcome.

2 Mobilization of entrepreneurs to participate in the project

Mobilisation, assessment and selection of entrepreneurs to join the Spark Fund project was the first activity carried out between July and August 2013. The participants were drawn from PDP3 pool of entrepreneurs. The selection criteria focussed on potential for growth, commitment and responsiveness to GVEP's interventions, interest to diversify product portfolio by introducing new stove designs, sufficient linkages with upstream and downstream value chain actors and the gender dimension whereby female entrepreneurs meeting the conditions were given preference. After the assessment, a total of 12 enterprises were selected and recruited. The enterprises are from Central and Kisumu regions, areas with most advanced businesses producing at significant volumes in the country.

Table 1: Enterprises recruited into the Spark Fund project

Name of Enterprise	Name of Entrepreneur	Gender	Region	Business line
Equator Fuel Wood Energy Saving (EFWES)	Josephat Kariuki	Male	Central	Assemblage of complete stoves, stocking of international brands & solar products
SoS Production Center	Sospeter Nyoko	Male	Central	Liner production, assemblage of complete stoves
JMM Clay Stove Producers	Joseph Muriuki	Male	Central	Liner production, assemblage of complete stoves
Riumbai-ini Energy Saving Stoves	Kenneth Gachanja	Male	Central	Liner production, assemblage of complete stoves
Cinda Juakali	Stephen Irungu	Male	Central	Liner production, assemblage of complete stoves
Omollo Works	Richard Omollo	Male	Kisumu	Assemblage of complete stoves
Lakenet Energy Solutions	Caleb Ochere	Male	Kisumu	Assemblage of complete stoves
Ekero Jiko Supplies	Mohammed Olunga	Male	Kisumu	Assemblage of complete stoves
Nyausonga Works	Christine Anyango	Female	Kisumu	Assemblage of complete stoves
Ona na Macho Workshop	Pamela Auko	Female	Kisumu	Assemblage of complete stoves
Nyamasaria Widows & Orphans	Herma Okonjo	Female	Kisumu	Liner production, minimal assemblage of complete stoves
Keyo Pottery Enterprise	Benta Alai	Female	Kisumu	Liner production, minimal assemblage of complete stoves

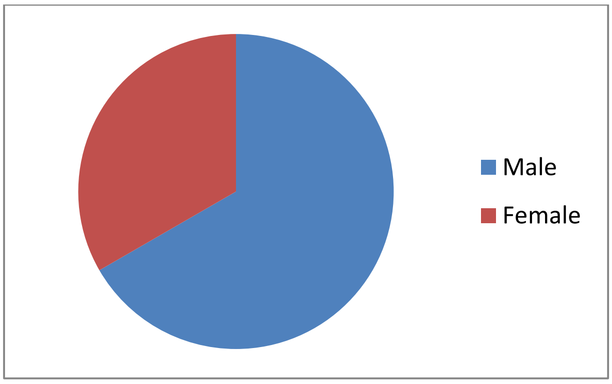

Figure 1 Distribution of project enterprises by gender

3 Stove design and testing

3.1 Selection of technical consultant

The aim of this activity was to develop two stove models- wood and charcoal- which offer improvements over locally produced models with respect to thermal efficiency, emissions and safety. Thermal efficiency for both stoves had to reach at least Tier 2 of IWA stove rating structure.

This activity began with recruiting a stove designer to support the stove design process. The recruitment was carried out in a transparent, competitive manner through ToRs which were widely circulated to accord equal opportunity to all interested parties. The ToRs spelt the activities under the assignment, qualifications required and the timelines for the assignment.

The call attracted several applicants and following a rigorous review of applications, Kenya Stove Works, a biomass stove Design and Manufacture Company based in Nairobi was selected due to its wide experience in stove design and testing for BoP markets, knowledge of stove manufacturing techniques, capacity to handle manufacturing work at proto-typing stages, and thorough knowledge of Kenyan cookstove market, cooking habits and end-user preferences. The engagement contract to commence the design support work was signed in October 2013.

It was agreed that though the assignment was about stove design, the work would avoid 're-inventing the wheel', and aim to improve on thermal efficiency, emissions and safety properties of local stove models while striving to retain all their positive attributes such as affordability and user-friendliness.

3.2 Selection of baseline stoves

The consultant started off with visits to Central region for initial contacts with entrepreneurs in order to understand the specific manufacturing environments and contexts. Thereafter, *Kenya ceramic Jiko (KCJ)* and *Jiko Kisasa portable* were selected as the baseline charcoal and wood stoves respectively against which improvements on the new designs would be benchmarked.

KCJ is a popular stove with Kenyan urban households whose design was borrowed from *Thai bucket* stove. Introduced to the Kenyan market in late 1970's, *KCJ* is regarded as one of the most successful urban projects in developing countries and the design has been replicated in Uganda, Tanzania, Rwanda, Ethiopia and Senegal. By the year 1995, an estimated 700,000 units had been disseminated in Kenya representing a penetration rate of 16.8% and 56% of all households and urban households respectively (Westhoff et al.1995). There is absence of current data on KCJ uptake levels but anecdotal evidence suggests high adoption in almost all urban and rural households that consume charcoal. The stove is available in three sizes: small, standard and medium and the price range is between 3 to 10 USD. The stove has impressive thermal efficiency of between 28-35% but scores low on carbon monoxide (CO)[1] emissions. The main focus on this stove therefore was to scale down CO emissions as efficiency levels are satisfactory.

Kisasa stove was introduced in Kenyan market in the early 1990s. Previously available in a fixed version, local innovation has led to the development of the current portable version. Made of a ceramic liner encased in a metallic jacket, *Kisasa* is a low-cost, wood burning stove whose price range

[1] Based on WBT's test results from University of Nairobi and KIRDI testing centers. Testing work was commissioned by GVEP International

is 8-10 USD. Kisasa stove, also known as *Upesi* or *Kuni Mbili*, has increasingly established presence in the market and is proving popular amongst rural households. Its thermal efficiency ranges between 18-20% and is characterized by high particulate matter (PM 2.5) emissions[2]. With respect to this stove the aim was improve on both efficiency and emissions.

Plate 1a Kenya Ceramic Jiko

Plate 1b Jiko Kisasa

3.3 Development of first generation prototypes

The consultant began with a technical interrogation of baseline stoves with a view to identifying bottlenecks that could be addressed to yield performance improvement. Table 2 below lists the factors identified as being responsible for the efficiency and emissions shortcomings revealed through WBTs.

Table 2. Main contributor factors to low performance of baseline stoves

[2] WBT's test results from UoN & KIRDI

	Stove	Contributing factors
1.	Jiko Kisasa	▪ The clay liner had excessive thermal mass, which kept the fire cooler for longer, negatively impacting on efficiency and emissions ▪ While the centre of fire was hot, incomplete combustion occurred when the gases released off wood came into contact with a relatively cold clay liner ▪ Heat loss through the clay liner was negatively impacting on efficiency through lost energy ▪ The interface between the stove and cooking pot was not optimized for efficient heat transfer
2.	Kenya Ceramic Jiko	• The clay liner had excessive thermal mass, which kept the fire cooler for longer, negatively impacting on efficiency and emissions • Excessive size of combustion chamber which increased the thermal mass and encouraged over-consumption of charcoal by end-users • Inadequate air flow into the combustion chamber • Relatively cold clay chamber inhibited oxidation of CO to CO2 resulting in excessive high CO levels • Non-optimized interface between the stove and the cooking pot

Based on the above identified bottlenecks, the target to comply with IWA tier 2 standard, end-user anticipations, and manufacturers' skills set and manufacturing capacities, the consultant developed the first wood and charcoal prototypes. These prototypes had the following improvement features.

Table 3. Improvement features incorporated into the first prototypes

	Stove	Improvement features
1.	Wood stove	• Clay liner with thinner walls to reduce thermal mass • Clay/vermiculite insulation mix between the liner and the outer metal casing to minimize heat loss through the surface • A metal concentrator to force combustion of wood volatiles away from the usually cold clay surface into the center of the stove with the aim of reducing products of incomplete combustion • Secondary air via two openings at the front of the stove • Optimized stove to pot heat transfer • A wood rack with air entering underneath the wood • Legs with wide stance to improve on stability

2.	Charcoal stove	• Clay liner with thinner walls to reduce thermal mass • Clay/vermiculite insulation mix between the liner and the outer metal casing to minimize heat loss through the surface • A metal combustion chamber liner for increasing chamber surface temperature and thus reducing CO • A metal grate to reduce thermal mass, increase flow of primary air and hence improve on combustion efficiency • Secondary air through two openings at the front of the stove • Optimized stove to pot heat transfer • Wide stance legs to enhance stability

Plate 2a First wood stove prototype

Plate 2b First charcoal stove prototype

3.4 Prototype testing at University of Nairobi

The prototypes were subjected to WBT tests at UoN testing center to check conformity with IWA tier 2 standards. Though UoN has capacity to only measure thermal efficiency and ambient emission levels, it was preferred to KIRDI due to the latter's low turnaround times. KIRDI, notwithstanding its fully equipped modern laboratory with capacity to apply latest testing methods especially on emissions, has unusually high waiting times and was therefore unreliable in the prototyping process which requires fast generation of test results to inform the next step.

Table 4. Performance of first generation prototypes relative to baseline stoves

Stove	Average thermal efficiency (%)	Average time to boil (mins)	Specific fuel consumption (g/liter)	Average CO exposure (PPM)	Average PM exposure (ug/m3)
Jiko Kisasa	20	20	190	43	1860
First wood prototype	28	19	87	11	297
[redacted]					
Kenya Ceramic Jiko	34	30	68	91	141
First charcoal prototype	35	21	45	46	67

Relative to baseline, the wood stove prototype had its thermal efficiency improve from 20% to 28%. The particulates and CO were also reduced considerably. The charcoal prototype did not register a substantial thermal efficiency improvement over the baseline but it managed to significantly scale down CO and PM emissions. The preliminary results were encouraging as they were in line with the project goals.

3.5 Focus Group Discussions to gain feedback on first prototypes

With impressive lab test results, the next step entailed focus grouping the prototypes with manufacturers and end-users to solicit their views. These forums were hosted at both Central and Kisumu regions. These sessions were informed by the desire to integrate local knowledge, expertise and expectations into the design process. Appreciating local inventiveness and knowledge, the process supports a two-way information exchange path whereby the stove designer learns from the expertise of locals and at the same time gets an opportunity to share proven scientific principles behind a high performing design. Without input from the target audience, a stove project is usually at risk of promoting a static design, effectively robbing itself of a key ingredient for success (Bryden et.al 2006). The manufacturers were to a large extent satisfied with the design configurations and foresaw no challenges to their manufacturing capacities. Their only concern was with respect to provisions for secondary air which necessitated additional metallic components and labour, effectively pushing up the price of the final product. It was thus decided that in light of the concerns and also considering that there was limited access to lab facilities with capacity to optimize secondary air, the concept of secondary air had to be excluded from the designs.

End–users, comprising of a group of women drawn from around the production facilities, were engaged to compare the performance of the prototypes with the respective baseline stoves while cooking the local *Ugali* and *sukuma wiki* staples. Fuels, pots and the cooking practices were standardized as much as it was possible. The manufacturers were also enjoined in this exercise. A number of observations were made and the cooks also put forward several suggestions which could better adapt the stoves to local cooking practices and make them more user-friendly. This feedback is summarized in Table 5 below.

Table 5. Feedback from manufactures & end-users on first prototypes

Wood prototype	Charcoal prototype
• *Manufacturers* foresaw no problems in manufacturing the prototype, however observed that cost could be by having shorter legs • *End-users* expressed reservations with the small size of combustion chamber which reduced restricted big pieces of wood relative to the baseline. This increased the level of tending thereby denying an user a chance to attend to other chores as the food cooks • Stove height was too high, making it unstable and over-exposing the cook to waste heat which is a potential hazard • Lack of enough fire-power as evidenced by half-cooked *Ugali* • A wood rack that was not user- friendly	• *Manufacturers* foresaw no problems in manufacturing the prototype, proposed a reduction in size of the legs • *End-users* largely happy with stoves, particularly on the hot start where it out-performed the KCJ


Plate 3) Manufacturers study the wood prototype during a FGD session at Murang'a

3.6 Development of second iteration prototypes

Following this feedback both the wood and charcoal prototypes underwent the second design iteration. Changes from the first to second iteration wood prototype mainly affected the combustion chamber which was made bigger to allow a larger quantity of firewood per feeding cycle and reduction of the overall stove height in response to instability and clothing fire hazard posed by waste heat.

Apart from changing the legs from wide stance, tall version to small legs on the underside of the stove body- a change that also affected the wood prototype- the charcoal prototype remained largely unmodified.

The central cluster manufacturers were then engaged to fabricate the second generation prototypes using local techniques and tools available in their workshops. The aim was to further assess the appropriateness of the both the components and the materials specified to the tools and skills available. The tasks were, to a large extent, within the manufacturers' skills set and technical capabilities. The only challenge encountered was difficulty in shearing and forming high gauge metals.

Plate 4) Assembling of 2nd iteration prototypes

Plate 5) Charcoal (left) and wood 2nd iteration prototypes

3.7 Second iteration prototype testing at UoN

The second iteration prototypes were subjected to WBTs to evaluate the effect of introduced modifications to performance. Whilst the thermal efficiency of the charcoal prototype remained unchanged at 35%, the wood prototype had its thermal efficiency drop to 20% from 28% in the first iteration. This steep fall in efficiency was attributed to the increase in combustion chamber diameter which had resulted in a larger clay surface area with more thermal mass. This new development was a big spanner in the works as the chamber had been enlarged to accommodate end-users views on the need for a stove that can be re-filled at reasonable intervals to allow the cook attend to other chores without the fire going out. Efficiency had clearly been lost in pursuit of user-satisfaction and this presented a dilemma on which of the two properties would take precedence as the two are equally important. It was later agreed that the best way out was to strike a compromise between both.

Table 6. Performance of second iteration prototypes relative to the first prototypes

Stove	Average thermal efficiency (%)	Average time to boil (mins)	Specific fuel consumption (g/liter)	Average CO exposure (PPM)	Average PM exposure (ug/m3)
First wood prototype	28	19	87	11	297
2nd iteration wood prototype	20	32	143	9	309
First charcoal prototype	35	21	45	46	67
2nd iteration charcoal prototype	35	33	49	35	67

3.8 Further FDGs to gather insights on 2nd iteration prototypes

The prototypes were further focus grouped with manufacturers and end-users form Kisumu cluster. Both groups were happy with the designs and recommended further changes to reduce cost, enhance durability and improve on aesthetics. One such suggestion was replacement of metallic top cover, for both prototypes, with cement/vermiculite composite to eliminate the cost of metal and intensive labour involved in forming it. The stakeholders also proposed introduction of pot supports similar to those of Kenya Ceramic Jiko.

