

Project Description

According to the IEA World Energy Outlook, the number of wood-based biomass energy consumers in Sub-Saharan Africa will reach nearly one billion by 2030 (IEA, 2010). Our company is based in Uganda, where 93 percent of the primary energy supply comes from wood fuels, and total energy demand is expected to double by 2025 (Khundi et al, 2010). Under business-as-usual, Uganda's entire forest resource will be lost by 2050 (NEMA, 2009).

Our solution is to replace woodfuels with clean burning briquettes made from carbonized [charred] organic waste. Briquettes are a superior product for the Sub-Saharan market because:

1. Briquettes are more affordable than traditional wood fuels

The current price of wood charcoal is 1500 UGX [Uganda shillings] per kg (GVEP International, 2012). We sell our briquettes profitably at 500 UGX/kg wholesale, 700 UGX/kg retail.

2. Briquettes integrate easily with existing cooking practices and equipment: Charcoal cooking is ingrained in Ugandan culture. Carbonized briquettes are ignited and used identically to wood charcoal and can be used in the same stoves. Adoption occurs naturally without extra infrastructure, teaching, or incentive

3. Briquettes are made from widespread, unutilized, renewable waste streams: Uganda is highly agricultural, and many crop residues are burned or left outside to rot. We've made briquettes from sugar cane litter, maize cobs/husks, rice straw/husks, stover, tea prunings, even leftover dust from traditional wood charcoal. Feedstock owners are eager to turn "waste" into fuel and/or income

4. Briquettes burn longer and cleaner than traditional wood fuels

This fact is demonstrable in any side-by-side comparison of wood charcoal and briquettes burned in identical stoves

5. Briquettes are made with simple, inexpensive technologies that create value-adding occupations in the energy supply chain

Potential Impact & Scale

Uganda's agricultural sector produces about 7.9 million tons of crop residues per year (UNEP, 2001).

Given that briquettes are equivalent in energy to wood charcoal, and that Uganda's charcoal consumption is about 850,000 tons annually (UN DESA, 2010), we can extrapolate that the entire wood charcoal market could be replaced by converting just under half of available crop residues into briquettes.

Where most people subsist on less than \$1 USD a day, the Eco-Fuel Press makes \$3 of briquettes per hour, plenty of income to sustain at least two workers per machine. Some 20,000 Ugandans are employed in the fuel-wood sector (GVEP, 2012). Completely displacing wood charcoal would result in a net gain of over 25,000 sustainable jobs for people at the base of the pyramid particularly marginalized women and youths

Briquette consumers are also direct beneficiaries of our model. A 2011 survey by NGO Everyday Stoves found that the average Ugandan spends 35% of their total income on cooking fuel. At current retail prices, fully replacing the charcoal market with briquettes would save 5 million charcoal consumers (GVEP, 2012) over 18% of their income, which equates to 2.7% of Uganda's total GDP!

Eliminating the charcoal trade would preserve 5.67 million tons of woody biomass annually. This would help alleviate the burden of forest conservation on the government, while keeping over 10 million tons of CO₂ equivalent out of the atmosphere and preserving biodiversity. (Assumptions: average tree 50% C, 1 kg C = 3.67 kg CO₂e. From Johnson and Coburn, 2010)

Mass-producing the Eco-Fuel Press is the avenue to scaling up. This crucial technology overcomes the grid-dependence handicap and creates a revolutionary growth opportunity for micro-scale bioenergy entrepreneurs.

Competitive Landscape

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A study of the wood charcoal value chain in Malawi found that transportation costs accounted for 20-25% of charcoal's final retail price. The same study attributed 12-20% of the final price to "private taxation" of trade routes by public officials- in other words, bribery. (Kambewa et al., 2007) This perverse market structure concentrates profits in the hands a few powerful trucking companies and negligent government institutions, while shifting costs to consumers and the environment. Even with wood charcoal prices in Uganda skyrocketing by 500% in the last 5 years, consumption in Kampala is growing at an exponential rate of 6% per year in lockstep with urbanization. (GVEP, 2012)

Our proposed solution solves the above challenges by enabling local communities to convert locally sourced farm or municipal waste into clean burning fuel briquettes thus eliminating the need to transport wood charcoal from remote villages. Because of this, our fuel briquettes are 20 percent cheaper than traditional wood charcoal. This saves an average Ugandan family about \$200/year.

Mass-manufacturing the Eco-Fuel Press machine will enable us to create more clean energy micro-entrepreneurs in slums and villages across Uganda. This will enable local communities to locally produce all the cooking fuel they need which will eliminate the need to purchase expensive fuel-wood produced in distant areas.

Users also prefer our fuel briquettes to traditional fuel-wood because they are less smoky and burn longer. This eliminates indoor air pollutions which kills many people in Africa particularly women and children.

Implementation Plans

We have been in the business of manufacturing fuel briquettes in Uganda since June, 2010. Until recently, our biggest setback has been lack of appropriate technology. Originally we used screw-type extruders powered by electricity. This proved a major liability to our project when a blown transformer outside our Kampala facility killed briquette production for over two weeks. People demand cooking fuel

every day, so we quickly realized that a failsafe, grid-independent machine was necessary to achieve sustainability.

This is why we are excited about our recent invention- a simple manual briquetting machine called Eco-fuel Press which converts farm or municipal waste into clean burning fuel briquettes without using electricity.

Our plan is to set up a local manufacturing center to mass manufacture the Eco-fuel Press Machines in Kampala and then lease these machines to local unemployed women and youths in slums and villages across Uganda. These will be trained and mentored to ensure that they use these machines to launch clean energy micro-businesses converting locally sourced farm and municipal waste into clean cooking fuel briquettes to meet local energy needs. The goal is to manufacture and lease at least 200 Eco-fuel Press Machines every year. Each Micro-entrepreneur will have the capacity to meet energy needs of at least fifty local households and employ at least two local people.

The new proposed manufacturing center will also focus on continuously improving the Eco-fuel Press through continuous research and customer feedback. We will continuously work with the users of the Eco-fuel Press Machine to identify weaknesses of our current design and come up with improvements. Our goal is to create a briquetting machine that will be used in all developing countries to make clean cooking fuel from farm and Municipal waste.

Stakeholder Engagement

Our most important stakeholders are the local communities where we shall work. We will particularly work with groups of marginalized women, youths and farmers in rural areas and slums across Uganda.

Currently, we have 178 community based groups in Uganda that have contacted us expressing interest to buy or lease the Eco-fuel Press. Most of these groups see the Eco-fuel Press as an opportunity to create sustainable jobs for their members. We are also beginning to see a lot of interest from NGOs that advocate for environmental protection in Uganda.

We therefore quickly need to create local capacity to mass manufacture the Eco-fuel Press Machine so that we meet the overwhelming demand for these machines.

Project Indicators that will be used to track the project

We will measure the following success indicators:

- Number of Eco-fuel Press Machines Manufactured. Our target is to manufacture at least 200 machines under this project
- Number of clean energy micro-entrepreneurs trained and mentored. The target is train and mentor at least 200 micro-entrepreneurs under this project
- Number of new households enabled to use our eco-fuel products. The target is to reach at least 10,000 new households
- Cost saving per user of our eco-fuel products versus users of competing alternatives. The target is to enable users save at least \$200/year.
- Social Impact on the users of our eco-fuel products versus users of competing alternatives. The target is to ensure that users are healthier, their children particularly girls stay in school and they can cook regular meals without suffering from indoor air pollution

- Kwh of electricity saved by using eco-fuel products versus competing alternatives. This will be tracked by measuring the amount of electricity that people who use our eco-fuel would otherwise need to cook their meals. The target is to save at least 1 Kwh of electricity during the project
- Tons of CO2 emissions mitigated by using eco-fuel products versus the alternatives. The goal is to save at least 10,000 tons of CO2 during the project. This will be measured by looking at avoided deforestation
- Improved crop yield obtained from using eco-fuel products versus the alternatives. The goal is to help farmers improve their food harvests by at least 30 percent.

Data collection Strategy

- Questionnaires will be used to capture relevant data like the level of unemployment, income levels, number of children going to school etc before our project launches in a given community. We will then periodically measure these indicators after our project launches to determine whether our project has led to any significant positive impact;
- Focus groups like women and youths. We will also intentionally measure the impact of our project on specific groups like marginalised women and youths to verify whether our project has increased incomes and general living conditions of these groups;
- Partnerships with schools and other organised groups like community based groups will also be leveraged to help us measure the impact of our project on issues like the number of girls going to school and new jobs created for specific groups of people;
- Customer visits will also be used. Our team will periodically visit our beneficiaries to observe whether our project has led to any noticeable positive changes in the lives of its beneficiaries. During these visits, the team will also ask beneficiaries a number of specific questions which will enable us to determine the impact of our project on the communities we target.

