

# Briquette Businesses in Uganda

The potential for briquette enterprises to address the sustainability of the Ugandan biomass fuel market



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# TABLE OF CONTENTS

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<b>Summary .....</b>	<b>1</b>
<b>Chapter 1: Introduction.....</b>	<b>2</b>
1.1. Biomass Use in Uganda .....	2
1.2. Briquettes and their Potential .....	5
1.3. A Commercial Case for Briquette Businesses.....	5
<b>Chapter 2: Briquettes .....</b>	<b>7</b>
2.1. Briquette Markets.....	7
2.2. Biomass for Briquettes .....	8
2.3. How Briquettes are made .....	9
<b>Chapter 3: Briquette Businesses in Uganda .....</b>	<b>15</b>
3.1. GVEP International.....	15
3.2. Briquettes in the Developing Energy Enterprises Programme (DEEP) .....	16
3.3. Impacts of the Developing Energy Enterprises Programme (DEEP).....	19
3.4. The Uganda Briquette Industry .....	20
3.5. Briquetting in East Africa – Notable Businesses and Projects.....	25
<b>Chapter 4: Challenges.....</b>	<b>29</b>
<b>Chapter 5: Opportunities .....</b>	<b>36</b>
<b>Chapter 6: Conclusions.....</b>	<b>41</b>

# Summary

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Since 2008 GVEP International has been working to strengthen the ability of micro- and small-scale energy enterprises in East Africa through the Developing Energy Enterprises Programme (DEEP). Of the 705 energy enterprises currently active in the programme, biomass briquettes have emerged as one of the top three energy products dealt with and Uganda has seen the greatest concentration of producers.

This report investigates further the conditions in which these micro- and small-scale briquette producers are operating and examines their potential for growth.

Biomass has historically been a cheap and accessible source of fuel for Uganda's population but this is unlikely to continue. The current level of demand, coupled with unsustainable harvesting and poor management of forests, means that Uganda is approaching something of a biomass crisis. This provides a context in which the economics of briquette production become feasible and as more ventures are starting to appear, there is much scope for growth within an industry that is still in its infancy.

The report presents an overview of GVEP International's work with 139 briquette micro-enterprises and provides an outline of the wider briquette industry in Uganda; including case studies of micro- and small-scale entrepreneurs and profiles of some of the most prominent briquette businesses and projects in the East Africa region.

From these experiences, some of the key challenges found to limit the growth of small briquette producers include, the ability to maintain product quality; having access to the appropriate technology; limitations in feedstock supply; increasing consumer awareness; and accessing necessary finance.

While concluding that biomass briquettes from waste could only contribute a maximum of 6% of the country's total wood consumption and 50% of the charcoal trade and will therefore not be a single solution to addressing the sustainability problems of biomass use in Uganda, if production can be scaled up they can certainly play an important part and represent commercial opportunities at multiple scales of operation in the domestic and institutional fuel markets.

By providing support to develop the briquettes value chain and to create financial linkages, there are opportunities to grow micro-entrepreneurs into small to medium scale producers (20 – 200 tonnes per year) using locally available machinery. By attracting suitable investment, opportunities also exist for new entrants to open medium to large scale production facilities (200 – 2,000 + tonnes per year), using imported equipment.

# Chapter 1: Introduction

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Biomass for energy consists of any organic material that can be used as a fuel; including firewood, forest wastes, dung, vegetable matter and agricultural residues. Energy from biomass accounts for 15% of global energy consumption yet in Uganda it supplies more than 90% of the country's energy needs. Biomass has historically been a cheap and accessible source of fuel for Uganda's population but this is unlikely to continue as a high dependency is raising concerns for the sustainability of the resources as human populations and competing demands increase.

## 1.1. Biomass Use in Uganda

### *Demand*

With only 5% of the rural population having access to electricity, more than 90% of the country's total energy needs in Uganda come from biomass sources. Of this, wood accounts for 80%, charcoal 10% and crop residues at nearly 4%<sup>1</sup>. The use of dung for fuel is rare, although recent implementation of a national biogas programme is seeking to utilise it more on a domestic scale.

For households specifically, the 2009-10 Household Survey conducted by the Uganda National Bureau of Statistics provides a more detailed analysis, reporting that 82% of households use firewood for cooking while 15% use charcoal. Firewood was most commonly used by rural households (86%) while charcoal is commonly used in urban areas (70%). In Kampala, 76% of the population use charcoal as their main source of fuel for cooking.

As quantities, the household consumption of firewood and wood for charcoal was estimated at 22.2 million tonnes in 2006<sup>2</sup>, with small industries consuming a further 5.5 million tonnes creating a total annual biomass demand of 27.7 million tonnes nationwide. Annual biomass consumption per capita is estimated, for rural and urban areas respectively, at 680 kg and 240 kg of firewood and 4 kg and 120 kg of charcoal.

Approximately 4 million tonnes of wood (15% of the total) are consumed to meet the annual demand for charcoal, which in 2010 was estimated by different sources to be between 700,000 and 850,000 tonnes<sup>3</sup>. In Kampala alone charcoal demand was 205,852 tonnes. Used mainly in urban areas, charcoal use is estimated to increase at 6% per year, which matches the rate of urbanisation.

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<sup>1</sup> Data from the Uganda Ministry of Energy and Mineral Development (MEMD), Energy balance 2008

<sup>2</sup> Uganda Renewable Energy Policy, MEMD, 2007

<sup>3</sup> Individual studies by the National Forest Authority and UN Department of Social and Economic Affairs

Methods of charcoal production remain highly wasteful with traditional methods achieving conversion efficiencies as low as 8-15%. Despite efforts to improve the efficiencies of traditional biomass energy technologies, including wood and charcoal stoves, significant results are yet to be seen and many continue to be inefficient.