Plate 6) Stakeholders discuss 1st & 2nd iteration prototypes at Kisumu

3.9 Construction of 3rd iteration prototypes

Based on feedback from FDGs and lab results on 2nd iteration prototypes, 3rd iteration prototypes were designed. Two versions of the wood prototype were designed; iterations 3a and 3b. 3a had a smaller combustion chamber similar to the one of 1st iteration prototype but a larger door opening. Iteration 3b had a combustion chamber diameter in between the 1st and 2nd iteration prototypes. The prototypes also incorporated most of the suggestions put forward during the FGDs. Manufacturers from Kisumu and Central were then engaged to fabricate them.

3.10 WBT results on 3rd iteration prototypes

WBT results revealed that tweaking the diameter of the combustion chamber was having a direct implication on thermal efficiency. Iteration 3a which had a smaller-sized diameter performed better at 25% than iteration 3b whose efficiency remained at 20%. It was thus decided that iteration 3a was the best wood design to adopt since it had achieved IWA's Tier 2 efficiency level and had a good compromise of usability and performance.

After the introduction of the changes, the charcoal prototype registered a tolerable decline in efficiency from 35 to 33%. Emissions levels were largely unaffected. It was thus also adopted as the final design.

Table 7. Performance of 3rd iteration prototypes relative to the 2nd prototypes

Stove	Average thermal efficiency (%)	Average time to boil (mins)	Specific fuel consumption (g/liter)	Average CO exposure (PPM)	Average PM exposure (ug/m3)
2nd iteration wood prototype	20	32	143	9	309
3rd iteration wood prototype (3b)	20	31	140	15	648
3rd iteration wood prototype (3a)	25	25	101	10	453
2nd iteration charcoal prototype	35	33	49	35	67
3rd iteration charcoal prototype	33	29	50	40	80

Plate 7) Final stove designs; charcoal (left) and wood (right)

1
- Selection of baseline stoves (Kuni mbili & KCJ)

2
- Technical interrogation of baselines stoves.
- Performance constraints identified

3
- Development of 1st iteration prototypes
- Designed with features to address the constraints

4
- Lab oversight at UoN (both prototypes shows improvement in performance)
- FDGs with end-users and manufacturers
- end-users unhappy with with wood prototype's small fuel chamber

5
- Development of 2nd iteration prototypes
- feedback from FGDs integrated
- manufacturers fabricate the stoves

6
- Lab testing at UoN (wood prototype has its thermal efficiency dip)
- FGDs with end-users and manufacturers
- Further feedback obtained

7
- Development of 3rd iteration prototypes
- Conflict between usability and efficiency on wood stove; a compromise made to accommodate both

8
- Further lab testing at UoN
- Results found satsifactory and prototypes adopted as final designs

Figure 2: Summary of prototyping iterations

3.11 Technical description of new designs

The stoves were aimed at offering improvements in fuel use and emissions at a reasonable price point. The design constraints in the project were achievement of Tier 2 thermal efficiency performance, capping the retail price at $ 20, use of clay liners and alignment to manufactubility abilities of juakali artisans.

Properly sintered clay has relatively good durabity and is inexpensive making it suitable for low cost stoves. Its main drawback is high thermal mass which negates fuel efficiency by absorbing heat from the fire. Additives such as saw dust, pumice, perlite or charcoal dust can be mixed with clay and when fired the organic matter burns out leaving pockets of air resulting in a light weight insulative material (Baldwin. 1987) . This option was tried out through blending clay with saw dust at various ratios but the resulting liners had low strength and the increase in insulative properties did not yield appreciable gain in fuel efficiency. It was therefore decided to use thin clay liners so as to guarantee strength while minimizing thermal mass.

Cost constrained the choice of insulation material and vermiculite was chosen as the most cost-effective material. The vermiculite would be mixed with clay in the ratio of 8 parts clay to 1 part vermiculite to bind its particles together.

Ensuring proper stove geometry is instrumental for optmized stove to cooking pot heat transfer. The flow rate of primary air and efficient heat exchange between hot gases and the pot griddle was prioritized in the designs. Following are design elements specific to each of the stoves.

Wood design: The outer metallic jacket is made of 22 gauge mild steel. Feet, pot-support brackets, door liner and combustion chamber liner are made of 18 gauge mild steel. The wood rack and the pot rests are made of 10mm round bars. Metallic parts are joined by solid rivets. The space between the liner and the metallic body is filled with loosely packed vermiculite-clay insulation matrix. Specific elements to improve performance include: a metallic fire concentrator to force combustibles away from the lay liner and hence attain high-temperatures sufficient for maximum combustion in order to reduce products of incomplete combustion, thinner clay liner with lower thermal mass, thick insulation and a wood rack for sufficient flow of primary air.

Charcoal design: The outer metallic jacket is made of 22 gauge mild steel. Feet, pot-support brackets, door liner and combustion chamber liner are made of 18 gauge mild steel. The charcoal grate is made of 6mm square bars and the pot rests are made of 10mm round bars. Metallic parts are joined by solid rivets. The space between the liner and the metallic body is filled with loosely packed vermiculite-clay insulation matrix.

Specific elements to improve performance include: a metallic fire liner to enable high-temperatures sufficient for maximum combustion in order to reduce CO, thinner clay liner with lower thermal mass, thick insulation and a metallic grate that allows sufficient primary air.

3.12 Production trainings for Spark Fund manufacturers

With the design phase complete, the next activity was to train manufacturers on how to make the stoves. Two trainings were held in Central and Kisumu regions. Each training lasted for two days. The entrepreneurs were provided with production manuals that details the production steps and have parts drawings with dimensions for various components. The entrepreneurs were guided on how to intrepret the drawings and cut metallic templates for use in subsequent production work. Special attention was paid to formulation of vermiculite/clay insulation matrix and assemblage of the stove to the right geometry. The artisans have gained stove fabrication experience over time in the course of producing other stove types and had no difficulties learning. A number of tooling gaps were however identified as the local methods of forming metal into various shapes with tools available are time consuming and hazardous in some applications. These tooling gaps and feasible solutions have been discussed in a subsequent section of this report.

Plate 8) A production training session in Kisumu

3.13 Performance of final designs on IWA standards scale

By the time the design process was getting completed, KIRDI also submitted test results for baseline stoves. To be able to compare the performance of the new deisgns against the baseline stoves on a similar platform, the new designs needed to be tested against the IWA framework. Due to KIRDI's long delays in completing testing work, it was decided to try CREEC testing centre in Uganda. Three samples of each stove design were delivered to CREEC for testing against the IWA standards

Table 8) fuel use[3] : New wood design vs. Kuni Mbili

Stove	Thermal efficiency (%)	Sub-Tier	Low power consumption (MJ/min/l)	Sub-Tier	Overall Tier
Kuni mbili sample 1	16.4%	1	0.07	0	0
Kuni mbili sample 2	17.4%	1	0.06	0	0
New design sample 1	27.9%	2	0.04	1	1
New design sample 2	32.0%	2	0.04	1	1
New design sample 3	33.8%	2	0.05	1	1

Table 9) Fuel use: New charcoal design vs. KCJ

Stove	Thermal efficiency (%)	Sub-Tier	Low power consumption (MJ/min/l)	Sub-Tier	Overall Tier
KCJ sample 1	27.9%	2	0.04	1	1
KCJ sample 2	27.9%	2	0.04	1	1
New design sample 1	34.0%	2	0.01	4	2
New design sample 2	35.6%	3	0.01	4	3
New design sample 3	35.8%	3	0.01	4	3

Table 8) The results show an increase in new wood design's thermal efficiency by at least 10 points. The objective of improving the thermal efficiency to at least 25% so as to qualify to 'sub-tier 2' status was thus achieved. With respect to low power consumption, the new design falls under 'sub-tier 1'. Overall, the new design is rated 'tier 1'. This according to IWA standards denotes measurable improvement over the baseline stoves.

Table 9) As explained earlier, *KCJ has got good* thermal efficiency and the project aim really was to improve on CO emissions. Results do however demonstrate an improvement in thermal efficiency, specific fuel consumption and overall fuel use.

[3] Fuel use is a function of thermal efficiency and specific low power consumption sub-parameters. Its value assumes the lowest value of the two sub-parameters

Table 10) Emissions[4] : New wood design vs. Kuni mbili

Stove	High power PM (mg/MJ$_d$)	Sub-Tier	Low power PM (mg/min/L)	Sub-Tier	High power CO (mg/MJ$_d$)	Sub-Tier	Low power CO (g/min/L)	Sub-Tier	Overall Tier
Kuni mbili sample 1	424.55	1	0.78	4	11.74	1	0.18	1	1
Kuni mbili sample 2	906.68	1	0.91	4	14.12	1	0.21	0	0
New design sample 1	288.34	1	1.61	2	50.94	0	0.47	0	0
New design sample 2	60.57	3	0.45	4	25.3	0	0.41	0	0
New design sample 3	118.28	3	0.49	3	27.79	0	0.39	0	0

The new wood design managed to significantly scale down particulate matter. There was however no improvement on CO emissions. Indeed, the results show that one of the *kuni mbili* samples performed better than the new design. The gain in PM emissions reduction was thus cancelled by the high CO levels and the overall rating on emissions was 'tier 0' denoting absence of improvement over 3 stone open fire.

Table 11)[5] Emissions: New charcoal vs. KCJ

Stove	High power PM (mg/MJ$_d$)	Sub-Tier	Low power PM (mg/min/L)	Sub-Tier	High power CO (mg/MJ$_d$)	Sub-Tier	Low power CO (g/min/L)	Sub-Tier	Overall Tier
KCJ sample 1	49.73	3	0.05	4	18.47	0	0.28	0	0
KCJ sample 2	33.18	4	0.05	4	25.36	0	0.37	0	0
New design sample 1	-20.83	4	-0.24	4	55.76	0	0.15	1	0
New design sample 2	-29.04	4	-0.32	4	51.81	0	0.17	1	0

[4] Emissions are a function of high power PM, low power PM, high power CO and low power CO sub-parameters. Overall rating assumes the lowest value of the four sub-parameters

[5] Negative values due the fact that charcoal emits very low PM emissions and the PEMS used at CREEC are not sensitive to low PM levels. The negative values do not affect the sub-tier rating nevertheless

New design sample 3	-27.68	4	-0.32	4	52.71	0	0.15	1	0

The new charcoal design did not yield any improvements over *KCJ* with respect to emissions. In fact, results do show that the stove emits more CO during the high power phase than the *KCJ*. This was a big drawback as reduction of CO was the overaching objective.

Table 12) Indoor air emissions[6] : New wood designs relative to Kuni Mbili

Stove	Indoor emissions PM (mg/min)	Sub-Tier	Indoor emissions CO (g/min)	Sub-Tier	Overall Tier
Kuni mbili sample 1	47.88	0	1.30	0	0
Kuni mbili sample 2	94.21	0	1.49	0	0
Jiko smart sample 1	21.14	1	3.73	0	0
Jiko Smart sample 2	4.10	3	1.73	0	0
Jiko Smart sample 3	7.24	2	1.91	0	0

As is the case with emissions, the new wood design registered low PM but high CO emissions. The overall tier rating was zero.

Table 13) Indoor air emissions: New charcoal designs relative to KCJ

Stove	Indoor emissions PM (mg/min)	Sub-Tier	Indoor emissions CO (g/min)	Sub-Tier	Overall Tier
KCJ sample 1	3.38	3	1.41	0	0
KCJ sample 2	2.07	3	1.76	0	0
Jiko smart sample 1	-1.07	4	2.85	0	0
Jiko Smart sample 2	-1.45	4	2.63	0	0
Jiko Smart sample 3	-1.42	4	2.69	0	0

The new charcoal design performed poorer than *KCJ* with respect to CO emissions. The reduction in PM was neutralized by the increase in CO and the overall tier rating was a zero.

[6] **Indoor air emissions** refer to the emissions emitted into the kitchen during the test period. **Emissions** on the other hand are the pollutants emitted per unit energy delivered to the cooking pot or emissions per liter of water simmered per minute (WBT protocol, version 4.2.2 2013)

With respect to safety, the new wood design was rated as tier 1 while the new charcoal design was rated as tier 2. KIRDI did not provide safety ratings for the baseline stoves and therefore it was not possible to make comparisons on improvement or lack of it.

3.14 Field testing results

Field-based KPT tests were commissioned to test the new designs under real cooking conditions and ascertain if indeed the fuel savings advantages reported by WBT results were replicable in households. The study was conducted in Kisumu and Murang'a areas where a total of 28 households were sampled. The study employed a paired sample approach whereby households participated in both baseline and after-intervention phases.

Table 14: Household fuel and energy use; new wood design vs. baseline stoves

Firewood				
	Fuel Use		Energy Use	
	Firewood (Kg/HH/day	Firewood (kg/SA/day)	Firewood (MJ/HH/day)	Firewood (MJ/SA/day)
Traditional Stove (28)*	5.5±2.2	2.7±0.7	106.5±43.9	38.4±20.5
New wood design (28)	3.7±1.5	2.5±0.7	70.5±28.6	24.2±15.2
% Difference	33%	7%	34%	37%
p-value	0.0005	0.426	0.000407	0.000024

*Disaggregation of primary traditional wood stoves by type

Primary Stove	No	%
3-stone	17	60
Improved wood stove**	11	40
Total	28	100

** Improved wood stoves include, (Maendeleo, Jiko Kisasa, Upesi and others)

Table 15: Household fuel and energy use; new charcoal design vs. baseline stoves

Charcoal				
	Fuel Use		Energy Use	
	Charcoal (Kg/HH/day	Charcoal (kg/SA/day)	Charcoal (MJ/HH/day)	Charcoal (MJ/SA/day)
Traditional Stove (28)***	1.3±0.9	0.4±0.2	38.6±24.5	11.2±4.4
New charcoal design (28)	1.1±0.8	0.3±0.2	32.9±21.6	10.1±6.0
% Difference	15%	25%	15%	10%
p-value	0.008	0.062	0.043	0.314

*** All the 28 baseline charcoal stoves were KCJs

Out of the 28 households in Table 14 above, 60% used 3-stone fire while the remaining 40 % owned an improved stove. These improved stoves were portable and fixed versions of *Maendeleo, Jiko Kisasa* and *Upesi*. The results show that, relative to the baseline wood stoves, households adopting the *new wood stove* and using it exclusively can save up to 33% of their daily wood consumption. Similarly, those households switching to *new charcoal design* from *KCJ* can save up to 15% of daily charcoal consumption (Table 15).

The study also investigated new designs' usability aspects and reported that end-users hailed its fuel saving characteristics and were content with speed of cooking. They however expressed dissatisfaction in that the *new wood design* could not warm the space during cold season, required more time to start and could not sufficiently light the rooms at night. These concerns were mostly raised by users of 3-stone fire as the stove offers all these benefits but at the expense of gross fuel inefficiency.

The field feedback also recommended consumer education on best stove operation practices. It was observed for instance that some end-users opted to use the new wood stove without the metallic fire concentrator which helps clean up combustion. Also recommended was the need to educate end-users on importance of using the stoves in well ventilated environments notwithstanding that they are 'improved' versions.