Sampling Strategy

Because we intend to study two different groups i.e households of the micro-entrepreneurs and the households of the users and because these groups are different in size, we intend to use two sampling designs as follows:

- a. For households of retailers, we intend to use **simple random sampling**. Each of the 200 micro-entrepreneurs will be assigned a number. A set of random numbers will then be generated and the retailers having those numbers will be included in the sample. The sample size for this group will be 10% (20 micro-entrepreneurs for the life of the project)
- b. **For households of users of our fuel briquettes, we intend to use cluster sampling**. Because of the big number of marginalized households which will be enabled to access our fuel briquettes by this project, it will be impossible and impractical to compile an exhaustive list of the households that will make up all the beneficiaries but because these households will belong to fifty specific villages, these villages will be divided into fifty clusters and each village assigned a number. A set of ten random numbers will be generated and the villages

having those numbers will be included in the study. Each micro-entrepreneur will be required to record the names of households buying fuel briquettes from their in the village. From the names recorded, ten households will be randomly selected from each of the ten selected villages. Therefore, a total of 100 households will be studied for the life of the project.

Time frame for data collection

Data about this project will be collect at three stages, baseline, midline and end of project as follows:

Data collection Stage	Time frame
Baseline	At the start of the project. Baseline report to be completed by July, 2013
Midline	Six months after the project. Midline report to be completed by December, 2013
End of project	After all project activities have been carried out. End of project Report to be completed by July, 2014

Marketing Strategy

The project will mainly be marketed through radio talk-shows

Project Team

Sanga Moses-Founder and CEO: Sanga is a devoted social entrepreneur who has committed himself to bettering the lives of his fellow Ugandans. His vision is to provide clean, inexpensive cooking energy to all Africans while improving socioeconomic outcomes and reversing deforestation. A former corporate accountant, Sanga is a graduate of Business Administration at Makerere University, Kampala and has started three successful enterprises before EFA that currently employ over 120 people. Sanga is a TED Fellow, 2012; a Community Solutions Fellow, 2012; a Tech Awards Laureate, 2012 and an Unreasonable Institute Fellow, 2011.

In January, 2009, Sanga travelled from Kampala where he worked as an accountant in a top

Mulinda Peter- Chief Finance Officer: Peter holds a degree in accounting from Makerere University and over 20 years hands-on accounting experience. Before Eco-fuel Africa, Peter worked as a Revenue Officer for Uganda Revenue Authority for over 20 years. Peter therefore brings vast financial management experience to the team.

Tandekwire Ben- Operations Manager: Ben holds a degree in developmental studies from Mbarara University of Science and Technology. Immediately after school, Ben turned down lucrative job offers to return to his home village in Uganda to sensitize villagers about HIV/AIDS. In 2009, Ben also initiated a

community based project that brought clean water to 3,100 families in Kiboga District, one of the poorest districts in Uganda. Ben therefore brings vast experience in implementing innovative projects that improve lives of people at the base of the pyramid.

Tushemereirwe Richard- Chairman, Advisory Board: Mr. Tushemereirwe holds a Post Graduate Diploma in Business Administration from Cambridge International College and a Bachelors of Science degree majoring in Biochemistry from Makerere University

Richard joined the office of the President of Uganda in 2004 as an Assistant Private Secretary/Science and Technology until 2008 when he was promoted to Senior Private Secretary, his current position. As Senior Private Secretary to the President of Uganda, Richard assists the President on matters of Science and Technology. His work ranges from Policy, Investment, Research and other related issues

Frank Bukenya- Senior Engineer: Frank has an engineering degree from Kyabogo University, Uganda and over 5 years hands-on engineering experience. Frank was head of the engineering team that designed the first prototype of the Eco-fuel Press Machine. Frank does not work for us full-time yet but has committed to join our team full-time if we secure the funding needed for this project.

Project Costs/ budget

Project Cost						Project Costs allocation		
Number	Description	Measurement unit	Quantity	Unit cost	Total Project Costs	USAID Contribution	EFA Contribution	Check
1	Personnel Costs				\$58,965.12	\$58,965.12	\$0.00	\$0.00
1.1	Chief Executive Officer	Number of hours worked during life of the project	1,920	\$7.53	\$14,448.00	\$14,448.00	\$0.00	ok
1.2	Operations Manager	Number of hours worked during life of the project	1,920	\$4.28	\$8,220.48	\$8,220.48	\$0.00	ok
1.3	Chief Finance Officer	Number of hours worked during life of the project	1,920	\$4.28	\$8,220.48	\$8,220.48	\$0.00	ok
1.4	Senior Engineer	Number of hours worked during life of the project	1,920	\$4.28	\$8,220.48	\$8,220.48	\$0.00	ok
1.5	Training Manager	Number of hours worked during life of the project	1,920	\$4.28	\$8,220.48	\$8,220.48	\$0.00	ok
1.6	Engineer 1	Number of hours worked during life of the project	1,920	\$3.03	\$5,817.60	\$5,817.60	\$0.00	ok
1.7	Engineer 2	Number of hours worked during life of the project	1,920	\$3.03	\$5,817.60	\$5,817.60	\$0.00	ok
2	Equipment				\$60,000.00	\$33,834.88	\$26,165.12	ok
2.1	Purchase of a Lethe Machine	Number of machines	1	\$15,400.00	\$15,400.00	\$0.00	\$15,400.00	ok
2.2	Purchase of a Grinder Machine	Number of machines	1	\$600.00	\$600.00	\$0.00	\$600.00	ok
2.3	Purchase of a Drilling Machine	Number of machines	1	\$2,500.00	\$2,500.00	\$2,500.00	\$0.00	ok
2.4	Purchase of a Welding Machine	Number of machines	1	\$1,500.00	\$1,500.00	\$1,500.00	\$0.00	ok
2.5	Purchase of initial supplies needed to manufacture 200 units	Number of units	200	\$200.00	\$40,000.00	\$29,834.88	\$10,165.12	ok
3	Rent for the manufacturing center				\$3,600.00	\$3,600.00	\$0.00	ok
3.1	Monthly rent for the manufacturing center	Number of months	12	\$300.00	\$3,600.00	\$3,600.00	\$0.00	ok
4	Training new micro-entrepreneurs				\$13,510.00	\$0.00	\$13,510.00	ok
4.1	Hiring Training Venues	Number of days the training venues will be hired	10	\$57.00	\$570.00	\$0.00	\$570.00	ok
4.2	Training materials	Number of pamphlets to be printed	200	\$20.00	\$4,000.00	\$0.00	\$4,000.00	ok
4.3	Lunch and breakfast for the 200 micro-entrepreneurs during training	Number of total days	2,000	\$3.42	\$6,840.00	\$0.00	\$6,840.00	ok
4.4	Fees for consultants who will conduct the training	Number of hours worked by consultants	100	\$21.00	\$2,100.00	\$0.00	\$2,100.00	ok
5	Marketing (Radio talk-shows)				\$3,600.00	\$3,600.00	\$0.00	ok
5.1	Paying for air time on radio stations to conduct radio talk-shows	Number of radio talk-shows	12	\$300.00	\$3,600.00	\$3,600.00	\$0.00	ok
Total Costs					\$139,675.12	\$100,000.00	\$39,675.12	ok

Baseline Study Report-Eco-fuel Africa

We conducted a baseline study in the areas of Buikwe, Mukono and Wakiso to understand the starting point of the DIV project. The purpose of the baseline survey was to understand the starting point of the project against which the progress of the project would be measured.

In Buikwe District, we studied 165 households. All families depended on wood for fuel. These families reported spending over 35% of their incomes on fuel-wood. This was worsening poverty levels in these households.

Some households also told us that they were no longer able to cook regular meals because of fuel scarcity and the children from such households went to school hungry and could not concentrate in class!

In Wakiso District, we visited 142 households. 98% of them earned less than \$3/day. All of these households also depended on fuel-wood. When we asked them what their three biggest costs were, fuel-wood ranked second to food!