## Supply

Following a comprehensive study<sup>4</sup> into the biomass resource during the 1990s, the total biomass stock (air-dry, above ground) in Uganda in 2002 was estimated to be 468 million tonnes. Of this, approximately 33% was in protected forest areas leaving the amount available for energy uses around 312 million tonnes. While predicting that Uganda can expect a total annual growth of 50 million tonnes of biomass per year, the study concludes that despite a positive growth rate in protected areas, the biomass stock on private lands (and thus available for wood fuel) will soon face a deficit. Such a detailed study has not been carried out since; however more recent estimates support its conclusions. The FAO reported that between 1990 and 2005 Uganda lost 26% of its forests (78% in areas around Kampala), estimated now to be 24% of total land cover, and the National Environment Management Authority (NEMA) *State of the Environment Uganda 2008* report predict that this deficit will lead to complete depletion of the nation's forests by 2050. What is clear is that Uganda's heavy dependence on biomass is severely impacting the destruction of the country's forest cover.

While wood from trees constitutes the greatest amount of biomass stock available in Uganda and consequently the most used form of biomass by locals, agricultural residues are also utilized. Crops can produce biomass energy from agricultural residue made available from growing, harvesting and processing food crops such as cereals and roots as well as cash crops such as tea, cane sugar and coffee. Data provided by the government in the *Uganda Renewable Energy Policy 2007* suggests that 1.2 million tons of agricultural residues are available each year.

**Table 1:** Annual production of agricultural residues. Source: Uganda Renewable Energy Policy, MEMD, 2007

Agricultural Residue	Annual Production ('000 tons / year)
Bagasse	590
Rice Husks	25-30
Rice Straw	45-55
Sunflower Hulls	17
Cotton Seed Hulls	50
Tobacco Dust	2-4
Maize Cobs	234
Coffee Husks	160
Groundnut Shells	63

<sup>4</sup> Uganda Forest Department, Ministry of Water Lands and Environment, National Biomass Study, 2002

## **The Biomass Economy**

The contribution of firewood and charcoal to Uganda's GDP is estimated at US\$48 million and US\$26.8 million respectively (UNDP, 2011). In terms of employment, biomass production creates nearly 20,000 jobs for Ugandans. Nonetheless these economic activities are also accumulating significant costs as a result of environmental degradation. Millions of Ugandan Shillings are estimated to be lost each year as a result of biodiversity loss and degradation of soil resources.

Despite the on-going environmental degradation, it is clear that these industries represent significant economic activity and any future alternative will have to fill this gap.

## **Biomass Policy**

The most recent government strategy relating to biomass use is reflected in the *Renewable Energy Policy 2007*, which is an extension to the wider *Energy Policy for Uganda 2002*. On the topic of biomass, the policy focuses on demand-side management through the dissemination of more energy efficient technologies (such as improved cook stoves). Where supply is considered, the approach is largely through afforestation and reforestation, however Uganda's president, Yoweri Museveni, has recently been reported<sup>5</sup> as saying that he wants the government to intervene by supporting Kampala's Makerere University to research briquette technology.

With support from the UNDP, the government is also implementing key interventions in charcoal production<sup>6</sup> which includes increasing the charge that the National Forestry Authority levies on charcoal burners. This could provide an opportunity for alternative fuels to compete further with the cost of charcoal.

Critical assessments of the government's ability to implement a biomass strategy have been carried out by the EAC in their *Regional Strategy to Scale up Access to Modern Energy Services* (Uganda Report 2008), in which it praises the *Renewable Energy Policy 2007* and the creation of a division within the Ministry with a specific mandate to handle household energy issues but highlights the following weaknesses in governance:

- A lack of appropriate regulatory framework governing the use of biomass resources, especially those on private lands.
- A lack of strong enough focus on wood fuel resources in the forestry policy.
- A lack of standards and quality assurance leading to production of sub-standard products, lowering the adoption of new technologies

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<sup>5</sup> All Africa, "Uganda: Museveni Re-Assures Citizens On State of Economy", 22 September 2011

<sup>6</sup> Uganda Ministry of Energy and Mineral Development, 2008 Annual report



## ***An Approaching Crisis***

The level of demand, coupled with unsustainable harvesting and poor management of forests, means that Uganda risks approaching something of a biomass crisis. As a result, increased attention has been given to small-scale rural based bio-energy technologies such as improved cook stoves, gasification, biogas and briquettes. Nevertheless these technologies must now be propagated on a much larger scale and across the country if the issue is to be significantly addressed.

### **1.2. Briquettes and their Potential**

Biomass briquettes are a form of solid fuel that can be burned for energy. They are created by compacting loose biomass residues into solid blocks that can replace fossil fuels, charcoal and natural firewood for domestic and institutional cooking and industrial heating processes. Briquettes have the potential to be a source of renewable energy if they are made from sustainably harvested biomass or waste agricultural residues.

Crops grown in Uganda such as maize, cereals, roots, cane sugar and coffee all produce residues that are suitable for briquetting as does dried organic municipal solid waste (MSW). Data provided by the Ugandan government (see Table 1) indicates that 1.2 million tonnes of agricultural wastes are available each year and an additional 1,500 tonnes of MSW are estimated to be produced in the capital city Kampala daily<sup>7</sup>.