3.15 Challenges experienced

The first challenge in this phase was lack of a stove testing facility that could provide test results benchmarked against the IWA standards during the prototyping phase at short turnaround times. Due to KIRDI's long turnaround times, the project had to rely on UoN facility which lacks capacity to measure the parameters specified under IWA standards save for thermal efficiency and ambient emission concentrations. It is true that UoN testing lab was indispensable to the design process but the results generated only helped optimize thermal efficiency. There lacked information to optimize emissions. This would haunt the project at later stages when results from CREEC testing center showed that the designs were emitting higher CO than the baseline stoves. Had this been revealed at the prototyping level, the consultant would have addressed it. Owing to this challenge also, the possibility of introducing secondary air to clean up combustion had to be abandoned at the preliminary stages.

The second challenge related to balancing the design parameters of performance, usability and cost. The project aim was to design fairly improved stoves that are available at a modest price and which are adapted to local cooking needs and practices. For perfomance to improve, certain materials which inadvertently increase the cost, have to be used. For example, a stove made exclusively of clay will be cheaper but low-performing while one that incorporates metal and insulation is high-performing but more expensive. Again when certain features are introduced to make the stove user-friendly, the performance ends up being compromised. This was the case with the wood design, whereby when end-users' request to increase fuel chamber to accommodate large pieces of wood was granted, thermal efficiency dropped from 28% to 20%. This inherent conflict amongst the three design parameters led to several prototying iterations which ate into time for other activities and ultimately delayed project completion. The wood stove was the most affected.

The third challenge was presented by use of clay liners. From the standpoint of cost, strength and durability, clay is a good material for stove liners. However, from the stand point of efficency, clay has high thermal mass which erodes thermal efficiency. The project settled for thin-walled liners to mitigate against the challenge. Clay liners also take a relatively long time to cure and the process is weather sensitive (a minimum of 21 days when the weather is dry). Every time a new prototype was developed, at least a month of dead time had to elapse so as to mould, cure and fire the liners. This ended up slowing the pace of the design process.

The last challenge relates to the natural inertia that characterized the partipating enterprises at the beginning. They lacked full conviction that the prototypes would mature into designs with good market appeal. The start was thus somewhat sluggish. However, as the work progressed and their views integrated, they embraced the designs.

3.16 Lessons learnt

Lesson #1: With rocket wood stoves, there exists an intrinsic conflict between user-requirement that the stove accommodates big pieces of wood and thermal efficiency. In the final design, a compromise was reached whereby the combustion chamber was maintained at a relatively small diameter for thermal efficiency but the door size enlarged to allow bigger pieces of wood. It was observed that a 'dirty' stove which allows the cook room to load more firewood and therefore step away from emissions is better than 'a barely improved stove' which forces the cook to remain around the stove and tend the fire. This means that if a stove demands high-level stoking, then its emissions must be kept at minimum as the cook is inevitably over-exposed.

Lesson #2: Amount of wood, its dimensions (length and width), how it is arranged and how it is fed into the the stove has a significant bearing on emissions and efficiency. Longer wood that pre-warms as it is fed into the stove helps to improve combustion. Excessive disturbance of the wood during stoking also increases the PM. It is only the burning part of the of the wood that should be in contact with the fire. Heating non-burning wood results in smoke.

Lesson #3: Choice of technology and delivery systems: The choice of designs should not solely be based on engineering principles and laboratory experiments. Instead, design work should endeavour to improve the local technologies that are already known and accepted. In this project, local popular versions of *Kuni mbili* and *KCJ* were selected as the baseline stoves against which improvement would be benchmarked. A totally new design would have been unfamiliar with the end-users and there is a high likelihood that it would not have met their perceived needs.

Lesson #4: In stove design work, emphasis should be not be on optimizing all the factors but rather on developing an acceptable product which strikes a compromise between the attributes of cost, performance and usability. The resultant design may be *good* but not the *best*. After all, 'the best can be the enemy of the good'. In this project, the wood design tried to balance all these attributes by incorporating views from end-users on usability and still managed to introduce a good level of improvement in thermal efficiency.

Lesson #5: Involvement of target groups is a must; without contribution from the community that will be producing, promoting and using the stoves, a project is usually deprived of a key input for success. An interactive process enables the stove designer integrate local knowledge and expertise with engineering principles to create a product which is not only high-performing but also adapted to local cooking practices and needs. Giving the end-users a prominent role in the design phase helps integrate their preferences and expectations. Actively involving manufacturers motivates them to produce and disseminate the stoves using their existing distribution infrastructures. In this project, the few FDGs conducted brought to the fore key insights that were instrumental in refining the prototypes. Where time and resources allow, extensive stakeholder involvement should be an integral component of a stove design process.

Lesson #6: Use of chimneys in the kitchens/ cooking in open places: all stoves, not withstanding degree of improvement will always emit some level of emissions. The wood design in this project managed to reduce the PM but failed to contain the CO. In fact, new charcoal design performed poorer than *KCJ* with respect to CO emissions, despite all the resources committed to the re-design process. End-users should be sensitized that even 'improved cookstoves' need to be operated in well ventilated environments.

Lesson #7: Clay for liners: clay from different regions have different shrinkage rates. Due to this reason, moulds should be manufactured by local artisans so as to correctly account for shrinkage rates and produce fired liners of the specified dimensions. Clay has a set back in its high thermal mass but has other advantages like low-cost, high strength and durability which makes it ideal for stove liners. One way to mitigate the high thermal mass is to limit the thickness of the liners and the size of the combustion chamber as was the case in this project.

Lesson #8: The size, moisture and density of charcoal has a significant impact on stove performance. Lower density, light-weight charcoal with more surface area is much better than big, high-density pieces with low surface area. There is usually preference of big-sized charcoal to small-charcaol by both vendors and end-users. Vendors prefer it because charcoal is usually sold by volume. End-users prefer it because it is convinient to handle during stove loading. This concept of small-sized particles can be exported to briquettes as it is difficult to apply in charcoal.

Lesson #9: Use a grate under the fire for wood stoves: air needs to pass under burning sticks, up through the charcoal, into the fire. A wood grate allows the air to pre-heat before reaching the combustion chamber. Air that passes above the wood sticks is not helpful as it is colder and cools the fire. Stove manufacturers often do not appreciate the importance of a wood rack and most wood stoves usually lack one. There is need therefore for more sensitization on its role in stove performance.

Lesson #10: A stove design can be a lengthy, challenging process with numerous iterations. The process is further complicated by absence of a well-equipped testing facility that can punctually generate test results. Projects with a stove design component should be accorded enough time so as to factor in the uncertainities around performance optimization process (1 year minimum for design). In this project, the design phase overran the initial allocated time, delaying other activities that were dependent on its completion, finally necessisating an extension of 3 months.

3.17 Recommendations for further work

To further enhance the perfomance of these designs, there are a number of design and delivery constraints which can be addressed through further modification work. The re-design work will require additional resources and GVEP would greatly appreciate financial support from the Alliance to facilitate this.

Reducing high CO levels: Both the wood and charcoal designs are characterized by very high CO levels. There is need to explore ways of reducing the CO as the stoves have already been released into the market. CO is a key product of incomplete combustion responsible for household air pollution with significant disease burden (WHO 2014).

Diameter of the rocket stove: It has been noted that the wood stove owing to its height and large diameter uses a lot of vermiculite. The large diameter was chosen so as to improve stove stability and enhance safety. Vermiculite is itself expensive and unavailable in many remote rural areas where majority of stove artisans are located. The diameter can be reduced in order to minimize the amount of vermiculite and metal and hence the cost of stove but it calls for additional focus grouping and lab testing so as not to compromise efficiency and safety.

Insulation: Due to design and cost constraints, vermiculite was chosen as the insulation material. Vermiculite is a good insulator but it is expensive to the local stove assemblers. Factories producing vermiculite are only found around Nairobi. A bag of vermiculite in Nairobi sells at around KES 1200 ($ 14) with the cost shooting to KES 1600 ($ 19) in distant places like Kisumu due to transport costs. Manufacturers intending to assemble a large batch have to commit sizeable financial resources to order several bags all the way from Nairobi. Only few of the businesses currently producing the new design stoves have the capital to purchase vermiculite in bulk. The high cost of vermiculite and its inavailability at the local levels has negatively affected production.

Another challenge with loose vermiculite is that it flows easily through small openings. To manage this, wet clay was chosen as the binder to hold its particles together. The challenge with vermiculite/clay mixture is that it takes a long time to cure and renders the stove very heavy. A properly cured wood stove weighs about 20Kgs. The high weight has been a challenge to enterprises during transportation to the market and to end-users while transporting from market to homes.

Enterprises from Kisumu region have replaced clay with rice husks ash. The resulting matrix is much lighter and this has reduced the weight of the stove. This option that can be pursued further to evaluate the effect on performance as well as map other such cost-effective, locally available materials which can be blended with vermiculite or used exclusively.

Clay liners: A design innovations with stoves is the concept of using thinner clay liners to reduce thermal mass. More work needs to be done to evaluate how thin a clay liner can be made without compromising its structural integrity. The option of blending clay with saw dust to reduce thermal mass was also tried but abandoned after lack of a major breakthrough. It is however, still believed that this in an area that can be pursued further to deeply understand the effects of additives like sawdust or chardust on thermal efficiency.

Secondary air: Secondary air was initially part of the design concepts but the idea was abandoned due to time limitations and lack of access to a laboratory with capacity to optimize efficiently. Secondary air is important for improving combustion efficiency and reducing products of incomplete combustion and can be a potential measure against the high CO levels. With a cost-benefit analysis of the impact, secondary air could still be incorporated and optimized in future designs.

4 Marketing

4.1 Marketing support given under the Spark fund project

In the course of design phase, efforts were made to gradually introduce the stoves to the market through marketing activites promoting other stove models. The prototypes under development were exhibited at various promotional events and this initial feedback was important in gauging and predicting the market reaction once the final designs would be commissioned. Feedback on the stoves from potential consumers at such marketing events was largely positive. The wood stove in particular was proving popular, with reports of customers waiting several hours to be able to buy the stoves that had been brought along for demonstration purposes. The stoves were exhibited in 6 such events.

After finalizing design work, the enterprises were supported to produce 10 stoves each for initial marketing and promotional efforts. While producing the stoves, the manufacturers would get a chance to practice and refine the skills they had learnt during the production trainings. The support was also aimed at circumventing the financial barrier of obtaining the materials to start off which was holding back most entrepreneurs. It was calculated that profits from the initial sales would be invested back into more materials for further production.

Mareco consultants were then competitively engaged to develop effective, low-cost and sustainable strategies of introducing the stoves into the market. The strategy recommended use of paid, owned and earned media to introduce the stoves into the market and communicate their benefits. Specific recommendations were stoves branding, market development activities, advertising in vernacular radio stations, market day road shows, competition demos, partnering with financial institutions to arrange 'easy payment plans', marketing materials for entrepreneurs, production guides for entrepreneurs and a brand video that delivers the brand story. Acting on these recommendations;

- The stoves were christened '**Jiko Smart'**. This brand name was proposed by entrepreneurs themselves and was adopted on account of uniqueness and that it communicates the 'smart' fuel efficiency and emission characteristics that differentiate the brand from others.
- There were held 6 market development activities aimed at introducing the stoves to the market. These activities are as summarized in table 16.

Table 16: Market development activities to introduce Jiko Smarts into the market

Event	Location	Stoves sold
Marketing development	Awendo, Kisumu	91
Marketing development	Kakamega	55
Marketing development	Laikipia	32
Marketing development	Loitoktok	30
Official launch for Kisumu cluster	Kakamega	3
Official launch for Central cluster	ASK show, Nairobi	39

Total	250

- Two talk shows were held at popular vernacular radio stations to promote the Jiko Smart stoves. The first talk show was at *Kameme* radio station that broadcasts mainly into Central region. The second talk show was at *Radio Lake Victoria* which broadcasts into Kisumu cluster. At the shows, two entrepreneurs from the respective regions and a GVEP staff engaged listeners for an hour explaining efficiency, emissions and economic benefits of Jiko Smart stoves.
- Pamphlets and business cards for entrepreneurs. The pamphlets communicate the distinct advantages of the stoves. The business cards are instrumental in networking the entrepreneurs with prospective clients. A total of 7500 pamphlets and 3600 business cards were made and distributed to the 12 entrepreneurs.
- A brand video which recounts the brand story. This video captures the impact of Jiko Smart stoves at manufacturers and end-users levels with emphasis on transformational impact in household's cooking experiences. The video will aid entrepreneurs in communicating the message on stove benefits while approaching prospective clients like financial institutions, community groups and other groups of interest. The video can be accessed through this link: **https://www.youtube.com/watch?v=7d6aY_gnC6Y**
- Production manuals distributed to 12 entrepreneurs. These manuals document materials specifications and steps involved in fabricating the stoves and will be important in enhancing standardization.

4.2 Post Spark fund marketing support and sustainability question

4.2.1 Innovative result-oriented marketing model

After the Spark Fund ended in September last year, the enterprises continued receiving marketing support to expand Jiko Smart's market share through the larger CARE2 program. This has mainly been through market development activities (MDAs) and business linkages with stove retailers.

Through the MDAs, entrepreneurs are usually facilitated to exhibit and showcase products during local market days. Previously, GVEP used to 'own' these activities whereby all logistical costs involved (venue, transport, local permits, security and public address system) could be catered for and local communities sensitized about the availability of stoves in the market prior to that market day. It was later realized that this model had a top-bottom approach with little or no ownership by the enterprises as the process was largely driven by GVEP. From the year 2015, a new, more result-oriented marketing-support model which calls for ownership and cost-sharing from the enterprises was adopted. The new model is placing greater emphasis on exploration of niche markets through organized groups such as flower farms, sugar factories, tea estates, women groups, saccos and FSAs. The entrepreneurs are normally trained on pitching the marketing messages and sponsored to travel to site and sell their stoves. The timing for such events coincides with periods when the group members have wherewithal to purchase e.g. during payment days for farm produce delivered to factories. A large proportion of sales realized in year 2015 are attributable to the new marketing approach.

4.2.2 Business opportunities through value chain linkages

Post Spark-Fund project, a total of **27** MDAs have been carried out in Central and Kisumu clusters. The enterprises have also been linked with retailers outside their geographical domains in a bid to disperse the distribution outlets throughout the country. Through these business linkages, a total of **32** retailers are now actively buying Jiko Smarts from the producers and stocking them at their outlets. The list of these retailers is contained in **annex (1)**.

4.2.3 Jiko Smart's scale-up and scale-out project

In May 2015, GVEP secured a grant of 43,050 $ from The Adventures Project to implement a 12 months stove project in Kenya. The project aims at increasing uptake of *Jiko Smarts* in Kenyan households through market activation initiatives to create demand and training of more producers to strengthen supply. The Adventures project is building on the achievements of Spark Fund 1 project by supporting 11 out the 12 enterprises which benefited from the Spark fund project upscale production and dissemination through innovative and result-oriented market stimulation initiatives. The project will also benefit 8 high-potential PDP3 enterprises with production skills as well as initial production and market support to further strengthen supply and expand the distribution network.