Based on the facts above, we believe that the leading problem facing households in Uganda now is fuel scarcity. This is worsening poverty levels, worsening the rate of deforestation and denying tens of thousands of young girls an opportunity to go to school. Therefore, in line with results from our baseline study, we have the following plans to address the above problems:

Situation at the baseline for each of the key output indicators;

Indicator	Baseline	Target at the end of the DIV project
Number of households using eco-fuel products	3,500	10,000
Cost saving per user of eco-fuel products versus other products	An average household in our target areas currently spends Uganda shillings (UGX) 45,000/month or UGX 540,000/year on fuel-wood for cooking	With our ecofuel, an average household in our target areas will spend UGX 21,000/ month or UGX 252,000/year on cooking fuel
Number of new micro-entrepreneurs created	0	200
KwH of electricity saved	We tested both charcoal from wood and our briquettes and discovered that, 1 kg of charcoal from wood gives 3500 (Kcal/kg) \times 0.08 (thermal energy yield) = 280 Kcal; while 1 kg of our briquettes gives = $1 \times 0.20 \times 0.28$ (thermal energy yield) \times 75.00 (Kcal/kg) = 420 Kcal. Thus there	Our target is to reach at least 10,000 households by the end of this project. 10,000 households consume about 3.6 million kilograms of our briquettes a year. Therefore, 504,000,000 Kcal or 196,002.18 KwH of energy will be saved by the end of the project if our briquettes

	is a net saving of 140 Kcal of energy if, our briquettes are used instead of wood. There are about 83,333 households in our target area and each of these households consumes an average of one kilogram of charcoal per day. Therefore in a year, about 4.2 billion Kcal of energy is wasted if charcoal from wood is consumed. Since 1 kWh is equal to 2571.4 Kcal, this is equivalent to 1,633,351 kWh of electricity wasted every year	are adopted
Tons of CO2 emissions mitigated	Each kilogram of charcoal produces 1.11 kg of CO2 (FAO). In our target areas, currently about 30 million kilograms of wood charcoal are consumed every year. Therefore, about 33,333,333 kgs of CO2 are emitted every year.	Our briquettes are carbon neutral and since we target to reach 10,000 households by the end of the project, we shall have mitigated at least 4 million tons of CO2 by the end of the project because the target households will have consumed 3.6 million kilograms of our briquettes by the end of the project
Improved crop yield of farmers	From our household survey in our target communities, farmers currently harvest an average of 567kgs per hectare. We mainly tracked crop yields for cereal crops like beans, maize and millet because these can be easily estimated in kilograms	The target is to help farmers increase their harvests to at least 737 kgs/hectare by the end of the project

Implementation Plans

We have completed setting up a local manufacturing center to mass manufacture the Eco-fuel Press Machines in Uganda. These machines will be leased to local unemployed women and youths in slums and villages across Uganda. These will be trained and mentored to ensure that they use these machines to launch clean energy micro-businesses converting locally sourced farm and municipal waste into clean cooking fuel briquettes to meet local energy needs. The goal is to manufacture and lease at least 200 Eco-fuel Press Machines every year. Each Micro-entrepreneur will have the capacity to meet energy needs of at least fifty local households and employ at least two local people.

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Time frame for data collection

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Project Cost

Project Costs allocation

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4.2	Training materials	Number of pamphlets to be printed	200	\$20.00	\$4,000.00	\$0.00	\$4,000.00	ok
4.3	Lunch and breakfast for the 200 micro-entrepreneurs during training	Number of total days	2,000	\$3.42	\$6,840.00	\$0.00	\$6,840.00	ok
4.4	Fees for consultants who will conduct the training	Number of hours worked by consultants	100	\$21.00	\$2,100.00	\$0.00	\$2,100.00	ok
5	Marketing (Radio talk-shows)				\$3,600.00	\$3,600.00	\$0.00	ok
5.1	Paying for air time on radio stations to conduct radio talk-shows	Number of radio talk-shows	12	\$300.00	\$3,600.00	\$3,600.00	\$0.00	ok
Total Costs					\$139,675.12	\$100,000.00	\$39,675.12	ok

PROGRESS REPORT- ECO-FUEL AFRICA

Contents

1. What have we done so far with DIV funding?
2. Progress to date

1. What have we done so far with DIV funding?

Since receiving DIV funding, we have focused on improving both our large and small-scale briquetting technology. Our large scale technology is used directly by us to make more green charcoal so as to be able to meet the ever increasing demand for our product while small-scale technology is mainly used to create new clean energy micro-entrepreneurs in areas we don't currently work. These micro-entrepreneurs are then empowered to replicate our business model in their local areas. This is helping to take clean cooking fuel to remote villages in Uganda

2. Progress to date

Since receiving DIV's funding, we have made the following progress:

1. ***Designed and manufactured one unit of the large capacity briquetting machine:***



Already, we have manufactured one unit of this large capacity briquetting technology. This will help to increase our daily production capacity from just 5,000 kgs of green charcoal a day to at least 20,000 kgs of green charcoal a day. This will enable us to reach up to 20,000 new households with green charcoal.



Increasing our production capacity will also create many new local jobs for people at the base of the pyramid. For example, as our production capacity increases we intend to create new women micro-retailers who will help us to sell the additional green charcoal that will come with the new technology

2. Creation of micro-franchisees in remote villages where we currently don't work



With DIV funding, we are also creating micro-franchisees in remote villages where we current don't work using manual briquetting machines shown above. The manual briquetting machines do not use electricity to operate, are easy to use and can be used by people with limited skills. This is enabling us to take clean cooking fuel to remote villages where no any other intervention currently is able to reach. Since the beginning of the DIV project, we have made and sold 20 manual machines. This has created at least 60 new jobs and enabled at least 1,000 new households to access our clean cooking fuel briquettes

Thank you so much for your support

Kindest Regards,

Sanga Moses

CEO-ECO-FUEL AFRICA

www.ecofuelafrika.com



Midline Study Report-DIV Project

Between February and March, 2014, we conducted a midline study in the areas of Buikwe and Wakiso to understand the progress of the DIV project to date. The purpose of the midline survey was to track the progress of the DIV project since the baseline.

Data collection Strategies used:

- Questionnaires were used to capture relevant data during household surveys at midline;
- We also used focused group discussions for people like women and youths;
- We also conducted Key Informant Interviews with head teachers and local leaders to collect information about our impact on issues like the number of girls going to school and new jobs created for specific groups of people;
- We also visited a number of users of our fuel briquettes and used questionnaires to gather information cost savings, quality of our fuel briquettes to mention but a few

Sampling Strategy:

During the midline study, we used the following sampling designs:

- a. For households of retailers, we used **simple random sampling**
- b. For households of users of our fuel briquettes, we used **cluster sampling**. Because of the big number of marginalized households which use our fuel briquettes, it was impossible and impractical to compile an exhaustive list of the households that make up all our beneficiaries but because these households belong to specific villages, these villages were divided into clusters and each village was assigned a number. A set of random numbers was generated and the villages having those numbers were included in the study.

Study Findings:

In Buikwe District, we studied 165 households. These are the same households that were studied at baseline. By midline, all the households studied had adopted our clean cooking fuel briquettes for cooking. At baseline, these households had reported spending over 35% of their incomes on fuel-wood. By midline, these households now only spend about 15% of their incomes on our clean burning fuel briquettes. This represents a cost reduction of over 50%

Because of the above cost savings on cooking fuel, 45% of households which cooked only one meal at baseline because of high cooking fuel costs now cook two meals a day while 18% now cook three meals a day. This is increasing the quality of life of children in these households

In Wakiso District, we visited 142 households. Like in Buikwe, these were the same households we studied at baseline. 102 of these holds or 72% of the households studied were now using our fuel briquettes by the midline. 40 households were still using charcoal from wood but these households are mainly in areas where we do not have retailers yet. Therefore, the reason they have not yet adopted our fuel briquettes could be because they cannot easily access it. Like in Buikwe, by midline, households which have already adopted our fuel briquettes in Wakiso were also able to report cost savings in energy costs.

From Key Informant Interviews with local leaders and Head Teachers in both Wakiso and Buikwe districts, school enrolments for particularly girls have increased by 17.2% since the beginning of the project. This could be attributed to both increased incomes of our beneficiaries and the fact that some of these girls no longer have to stay home to gather wood for their households.