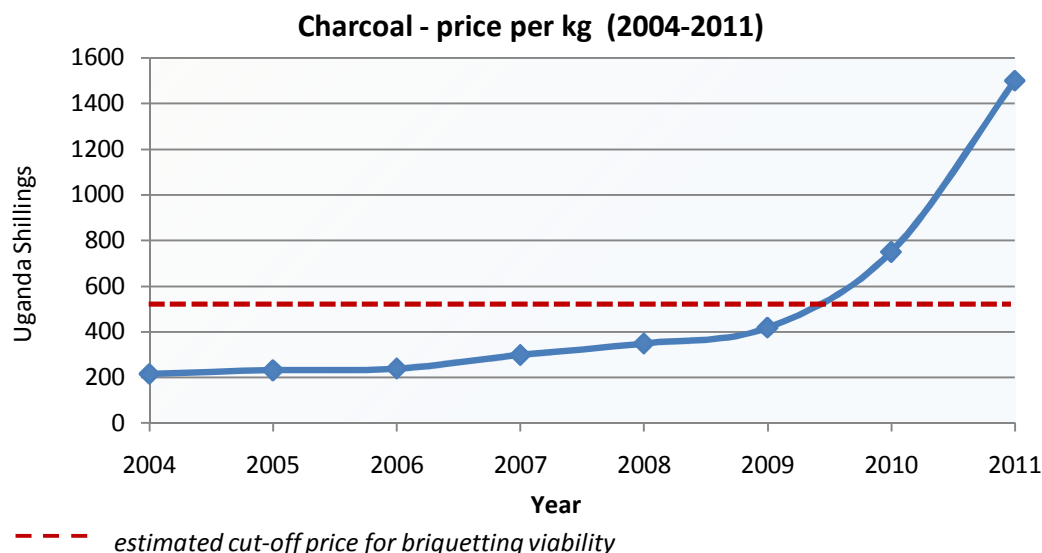
These two sources combined provide a theoretical limit which indicates that at most 6% of the country's total wood consumption and up to 50% of the charcoal trade could be replaced by briquettes from waste. Nevertheless practical limitations such as seasonal variations, competing uses and collection significantly lower the amount of raw material available for commercial opportunities. Hence, briquettes alone will not have the potential to fully address the approaching biomass crisis in Uganda, however they will certainly be part of the solution and there is large scope for growth from an industry that is starting from a very low base.

### **1.3. A Commercial Case for Briquette Businesses**

The availability of cheap (and often free) firewood and charcoal has been part of the reason why such biomass has prevailed as the dominant source for energy in developing countries. However in recent years Uganda has faced significant increases in charcoal prices.

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<sup>7</sup> Uganda Investment Authority, proposals for the Manufacture and Marketing of Charcoal Briquettes, 2010



**Figure 1:** Average market prices for selected goods in Kampala 2004-2009, *Uganda Bureau of Statistics 2010 Statistical Abstract*. Updated with prices reported for 2009-2011 in *newvision.co.ug*

In 2008 the average price of a 40 kg charcoal sack was USh15,000 (US\$6) and during 2009 it rose to USh25,000 (US\$10), an increase of 66% in just twelve months. Prices increased substantially again in 2011, with the cost of a sack in the capital Kampala reaching USh60,000 (US\$24). Meanwhile, 4 pieces of firewood (which is estimated to substitute 3.3 kg of charcoal) were sold for Ush2,000 (US\$0.8). Research by the Uganda LPG Association<sup>8</sup> expects Ush80,000 (US\$33) of charcoal to last 2 weeks, whereas Ush80,000 of LPG would last for between 4 to 10 weeks, depending on the family size and cooking frequency. For the purpose of comparison, the assumption that briquettes can replace charcoal weight for weight means that Ush80,000 could last for between 2 and 4 weeks.

These kinds of price trends are beginning to make an economic case for briquettes which can cost between Ush32,000 (US\$13) and Ush40,000 (US\$16) for a similar 40 kg sack and often last longer than traditional charcoal. As of December 2011, a Kenya based briquette company, Chardust Ltd, estimate a minimum charcoal price of US\$0.2 (sold by the sack at the point of delivery to urban wholesalers) as a pre-condition for the financial viability of a briquette venture in an East African setting.

**Table 2:** Comparison of price per Kg

Price per Kg ( Kampala, Uganda, December 2011 )		
	UGX	USD
<b>Charcoal</b>	1500	0.60
<b>Briquettes</b>	500 - 1000	0.20 - 0.40
<b>Firewood<sup>9</sup></b>	600	0.24

<sup>8</sup> ULPGAS, *Shortage of LPG (cooking gas) in Uganda*, [www.uplgas.org](http://www.uplgas.org), September 2011

<sup>9</sup> Equivalent substitution for 1kg charcoal

# Chapter 2: Briquettes

Worldwide, many different types of briquettes exist for a variety of applications. In industrialised countries briquettes are commonly used as a fuel in industrial boilers and biomass cogeneration plants. In East Africa, where biomass dominates the domestic energy market, briquetting technology is gaining momentum particularly as wood resources become scarcer and the price of regular charcoal increases. Although they can come in an assortment of shapes and sizes, there are two main types; carbonised and non-carbonised.

**Table 3:** Fuel Comparison: calorific values

Type of Fuel	Energy (Kcal / kg)
LGP	11,100
Natural gas	9,100
Wood charcoal	7,500
Charcoal dust briquette (carbonised)	7,400
Sawdust briquette (non-carbonised)	4,800
Raw wood	4,100



**Figure 2:** From left-right: honey-comb briquette (hydraulic press); non-carbonised straw briquette (piston-extruded); carbonised charcoal dust (roller press); hand-made charcoal dust briquettes

## 2.1. Briquette Markets

Carbonised briquettes can act as a replacement for charcoal for domestic and institutional cooking and heating, where they are favoured for their near-smokeless use. In comparison to charcoal, they generally burn for longer and have a more consistent heat output, which is preferred by certain market segments such as restaurants, hospitals and schools. Poultry farming is a large industry in Uganda and smokeless, longer burning briquettes are also well suited to heating cages overnight when temperatures are low as a cheaper alternative to electric heating lamps.