All these initiatives have raised awareness about *Jiko Smart,* increased its market presence and will help accelerate the adoption rate. However, the efforts are far from creating the level of demand that would translate into large scale adoption. It is in fact feared that in absence of further market prop-up, the current demand may not be enough to sustain the *Jiko Smart* initiative over the long-term. There is hence need for more market activation in order to stimulate adequate demand that will yield more business for the enterprises. An effective stove marketing calls for sufficient capital which most micro-enterprises unfortunately lack.

The current focus has been on 9 main enterprises in Central and Kisumu clusters which are relied upon to serve the entire Kenyan market. This narrow supply base underscores the need to train more enterprises in other parts of the country, and in effect strengthen and disperse the distribution outlets. An expanded supply base reinforced with aggressive promotional campaigns will significantly scale-up adoption.

GVEP would therefore welcome more support from the Alliance in a partnership that would whet the demand further and get the stoves fully integrated in the product portfolios of most stove assemblers in the country.

4.3 Jiko Smart sales and production figures

Out of the 12 entrepreneurs initially recruited into the project, 11 are actively producing and selling *Jiko Smarts.* One enterprise, JMM Clay Stove producers has been experiencing a sharp decline in total production output since the beginning of this year with zero sales for *Jiko Smart*. This situation is suspected to be as a result of both internal (management and leadership gaps-proprietor currently confronting a range of personal challenges, working capital constraints etc.) and external (competition, absence of aggressive marketing etc.) factors. Up to end of June this year, **4,469** units have been produced and **3,153** units sold. Annex **2** disaggregates this data by enterprises.

4.3.1 Production and Sales trends

4.3.1.1 Production

Table 17: Production figures (September 2014 to June 2015)

	July to Sept 2014	Oct to Dec 2014	Jan to March 2015	April to June 2015	
Name of Enterprise	**# produced**	**# produced**	**# produced**	**# produced**	**Totals**
Equator Fuel Wood Energy Saving	120	90	80	115	**405**
SoS Production Center	420	100	150	115	**785**
JMM Clay Stove Producers	100	50	20	0	**170**
Riumbai-ini Energy Saving Stoves	170	105	240	106	**621**
Cinda Juakali	140	70	90	90	**390**
Omollo Works	112	200	273	320	**905**
Lakenet Energy Solutions	44	15	77	189	**325**
Ekero Jiko Supplies	120	0	30	96	**246**
Nyausonga Works	44	48	83	60	**235**
Ona na Macho Workshop	98	41	83	81	**303**
Nyamasaria Widows & Orphans	0	0	0	84	**84**
Keyo Pottery Enterprise	200	0	0	780	**980**
Nyamasaria Widows & Orphans	351	130	50	810	**1341**
Total (stoves)	**1368**	**719**	**1126**	1256	**4469**
Total (liners)	551	130	50	1590	**2321**
	Liners distinguished by yellow color				

4.3.1.2 Production trend analysis

The highest output was registered in the July to September 2014 quarter. The reason behind the high output yet production had just begun is the grant in form of materials and labour which facilitated production of 750 units (refer to table 12). The entrepreneurs' own resources only accounted for 618 units out of the total 1368 units reported for the period. Between October and December in the same year, 719 units were produced. Although this represented a drop in the overall production relative to the last quarter, all the units had been produced with entrepreneurs own resources. In 2015, the output has progressively increased, a trend expected to be maintained if the promotional efforts to create awareness and conquer new markets are sustained and more producers trained.

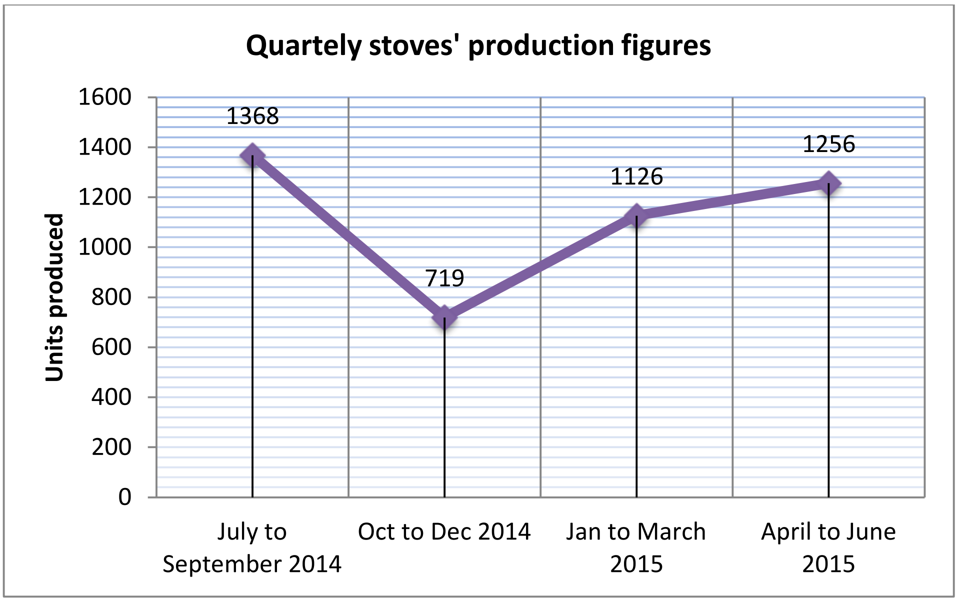

Figure 3: production trend (September 2014 to June 2015)

4.3.1.3 Sales

Table 18: Sales (September 2014 to June 2015)

	July to Sept 2014	Oct to Dec 2014	Jan to March 2015	April to June 2015	
Name of Enterprise	# sold	# sold	# sold	# sold	**Totals**
Equator Fuel Wood Energy Saving	49	31	134	94	**308**
SoS Production Center	286	40	80	97	**503**
JMM Clay Stove Producers	15	0	0	0	**15**
Riumbai-ini Energy Saving Stoves	53	41	92	78	**264**
Cinda Juakali	44	28	69	68	**209**
Omollo Works	102	182	270	275	**829**
Lakenet Energy Solutions	44	11	77	172	**304**
Ekero Jiko Supplies	20	22	30	96	**168**
Nyausonga Works	44	45	81	32	**202**
Ona na Macho Workshop	91	41	81	63	**276**
Nyamasaria Widows & Orphans	0	0	0	75	**75**
Keyo Pottery Enterprise	200	0	0	470	**670**
Nyamasaria Widows & Orphans	351	30	50	460	**891**
Total (stoves)	**748**	**441**	**914**	1050	**3153**
Total (liners)	551	30	50	930	**1561**

Liners distinguished by yellow color

4.3.1.4 Sales trend analysis

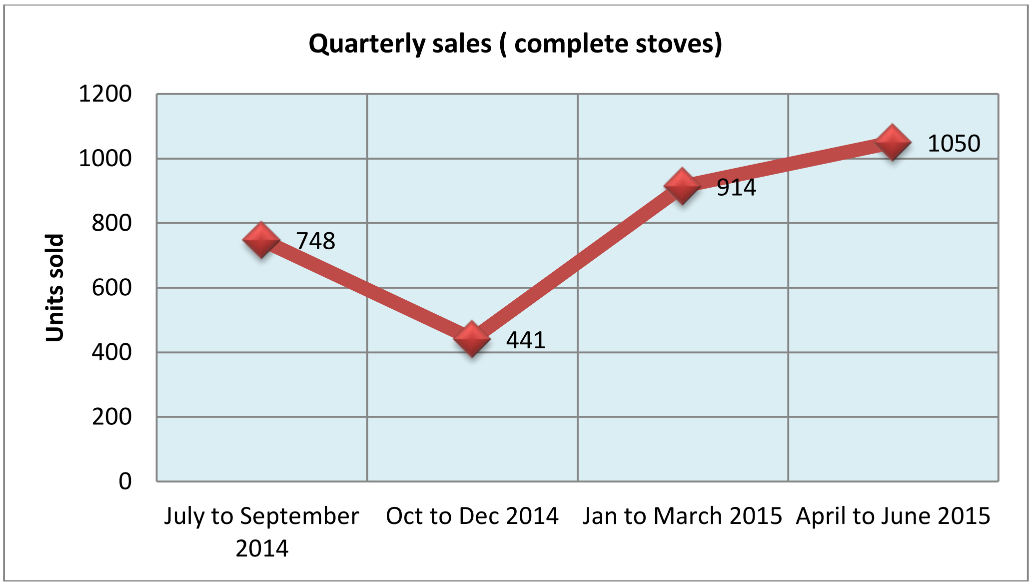

Figure 4: Sales trend (September 2014 to June 2015)

For a product new in the market, the sales registered in July to September 2014 period were quite impressive. It must however be noted that recommendations from the marketing strategy (radio talk shows, MDAs, promotional materials etc.) were implemented during this period. The decline experienced in the subsequent quarter can be attributed to market settlement following the withdrawal of heightened market activation characterizing the previous quarter. The steady growth in sales registered in half of year 2015 is attributable to the various marketing initiatives discussed under the 'post Spark-fund marketing support and sustainability question' section. Another notable development is that *Nyamasaria*, previously exclusive liner producers, have now diversified into *Jiko Smart* and sold 75 units in the April to June quarter.

Notwithstanding the growth in sales, the overall sales are still very low when compared to baseline *Kuni mbili* and *KCJ* models. As previously explained, more effort is required on both demand and supply sides of the market equation. Interventions to activate further demand while at the same time transferring the skills to more producers to strengthen the supply are required so as to push the *Jiko Smart* initiative to a level that would guarantee sustainability once the external support ceases.

4.4 Challenges experienced

Most potential end-users are finding *Jiko Smart* too expensive. The retail prices are KES 2000 ($ 24) and 1500 ($ 18) for the wood and charcoal stoves respectively. Whilst the potential customers are impressed with the benefits offered by Jiko Smart such as fuel savings, reduced PM emissions and increased durability, they have always complained that the prices should be limited to KES 1000 ($ 12). This has tempted some enterprises to deviate from specifications by opting for lower-gauge metal to lower the cost of production and hence make the stove more affordable.

Inability by most enterprises to raise enough finances to roll out aggressive marketing initiatives on their own has been a challenge. Marketing is an expensive undertaking which requires substantial resources. Further, stoves are bulky, high-weight, low-value items which attract high transport costs whenever long distances are involved, effectively limiting the geographical extent to which enterprises can travel to exhibit to prospective customers.

Stove entrepreneurs have for many years relied on traditional market outlets and strategies. These market outlets include selling to end-users, retailers and distributors with marketing mainly done through shop displays and or exhibiting in local markets during market days. The current environment however dictates a change of strategy to approaches that deliver marketing messages to potential customers (exhibition in new far-away virgin markets, pitching to organized groups etc.) rather than sitting back and waiting for potential buyers to 'find-out' about the product. The new approach is impactful but also expensive rendering it unaffordable to most enterprises.

As earlier mentioned, the current formulation of the insulation matrix has rendered *Jiko Smart* too heavy, especially so the wood type. A properly cured *Jiko Smart* wood weighs close to 20Kgs. The high weight has negatively impacted marketing due to high transport costs. Some end-users are also discouraged by this weight since they would be forced to pay an extra-cost while transporting the stove from point of purchase to their homes (e.g hire a *boda boda* from bus stage to the house).

4.5 Lessons learnt

Lesson#1. Marketing approach: Over the recent past, there has been heightened sensitization on improved cookstoves and their benefits. However, awareness levels on benefits are still low. Further, prospective customers are best persuaded to purchase a product when they physically 'see' it and hear about its benefits. The message about improved cookstoves should therefore be reinforced with demonstrations so as to fully convince the end-users that they are real benefits offered by improved stoves.

Lesson#2. Organized groups offer an efficient and cost-effective marketing channel. Groups such as flower farms, sugar factories, tea estates, women groups, saccos and FSAs normally have many members who can be reached without incurring advertising and mobilization costs. These groups are therefore effective platforms for promoting stoves while keeping the marketing budget at a minimum. The leaders of the groups are important opinion shapers whose influence can be leveraged to win-over the members. The FSA model being employed to promote *Jiko Smart* is exploiting this channel.

Lesson#3. Pricing point and consumer financing; the single-most important factor that influence stove adoption is the cost. For instance, the current cost of *Jiko Smart* has been identified as a key barrier to large-scale adoption, necessitating use of consumer financing schemes. Whilst there are only a few financial institutions in Kenya with nascent energy financing schemes, majority of end-users would actually be hesitant to take conventional loans to purchase a cook stove (GACC. 2014). They instead prefer low-risk options such as groups and village saving schemes. There is therefore need to explore low-risk, innovative financing schemes that can help overcome the affordability barrier. One enterprise, EFWES, is offering such a scheme through village women groups. The groups are required to pay a 30% deposit of the value of *Jiko Smart* ordered before a delivery can be made. The balance is then cleared within six to nine months through monthly remittances.

Lesson#4. The weight of a portable stove is an important attribute which customers consider before buying a stove. Our experience with *Jiko Smart* shows that ideally, a stove should neither be too heavy nor too light. If it is too light, there is likelihood that it will lack stability especially while cooking meals that require vigorous stirring. If it is too heavy, then its portability status is compromised, disadvantaging both manufacturers and end-users in high transport costs and handling inconveniences respectively. There is need to carefully balance the weight of a stove at the design stage.

Lesson#5. Women are key drivers of cook stove adoption. Women are primarily responsible for cooking and are therefore central to cook stove adoption. For women, cooking defines their roles as mothers and wives, and is an integral part of their daily lives. Marketing initiatives should hence target women audiences more, particularly through their local welfare groups.

Lesson#6: Need for adapting improved cook stoves to local cooking needs and expectations. End-users have certain expectations which must be met before they can find new improved stoves applicable. Some of these desired attributes include ability to light fast, cook fast with little fuel, demand minimal tending to allow room for other chores, and ability to regulate heat easily. Addressing these needs is important for achieving adoption and sustained use of improved cook stoves.

Lesson#7. While crafting marketing messages, there is need to emphasize direct benefits that the end-users can easily understand and apply to their cooking contexts. Examples include contextualized fuel savings benefits (e.g. from 3 trips to 1 trip per week to forage for firewood or a reduction in daily charcoal budget by KES 50 ($ 0.6)), cleaner kitchens with no soot (as a result of reduction in emissions), safe handling while cooking and durability properties.

Lesson#8. It is important to enhance quality standards and offer after sales services to manage the negative perceptions about improved cook stoves often emanating from past bad experiences. The manufacturers should adhere to quality standards. They should further disclose to the buyers about the after-sale services at the time of closing on a sale. Our monitoring has revealed that they are cooks using the *Jiko smart wood* without the metallic fire concentrator after it wears out, oblivious of the fact that a new component can be purchased from the manufacturer. Retailers and stockists should also have mechanisms in place to ensure that stoves distributed via their outlets are promptly repaired.