We also tracked a number of other indicators which we had studied at baseline to see if something has changed at midline. Below are the details:

Comparison of baseline and midline situation for each of the key output indicators:

Indicator	Baseline	Midline	Comment
Number of households using eco-fuel products	3,500 households	9,573 households	We have greatly expanded since the baseline and as a result an additional 6,073 households now use our ecofuel on a daily basis.
Cost saving per user of eco-fuel products versus other products	At baseline, our target households spent an average of Uganda shillings (UGX) 45,000/month or UGX 540,000/year on fue-wood for cooking	With our ecofuel, these households now spend only UGX 21,000/month or UGX 252,000/year on cooking fuel. This represents a cost saving of ugx 5,520,096,000 or USD 2,208,038/ year	Our ecofuel is less than half the price of traditional charcoal from wood, cooks longer and burns cleaner
Number of new micro-entrepreneurs created	0	102 new micro-entrepreneurs have been created since the baseline	
KwH of electricity saved	We tested both charcoal from wood and our briquettes and discovered that, 1 kg of charcoal from wood gives 3500 (Kcal/kg) × 0.08 (thermal energy yield) = 280 Kcal; while 1 kg of our briquettes gives = 1 × 0.20 × 0.28 (thermal energy yield) × 75.00 (Kcal/kg) = 420 Kcal. Thus there is a net saving	Now 9,573 households use our ecofuel. These consume about 287,190 kilograms of our ecofuel a month. Therefore, 120,619,800 Kcal or 46,908 KwH of energy are saved every month as a result of our project	

	of 140 Kcal of energy if, our briquettes are used instead of wood. There are about 83,333 households in our target area and at baseline, each of these households consumed an average of one kilogram of charcoal per day. Therefore in a year, about 4.2 billion Kcal of energy was wasted as a result of consuming charcoal from wood. Since 1 kWh was equal to 2571.4 Kcal, this was equivalent to 1,633,351 kWh of electricity wasted every year		
Tons of CO2 emissions mitigated	Each kilogram of charcoal from wood produces 1.11 kg of CO2 (FAO). At baseline, about 30 million kilograms of wood charcoal were consumed every year in our target areas. Therefore, about 33,333,333 kgs of CO2 were emitted every year.	Our briquettes are carbon neutral and since we now serve 9,573 we are now mitigating 3,825,371 tons of CO2 every year.	
Improved crop yield of farmers	At baseline, farmers harvested an average of 567kgs per hectare. We mainly tracked crop yields for cereal crops like beans, maize and millet because these can be easily estimated in kilograms	By midline, our beneficiary farmers now harvest 669 kgs/hectare. Indicating an increase in crop yields of about 18%	The increase in crop yields is still lower than 30% increase anticipated at baseline because most of the beneficiary farmers have not yet mastered how to use biochar

Thank you so much
Sanga Moses
CEO-ECO-FUEL AFRICA
www.ecofuelafrika.com



Progress Report since the Midline -DIV Project

Contents:

- Progress since the midline study
- Data collection strategies
- Final Remarks

Since completing the midline study in March, 2014, Eco-fuel Africa has made the following strides:

Indicator	Midline	Now	Comment
Number of households using eco-fuel products	9,573 households	19,167 households	We have greatly expanded since the midline and as a result an additional 9,594 households now use our ecofuel on a daily basis. This has already exceeded our endline target which was 10,000 households
Cost saving per user of eco-fuel products versus other products	At midline, our target households spent an average of UGX 21,000/ month or UGX 252,000/year on cooking fuel. This represents a cost saving of ugx 5,520,096,000 or USD 2,208,038/ year	Now, these households still spend only UGX 21,000/ month or UGX 252,000/year on cooking fuel and are still making the same cost savings as at the midline	Our ecofuel is less than half the price of traditional charcoal from wood, cooks longer and burns cleaner
Number of new micro-entrepreneurs created	At midline, 102 new micro-entrepreneurs had been created since the baseline	Now 245 new micro-entrepreneurs have been created. This indicates an additional 143 new micro-entrepreneurs since the midline	This is creating new jobs for people at the base of the pyramid
KwH of electricity saved	At midline 9,573 households used our ecofuel. These	Now 19,167 households use our ecofuel. These	Therefore, an additional 47,011.30 KwH of energy

	consumed about 287,190 kilograms of our ecofuel a month. Therefore, 120,619,800 Kcal or 46,908 kWh of energy were saved every month as a result of our project	consume about 575,010 kilograms of our ecofuel a month. Therefore, 241,504,200 Kcal or 93,919.3 kWh of energy are saved every month as a result of our project	are being saved every month since the midline
Tons of CO2 emissions mitigated	Since we served 9,573 households at midline, we were mitigating 3,825,371 tons of CO2 every year at midline.	Since we now serve 19,167 households, we are now mitigating 7,659,133.2 tons of CO2 every year.	Therefore, an additional 3,833,762.20 tons of CO2 are being mitigated every year since the midline
Improved crop yield of farmers	By midline, our beneficiary farmers were harvesting 669 kgs/hectare. Indicating an increase in crop yields of about 18% since the baseline	Now, our farmers are harvesting 748kgs/hectare. Indicating	This indicates a 32% increase in crop yields since the baseline study and already exceeds the endline target of 30%

Data collection Strategies used:

- Questionnaires were used to capture relevant data during household surveys;
- We also used focused group discussions for people like women and youths;
- We also visited a number of users of our fuel briquettes and used questionnaires to gather information cost savings, quality of our fuel briquettes to mention but a few

Final Remarks:

We want to thank DIV for your invaluable support and to express our continued dedication to making this project a success

Thank you so much

Very Warm Regards,
Sanga Moses
CEO-ECO-FUEL AFRICA
www.ecofuelafrika.co.ug



DIV PROJECT END-LINE REPORT- ECO-FUEL AFRICA

Contents

1. Background of the project
2. Geographical areas of the study
3. Sampling Strategy
4. Data Collection Strategy
5. End-line position for all project indicators
6. End-line Data Analysis
7. What next for Eco-fuel Africa?

1. Background of the project:

The vast majority of Ugandans cook their food using dirty and expensive wood-based fuels. This leads to unsustainable levels of deforestation, worsens household poverty and causes indoor air pollution related illnesses. To try and address these challenges, in May, 2013, Eco-fuel Africa was awarded a grant of USD 100,000 by Development Innovation Ventures (DIV) at USAID to test its innovative and low-cost technology which low-income communities in Uganda can use to convert locally sourced agricultural waste like sugarcane waste and corn waste into clean cooking fuel and organic fertilizers. The purpose of this end-line report therefore, is to track the success of this project.

2. Geographical areas of study

We conducted an end-line study in the areas of Buikwe, Mukono and Wakiso to understand the end point of the DIV project. These are the same areas where the baseline study was conducted at the beginning of the project.

Below is a map showing areas where the end-line study was conducted:



In Buikwe and Mukono Districts, we studied 114 households. All these households depended on wood-based fuels at baseline but had now adopted eco-fuel briquettes by the end-line.

In Wakiso District, we studied 114 households. These were the same households studied at the baseline. Just like in Buikwe and Mukono, all of these households depended on wood-based fuels at the baseline and all of them had adopted eco-fuel briquettes by the end-line.

According to Uganda Bureau of Statistics, an average household in Uganda has 6 people.

3. Sampling Strategy

We studied two different groups i.e. households of the micro-entrepreneurs and the households of the users of eco-fuel briquettes and because these groups were different in size, we used two sampling designs as follows:

- a. For micro-entrepreneurs, we used **simple random sampling**. Each of the 280 micro-entrepreneurs was assigned a number. A set of random numbers was then generated and the micro-entrepreneurs having those numbers were included in the sample. The sample size for this group was 10% of the 280 micro-entrepreneurs created under this project. Therefore, 28 micro-entrepreneurs were studied under this group.
- b. **For households of users of our fuel briquettes, we used cluster sampling**. Because of the big number of marginalized households which were enabled to access our fuel briquettes by this project, it was impossible and impractical to compile an exhaustive list of the households that would make up all the beneficiaries but because these households belong to fifty specific villages, these villages were divided into fifty clusters and each village assigned a number. A set of ten random numbers was generated and the villages having those numbers were included in the study. Each micro-entrepreneur was required to record the names of households buying fuel briquettes from them in the village. From the names recorded, twenty households were randomly selected from each of the ten selected villages. Therefore, a total of 200 households were studied under this group.

4. Data collection Strategy

- Questionnaires were used to capture relevant data like percentage of household income spent on cooking fuel, type of cooking fuel used in the household to mention but a few;
- Focus groups were used. Different beneficiary women were gathered and asked to debate specific topics like whether they thought that the project had increased incomes and general living conditions of their households;
- Partnerships were formed with schools and other organized groups like community based groups and these were leveraged to help us measure the impact of our project on issues like the number of new girls going to school for the first time as a result of our project;
- Customer visits were also used. Our team periodically visited our beneficiaries to observe whether our project was leading to any noticeable positive changes in the lives of its beneficiaries. During these visits, the team also asked beneficiaries a number of specific questions which enabled us to determine the impact of our project on the beneficiary households and communities.

5. End-line position for all project indicators

Indicator 1: Number of households using eco-fuel products

Baseline position: 3,500 households

End-line Target: 10,000 households

Actual End-line Position: 19,320 households

How have we calculated this end-line figure?

We created 280 micro-entrepreneurs under the DIV project and each of these micro-entrepreneurs can potentially bring clean cooking fuel briquettes to 250 households. However, most of our micro-entrepreneurs are still just trying to create data bases for their beneficiary households. Fortunately, all our micro-entrepreneurs have started creating data bases for their beneficiary households and all of them have at least 69 households in their data bases already. Therefore, $96 \times 280 = 19,320$ households.