If the price of a briquette is competitive to charcoal, then domestic users among rural populations as well as the urban and peri-urban poor can adopt them to replace charcoal for cooking. In terms of burning characteristics, households and institutions have similar requirements as both require the fuel for cooking. The size and shape however may be different because institutions will typically have larger stoves.

Non-carbonised briquettes on the other hand serve as a replacement to natural firewood and raw biomass fuel. They offer greater energy per unit weight than wood or raw biomass (see Table 3) but release as much smoke. Consequently these are more appropriate for industrial processes or institutions where emissions can be controlled. They can also be offered as a replacement fuel among rural populations where firewood is still dominant. Further commercial processes such as crop drying, tea drying, tobacco curing, ceramics/brick firing can also make use of briquettes.

## 2.2. Biomass for Briquettes

Briquettes can be made out of any biomass material, although the choice of feedstock can determine its heating potential as a fuel.

The available biomass resource consists primarily of:

- Wood
- Agricultural Waste (field residues and process residues)
- Animal Manure
- Municipal Solid Waste (Household and Food Processing Wastes)

While wood from trees constitutes the greatest amount of biomass stock available in Uganda and consequently the most used form of biomass (including its use for charcoal), crop residues are also utilised and are receiving increased attention as awareness of the unsustainability of the wood and charcoal trades grows. Table 1 highlights the most widely available residues in Uganda, of which up to 1.2 million tons are estimated to be available each year.

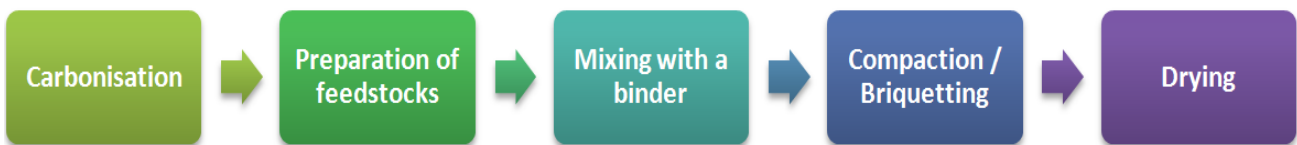
Animal manure results in a briquette with a low calorific value, and so is normally used to add bulk to other woody material, however this is rarely done and the scattering of livestock in rural Uganda makes collection on a commercial scale difficult. The use of dried organic municipal solid waste (MSW) offers potential for briquetting purposes and pilot projects have been carried out in Rwanda<sup>10</sup>, but this resource remains largely untapped in Uganda. In 2010 the Uganda Investment Authority put forward investment proposals for a 70-tonne per day manufacturing plant for briquettes made from MSW collected from households and surrounding markets in Kampala, of which it estimates 1,500 tonnes are produced daily.

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<sup>10</sup> *Feasibility and Impact Assessment of a Proposed Project to Briquette Municipal Solid Waste for Use as a Cooking Fuel in Rwanda*, Practical Action, 2003

Another key opportunity is the recycling of charcoal fines, small particles of charcoal lost during retail and distribution, estimated at 10-15% of charcoal produced, equating to at least 70,000 tonnes yearly. This is a popular feedstock for current small scale briquette producers as it can be collected locally, cheaply and has already been processed (raw biomass turned to char), making it the most economically viable resource for briquetting. It does however create an unsustainable dependence on the charcoal trade.

### 2.3. How Briquettes are made



Briquetting is carried out on raw biomass to improve the density, burn time and other energy characteristics and to turn it into a size and shape to suit its purpose. Raw materials are sometimes carbonised first to produce char, which can then be compacted into a briquette. If the feedstock is not already in powder form, it needs to be ground prior to briquetting. Depending on the material, the pressure and the speed of compaction, additional binders such as starch or clay soil may also be needed to bind the matter together.

Briquettes can be made on both a small and industrial scale. Although a variety of types and scales of machines and equipment can be used, the main processing steps remain the same. These are described below.

#### **Carbonisation**

Carbonisation (or partial pyrolysis) drives off volatile compounds and moisture leaving a fuel with a higher proportion of carbon remaining (char). This is the same process that creates charcoal from wood and is preferred particularly in urban environments for its superior burning characteristics and smokless use. Conversion to char in a controlled process also reduces the amount of harmful emissions compared to when raw biomass is burned. The decision to carbonise depends on the application.

Methods of carbonisation in developing countries largely follow traditional charcoal making techniques, which achieve conversion efficiencies of less than 10%. However some improved processes have been developed for small scale char production, with improved efficiencies of up to 30%.

**Table 4:** Comparison of carbonisation methods

Carbonisation Method	Yield %	Duration	Capital Intensity	Labour Intensity	Cost US\$
Earth pit kilns	10-15	Days	Low	High	0
Brick & steel kilns	25-30	hours	Medium/high	Medium	50-200
Large-scale plants / retorts	30-40	Continuously	High	Low	3,000-5,000



**Figure 3:** From left-right: traditional open air carbonisation method; top-lit-down-draft (TLUD) steel kiln; ARTI steel drum retort ([www.arti-africa.org](http://www.arti-africa.org))

### Preparation of Feedstock

Before compacting into a briquette, the feedstock must be in a powder form. Some raw materials such as sawdust and rice husks are already in small particle form, however others such as bagasse, straw and large charcoal fines need powdering. This can be done manually by crushing, chopping or by using mechanised milling machines. It is often then sieved to ensure consistency in the powder.



**Figure 4:** From left-right: Ugandan micro-entrepreneur manually grinding large charcoal fines into dust for briquetting; Locally fabricated electric grinding machine costing approximately US\$2,000 in Uganda; Industrial Hammer Mill Grinder similar to those used by larger-scale briquetting companies in East Africa such as Chardust Ltd. This type from SREE Engineering Works, India, has capacities of 200 – 1,500 kg/hr at a cost of US\$3,000-13,300.