4.6 Recommendations

Before customers can purchase an improved cook stove, they first need to see it and hear about how the stove will add value to their cooking experiences. Marketing is hence indispensable to improved cook stove programs. Marketing is also fairly expensive, especially when using some channels like print and electronic media. Marketing cook stoves is further complicated by the nature of stoves-high weight, high volume and low value products. Improved cook stove programs should therefore always designate a good proportion of the budget to the marketing function.

In marketing, there is need to segment the target market according to the needs and preferences, develop messages that are well resonating and hence tailor strategies that are most effective and efficient.

Consumer financing is also important to help overcome the affordability barrier. Village banks and other localized financial associations are more appealing as they can give asset loans at low interest rates and flexible repayment plans and can be pursued as promising avenues for stove financing. Aggressive marketing when matched with product availability, quality assurance and consumer financing will result in sustainable improved stove uptake.

4.6.1 An example of the Innovative market approaches in marketing Jiko Smart: The FSA Model

The Background: What led to the approach?

The approach was driven by the need to improve the effectiveness, results and impact of GVEP's market development approach. There was also need to overcome Jiko Smart's last mile distribution challenge posed by low consumer awareness, affordability challenge, wrong product perceptions and cultural attachments to traditional cooking methods.

GVEP and K-Rep Development Agency (KDA) entered into partnership to model an effective last mile distribution channel of clean cookstoves through KDA's network of Financial Services Associations (FSAs) and GVEP's network of stove manufacturers.

GVEP's role was to introduce to the relevant FSAs cookstove enterprises working with GVEP and specifically manufacturers of Jiko Smart. KDA's role was to promote the stoves to relevant FSAs which would then purchase and resell the stoves to their members, village banks and Saccos. The FSAs would act as distributors or retailers of the stoves purchased from stove manufacturers.

The Engagement process

The partnership required that KDA would introduce GVEP to the governance, management and group leadership of the relevant FSAs. The relevant FSAs were identified from Homa Bay, Bomet and Makueni counties. The process of engaging the FSAs involved selling the concept of FSAs as a model for last mile distribution of clean energy technologies. This sequence of meetings was as follows;

1. *Meeting with board of directors representing members or shareholders of FSAs under KDA*
2. *Meeting with the management and staff of the FSAs*
3. *Training FSA staff and selected group leaders on the model and the product*
4. *Product demonstration to group members at group level to facilitate adoption*
5. *Facilitation of cookstoves delivery from the entrepreneurs to the FSAs and subsequently to clients*

Objectives

- *Offer Jiko Smart entrepreneurs a unique opportunity to showcase their products for networking and trade*
- *Build a model for last mile distribution of renewable energy technologies especially ICS through the FSAs*
- *To stimulate demand for renewable energy products*

Resources put in by GVEP

GVEP provided the following services:

- *With the support of KDA, rolled out a capacity building, training and sensitization programme for FSA staff*
- *Provided training modules to FSAs*
- *Supported the relevant FSAs and entrepreneurs to build productive commercial relationships*

Achievements so far

- *Demand for energy products stimulated*
- *The buy-in to the model of last mile distribution through the FSAs by the group officials of the FSAs achieved in 6 FSAs namely Siongiroi, Uswet, Great Wang' chieng, Homabay, Muungano and Makindu*
- *Board members, group officials and staff of the FSAs visited trained on the model and the product*
- *Increased sales for participating entrepreneurs. A total of ksh 1,841,930 ($ 21,670) realized in sales in a period of 5 months*
- *Increased customer base for entrepreneurs. A total of 6 FSAs with over 20,000 members reached and sensitized on clean energy products*
- *New dealers/stockists identified*
- *New business networks formed*

Challenges

1. *Most FSAs approached had already approved their 2015 Business plans and could not factor in new targets for the loans officers.*
2. *Some FSAs had liquidity challenges to allow for disbursement of the cookstoves as asset loans.*
3. *Transportation of the cookstoves to group members was a challenge because of their high weight, rough terrain and often long distances from the FSAs to the group meeting venues.*
4. *The entrepreneurs were sometimes unable to make timely deliveries for orders made.*

Lessons learnt and Recommendations

FSA clients are interested in Jiko Smarts and other ICS although most members are unable to purchase on cash basis. This calls for a loan fund to be availed at the FSA level to facilitate their capacity to disburse Jiko Smarts as assets to members.

Some entrepreneurs may lack adequate capacity to supply the FSAs with cookstoves especially when the liquidity challenge on the part of FSAs is addressed. There is need to further build the capacity of the entrepreneurs to address the challenge of timely product deliveries to the FSAs to avoid stock-outs.

Such partnership with the village banks will enhance adoption of more stoves by households and become efficient channels of last mile distribution. This will also strengthen the working relationship between FSAs and cookstoves entrepreneurs who can also access loans from the FSAs to grow their production and supply chains.

5 Trialling efficient manufacturing and tooling options

Initially, the plan was to conduct research on feasible, cost-effective efficient manufacturing and tooling options that are applicable in small-scale manufacturing contexts and then apply the findings to the subsequent seed grant disbursement phase since a huge share of the grant was to be utilized in tools and small machines. However, when the whole trialling process was mapped out and analysed, it became evident that it would be impractical to implement given the project's timelines. For instance, a total of eight, highest priority machines had been selected for trialling. It was estimated that the procurement process would take approximately one and a half months. The piloting phase would then roughly consume a similar amount of time. The total time required thus was about 3 months. It is worth noting that these were fairly conservative time estimates given that there are many variables that could affect the speed of the process such as lack of adequate and right materials for trialling the machines, high rhythm of work at the enterprises that could limit time and staff availability etcetera. Taking into consideration that the earliest this activity would commence was in May 2014, yet the project was scheduled to close in September 2014, it was decided to abandon the activity and instead train the entrepreneurs and their lead artisans on best manufacturing principles and practices that can be applied to introduce production efficiency in stove manufacturing facilities.

The training was structured into two components. The first component was a one day theoretical training delivered by Kenya Association of Manufacturers. This training focussed on inventory management strategies, workshop layouting, quality control & assurance, production system inefficiencies and introduction to human resource management. The second component was a one day practical demo at Kenya Stove Works (the same company that designed *Jiko Smart*) of stove production employing various machines. Some of these machines, tools and techniques demonstrated include shearing machines (bar shear, plasma cutter and guillotine), bending techniques (sheet & bar benders), forming techniques (forming press & drill press), rolling techniques (slip & bar rolling) and joinery methods (pop riveting, mig and spot welding).

Through the trainings, the entrepreneurs got a chance to learn about principles, practices and methods that can make their businesses more efficient and productive.

Plate 9) An entrepreneur tries his hand at a Plasma cutter at Kenya Stove Works workshop during the practical demo

An insightful trialling exercise would have required ample time (at least six months) so as to be able to procure the machines and pilot all of them with at least each enterprise for a period long enough to allow for detailed and helpful inferences. This was impossible in light of the short project life. A project incorporating such an activity should thus be designed with ample time and the activity allocated not less than six months.

6 Disbursement of seed fund grants

6.1 Introduction

The seed grant was aimed at capacity building the enterprises with support that could enable them fully incorporate *Jiko Smart* into their product mix as well as enhance their overall production capacities. It was acknowledged that the high-gauge metallic materials specified for *Jiko Smart* would require simple tools and machinery for the stoves to be produced efficiently. It was further acknowledged that the enterprises would need materials to kick start production as this was a new venture which carried an inherent risk since the demand yet to be proven. It was further figured that such support, though inclined towards production of *Jiko Smart*, would benefit the entire business and therefore contribute to overall business growth.

6.2 Disbursement process

A grant disbursement structure which outlined the application process, eligible/ineligible items, review of applications and disbursement procedure was then drafted. Any support granted was to be in kind. The structure also articulated the 60-40 cost-sharing arrangement whereby 60% of the support items would be financed through the grant with the enterprises contributing the remaining 40%. The enterprises were required to lodge in applications for support items that they wished to be assisted purchase. The applications would then to be reviewed by a GVEP's investment committee comprised of business and technical support staff, and a decision communicated on amounts approved for each enterprise. The process of procuring the support items would then be initiated by the enterprises themselves by paying 40% matching amounts to the respective service providers and then present a proof of payment for GVEP to pay the remaining 60%. A copy of this structure is annexed to this report.

In August 2014, about one and a half months to the closure of the project in September, it was realized that there was lack of adequate stock of *Jiko Smarts* at the enterprises to support implementation of the marketing strategy. The entrepreneurs needed to have enough units to service the demand which would be created. It was observed that though the entrepreneurs were taking their time to study the market reaction to *Jiko Smart*, financial constraint was the main obstacle behind the slow integration of Jiko Smart into the product portfolios. It was therefore decided to procure materials, fully financed through the seed grant, for distribution to 10 entrepreneurs to produce a sizeable batch. Compensation for labor costs incurred was also paid to incentivize the enterprises to prioritize this work. The two entrepreneurs from Kisumu (Keyo & Nyamasaria), whose core business line is liner production were also contracted to supply liners to Kisumu group of stove assemblers. This first phase disbursement in form of materials, labor compensation and purchase of liners was financed 100% from the seed fund grant. Table 19 below has a breakdown of the amounts awarded to respective enterprises.

Table 19: Amounts disbursed in form of materials and labor cost, financed 100% from seed fund

Enterprise	No of stoves	Materials (cost & labor)	Labor	Amount awarded (KES)
EFWES	100	108,891.00	20,000.00	128,891.00
SoS Production	100	108,891.00	20,000.00	128,891.00
Riumbai-ini Energy Saving stoves	100	108,891.00	20,000.00	128,891.00
Cinda Jua kali	100	108,891.00	20,000.00	128,891.00
Jmm Clay & Products	50	54,454.00	10,000.00	64,454.00
Ekero Energy Saving Jikos	100	117,780.00	20,000.00	137,780.00
Omollo Works	50	58,899.00	10,000.00	68,899.00
Lakenet Energy Solutions	50	58,899.00	10,000.00	68,899.00
Nyausonga General Works	50	58,899.00	10,000.00	68,899.00
Ona Na Macho	50	58,900.00	10,000.00	68,900.00
Nyamasaria Widows & Orphans	200 liners	30,000.00	0.00	30,000.00
Keyo Pottery	200 liners	30,000.00	0.00	30,000.00
Total				**1,053,395.00**

The first phase of disbursement did contravene the earlier cost-sharing arrangement outlined in the grant structure. However, disbursement of this support to produce the first sizeable batch of stoves was considered necessary since there was a marketing strategy to be implemented and the strict project timelines at this point could not accommodate delays that were inevitable in the event that the enterprises were required to mobilize funds for 40% share of the materials cost.

By the time the first phase disbursement was completed, the enterprises had also submitted grant application forms. The applications were reviewed and respective grant amounts approved after off-setting the amounts that had been awarded in the first round of disbursement. Potential service providers were then identified and quotes for all support items approved were obtained. The enterprises were then informed about the support items which had been approved and the service providers that could supply quality items at competitive prices. However, the enterprises were given room to procure from other providers of their choice, provided such providers had adequate capacity and good reputation in the market.

By the end of the project in September 2014, disbursement of the second phase was yet to commence. This phase was characterized by inordinate delays that were not anticipated. It was planned that the disbursement would take a maximum period of two months. However, the entrepreneurs kept on requesting for more time to mobilize funds for their 40% obligation. By end of year 2014, only one enterprise, EFWES, had paid 40% matching amount for a firing kiln. By February, 2015, a few more enterprises had paid the 40% contribution for one or two of the support items applied for, namely water tanks and workshop expansion materials. As it turned out, these are only support items that would be financed through the cost sharing arrangement.

These items financed through 40-60% cost sharing arrangement and the amounts paid from the seed fund are as shown in Table 20.

Table 20: Support items financed through 40-60% cost sharing arrangement

Enterprise	Item (s) paid for	Item cost (KES)	40% entrepreneur contribution (KES)	60% seed fund contribution (KES)
EFWES	Kiln	210,000.00	84,000.00	126,000.00
SoS Production	Water tank (10m3)	85,000.00	34,000.00	51,000.00
	Workshop expansion materials	117,800.00	47,120.00	70,680.00
Riumbai-ini Energy Saving stoves	Water tank (10m3)	85,000.00	34,000.00	51,000.00
	Workshop expansion materials	95,850.00	38,340.00	57,510.00
Cinda Jua kali	Water tank (10m3)	85,000.00	34,000.00	51,000.00
Keyo Pottery	2 water tanks (10m3)	170,000.00	68,000.00	102,000.00
Total				**509,190.00**

Due to the long delays experienced in getting the entrepreneurs to raise the 40% matching funds, it was decided to re-appraise the enterprises with a view to ascertaining the underlying factors behind the extremely slow uptake of the seed fund. The assessment was carried out by the business support team. To be able to decide on the best course of action, the assessment grouped the enterprises according to the following four categories.

Category a): Enterprises that could afford to pay the 40% requirement by Mid-March 2015 without seeking debt financing. The feedback was that none of the enterprises could afford to beat the mid-March deadline without debt financing.

Category b): Enterprises that could afford to pay the 40% requirement by Mid-March 2015 through debt financing. It was only JMM that qualified for this category. However, it was reported that the entrepreneur was not very enthusiastic about applying for a loan for this purpose. Other entrepreneurs like Lakenet and Nyausonga had loan applications pending bank approval which were intended for uses other than 40% obligation.

Category c): Enterprises **unable** to pay the 40% requirement by Mid-March 2015 because they were servicing loans and hence ineligible for other loans. Nyamasaria, Omollo works, Ona na Macho and EFWES were servicing bank loans at the time.

Category d): Enterprises totally **unable** to pay the 40% requirement by Mid-March 2015 due to factors beyond their control. Ekero, SoS, Riumbai-ini and Cinda cited such impending factors as tied-up capital, cash flow constraints and more urgent financial obligations like school fees. Some also proposed a downward review of matching contribution from 40% to 20%.

With this feedback, it was decided that, in light of the need to conclude the process and taking into consideration that there lacked certainty on the exact time when most entrepreneurs would manage to raise the funds, it was better to disburse the remaining seed grant without 40% matching contribution from the entrepreneurs. It was feared that going by the experience in the preceding six months, the process could drag on endlessly.

The earlier list of support items was reviewed to only include those items that entrepreneurs considered most necessary. The items were however fewer since they were being financed 100% from the seed fund. It was further decided to only include items that could be purchased off-the-shelf in order to speed up the process and leverage on price discounts since several items could be sourced from a single supplier. In fact all the items procured were sourced from only two suppliers.