Other benefits beneficiary households have received from the project:

Some households which were not able to cook regular meals at baseline, are now able to cook at least 3 meals a day because they can now afford the cooking fuel and have money left to buy food and other basic necessities. Because of this, children from these households no longer have to go to school hungry. This is enabling children particularly girls from the beneficiary households to improve their learning outcomes

Indicator 2: Cost savings per user of eco-fuel products versus other products

Baseline Position: Average households were spending Uganda shillings (UGS) 540,000/year on cooking fuel at baseline and at baseline, the price of one kilogram of charcoal from wood was only Uganda shillings 1,500/kg. This price has ever since increased to Uganda shillings 2,000/kg. Therefore, now households which still depend on charcoal from wood spend UGS 730,000/year on cooking fuel

End-line Target: The initial target was a 47% cost saving. This target was based on old prices of traditional charcoal from wood. I.e UGS 1,500/kg which have ever since increased to UGS 2,000/kg

Actual End-line Position: By end-line, beneficiary households are saving 65% of money previously spent on dirty and expensive traditional charcoal from wood. Immediately after the baseline study, prices of traditional charcoal from wood which is our major competition, increased from UGS 1,500/kg to UGS 2,000/kg. Because of this, the target was revised and the new target was to reduce household cost on cooking fuel from UGS 730,000/year to UGS 255,500/year representing a 65% cost saving.

Now, households using eco-fuel briquettes are able to save UGS 474,500/ year. This money is used to send children to school, buy food and generally improve living conditions of the beneficiary households.

How have we calculated this end-line figure?

An average household in Uganda uses one kilogram of charcoal (both traditional charcoal and our eco-fuel briquettes) a day. If a household uses traditional charcoal, this means that it will be spending UGS 2,000/day on cooking fuel but If the household uses our eco-fuel briquettes, it will only spend UGS 700/day. Therefore, a household which uses traditional charcoal spends UGS 730,000/year ($2,000 \times 365 = 730,000$) while a household which uses our eco-fuel briquettes spends UGS 255,500/year ($700 \times 365 = 255,500$) on cooking fuel. This represents a cost saving of UGS 474,500/year.

Indicator 3: Number of new micro-entrepreneurs created

Baseline Position: 0 micro-entrepreneurs had been created at baseline

End-line target: the target was to create 200 micro-entrepreneurs by the end of the project

Actual End-line Position: By end-line, 280 new micro-entrepreneurs have been created. This means that we exceeded our target by 80 micro-entrepreneurs. We identified and selected these micro-entrepreneurs mainly through partnerships with community based organizations and cooperatives.

How have we calculated this end-line figure?

This number is based on the actual number of micro-entrepreneurs selected, trained and technology sold.

Indicator 4: KwH of electricity saved

Baseline Position: We tested both charcoal from wood and our briquettes and discovered that, 1 kg of charcoal from wood gives $3,500 \text{ (Kcal/kg)} \times 0.08 \text{ (thermal energy yield)} = 280 \text{ Kcal}$; while 1 kg of our briquettes gives $1 \times 0.20 \times 0.28 \text{ (thermal energy yield)} \times 75.00 \text{ (Kcal/kg)} = 420 \text{ Kcal}$. Thus there is a net saving of 140 Kcal of energy if, our briquettes are used instead of charcoal from wood. 3,500 households were using our eco-fuel briquettes at baseline. Therefore, only 571.673 KwH of electricity were being saved every year by our project at baseline.

End-line Target: The target was to reach at least 10,000 households by the end of the project and save 196,002.18 KwH of energy by the end of the project if our briquettes are adopted

Actual End-line Position: By the end-line, 19,320 households use our eco-fuel on a daily basis and 378,676.2 KwH of energy are being saved every year by the end-line.

How have we calculated this end-line figure?

According to our primary studies, one household saves an average of 19.6 kWh of energy a year if it adopts our eco-fuel briquettes. Since the project reached 19,320 households, the project is now saving 378,676.2 kWh of energy every year ($19.6 \times 19,320 = 378,676.2$)

Indicator 5: Tons of CO2 emissions mitigated

Baseline Position: At baseline, about 33,333,333 kgs of CO2 were being emitted every year as a result of using wood-based fuels.

End-line Target: The target was mitigating at least 4 million kgs or 4,000 tons of CO2 by the end of the project

Actual End-line Position: By the endline, our project is mitigating at least 7,827,498kgs or 7,827.498 tons of CO2 every year.

How have we calculated this end-line figure?

Each kilogram of charcoal produces 1.11 kg of CO2 (FAO). As a result of the DIV project, we are now reaching 19,320 households with our eco-fuel briquettes and our eco-fuel briquettes are carbon negative. Since an average household in Uganda uses one kilogram of eco-fuel briquettes a day, an average household uses an average of 365 kilograms of eco-fuel briquettes a year and since for every kilogram of eco-fuel briquettes consumed, 1.11 kgs of CO2 are mitigated, 7,827,498 kgs of CO2 are mitigated every year as a result of our project and since 1 ton = 1,000 kgs ($7,827,498/1,000 = 7,827.498$ tons of CO2 mitigated every year.

Indicator 6: Improved crop yields of farmers

Baseline Position: At baseline, farmers harvested an average of 567kgs per hectare

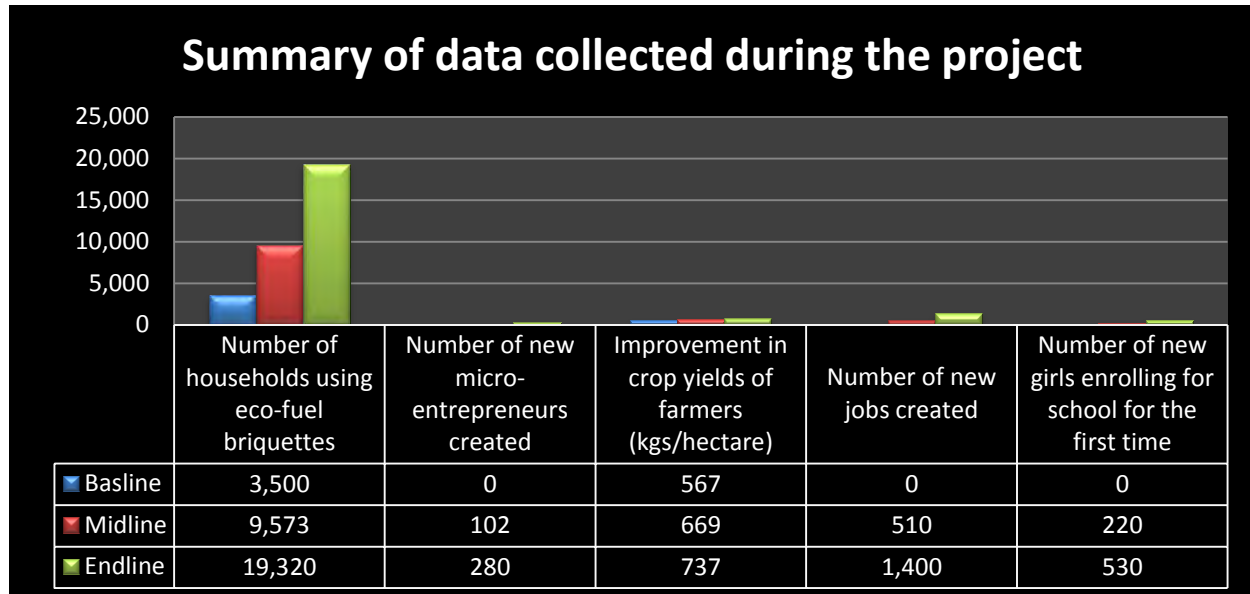
End-line Target: The target was to help farmers increase their harvests to at least 737 kgs/hectare by the end of the project

Actual End-line Position: By the end-line, our farmers are harvesting 748kgs/hectare. Indicating a 32% increase in crop yields since the baseline study.

How have we calculated this end-line figure?

We studied farmers who grow seasonal crops like beans and maize. At baseline, we recorded the number of kilograms farmers harvested per hectare. When beneficiary farmers started using our kilns to make organic fertilizers (biochar) and applying them to their farms, we started tracking the increase in crop yields per season. We noticed a consistent increase in crop yields per hectare as farmers learned how to correctly apply biochar to their farms. By the end-line farmers are now harvesting at least 737 kgs/ hectare.

6. End-line Data Analysis



The graph above summarizes key data collected during the life of the project

7. What next for Eco-fuel Africa?

Now that we have successfully piloted our solution with help of DIV 1 funding, we are ready to take this solution to scale through a program called micro-franchising.