## Binding

Binding is the process of 'sticking together' the compacted material. If subjected to sufficiently high temperature and pressure biomass materials can bind together naturally, without the addition of extra binding agents. High temperature can melt a naturally occurring substance called lignin and under pressure this can act as a glue.

If high temperatures cannot be achieved (as is the case with most locally made briquette machines) additional binding agents need to be added to enhance or activate the binding process.

Common binders include:

- Cassava flour
- Molasses
- Wheat flour
- Fine clay
- Red soil



**Figure 5:** Mixing cassava flour as a binder for charcoal dust

## Drying

Drying is a critical process in briquette manufacture and is often the limiting process for East African producers. Non-carbonised briquettes require the feedstock to be dried to a moisture content of around 13% before entering the briquette machine; they finish 'dry' so can be immediately packaged. Carbonised briquettes require raw materials to be dried prior to carbonisation, for the process to be effective, and the finished briquettes to be dried (to less than 10% moisture content) post briquetting, since they are produced wet.

The most common method for doing this in Uganda is through sun-drying due to the favourable climate. This is usually done by laying the briquettes out on polythene or iron sheets or a wire mesh. Sun-drying can take up to 3-4 days to dry the briquettes completely. Even the larger companies in East Africa, producing 2,000 tonnes of briquettes per year, continue to use sun-drying methods for finished briquettes.

Other low-capital solutions include solar driers, such as are used to dry fruit in East Africa. Industrial methods accelerate the process through the use of heated fans or a tunnel 'oven'. Kampala Jellitone Suppliers, the largest producer of non-carbonised briquettes in Uganda, utilise a Flash Drier for drying feedstock for non-carbonised briquettes in addition to sun-drying.



**Figure 6:** From left-right: briquettes sun drying on raised wire mesh in Uganda; Tunnel Drier for briquettes and a Flash Drier for feedstock (both SREE Engineering Works in India)

### Compaction / Briquetting

Worldwide a number of machines and techniques have been developed for briquetting on a range of different scales. The leading types are described here. In Uganda the informal sector has emerged in providing low-capital solutions to small-scale briquetting technology while larger scale machinery is imported, usually from India.

**Piston extruders** are relatively large machines in which a heavy piston forces biomass material through a tapered die. These are capable of producing non-carbonised briquettes:

- Biomass is forced through a tapered die by a ram using high pressure
- Briquettes are extruded as a continuous cylinder.
- The area of the die tends to determine the output of a machine; the larger die (and correspondingly larger machine components) results in a larger production rate.
- Flywheel drive machines can produce between 250-750kg of briquettes per hour while hydraulic machines typically produce up to 200kg per hour

**Screw extruders** use a screw action to extrude a briquette through a die. Biomass is fed into the machine from a hopper into the screw chamber. Powered by an electric motor, the screw forces the material through a die and out of the machine as a continuous (usually cylindrical) briquette.

- A **Conical Die Screw Extruder** uses a conical screw that tapers from large (at the input) to small (at the output). This type of machine can achieve high pressures, generating sufficient compaction for briquetting both carbonised and un-carbonised feedstocks.
- A **Heated Die Screw Extruder** uses a non-tapered screw and a heated die that enables lignin breakdown to occur, making it suitable for briquetting un-carbonised feedstocks.
- **Plain Screw Extruders** are the most common type used in East Africa due to the simplicity of the mechanism and can be fabricated by skilled workers using locally available tools. They can often be adapted from similar devices such as a meat mincer, however are only suited to making carbonised briquettes.





**Figure 7:** Motorised Plain Screw Extruder, Alfatar Industries, Kenya



**Figure 8:** Roller Press, SREE Engineering Works, India

**Roller Presses** are commonly used to make charcoal briquettes. They involve two adjacent counter-rotating rollers with indentations in the shape of the desired briquette. Powder is fed from above, which falls into the indentation and is compressed as the rollers turn. The briquette then exits the machine as a single pillow shaped lump. The level of compaction achieved by a roller press is relatively low compared to a piston or screw extruder and so is suited more to briquetting of wet powders containing a binding agent. However production rate of a roller press can be very high, reaching 1.5 tonnes per hour. Roller Presses are used by most of the largest East African producers of carbonised briquettes.

A considerable number of low-capital **manual techniques** have been developed both for carbonised and non-carbonised feedstocks. Many of these designs have been disseminated in developing countries to encourage the production of briquettes among rural communities who would otherwise lack access to industrial technology.



**Figure 9:** From left-right: Manual Extruder, Alfatar Industries, Nyeri, Kenya; Manual Screw Extruder, Uganda; D-Lab hand briquette press(image source: *Engineering for Change*)

**Table 5: Briquette Machines: Costs and Availability**

Type	Capacity (kg/hr)	Availability in East Africa	Cost (US\$)
Piston Extruder	250 – 750	Import Required	20,000 – 30,000
Roller Press	900 – 1500	Import Required	14,000 – 19,000
Electric Screw Extruders	150	Known to be available in Kenya, lacking in Uganda	1,350
Manual Extruders	6	Locally fabricated throughout the region	150

## Chapter 3: Briquette Businesses in Uganda

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Although briquetting technology has been present in Uganda for over twenty years the wide availability of (often free) biomass for energy purposes has meant that the extra processing steps involved in producing briquettes have never allowed it to compete on a commercial scale. However, with the current rate of rising charcoal prices, lack of firewood and further deforestation concerns leading to increases in the levies on charcoal burners, the economics of briquette production are narrowly becoming feasible and more ventures are beginning to appear.

The present chapter begins with an overview of GVEP International's work with briquette micro-enterprises and then provides an outline of the wider briquette industry in Uganda; including case studies of three micro- and small-scale entrepreneurs at different levels of production. The chapter concludes with profiles of some of the most prominent briquette businesses and projects in the East Africa region.