Table 21: Tools and simple machines granted; financed 100% through the seed grant

Central cluster		Kisumu cluster	
Enterprise	**Support items granted**	**Enterprise**	**Support items granted**
EFWES	• Bar cutter	**Ekero jikos**	• Electric shears
	• Welding machine		• 2 welding machines
	• 4 Tinsnips		• 5 tinsnips
	• Spray painter		• Spray painter
	• Angle grinder		• 2 angle grinders
SoS Production	Electric shears	**Omollo works**	Electric shears
	Bar cutter		Bar cutter
	2 Tinsnips		Welding machine
	Spray painter		5 tinsnips
Riumbai-ini	• Electric shears		Spray painter
	• Bar cutter		Angle grinder
	• 2 Tinsnips	**Lakenet**	• Electric shears
	• Spray painter		• Bar cutter
Cinda	Electric shears		• Welding machine
	Bar cutter		• 3 tinsnips
	Welding machine		• Spray painter
	2 Tinsnips		• Angle grinder
	Spray painter	**Nyausonga**	Electric shears
	Angle grinder		Bar cutter
JMM	• Welding machine		Welding machine
	• 3 Tinsnips		5 tinsnips
	• Spray painter		Spray painter
			Angle grinder
		Nyamasaria	• Workshop
		Keyo	Workshop
			A set of mold

Plate 10) Entrepreneurs collect machines and tools from GVEP office, Nairobi

Table 22 below summarizes the distribution of grant seed amounts to the 12 beneficiary enterprises. The first phase disbursement was in form of materials and labour cost reimbursements for production of the first batch of *Jiko Smarts*. The second disbursement was in two phases. The first phase financed a few items cost-shared with entrepreneurs (Table 20). In the second phase, all the support items given out were financed wholly through the seed fund (Table 21). For a comprehensive account of second disbursement per enterprise including items' unit costs, and specifications where applicable, refer to annex **3**.

Table 22: Distribution of the seed grant to 12 beneficiary enterprises

	First phase (materials & labor) 100% financed	Second phase,60% financed	Second phase, 100% financed	Total grant awarded (KES)
Enterprise	Amount granted	Amount granted	Amount granted	Total
EFWES	128,891.00	126,000.00	141,932.00	396,823.00
SoS Production Center	128,891.00	121,680.00	136,388.00	386,959.00
Riumbai-ini Energy Saving stoves	128,891.00	108,510.00	136,388.00	373,789.00
Cinda Jua kali	128,891.00	51,000.00	203,064.00	382,955.00
Jmm Clay & Products	64,454.00	0.00	97,342.00	161,796.00
Ekero Energy Saving Jikos	137,780.00	0.00	251,482.00	389,262.00
Omollo Works	68,899.00	0.00	208,806.00	277,705.00
Lakenet Energy Solutions	68,899.00	0.00	204,978.00	273,877.00
Nyausonga General Works	68,899.00	0.00	208,806.00	277,705.00
Ona Na Macho	68,900.00	0.00	206,892.00	275,792.00
Nyamasaria Widows & Orphans	30,000.00	0.00	210,000.00	240,000.00
Keyo Pottery Group	30,000.00	102,000.00	227,000.00	359,000.00
	1,053,395.00	**509,190.00**	**2,233,078.00**	**3,795,663.00**

6.3 Impact of the support items on the enterprises

Before the enterprises could assume ownership of the items, they had to commit by way of writing to only use the items for stove production work, to only use the items from their facilities, to inform GVEP while undertaking major repairs and never to dispose-of unless with authorization. Three hand-over ceremonies were also held in Kisumu, Murang'a and Nanyuki which were meant to further publicize existence and availability of *Jiko Smart*. The County government officials, amongst other stakeholders, were invited in an effort to sensitize them about the significant contributions that stove businesses can make to Counties' socio-economic transformation and possible partnership areas.

Most enterprises commissioned the machines immediately they received them. However, there are two enterprises in Kisumu cluster (Nyausonga & Ona na Macho) that are yet to start utilizing the machines due to space constraints and security concerns. Their workshops consist of tiny, semi-permanent *mabati*[7] structures. Since it is not certain on when they will acquire spacious, permanent premises, they have been advised to try and utilize the communal corridors within their workshops or otherwise risk having the items re-possessed.

It is acknowledged that more time will be needed to study and quantify the long-term impacts of the support items on production capacities. However, the following registered/ anticipated impacts can preliminarily be reported:

Table 23: Short-term evaluation of grant support impacts

Support item	Quantity	Beneficiary	Registered/ anticipated impacts
Kiln	1	EFWES	EFWES has been relying on liners outsourced from Murang'a entrepreneurs. They have always incurred huge transportation costs and at times their production schedules disrupted by shortages at Murang'a. With a kiln in place, they will now be able to produce at lower costs and in return enjoy better profit margins. They will also be in firm control of their production plans. The kiln was installed at a piece of land outside Nanyuki town on which the entrepreneur plans to build a spacious production facility. A workshop has since been constructed and the entrepreneur is currently mobilizing women around the area to have them trained on liner moulding. He has also acquired moulds and the production work is planned to start in this month of September.
Water tanks	5	SoS Riumbai-ini Cinda	Clay preparation and formulation require plenty of water. During the dry periods, liner producers spend fairly huge budgets in hiring vans, *boda bodas*[8] or donkey transporters to fetch water.

[7] Mabati is a Kiswahili word for old corrugated iron sheets

[8] A motor cycle

		Keyo (2)	Through harvesting and storing rain water, the water tanks granted have alleviated the water shortage problem.
Workshops	2	Keyo Nyamasaria	Keyo and Nyamasaria are already using their workshops to store curing liners. Space constraint has previously been a significant bottleneck affecting liner production especially during wet seasons. The new workshops have enhanced their output capacities as evidenced by a growth in production level of *Jiko Smart* liners.
Spray painters	10	EFWES SoS Riumbai-ini Cinda JMM Ekero Omollo Lakenet Nyausonga Onana Macho	The entrepreneurs were previously relying on hand brushes to paint the stoves; a slow and laborious application. With paint sprayers, the process is now faster and the surface finish smooth and more appealing. The sprayers have also lowered the cost of production since the amount paid to paint a stove has now reduced by an average of 3 KES ($ 0.04).
Welding machines	9	EFWES Cinda JMM Ekero Omollo Lakenet Nyausonga Onana Macho	Certain *Jiko smart* components can only be fabricated through welding. Previously, most enterprises were outsourcing this function and ended paying more. With the high gauge metal specified, it is also possible to weld the outer cladding and do away with riveting, making the process more efficient and cost-effective ultimately translating into bigger profit margins.
Bar shears	8	EFWES	Bar shearing was identified as the most strenuous and highly hazardous process in the entire stove fabrication process. The

		SoS Riumbai-ini Cinda Omollo Lakenet Nyausonga Onana Macho	artisans had been employing a cold chisel and a ball peen hammer to shear bars. These chisels are often worn out and lacking in grip and can easily cause severe limb injuries. With bar shears, the entrepreneurs are now able to shear thick metal bars efficiently and without the risk of suffering injuries in the process.
Tin-snips	35	All, except Keyo & Nyamasaria	Previously the entrepreneurs were using light shears only suited for light gauge metals. When shearing heavy gauge metal, they were resorting to a chisel and a hammer. Metal shearing has therefore been a laborious and slow process, yet it is a very important step in stove production. The electric shears are highly efficient at shearing metal. Entrepreneurs were also supplied with heavy gauge tin-snips. It has been observed that metal shearing has now greatly improved.
Electric shears	8	SoS Riumbai-ini Cinda Ekero Omollo Lakenet Nyausonga Onana Macho	

6.4 Challenges experienced

The main challenge was inability by enterprises to contribute the required 40% matching amounts. It was observed that whilst there were a few which were genuinely unable to raise the funds, there were others in a position only that they did not prioritize this obligation. This has remained a puzzle as to why the capable enterprises were reluctant to contribute towards a scheme that would enhance their businesses with more efficient production processes. It was suspected that there were a few capable enterprises which deliberately bought time knowing that finally GVEP would consider financing the scheme fully.

This perhaps is a symptom of deeply entrenched 'dependency syndrome' nurtured over the years whereby development organizations are still viewed as sources of 'free aid,' and which will require time and more effort to change.

The second challenge was time constraints, it was not possible to first pilot the select simple machines at enterprises to ascertain the real impact on the production systems. Had piloting been done, the feedback obtained would have been helpful in prioritizing the support items.

6.5 Lessons learnt and recommendations

#1: The enterprises appear more inclined towards production facilities such as kilns, workshops, water tanks- than simple tools and machineries. This is demonstrable from the fact that the partial 40% commitment which was paid by 5 out of the 12 enterprises was for acquisition of such facilities (Table 20). It is worth noting that most of these enterprises already own these facilities and the ones acquired were additional.

#2: The enterprises appear content with the level of business efficiency achieved by those manual driven operations targeted by simple tools and machinery. This could be due to limited capital, cheaply available labour and lack of exposure to the positive impacts of mechanized operations on business performance amongst other factors. More value is hence attached to items like kilns, water tanks and workshops whose roles lack cheaper alternatives. For instance, a kiln is mandatory and has no alternative and is thus a priority but an electric shear has an alternative in hand-held shears and therefore ranks lowly on the priority hierarchy.

#3: Off the shelf support items are only suited for general production processes like metal shearing, welding and paint spraying. Other more specific processes like metal folding, rolling, grooving etcetera require machines that are designed for that specific job and further customized to a particular stove model. To mechanize stove production therefore calls for extensive research, development and dissemination work. This can be achieved through partnerships with technical training institutes at the research and prototyping level followed by capacity building of artisanal shops that fabricate metal which will in turn disseminate the technologies to local enterprises.

#4: An oversight in the design of the Spark Fund project was to slot the grant disbursement activity in the last quarter of the project. It had also been decided internally not to disclose about the grant so as to gauge the natural commitment of the enterprises to the project activities while they expected nothing in return. The aim was to work with only those genuinely interested in adopting and commercializing the new designs and eliminate joy riders who would play along to activities while only waiting to benefit from the grant. As such, the entrepreneurs first heard about the grant in the third quarter, about four months to the end of the project. This late disclosure denied the entrepreneurs adequate time to look for funds. In hindsight and owing to the complexities around designing and implementing an effective disbursement scheme, both disclosure and the start of the disbursement process should have happened at project inception. This would have allowed entrepreneurs ample time to raise the matching funds and also allowed time for the piloting of the support items.

#5: Most stove businesses are heavily dependent on loans to finance growth plans. For example, 4 enterprises were servicing loans at the time of grant disbursement. A further 2 had loan applications pending bank approvals while 2 had just completed servicing their loans. There is thus need to sensitize financial institutions to develop loan products that are attractive and in touch with the sector's unique challenges.

#6: Though there was room for entrepreneur's input, eligible support items had broadly been pre-defined; either materials for initial batch, tools & machineries or production facilities. Some entrepreneurs had other priorities like branded vans for outdoor marketing and stoves transportation. Though there must be input from the grantor on how the grant will be utilized, the process should be more enterprise driven. It should never appear like the grantor is forcing the grantee to utilize the grant in a particular way. After all, it would be better to finance items that the enterprises prioritize the most, rather than those which may be most 'ideal' but rank low in enterprises' hierarchy of needs. They own the businesses after all.

#7: It is important to conduct a comprehensive enterprise-financial-capability-assessment that goes beyond word of mouth commitment early enough into the project life and reach a decision on how to treat different cases based on findings. The findings may reveal for instance, that some enterprises need to be exempted from cost-sharing requirement while others may only afford to pay only 10% or 30% or even 50%.

#8: It could help to partner with a single financial institution and craft a financing scheme to provide credit to all enterprises in need. This would simplify logistics around loan negotiations & processing and ensure that the money is channelled directly to service providers. Such an approach, as long it has a buy-in from enterprises, would eliminate the need to mobilize and follow-up enterprises to pay from their pockets once the loans are processed.

#9: The matching amounts should not be uniform across all beneficiaries but rather should be based on each enterprise's financial ability. This is due to the fact that the target enterprises will always be at different stages of growth.

Plate 11) A spray painter in use at EFWES' workshop

7 Carbon Finance Feasibility Study

The study was aimed at assessing the feasibility of *Jiko Smart* producers accessing carbon finance markets. This was in recognition of the potential of carbon financing as an avenue for financing both stove manufacturers and end-users. Act Global consultants were competitively engaged to carry out the assessment. The consultant was to assess the 12 entrepreneurs to understand their business models as well their current and projected business capacities and then recommend possible frameworks for setting up carbon projects and models for sharing the generated carbon revenue throughout the value chain. The consultant was also required to disseminate the study findings to the 12 entrepreneurs so as to enlighten them about carbon markets for cook stoves in general and share the specific carbon financing opportunities (if any) presented by *Jiko Smart*.

The study found out that *Jiko Smart* designs do present considerable offsetting potential particularly if majority of sales are to customers using non-improved models like 3 stone fire and metal charcoal stove. The most suitable project framework was found to be a Gold Standard Micro-Program of Activities applying Technologies and Practices to Displace Decentralized Thermal Energy Consumption (TPDDTEC) methodology. Owing to the relatively low sales forecasts, each group of enterprises from Kisumu and Central clusters would form aggregated bodies which would comprise the micro-programs under the program. The Micro-program framework has flexibility advantage in that it would allow admission, at a later date, of entrepreneurs from other clusters producing *Jiko Smart* to be incorporated into an existing carbon project as new micro-programs.

Owing to the huge initial financial outlays and the elaborate technical capacity required to set-up and run a carbon finance project, the current regime of micro-enterprises cannot afford to initiate and implement such a project on their own. Whilst GVEP has been on the look-out for opportunities which can empower *Jiko Smart* enterprises exploit the identified carbon financing opportunities, none has been secured to date. GVEP therefore welcomes support of the Alliance and its wide network of partners as it continues to pursue cook stove carbon finance prospects on behalf of stove enterprises in Kenya.

8 Conclusion

The Spark Fund project was largely a success. There were challenges encountered along the implementation path, but the overall project outcome was still achieved. In any case, the challenges have provided insightful learning points which will inform similar projects in future. There now exists in the Kenyan market *Jiko Smart* stoves which are fairly affordable and fairly fuel-efficient.

As previously explained, the objective of reducing emissions was not satisfactorily achieved as *Jiko Smart* models have been characterized by very high CO emissions. This was a major drawback since the other main pollutant, PM2.5, has considerably been reduced. Improvement in emission levels has therefore been watered down by the high CO emissions. Though typical end-users are rarely concerned about emissions while purchasing stoves, these emissions have been strongly linked to adverse health impacts and hence there is need to promote stoves whose emissions have been highly optimized. Indeed, GVEP has always harboured a level of guilt whenever entrepreneurs describe the stoves as ‘emissions free”. This is an area that the Alliance can support to further refine these emissions and hence harmonize the fuel-efficiency and emissions benefits.

All the activities planned were completed, though as previously explained, some fell behind schedule due to factors beyond the grantee’s control. The design phase was particularly prolonged due to numerous iterations occasioned by the need to accommodate views and aspirations from stakeholders. The idea was to avoid develop a design that is improved but still adapted to the cooking preferences of local end-users. *Jiko Smart* designs are certainly not be the best in the market but they have so far registered good market reception. Input from stakeholders was vital in refining *Jiko Smart* and should always be considered while designing stoves. This process of gathering and implementing feedback is involving and time consuming but should always be factored while designing cook stove projects.