Through micro-franchising, we intend to empower local communities to replicate our solution in their local communities by leveraging our strong brand, innovative and tailor-made technology and inclusive business model. As demand for our fuel briquettes (green charcoal) increases, our demand for biomass waste also increases. However, this biomass waste is scattered in different communities across Uganda. Some of these communities are so remote that we cannot transport biomass waste out of them. It is also only fair that communities which supply us with biomass waste can also easily access our green charcoal. This therefore means that we have to transport finished green charcoal back to these communities but because of poor infrastructure and high fuel costs, it is impossible to transport green charcoal over very long distances and still keep the cost down to ensure that people at the base of the pyramid can also afford it. Micro-franchising is the answer to this challenge! Through micro-franchising, we create a decentralized network of community based briquetting micro-factories using our already tested technology and business model to convert locally sourced biomass waste into green charcoal and making it easily accessible to local people. This eliminates the need to transport biomass waste and green charcoal over very long distances, keeps the cost of green charcoal down which makes it affordable to all people including the poorest of the poor and creates local sustainable jobs.

These community based briquetting micro-factories will be managed by local micro-entrepreneurs particularly vulnerable women and youths who will be identified and trained by Eco-fuel Africa through partnerships with women and youth groups, farmer cooperatives and other community based

organisations. We are specifically seeking funding to setup a revolving loan fund which will be used to finance the initial investment in equipment and training needed by these micro-franchisees. Each of these micro-franchisees will be provided with an initial in-kind loan of \$ 1,000 in form of technology and training and will be helped to start-up production and sales. This loan will attract an interest rate of 1% per month or 12% per annum which is below the market rate in Uganda. When the micro-franchise starts making income, they will be required to start repaying the loan (principle

Thank you so much for your support

Kindest Regards,

Sanga Moses

CEO-ECO-FUEL AFRICA

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DIV 1 FINAL REPORT- ECO-FUEL AFRICA

Table of Contents

1. Executive Summary.....	Page 2-3
2. Project Background.....	Page 4
3. Geographic Areas of Study.....	Page 4
4. Evaluation Design.....	Page 5
5. Sampling Strategy.....	Page 5
6. Data Collection Strategy.....	Page 5-6
7. Key milestones achieved by the project shown by the study.....	Page 6-9
8. Key Lessons Learned.....	Page 9-10
9. Competitive Advantage.....	Page 10-11
10. Financial Results and Scaling Plan.....	Page 11-14
11. Project Theory of Change.....	Page 14
12. What other entrepreneurs can learn from our journey.....	Page 14

Executive Summary

Key Objectives of the DIV Funded Project:

In May, 2013, Eco-fuel Africa was awarded a stage one grant of USD 100,000 by Development Innovation Ventures (DIV) at USAID to implement a project with the following objectives:

- Mass manufacture the Eco-fuel Press Machines
- Train and Mentor at least 200 new clean energy micro-entrepreneurs in Uganda
- Pay Salaries for the team that will manage the project

Eco-fuel Africa spent the grant funds from DIV 1 as planned on the above project objectives and the results of the project exceeded our initial expectations in many ways. Below is a brief summary of the key results and lessons.

Key Results

Number of households reached: At the start of the project, our goal was to increase the number of households using our fuel briquettes on a daily basis from just 3,500 households at the start of the project to at least 10,000 by the end-line. However, we exceeded this goal by 9,167 households and instead we're now reaching at least 19,167 households with our fuel briquettes on a daily basis

Number of new micro-entrepreneurs created: At the start of the project, our goal was to create at least 200 clean energy micro-entrepreneurs by the end of the project. We're happy to report that we exceeded this number and instead created 280 micro-entrepreneurs by the end of the project. This has created sustainable jobs for those at the base of the pyramid.

Note: We achieved and even exceeded many other milestones which will be shared in the main report but the above two achievements are the ones we're proud of the most.

Key Lessons

- **Many people are interested in becoming clean energy micro-entrepreneurs:** When we started, we were not very confident that we would sell enough briquetting machines to people interested in becoming clean energy micro-entrepreneurs but once we got the first few buyers, we do not know how the word

quickly spread and now we have many more applications than want we can take. Therefore, we are very excited about the fact that many people understand the problem we're trying to address and want to be part of the solution. The lesson here is that a good solution will always find customers. We therefore need to maintain the high quality of our products.

- **Decentralizing production through micro-franchising is a great strategy:** because of the infrastructural problems in Uganda and Sub-Saharan Africa in general, it is hard to ship green charcoal or char over long distances and still keep the cost down so that people at the base of the pyramid can still afford it. This is why we're very excited about a decentralized model that we have already successfully piloted in Uganda. Through this model, we create a decentralized network of micro-franchisees who are empowered to replicate our already tested model in their local communities. This creates local jobs, keeps the cost of production down and keeps the value among local farmers, distributors and users.
- **Simple technologies can transform agriculture.** With many years of poor farming methods, soils in Africa have been depleted and yet many farmers cannot afford to buy fertilizers. Therefore, projects like ours that enable farmers to make their own fertilizers are needed and can help farmers to rejuvenate their depleted soils and increase their soil fertility.

What are the next steps for Eco-fuel Africa?

Now that we have tested our technology, tested our business model and validated the demand for our solution, our focus going forward is going to be on taking our solution to scale. We intend to focus on increasing our production capacity in order to meet the current demand which exceeds our current supply by far and also launch the micro-franchising scheme through which we intend to reach areas we would ordinarily not be able to serve because they are hard to reach and lack basic infrastructure.

Also, in order to ensure that the micro-franchising scheme succeeds, we intend to create a revolving loan fund which will be used to provide initial in kind loans in form of machinery and training to new micro-franchisees. These loans will attract interest rate of 12 % per annum and from experience, micro-franchisees will be able to pay back these loans with 6 to 12 months. This will enable us to create jobs for marginalized women and youths who would ordinarily not have the initial funds needed to benefit from our micro-franchising program.

Project Background

The vast majority of Ugandans cook their food using dirty and expensive wood-based fuels. This leads to unsustainable levels of deforestation, worsens household poverty and causes indoor air pollution related illnesses. To try and address these challenges, in May, 2013, Eco-fuel Africa was awarded a stage one grant of USD 100,000 by Development Innovation Ventures (DIV) at USAID to test its innovative and low-cost technology which low-income communities in Uganda can use to convert locally sourced agricultural waste like sugarcane waste and corn waste into clean cooking fuel and organic fertilizers. The purpose of final project report therefore, is to track the success of this project.

1. Geographical areas of study

We conducted an end-line study in the areas of Buikwe, Mukono and Wakiso to understand the end point of the DIV project. These are the same areas where the baseline study was conducted at the beginning of the project.

Below is a map showing areas where the end-line study was conducted:



In Buikwe and Mukono Districts, we studied 114 households. All these households depended on wood-based fuels at baseline but had now adopted eco-fuel briquettes by the end-line.

In Wakiso District, we studied 114 households. These were the same households studied at the baseline. Just like in Buikwe and Mukono, all of these households depended on wood-based fuels at the baseline and all of them had adopted eco-fuel briquettes by the end-line.

According to Uganda Bureau of Statistics, an average household in Uganda has 6 people.

2. Evaluation Design

2.1 Sampling Strategy

We studied two different groups i.e. households of the micro-entrepreneurs and the households of the users of eco-fuel briquettes and because these groups were different in size, we used two sampling designs as follows:

- a. For micro-entrepreneurs, we used **simple random sampling**. Each of the 280 micro-entrepreneurs was assigned a number. A set of random numbers was then generated and the micro-entrepreneurs having those numbers were included in the sample. The sample size for this group was 10% of the 280 micro-entrepreneurs created under this project. Therefore, 28 micro-entrepreneurs were studied under this group.
- b. **For households of users of our fuel briquettes, we used cluster sampling**. Because of the big number of marginalized households which were enabled to access our fuel briquettes by this project, it was impossible and impractical to compile an exhaustive list of the households that would make up all the beneficiaries but because these households belong to fifty specific villages, these villages were divided into fifty clusters and each village assigned a number. A set of ten random numbers was generated and the villages having those numbers were included in the study. Each micro-entrepreneur was required to record the names of households buying fuel briquettes from them in the village. From the names recorded, twenty households were randomly selected from each of the ten selected villages. Therefore, a total of 200 households were studied under this group.

2.2 Data collection Strategy

- Questionnaires were used to capture relevant data like percentage of household income spent on cooking fuel, type of cooking fuel used in the household to mention but a few;
- Focus groups were used. Different beneficiary women were gathered and asked to debate specific topics like whether they thought that the project had increased incomes and general living conditions of their households;
- Partnerships were formed with schools and other organized groups like community based groups and these were leveraged to help us measure the

- impact of our project on issues like the number of new girls going to school for the first time as a result of our project;
- Customer visits were also used. Our team periodically visited our beneficiaries to observe whether our project was leading to any noticeable positive changes in the lives of its beneficiaries. During these visits, the team also asked beneficiaries a number of specific questions which enabled us to determine the impact of our project on the beneficiary households and communities.