### 3.1. GVEP International

GVEP International (Global Village Energy Partnership) is an international non-profit organisation that works to increase access to modern energy in developing countries by providing support services to micro, small and medium energy enterprises. GVEP seeks to reduce both energy poverty and income poverty in East Africa by strengthening the private sector's ability to offer relevant products and services in the region.

Using business-led solutions, GVEP's programmes are designed to help these enterprises overcome common challenges by providing them with technical and business support and linking them with financial institutions to access the capital they need to grow.

Through the **Developing Energy Enterprises Programme (DEEP)**, GVEP's goal is to enable the development of a widespread and sustainable industry of micro and small energy enterprises in the East African countries of Uganda, Kenya and Tanzania. The programme will span five years from 2008 and is supported by grant funding from the European Union and the Dutch Ministry of Foreign Affairs (DGIS).

GVEP International is the lead co-ordinator of the DEEP programme and works in close collaboration with a number of partner organisations to deliver training and mentoring programmes, identify viable energy markets and technology options and to facilitate links to the necessary financing.

## 3.2. Briquettes in the Developing Energy Enterprises Programme (DEEP)

As of September 2011 there were 885 active businesses within the programme. Of these, 169 were in the briquettes business and 139 (82%) of which were operating in Uganda. The DEEP programme was designed to support businesses in existing energy markets and participants were recruited into the programme without bias for a particular technology.

Within DEEP, briquettes have emerged as one of the top three energy products for micro-enterprises to deal in (with improved cook stoves and solar phone charging services) and are suitable as they can be produced on a small scale initially with very little capital and easily available resources.

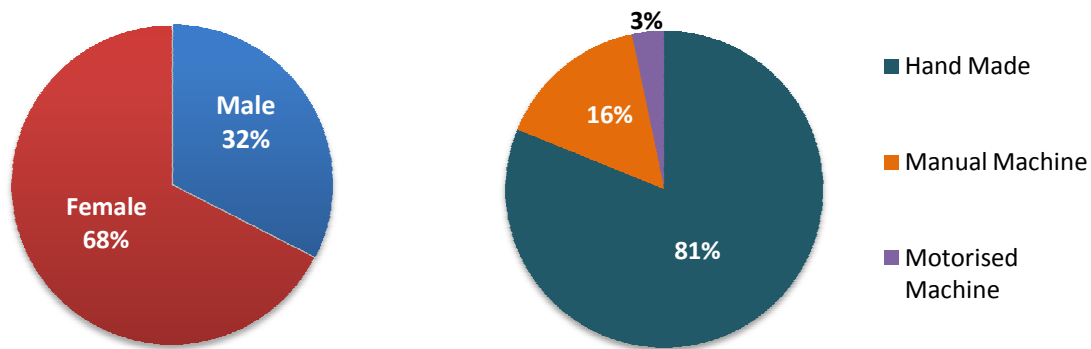
### *The Entrepreneurs*

There are currently 139 briquette entrepreneurs receiving mentoring from GVEP in Uganda. Of these, 68% are female and 32% are male. It has been observed across the programme that females are generally more involved in businesses that require a low capital start-up, are immobile in production at a micro scale, and deal in products that they can sell to immediate markets, which could partly explain their greater number in briquette businesses. Most of the businesses have started up in the last four years, reflecting the view that the industry is just beginning to flourish. 7% of businesses in the programme were introduced to briquettes, either as a new business venture or a diversification from their existing product line, whereas the rest were already in existence.

Almost all of the businesses are located in the districts of Luwero and Wakiso in Uganda's central region and the capital city of Kampala. These areas were chosen by the mobilisation team for recruitment of entrepreneurs due to the high potential here for the industry to spread.

### *The Briquettes*

Figure 10 illustrates the type of briquettes that are made by the 122 entrepreneurs in Uganda that data was held for. As many as 81% of the entrepreneurs use hand-made methods whereas only 3% use motorised machines. All of the producers use starch as a binder and some also add cow dung or clay. Although 95% of the producers sell carbonised briquettes, only 8 owned a carbonisation kiln. This is due to the large number that use already carbonised charcoal dust as a feedstock. This indicates that there is a high dependency among micro-producers on the charcoal industry for supply. While this is a cost effective resource to exploit and involves recycling an otherwise waste product, it is unsustainable for those producers who are seeking to scale up production.



**Figure 10:** Gender and briquetting method of DEEP Briquette Entrepreneurs in Uganda

### *Production and Sales*

Figure 11 shows how the average monthly turnover of the businesses for which data was held has increased over the last 18 months of the programme and Figure 12 illustrates the distribution of income among all the businesses.