Post the Spark Fund project, GVEP has continued to support promotional efforts aimed at activating more demand. It is however still felt that more demand needs to be created and the supply strengthened further before the *Jiko Smart* initiative can stand on its own. As previously noted, and even as GVEP continues to engage other partners, the Alliance should consider further partnership to support further marketing work and address the high emissions weakness explained earlier on.

The grant disbursement process was lengthy and challenging, and finally the cost-sharing arrangement was not implemented as earlier planned. Whilst preliminary feedback suggests that the support items awarded are boosting the production capacities, more time will be needed before actual impacts over the long-term can be determined and reported.

8.1 Summary of gaps that calls for further partnership/ funding support from the Alliance

Design gaps

High CO levels: Both the wood and charcoal designs are characterized by very high CO levels. There is need for design modification to contain the high CO as the stoves have already been released into the market.

Insulation: Wood stove due to its height and large diameter uses a lot of vermiculite which is expensive and inavailable locally. Current formulation matrix of vermiculite and clay has also rendered the stoves too heavy. There is a need for research to identify and appraise light-weight, cost-effective, locally available materials which can be blended with vermiculite or used exclusively.

Clay liners: The option of blending clay with saw dust to reduce thermal mass was also tried but abandoned after lack of a major breakthrough. It is however, still believed that this in an area that can be pursued further to deeply understand the effects of additives like sawdust or chardust on thermal efficiency.

Incorporation of secondary air: Secondary air is important for improving combustion efficiency and reducing products of incomplete combustion and can be a potential measure against the high CO levels.

Production, Marketing & Consumer financing gaps

Strengthening supply base: Currently, only 9 stove manufacturers are relied upon to serve the entire Kenyan market. 6 more assemblers have been trained under the Adventures project but their production work is yet to gain traction. The narrow supply base underscores the need to train more enterprises to strengthen supply.

Further demand activation: The current demand is not enough to sustain the *Jiko Smart* initiative over the long-term. There is hence need for more market activation to stimulate adequate demand that will sustain the initiative over the long-term.

Current cost of *Jiko Smart* has been identified as the main barrier to large-scale adoption. Consumer financing is hence required in overcoming the affordability barrier. Village banks and other localized financial associations are proving popular financing avenues as they can give asset loans at low interest rates and flexible repayment plans. GVEP is already leveraging this model through FSAs but more work is required to identify, sensitize and link the associations with *Jiko smart* producers.

Carbon market opportunities

Current regime of *Jiko smart* manufacturers lack finances and know-how to implement a carbon finance project, yet there is potential. The Alliance's expertise and networks in this sector can come in handy to assist entrepreneurs launch such a project to benefit from carbon revenues.

9 Financial Report

`	GVEP Nominal Ledger CODE	Quarter 1 Approved Budget (USD)	Quarter 1 Actual Spend (USD)	Quarter 2 Approved Budget (USD)	Quarter 2 Actual Spend (USD)	Quarter 3 Approved Budget (USD)	Quarter 3 Actual Spend (USD)	Quarter 4 Approved Budget(USD)	Quarter 4 Actual Spend (USD)	Re-allocations to marketing	Quarter 5 Actual Spend (USD)	Total Project Expenses to Date (USD)	Total Budget (USD)	Re-stated Budget (USD)	Project Variance (USD)	% Variance	Comments on variances
1. Project Management	**GVEP Nominal Ledger CODE**																
Local project manager	6005.1	4,661	1,171	4,661	4,126	4,661	6,088	4,661	4,202		5,713	**21,300**	18,644	18,644	(2,656)	-14.2%	More staff time was dedicated to deliver results in the last Quarter
UK project Direction	6001.1	3,650	123	3,650	1,733	3,650	4,409	3,650	4,202		7,718	**18,185**	14,598	14,598	(3,587)	-24.6%	More staff time was dedicated to deliver results in the last Quarter
M&E Manager	6005.1	2,185	1,693	2,185	2,433	2,185	2,018	2,185	1,073		2,849	**10,065**	8,741	8,741	(1,324)	-15.1%	More staff time was dedicated to deliver results in the last Quarter
Local project administrator	6005.1	1,454	493	1,454	534	1,454	2,443	1,454	1,633		1,330	**6,433**	5,815	5,815	(618)	-10.6%	More staff time was dedicated to deliver results in the last Quarter
Publications, documentation & communication	7060.1		-		-	2,000	267	2,000	768		2,422	**3,457**	4,000	4,000	543	13.6%	item cost was lower than planned
Recruitment	6500.1	800	-		-		-	-	-	(800)	-	**-**	800	-	-		
In country travel	6120.1	750	-	750	720	750	1,054	750	752		409	**2,935**	3,000	3,000	65	2.2%	Travel cost was lower than anticipated
Project management direct running costs	7019.1	1,565	1,095	1,565	1,095	1,565	1,956	1,565	1,471		642	**6,259**	6,259	6,259	-	0.0%	
Subtotal 1		**15,064**	**4,575**	**14,264**	**10,641**	**16,264**	**18,234**	**16,264**	**14,100**	**(800)**	**21,083**	**68,633**	**61,857**	**61,057**	**(7,576)**		
2. R&D Activities																	
Development of advanced stove design	7025.2	5,600	153	2,400	1,590	-	4,781	-	1,265		-	**7,789**	8,000	8,000	211	2.6%	Service cost was lower
Consultant services for developing advanced stove design	7000.2	18,000	-	12,000	5,015	-	3,650	-	11,866	(5,200)	4,270	**24,800**	30,000	24,800	(0)	0.0%	
International flights for consultant	7005.2	1,500	-		-	-	-	-	-		-	**-**	1,500	1,500	1,500	100.0%	A local consultant was hired. Flights were not necessary.
Testing of prototypes	7000.2	10,000	-	10,000	1,881	-	1,669	-	3,040	(3,800)	9,610	**16,200**	20,000	16,200	0	0.0%	
Field and lab testing of manufactured stoves	7000.2	10,000	135	10,000	-	-	920	-	6,095		17,560	**24,709**	20,000	20,000	(4,709)	-23.5%	Hiring CREEC to cover for KIRDI increased the cost
Biomass Technical Specialist	6005.2	5,859	5,269	5,859	4,126	-	3,088	-	-		-	**12,483**	11,717	11,717	(765)	-6.5%	Underestimated staff cost during budgeting for this position
per diem + accommodation	6120.2	2,340	818	2,340	858	-	3,038	-	202		-	**4,916**	4,680	4,680	(236)	-5.0%	Underestimated staff cost during budgeting for this position
Project R&D staff direct running costs	7019.2	988	692	988	692	-	628	-	-		-	**2,011**	1,976	1,976	(35)	-1.8%	Costs of service provider were higher
Subtotal 2		**54,287**	**7,066**	**43,587**	**14,161**	**-**	**17,774**	**-**	**22,468**	**(9,000)**	**31,440**	**92,909**	**97,874**	**88874**	**(4,035)**		
3. Technical Development																	
Technical Mentor	6005.3	3,312	1,479	6,624	3,157	1,104	5,086	-	900		779	**11,401**	11,039	11,039	(362)	-3.3%	More staff time dedicated to deliver results in the last Quarter
R&D for improved manufacturing	7025.3	3,200	-	4,800	-		-	-	-	(1,200)	8,000	**8,000**	8,000	6,800	(1,200)	-17.6%	Underestimated service cost during budgeting
Demonstrations of improved manufacturing and stove design	7025.3		-	3,000	-	2,000	-	-	-		3,452	**3,452**	5,000	5,000	1,548	31.0%	Overestimated service cost during budgeting
per diem and accommodation	6120.3	1,200	-	2,400	-	400	400	-	-		2,718	**3,118**	4,000	4,000	882	22.0%	Overestimated costs during budgeting

Technical mentoring and coaching running costs	7019.3	1,482	1,038	2,965	2,075	494	1,828	-	-			**4,941**	4,941	4,941	-	0.0%	
Subtotal 3		**9,194**	**2,517**	**19,788**	**5,232**	**3,998**	**7,314**	**-**	**900**	**(1,200)**	**14,950**	**30,913**	**32,980**	**31780**	**867**		
4. Marketing of New Stove Design																	
Production of marketing material	7065.4		-	4,250	-		-	-	-		3,286	**3,286**	4,250	4,250	964	22.7%	Did not produce banners; instead banners produced under the Sida Care2 programme were used during market development
Stove demonstrations and marketing events	7025.4		-	4,500	-	4,500	-	-	-	16,000	18,292	**18,292**	9,000	25,000	6,708	26.8%	Time ran out and a number of marketing events were not carried out
Business Mentors	6005.4		-	2,748	-	6,594	540	1,649	5,684		8,904	**15,128**	10,990	10,990	(4,138)	-37.7%	More staff time dedicated to deliver results in the last Quarter
Accommodation + per diem	6120.4		-	1,000	-	1,000	-	-	-		1,694	**1,694**	2,000	2,000	306	15.3%	Time ran out and a number of marketing events were not carried out
Business coaching and mentoring running costs	7019.4		-	1,153	-	2,767	277	692	2,352		-	**2,629**	4,612	4,612	1,983	43.0%	Costs were lower because of the close clustering of the entrepreneurs (there was an overestimation of the costs)
Subtotal 4			**-**	**13,650**	**-**	**14,861**	**817**	**2,340**	**8,036**	**16,000**	**32,176**	**41,029**	**30,852**	**46852**	**5823**		
5. Manufacturers Seed Fund																	
Financial Specialist	6005.5	-	-	5,208	-	5,208	816	5,208	5,225		17,905	**23,946**	15,625	15,625	(8,321)	-53.3%	More staff time was dedicated to deliver results in the last Quarter
Business Development Service Coordinator	6005.5	-	-	2,753	-	2,753	1,308	2,753	5,104		8,594	**15,006**	11,012	11,012	(3,994)	-36.3%	More staff time was dedicated to deliver results in the last Quarter
Grants for manufacturers	7610.5				-		-	50,000	-		43,133	**43,133**	50,000	50,000	6,867	13.7%	Due to complexities around disbursement process (refer to narrative report), actual grant amounts were lower than budgeted amount
Business Development Training	7025.5				-	3,200	-	-	-		3,047	**3,047**	3,200	3,200	153	4.8%	Cost of services was lower
Project SEED fund staff direct running cost	7019.5	1,153	-	1,153	-	1,153	346	1,153	1,499		452	**2,297**	4,612	4,612	2,315	50.2%	The actual costs for processing and disbursement were minimal
Subtotal 5		**1,153**	**-**	**9,114**	**-**	**12,314**	**2,469**	**59,114**	**11,828**	**-**	**73,131**	**87,428**	**84,448**	**84448**	**(2,980)**		
6. Accessing Carbon Finance																	
Carbon Specialist	7000.6		-		-	10,000	-	10,000	-	(5,000)	13,486	**13,486**	20,000	15,000	1,514	10.1%	The cost of services was lower was budgeted.
Accommodation+ per diem	6120.6		-		-	1,200	-	1,200	-		1,836	**1,836**	2,400	2,400	564	23.5%	The cost of services was lower was budgeted.
Training Entrepreneurs on carbon finance	7025.6		-		-		-	1,600	-		1,364	**1,364**	1,600	1,600	236	14.8%	The cost of services was lower was budgeted.
Subtotal 6		**-**	**-**	**-**	**-**	**11,200**	**-**	**12,800**	**-**	**(5,000)**	**16,686**	**16,686**	**24,000**	**19,000.00**	**2,314.18**		
Total direct project costs		**79,698**	**14,158**	**100,404**	**30,034**	**58,637**	**46,607**	**90,519**	**57,331**	**-**	**189,466**	**337,597**	**332,011**	**332,011.05**	**(5,586.12)**		
Indirect cost		**10,361**	**1,841**	**13,053**	**3,904**	**7,623**	**6,059**	**11,767**	**7,453**	**-**	**24,631**	**43,888**	**43,161**	**43,161.44**	**(726.20)**		
TOTAL PROJECT COSTS		**90,059**	**15,999**	**113,456**	**33,938**	**66,260**	**52,666**	**102,286**	**64,785**	**-**	**214,097**	**381,485**	**375,172**	**375,172.49**	**(6,312.31)**		

- Variances are as explained
- The overspend of $ 6,312.31 was absorbed by CARE2 program which Spark fund was co-funding

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11 Annexes

11.1 Annex 1. Retailers actively buying and stocking *Jiko Smarts*

	Retailer	Location	Supplier	Location	Purchase done
1	Malengo Women group	Kwale	Cinda Juakali	Murang'a	Quarterly
2	Joseph Kangethe	Taveta	EFWES	Nanyuki	Quarterly
3	James Njoroge	Taveta	EFWES	Nanyuki	Quarterly
4	John Kiai	Loitoktok	EFWES	Nanyuki	Quarterly
5	David Mungai	Loitoktok	EFWES	Nanyuki	Quarterly
6	Makindu FSA	Makueni-Makindu	Cinda Juakali	Murang'a	Quarterly
7	Sunrise Sacco	Timau	EFWES	Nanyuki	Quarterly
8	Mwaniki	Nanyuki	EFWES	Nanyuki	Quarterly
9	Charles Maina	Nyeri	EFWES	Nanyuki	Quarterly
10	Charles Maina	Kinamba	EFWES	Nanyuki	Quarterly
11	Dorcas Kamau	Ol- kalau	Riumbai-ini	Murang'a	Quarterly
12	Charity Njeri	Ol-Jororok	Riumbai-ini	Murang'a	Quarterly
13	Solomon Karuti	Nyahururu	Sos Production	Murang'a	Quarterly
14	John	Embu	Cinda Juakali	Murang'a	Quarterly
15	Uswet FSA	Bomet	Lakenet	Kibuye market	Quarterly
16	Siongiroi FSA	Bomet	Omollo Works	Kibuye market	Quarterly
17	Homabay FSA	Homabay	Omollo Works	Kibuye market	Quarterly
18	Great Wang'chieng FSA	Homabay	Nyamasaria	Kibuye market	Quarterly
19	Jackson Obonyo	Siaya	Ona na Macho	Kibuye market	Monthly
20	Silper Atieno	Siaya	Ona na Macho	Kibuye market	Monthly
21	Zakary Ogongo	Siaya	Nyausonga Works	Kibuye market	Monthly
22	Albert Okiro	Siaya	Nyausonga Works	Kibuye market	Monthly
23	Caroli Onyango	Siaya	Nyausonga Works	Kibuye market	Monthly
24	Nelly Adhiambo	Siaya	Ona na Macho	Kibuye market	Monthly
25	Digital Shop	Siaya	Omollo Works	Kibuye market	Monthly
26	Juliet Samuel Raduma	Siaya	Omollo Works	Kibuye market	Monthly
27	Alphrose Onyango	Kericho	Nyamasaria	Nyamasaria	Monthly
28	Sally Chebet	Kericho	Nyamasaria	Nyamasaria	Monthly
29	Joseph Onditi	Kericho	Nyamasaria	Kibuye market	Monthly
30	B. Kosgei	Kericho	Omollo Works	Kibuye market	Monthly
31	Salome Onyango	Awendo	Omollo Works	Kibuye market	Monthly
32	Joseph Onyancha	Awendo	Omollo Works	Kibuye market	Monthly