3. Key milestones achieved by the project shown by the study.

The purpose of the study was basically to measure the impact of the DIV one funded project since the baseline all through to the end-line. Data was collected for each project indicator. This was compared to baseline position and project goals at the start of the project to determine whether we met the project goals or not. Below is an analysis of the results of the study per project indicator:

Indicator 1: Number of households using eco-fuel products

Baseline position: 3,500 households

End-line Target: 10,000 households

Actual End-line Position: 19,320 households

How have we calculated this end-line figure?

We created 280 micro-entrepreneurs under the DIV project and each of these micro-entrepreneurs can potentially bring clean cooking fuel briquettes to 250 households. However, most of our micro-entrepreneurs are still just trying to create data bases for their beneficiary households. Fortunately, all our micro-entrepreneurs have started creating data bases for their beneficiary households and all of them have at least 69 households in their data bases already. Therefore, $96 \times 280 = 19,320$ households.

Other benefits beneficiary households have received from the project:

Some households which were not able to cook regular meals at baseline, are now able to cook at least 3 meals a day because they can now afford the cooking fuel and have money left to buy food and other basic necessities. Because of this, children from these households no longer have to go to school hungry. This is enabling children particularly girls from the beneficiary households to improve their learning outcomes

Indicator 2: Cost savings per user of eco-fuel products versus other products

Baseline Position: Average households were spending Uganda shillings (UGS) 730,000/year on cooking fuel at baseline and at baseline, the price of one kilogram of charcoal from wood was only Uganda shillings 1,500/kg. This price has ever since increased to Uganda shillings 2,000/kg. Therefore, now households which still depend on charcoal from wood spend UGS 730,000/year on cooking fuel

End-line Target: The initial target was a 47% cost saving. This target was based on old prices of traditional charcoal from wood. I.e UGS 1,500/kg which have ever since increased to UGS 2,000/kg

Actual End-line Position: By end-line, beneficiary households are saving 65% of money previously spent on dirty and expensive traditional charcoal from wood. Immediately after the baseline study, prices of traditional charcoal from wood which is our major competition, increased from UGS 1,500/kg to UGS 2,000/kg. Because of this, the target was revised and the new target was to reduce household cost on cooking fuel from UGS 730,000/year to UGS 255,500/year representing a 65% cost saving.

Now, households using eco-fuel briquettes are able to save UGS 474,500/ year. This money is used to send children to school, buy food and generally improve living conditions of the beneficiary households.

How have we calculated this end-line figure?

An average household in Uganda uses one kilogram of charcoal (both traditional charcoal and our eco-fuel briquettes) a day. If a household uses traditional charcoal, this means that it will be spending UGS 2,000/day on cooking fuel but If the household uses our eco-fuel briquettes, it will only spend UGS 700/day. Therefore, a household which uses traditional charcoal spends UGS 730,000/year ($2,000 \times 365 = 730,000$) while a household which uses our eco-fuel briquettes spends UGS 255,500/year ($700 \times 365 = 255,500$) on cooking fuel. This represents a cost saving of UGS 474,500/year.

Indicator 3: Number of new micro-entrepreneurs created

Baseline Position: 0 micro-entrepreneurs had been created at baseline

End-line target: the target was to create 200 micro-entrepreneurs by the end of the project

Actual End-line Position: By end-line, 280 new micro-entrepreneurs have been created. This means that we exceeded our target by 80 micro-entrepreneurs. We

identified and selected these micro-entrepreneurs mainly through partnerships with community based organizations and cooperatives.

How have we calculated this end-line figure?

This number is based on the actual number of micro-entrepreneurs selected, trained and technology sold.

Indicator 4: KwH of electricity saved

Baseline Position: We tested both charcoal from wood and our briquettes and discovered that, 1 kg of charcoal from wood gives $3,500 \text{ (Kcal/kg)} \times 0.08 \text{ (thermal energy yield)} = 280 \text{ Kcal}$; while 1 kg of our briquettes gives $= 1 \times 0.20 \times 0.28 \text{ (thermal energy yield)} \times 75.00 \text{ (Kcal/kg)} = 420 \text{ Kcal}$. Thus there is a net saving of 140 Kcal of energy if, our briquettes are used instead of charcoal from wood. 3,500 households were using our eco-fuel briquettes at baseline. Therefore, only 571.673 KwH of electricity were being saved every year by our project at baseline.

End-line Target: The target was to reach at least 10,000 households by the end of the project and save 196,002.18 KwH of energy by the end of the project if our briquettes are adopted

Actual End-line Position: By the end-line, 19,320 households use our eco-fuel on a daily basis and 378,676.2 KwH of energy are being saved every year by the end-line.

How have we calculated this end-line figure?

According to our primary studies, one household saves an average of 19.6 KwH of energy a year if it adopts our eco-fuel briquettes. Since the project reached 19,320 households, the project is now saving 378,676.2 KwH of energy every year ($19.6 \times 19,320 = 378,676.2$)

Indicator 5: Tons of CO2 emissions mitigated

Baseline Position: At baseline, about 33,333,333 kgs of CO2 were being emitted every year as a result of using wood-based fuels.

End-line Target: The target was mitigating at least 4 million kgs or 4,000 tons of CO2 by the end of the project

Actual End-line Position: By the endline, our project is mitigating at least 7,827,498kgs or 7,827.498 tons of CO2 every year.

How have we calculated this end-line figure?

Each kilogram of charcoal produces 1.11 kg of CO₂ (FAO). As a result of the DIV project, we are now reaching 19,320 households with our eco-fuel briquettes and our eco-fuel briquettes are carbon negative. Since an average household in Uganda uses one kilogram of eco-fuel briquettes a day, an average household uses an average of 365 kilograms of eco-fuel briquettes a year and since for every kilogram of eco-fuel briquettes consumed, 1.11 kgs of CO₂ are mitigated, 7,827,498 kgs of CO₂ are mitigated every year as a result of our project and since 1 ton = 1,000 kgs (7,827,498/1,000) = 7,827.498tons of CO₂ mitigated every year.

Indicator 6: Improved crop yields of farmers

Baseline Position: At baseline, farmers harvested an average of 567kgs per hectare

End-line Target: The target was to help farmers increase their harvests to at least 737 kgs/hectare by the end of the project

Actual End-line Position: By the end-line, our farmers are harvesting 748kgs/hectare. Indicating a 32% increase in crop yields since the baseline study.

How have we calculated this end-line figure?

We studied farmers who grow seasonal crops like beans and maize. At baseline, we recorded the number of kilograms farmers harvested per hectare. When beneficiary farmers started using our kilns to make organic fertilizers (biochar) and applying them to their farms, we started tracking the increase in crop yields per season. We noticed a consistent increase in crop yields per hectare as farmers learned how to correctly apply biochar to their farms. By the end-line farmers are now harvesting at least 737 kgs/hectare.

4. Key Lessons Learned:

- **Many people are interested in becoming clean energy micro-entrepreneurs:** When we started, we were not very confident that we would sell enough briquetting machines to people interested in becoming clean energy micro-entrepreneurs but once we got the first few buyers, we do not know how the word quickly spread and now we have many more applications than want we can take. Therefore, we are very excited about the fact that many people understand the problem we're trying to address and want to be part of the solution. The lesson here is that a good solution will always find customers. We therefore need to maintain the high quality of our products.
- **Decentralizing production through micro-franchising is a great strategy:** because of the infrastructural problems in Uganda and Sub-Saharan Africa in

general, it is hard to ship green charcoal or char over long distances and still keep the cost down so that people at the base of the pyramid can still afford it. This is why we're very excited about a decentralized model that we have already successfully piloted in Uganda. Through this model, we create a decentralized network of micro-franchisees who are empowered to replicate our already tested model in their local communities. This creates local jobs, keeps the cost of production down and keeps the value among local farmers, distributors and users.

- **Simple technologies can transform agriculture and reduce food insecurity.** With many years of poor farming methods, soils in Africa have been depleted and yet many farmers cannot afford to buy fertilizers. Therefore, projects like ours that enable farmers to make their own fertilizers are needed and can help farmers to rejuvenate their depleted soils and increase their soil fertility.