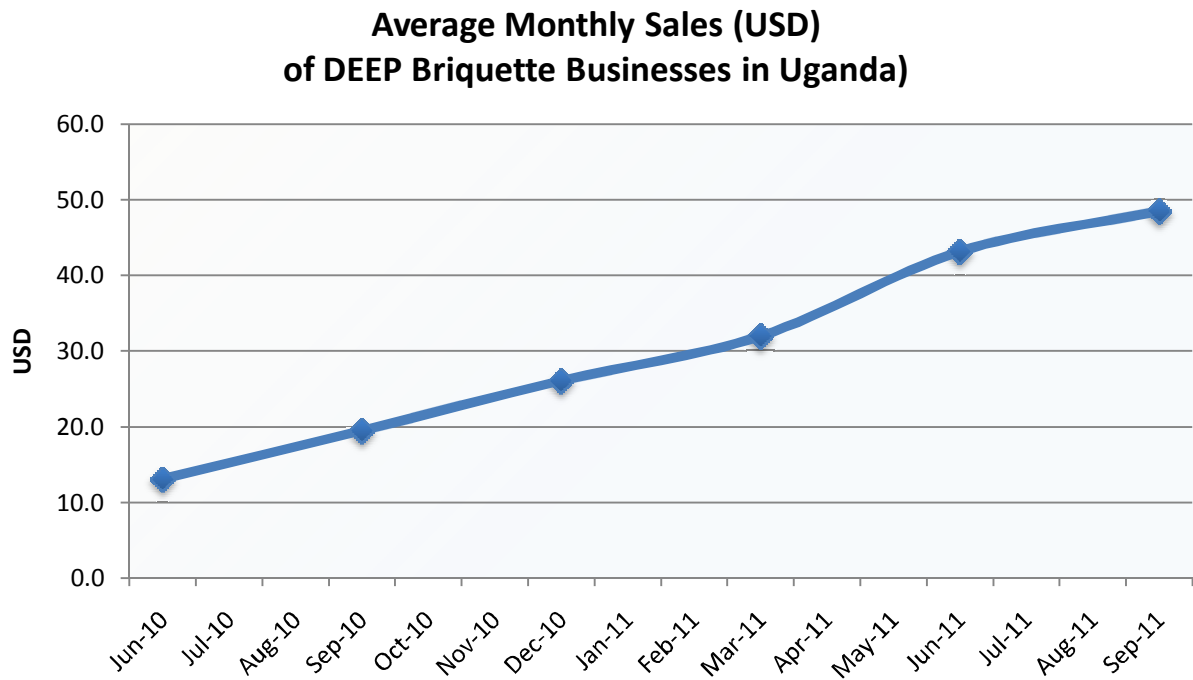
The total number of briquettes produced by DEEP enterprises in Uganda is currently 16,750 kg per month – or over 200 tonnes per year – representing a very small fraction of national charcoal consumption. However Uganda is producing far more than this in waste biomass and the demand for biomass fuel is high, which suggests that there is considerable potential to increase their production further if the sector is to be developed. Two thirds of businesses are producing less than 200 kg per month and the largest producer is managing to make an average of 1,100 kg per month.

Figure 12 highlights an important fact that a small number of businesses out of the total account for the majority of sales. In fact just eighteen enterprises (12%) are responsible for more than 50% of the total output. This pattern, often known as the Pareto Principle, seems as applicable to these micro businesses in East Africa as much as it is to other markets.

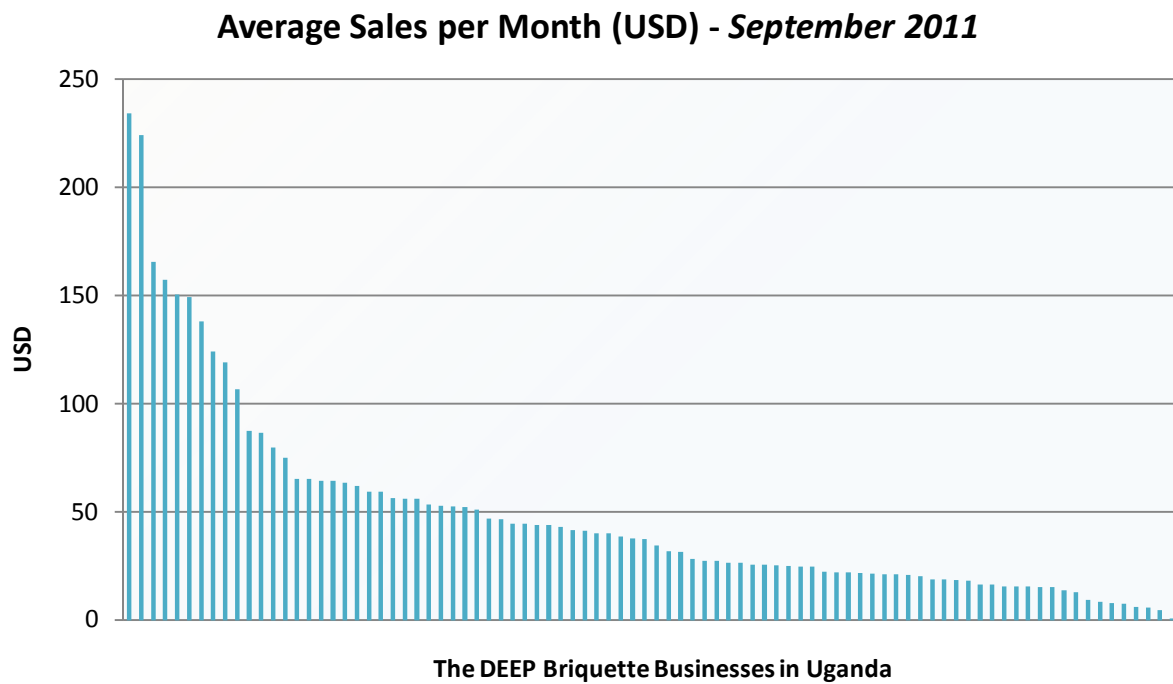
The vast majority of DEEP entrepreneurs use hand-made methods as can be seen in Figure 10. The maximum production rate achieved by hand is around 8kg per day whereas those with a motorised machine can produce up to 1,000 kg per day. Although the potential to increase the sectors output through the proliferation of machine sales seems large, experience through DEEP has shown that many of the producers are content with their small scale operations and view briquettes not so much as a business opportunity but simply one of several income generating activities. These businesses generate less than US\$50 in revenues per month; a small amount but one that contributes a useful source of extra income for rural households.

A few however, do show an appetite for business. These are people who make efforts to grow by investing in mechanised equipment, actively looking for new customers, improving product quality and professionalising their brand.