11.2 Annex 2: Jiko Smart's production and sales from July 2014 to June 2015, disaggregated by enterprises

	July to September 2014		Oct to Dec 2014		Jan to March 2015		April (2015)		May (2015)		June (2015)		**Totals**	
Name of Enterprise	# of Stoves produced (new model)	# of Stoves sold (new model)	# of Stoves produced (new model)	# of Stoves sold (new model)	# of Stoves produced (new model)	# of Stoves sold (new model)	# of Stoves produced (new model)	# of Stoves sold (new model)	# of Stoves produced (new model)	# of Stoves sold (new model)	# of Stoves produced (new model)	# of Stoves sold (new model)	# of Stoves produced (new model)	# of Stoves sold (new model)
Equator Fuel Wood Energy Saving	120	49	90	31	80	134	42	35	60	42	13	17	405	308
SoS Production Center	420	286	100	40	150	80	48	49	42	27	25	21	785	503
JMM Clay Stove Producers	100	15	50	0	20	0	0	0	0	0	0	0	170	15
Riumbai-ini Energy Saving Stoves	170	53	105	41	240	92	46	25	40	23	20	30	621	264
Cinda Juakali	140	44	70	28	90	69	40	31	35	22	15	15	390	209
Omollo Works	112	102	200	182	273	270	90	59	80	73	150	143	905	829
Lakenet Energy Solutions	44	44	15	11	77	77	20	16	100	87	69	69	325	304
Ekero Jiko Supplies	120	20	0	22	30	30	16	6	30	10	50	80	246	168
Nyausonga Works	44	44	48	45	83	81	27	12	21	8	12	12	235	202
Ona na Macho Workshop	98	91	41	41	83	81	38	35	22	15	21	13	303	276
Nyamasaria Widows & Orphans	0	0	0	0	0	0	**65**	**60**	**14**	**14**	5	1	84	75
Keyo Pottery Enterprise	200	200	0	0	0	0	200	100	350	250	230	120	980	670
Nyamasaria Widows & Orphans	351	351	130	30	50	50	250	200	230	130	330	130	1341	891
Total (stoves)	**1368**	**748**	**719**	**441**	**1126**	**914**	**432**	**328**	**444**	**321**	**380**	**401**	4469	3153
Total (liners)	551	551	130	30	50	50	450	300	580	380	560	250	2321	1561
	The units shaded in yellow are liners not complete stoves.													

11.3 Annex 3: Account of grant disbursement per enterprise including items' unit costs, and specifications where applicable

11.3.1 Central cluster

Central cluster					
Enterprise	Item	Financed (%)	Unit cost (KES)	No.	Cost (KES)
EFWES	Materials & Labor	100	128,891.00		128,891.00
	Kiln	60	126000.00	1	126000.00
	Bar cutter 25mm	100	24000.00	1	24000.00
	Welding machine (400 Amps)		48000.00	1	48000.00
	Tinsnip 12 "		1914.00	4	7656.00
	Spray painter (spray gun+ 50 liter comp.)		43600.00	1	43600.00
	Angle grinder		18676.00	1	18676.00
	Sub-total				**396823.00**
SOS	Materials & Labor	100	128,891.00		128,891.00
	10m3Water tank	60	51000.00	1	51000.00
	Workshop materials	100	70680.00		70680.00
	Electric shears (3.2 mm)	100	64960.00	1	64960.00
	Bar cutter 25mm		24000.00	1	24000.00
	Tinsnip 12 "		1914.00	2	3828.00
	Spray painter (spray gun+ 50 liter comp.)		43600.00	1	43600.00
	Sub-total				**386,959.00**
Riumbaini	Materials & Labor	100	128,891.00		128,891.00
	10m3Water tank	60	51000.00	1	51000.00
	Workshop materials	60	57510.00		57510.00
	Electric shears (3.2 mm)	100	64960.00	1	64960.00
	Bar cutter		24000.00	1	24000.00
	Tinsnip 12 "		1914.00	2	3828.00
	Spray painter (spray gun+ 50 liter comp.)		43600.00	1	43600.00

	Sub-total				**373,789.00**
cinda	Materials & Labor	100	128,891.00		128,891.00
	10m3Water tank	60	51000.00	1	51000.00
	Electric shears (3.2 mm)	100	64960.00	1	64960.00
	Bar cutter 25mm		24000.00	1	24000.00
	Welding machine (400 Amps)		48000.00	1	48000.00
	Tinsnip 12 "		1914.00	2	3828.00
	Spray painter (spray gun+ 50 liter comp.)		43600.00	1	43600.00
	Angle grinder		18676.00	1	18676.00
	Sub-total				**382,955.00**
JMM	Materials & Labor	100	64,454.00		64,454.00
	Welding machine (400 Amps)		48000.00	1	48000.00
	Tinsnip 12"		1914.00	3	5742.00
	Spray painter (spray gun+ 50 liter comp.)		43600.00	1	43600.00
	Sub-total				**161,796.00**

11.3.2 Kisumu cluster

Kisumu cluster					
Enterprise	Item	Financed (%)	Unit cost (KES)	No.	Cost (KES)
Ekero	Materials & Labor	100	137,780.00		137,780.00
	Electric shears (3.2mm)		64,960.00	1	64,960.00
	Welding machine (400 Amps)		48,000.00	2	96,000.00
	Tinsnips 12 "		1,914.00	5	9,570.00
	Spray painter (spray gun+ 50 liter comp.)		43,600.00	1	43,600.00
	Angle grinder (9 inch)		18,676.00	2	37,352.00
	Sub-total				**389,262.00**
Omollo Works	Materials & Labor	100	68,899.00		68,899.00

	Electric shears (3.2mm)		64,960.00	1	64,960.00
	Bar cutter 25mm		24,000.00	1	24,000.00
	Welding machine (400 Amps)		48,000.00	1	48,000.00
	Tinsnips 12 "		1,914.00	5	9,570.00
	Spray painter (spray gun+ 50 liter comp.)		43,600.00	1	43,600.00
	Angle grinder (9 inch)		18,676.00	1	18,676.00
	Sub-total				**277,705.00**
Lakenet	Materials & Labor	100	68,899.00		68,899.00
	Electric shears (3.2mm)		64,960.00	1	64,960.00
	Bar cutter 25mm		24,000.00	1	24,000.00
	Welding machine (400 Amps)		48,000.00	1	48,000.00
	Tinsnips 12 "		1,914.00	3	5,742.00
	Spray painter (spray gun+ 50 liter comp.)		43,600.00	1	43,600.00
	Angle grinder (9 inch)		18,676.00	1	18,676.00
	Sub-total				**273,877.00**
Nyausonga	Materials & Labor	100	68,899.00		68,899.00
	Electric shears (3.2mm)		64,960.00	1	64,960.00
	Bar cutter 25 mm		24,000.00	1	24,000.00
	Welding machine (400 Amps)		48,000.00	1	48,000.00
	Tinsnips 12 "		1,914.00	5	9,570.00
	Spray painter (spray gun+ 50 liter comp.)		43,600.00	1	43,600.00
	Angle grinder (9 inch)		18,676.00	1	18,676.00
	Sub-total				**277,705.00**
Ona na Macho	Materials & Labor	100	68,900.00		68,900.00
	Electric shears (3.2mm)		64960.00	1	64960.00
	Bar cutter 25 mm		24000.00	1	24000.00
	Welding machine (400 Amps)		48000.00	1	48000.00

	Tinsnips 12 "		1914.00	4	7656.00
	Spray painter (spray gun+ 50 liter comp.)		43600.00	1	43600.00
	Angle grinder (9 inch)		18676.00	1	18676.00
	Sub-total				**275,792.00**
Nyamasaria	Liners	100	30,000.00		30,000.00
	Complete workshop		210000.00	1	210000.00
	Sub-total				**240000.00**
Keyo	Liners	100	30,000.00		30,000.00
	10m3Water tank	60	51000.00	2	102000.00
	Complete workshop	100	210000.00	1	210000.00
	Multi-purpose mould set		17000.00	1	17000.00
	Sub-total				**359,000.00**

11.4 Grant disbursement structure

1. INTRODUCTION

In June 2013, GVEP International, simply referred to as GVEP, was awarded a grant from the Spark Fund to improve the performance and quality of locally manufactured efficient biomass cookstoves in Kenya. The grant will provide vital support to a number of high potential cookstove businesses in relation to technical capacity building, better product design and manufacturing practices and offer financial assistance for investing in necessary expansion activities. The Spark Fund is an initiative of the Global Alliance for Clean Cookstoves as part of their strategy to strengthen supply and enhance demand in the cookstove and fuels sector through innovation and tailored entrepreneurial capacity development.

2. Purpose of the seed grants

GVEP has been working closely with local manufacturers and end users, under the Spark Fund, to develop two stove designs (one using wood and one using charcoal) that can offer improvements in performance over current models being made. These improvements include increased thermal efficiency, so the stoves use less fuel, and reduced emissions, so the user is exposed to less harmful gases. These designs will be manufactured and sold by local entrepreneurs whom GVEP is working with. Several manufacturers have been taken through production training to equip them with the necessary skills to produce the stoves. Whilst GVEP has led the initial design stages of the work and will support entrepreneurs in marketing aspects, we are not taking ownership of the stove. Instead the stove design will be a product that producers can decide to produce and sell alongside their other products and its commercialization will ultimately depend on them.

GVEP recognises that for producers to incorporate the new stove design into their product mix there are financial implications and risks. For example producers will have to invest in materials and additional labour. In addition the new designs are more labour intensive to produce and investment in simple machinery is needed to make production more efficient. To upscale production of their stoves producers would also benefits from other general equipment and potential facility expansion. Since the designs that are being promoted under the program are new their profitability and demand is as yet unproven which poses unknown ricks if entrepreneurs were to invest in their production.

To support entrepreneurs in kick starting their production whilst at the same time reducing the financial risk associated with investing in a new product GVEP intends to establish a seed fund which entrepreneurs can apply to. This seed fund will provide producers with a small amount of grant funding to allow them to invest in activities to kick start and expand their production of the new stove designs.

3. STRUCTURAL FEATURES OF THE SEED FUND

The business plans should form the starting point of financial support that entrepreneurs apply for and will be submitted in conjunction with the application as supporting documentation. Financing needs identified in the business plan will not be met solely through grant funding. The entrepreneurs should also be planning to input additional financing through debt financing and personal contribution. This approach will ensure the commitment of entrepreneurs in the process, make additional funding available and focus the entrepreneurs in terms of the funds utilisation. The proportion of financing coming from each of these sources will be assessed on an individual basis, depending on the needs and capacity of the business.

In the majority of cases financing needs being met through the seed fund will be done so in kind by directly supplying entrepreneurs with equipment and services. This has the advantage of reducing the risk in terms of diversion of the funds, ensuring the entrepreneurs receive quality equipment and potentially reducing costs through economies of scale where several entrepreneurs require the same equipment. However it is up to the entrepreneur to decide what they will apply for from the seed fund.

Individual grants given under the seed fund will typical be between 80,000 to 400,000 KES, although higher amounts may be considered where the business can demonstrate exceptional potential impact. Amounts will vary between applications and will be assessed on a case by case basis.

4. ELIGIBILITY OF FUNDING

Seed grants are awarded through a competitive application process. The application process is only open to those businesses being supported under the Spark Project that have completed other activities under the program including;

- Production training on the new stove designs
- Submission of KPI's for the program
- Development of a business plan
- Attendance at market development activities

Applications must propose activities that contribute to the objectives of the Spark Fund in terms of improving on stoves performance and producers ability to produce quality products and scale up production.

The Spark Fund Investment Committee will review each application on a case-by-case basis. As a guide line, activities/ items that are considered eligible and ineligible for POC financing are as follows:

Eligible activities/ items:

- Materials for the new stove design
- Equipment and tooling to enhance production efficiency and quality
- Water storage facilities
- Additional kilns for increased liner firing capacity
- Additional workshop and storage space
- Licenses, KEBS certification and personal protective equipment
- Additional marketing material
- Other items that are contributing to the production and scaling up of new stove designs.

Ineligible activities/ items: Anything that is not directly related to ICS production (the following is a list of items that are not eligible, the list is not exclusive):

- Plot/shamba
- Gravelling feeder roads
- Travelling allowance
- Buying family assets
- Paying school fees

5. HOW TO APPLY

Eligible candidates will fill in an application form and provide a copy of a recent business plan.

6. PROCESS OF BUSINESS ASSESSMENT, GRANT APPLICATION AND APPROVAL

1. GVEP staff will verbally communicate to the enterprises details of the grant

a) Why the grant
b) Who qualifies for it
c) The use of the grant
d) The conditions to qualify for the grant
e) How to apply
f) How the grant will be disbursed

2. GVEP staff will carry out Business and Technology assessments of all spark fund supported enterprises. This will be done by the respective Regional Business Mentors together with Regional Technology Mentors and the overall Spark Fund Technical Consultant

3. During the enterprise assessments, grant application forms will be filled

4. Enterprise assessments will propose indicative grant amounts for each enterprise

5. The filled grant application forms will be handed over to the Business Development Coordinators by the field staff

6. The BDS Coordinators will organize a Grant Approval Meeting will include

   - Capital Access Staff
   - Country Manager
   - BDS Coordinators
   - Spark Fund Consultant/s

7. The Grant Approval Meeting will approve the amounts proposed for each enterprise

8. GRANT DISBURSEMENT

a) The Country Manager will instruct Finance to internally Transfer the designated approved grant amounts from the current park Fund Account to Spark Fund Grant Disbursement Account

b) The respective Regional Business Mentors together with the Regional Technical Mentors and the Spark Fund Technical Consultant will have identified the key service providers for Equipment/tools during grant assessment and mentoring process

c) When ready, each of the enterprises will formally request GVEP in writing to have the approved grant disbursed to them in form of equipment/tools.

d) GVEP will notify the enterprise how much grant is available for the business

e) GVEP will let the enterprise know that enterprise has to pay 40% of the expected grant to the equipment/tools service provider.

f) The respective service providers will be requested to issue quotations for the supply of the required equipment/tools.

g) The 40% will be paid by the enterprise **upfront** to the service provider after getting confirmation of the grant amount from GVEP

h) GVEP will issue LPOs to the qualified service providers to supply the required equipment/tools

i) After supplying the required equipment/tools to the enterprise, GVEP will pay the service provider the balance of 60%

9. CONTINUOUS MONITORING GRANT

GVEP will continue to monitor and evaluate the use and impact of the grant through monthly data collection. This monitoring will continue for at least 6 months after the end of the Spark Fund project.