5. Competitive Advantage

Wood fuels have dominated the sub-Saharan energy market due to their historically high abundance and accessibility. Urbanization and economic development led to rapid consumption of the "low-hanging fruit" near population centers. Local forest depletion instigated an urban shift from wood to charcoal, a more portable, energy-dense fuel than virgin wood. As African forests disappear at twice the rate of the next closest continent (UNEP, 2011), charcoal transporters must burn increasing amounts of fossil fuels. A study of the wood charcoal value chain in Malawi found that transportation costs accounted for 20-25% of charcoal's final retail price. This is because as forests disappear, it becomes hard to find charcoal and traders have to travel long distances in search of the few remaining forests. Unfortunately, charcoal traders shift the ever increasing costs to consumers and the environment. This worsens poverty levels of the consumers as they have to increasingly spend a huge portion of their income on charcoal and they cannot just stop buying charcoal because currently, it's the only type of cooking fuel that they can easily access. To understand the seriousness of the problem, even with wood charcoal prices in Uganda skyrocketing by 500% in the last 5 years, consumption in Kampala is growing at an exponential rate of 6% per year in lockstep with urbanization. (GVEP, 2012). This is mainly because people have no access to reliable alternatives.

Secondly, some projects have tried to promote solar ovens as a solution. However, these have serious weaknesses. For example, they can only be used when the sun is shining and only outside. This is a problem because people still need to eat even when

there is no sunshine and at night. Also, because Africa is very dusty, any solution that requires people to cook outside in the open sun faces the challenge of food being spoilt by dust when the wind blows.

Also, other projects have tried to promote efficient cook stoves. These are great. However, the challenge is that the good ones require a huge initial financial investment and yet most of the people who use charcoal are too poor and cannot afford the initial cost of these efficient cook stoves. Secondly, efficient cook stoves only solve half the problem because people still need to consume charcoal and that means that forests still have to be depleted but only at a reduced rate.

6. Financial Results and Scaling Plan

6.1 What next for Eco-fuel Africa?

Now that we have successfully piloted our solution with help of DIV 1 funding, we are ready to take this solution to scale through a program called micro-franchising.

Through micro-franchising, we intend to empower local communities to replicate our solution in their local communities by leveraging our strong brand, innovative and tailor-made technology and inclusive business model. As demand for our fuel briquettes (green charcoal) increases, our demand for biomass waste also increases. However, this biomass waste is scattered in different communities across Uganda. Some of these communities are so remote that we cannot transport biomass waste out of them. It is also only fair that communities which supply us with biomass waste can also easily access our green charcoal. This therefore means that we have to transport finished green charcoal back to these communities but because of poor infrastructure and high fuel costs, it is impossible to transport green charcoal over very long distances and still keep the cost down to ensure that people at the base of the pyramid can also afford it. Micro-franchising is the answer to this challenge! Through micro-franchising, we create a decentralized network of community based briquetting micro-factories using our already tested technology and business model to convert locally sourced biomass waste into green charcoal and making it easily accessible to local people. This eliminates the need to transport biomass waste and green charcoal over very long distances, keeps the cost of green charcoal down which makes it affordable to all people including the poorest of the poor and creates local sustainable jobs.

These community based briquetting micro-factories will be managed by local micro-entrepreneurs particularly vulnerable women and youths who will be identified and trained by Eco-fuel Africa through partnerships with women and youth groups, farmer cooperatives and other community based organisations. We are specifically seeking

funding to setup a revolving loan fund which will be used to finance the initial investment in equipment and training needed by these micro-franchisees. Each of these micro-franchisees will be provided with an initial in-kind loan of \$ 1,000 in form of technology and training and will be helped to start-up production and sales. This loan will attract an interest rate of 1% per month or 12% per annum which is below the market rate in Uganda. When the micro-franchise starts making income, they will be required to start repaying the loan and the principle

6.2 What are Eco-fuel Africa's specific expansion plans in the next 24 months?

Firstly, our focus now is to expand the production capacity of our existing briquetting centers from just 10 tons a day that we currently produce, to at least 30 tons a day. We will achieve this by investing in large-scale briquetting technology. This alone will enable us to reach at least 20,000 new energy poor households with our clean fuel briquettes (green charcoal). This will also create at least 1,090 new direct jobs. This is because, to be able to achieve this increase in capacity, we will have to train and supply kilns to 1,000 new farmers, employ 10 more direct employees and train and build kiosks for at least 80 new women micro-retailers.

Secondly, under this project, we intend to empower local communities to replicate our solution in their local communities by leveraging our strong brand, innovative and tailor-made technology and inclusive business model through a program called micro-franchising which we have already successfully piloted in Uganda. As demand for our fuel briquettes (green charcoal) increases, our demand for biomass waste also increases. However, this biomass waste is scattered in different communities across Uganda. Some of these communities are so remote that we cannot transport biomass waste out of them. It is also only fair that communities which supply us with biomass waste can also easily access our green charcoal. This therefore means that we have to transport finished green charcoal back to these communities but because of poor infrastructure and high fuel costs, it is impossible to transport green charcoal over very long distances and still keep the cost down to ensure that people at the base of the pyramid can also afford it. Micro-franchising is the answer to this challenge! Through micro-franchising, we create a decentralized network of community based briquetting micro-factories using our already tested technology and business model to convert locally sourced biomass waste into green charcoal and making it easily accessible to local people. This eliminates the need to transport biomass waste and green charcoal over very long distances, keeps the cost of green charcoal down which makes it affordable to all people including the poorest of the poor and creates local sustainable jobs.

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6.3 What will be the Financial Impact of the above expansion plans on our business?

Next 12 Months:
Our expansion plans in the next 12 months will:

Increase our gross revenue from \$662,692 in 2014 to \$ 2,076,923 in 2015

Next 24 months:
Our expansion plans in the next 24 months will:

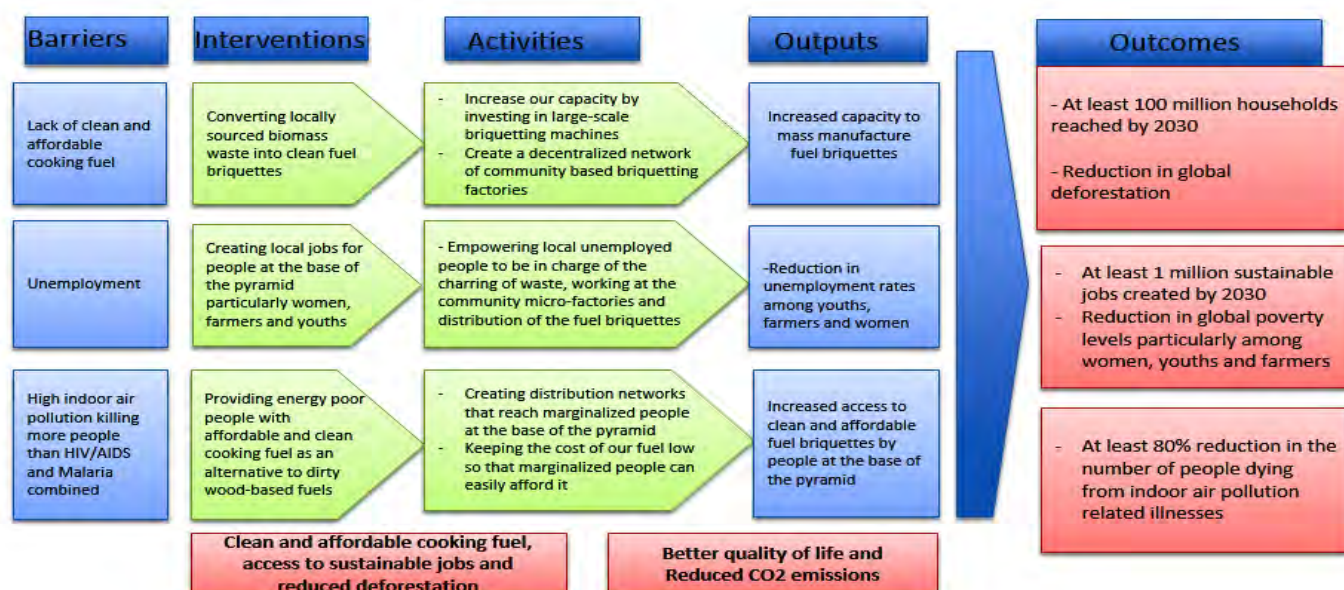
Increase our gross revenue from \$2,076,923 in 2015 to \$5,923,077 in 2016

What the above numbers show is that by the end of 2016, we shall be making enough internal revenue that we shall be able to continue growing without needing any more external investment. However, in order to achieve the above goals, we still need a stage

two investment from DIV and after that we will begin our journey to financial sustainability.

6.4 Project Theory of Change

Going forward, Eco-fuel Africa will be guided by the following theory of change:



7. What can other social entrepreneurs learn from our project's journey?

- That involving local communities in the project makes it easy to solve many challenges because the community feels part of the project
- That it is important to tailor the project to local needs. For example, our micro-franchising model, come out of the fact that some areas in our target areas cannot be easily accessed. Therefore, the only way to serve these areas is to empower people in these communities to replicate our already tested model in their local communities.