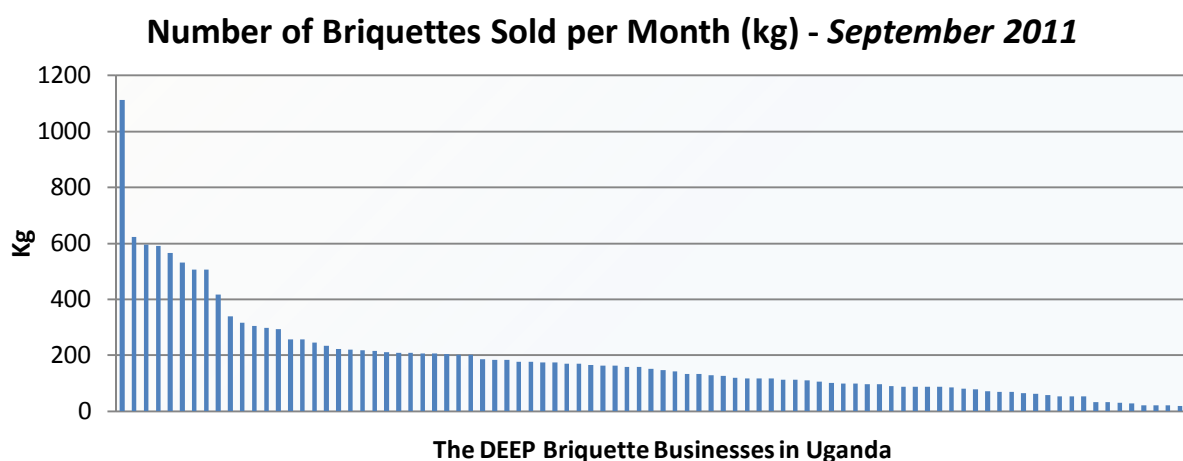
For these people, the term ‘entrepreneur’ is more appropriate and they turnover more than US\$100 per month showing signs of continuous growth. The top performing businesses in DEEP have a monthly turnover of up to US\$230.



**Figure 11:** Average Monthly Sales (USD)of DEEP Briquette Businesses in Uganda



**Figure 12:** Average Sales per Month (USD)September 2011



**Figure 13:** Number of Briquettes Sold per Month (kg) - September 2011

### 3.3. Impacts of the Developing Energy Enterprises Programme (DEEP)

#### Employment

Increasing employment through the energy sector is a key aim of DEEP and in September 2011 the number of people employed full-time by a DEEP briquette business ranged from 1 to 3 people, with a maximum of 5 additional casual workers. The average of number of employees (both casual and permanent) is 1.9 employees. This is an increase from an average of 1.5 employees in June 2010.

#### Beneficiaries

When assessing the increase in access to energy for the local populations, the cumulative impact of DEEP briquette entrepreneurs in Uganda amounts to over 3,000 beneficiaries. The number of beneficiaries is calculated based on factors such as the average number of people per household (who will benefit from the purchase of the briquettes) and the longevity of the briquettes. This does, however, assume that briquettes are used exclusively by these households. In reality it is noted that households often use a mix of briquettes, wood and charcoal so briquettes may provide partial fuel substitution for a much larger number of households. Moreover, some customers are restaurants, roadside food vendors, poultry farmers and others making calculation of beneficiaries a difficult task.

#### Environmental Impact

The environmental impact can be estimated if making the assumption that briquettes are directly replacing charcoal consumption. As all the briquettes are currently made out of waste material, the greenhouse gas emission savings can be thought of in terms of the number of trees left standing as a result of replacing firewood and charcoal. It is estimated that each tonne of charcoal requires the felling of 88 medium size trees. Using this figure, the total amount of deforestation avoided by businesses participating in the DEEP programme can be roughly estimated at 17,600 trees annually.

## Case Study

Elivansoni Nakimbugure is a briquette customer in Besoke, Uganda, who has experienced the benefits of using briquettes.

“At first I was using firewood but now I use briquettes. Using briquettes I can relax when I am cooking and don’t have to pay as much attention to the fire. Because they burn longer the food will keep warm for a long time. After using briquettes there is no more firewood.”



Elivansoni has a family of five to feed and would previously use around 4 bundles of firewood a week costing her around 8000 Ush (US\$3.42). With briquettes she uses around 3kg a week which only costs her 1500 Ush (US\$0.64). The money she saves on fuel she now uses for other household needs such as buying maize flour.

The traditional fire that Elivansoni was previously cooking with gives off a lot of smoke. “Briquettes don’t produce smoke and we can even put the stove inside the house”, she says. “Using firewood gives off a lot of smoke and I would have tears in my eyes and a pain in my head. Now my eyes are clear and my head feels normal. I tell my friends about briquettes”.

### 3.4. The Uganda Briquette Industry

Briquette producers in Uganda fall into distinct scales of operation characterised mainly by their type of briquette machine. Examples of these businesses, their equipment, products and value chain are detailed in Table 6 on the following page.

There are hundreds of micro-scale producers in operation who use primitive equipment and are largely engaged in income supplementing ventures. Most are making briquettes by hand in quantities of less than 2 tonnes per year and for their own consumption as well as to sell in their local neighbourhood. Many of the more enterprising of these, often with support such as from the DEEP programme have purchased manual machines to enable them to produce up to 20 tonnes per year.

Motorised machines fabricated by skilled artisans are capable of manufacturing up to 200 tonnes of briquettes per year. This is a typical entry point for entrepreneurs to enter the market with powered machinery that they can purchase locally.



**Table 6:** Analysis of the Ugandan Briquette Industry

Number Currently Operating in Uganda	100s	< 10	1	0
<b>Example Businesses</b> including those in other East African countries	<ul style="list-style-type: none"> <li>• Top DEEP Producers (Uganda)</li> <li>• NGO-supported micro-entrepreneurs</li> </ul>	<ul style="list-style-type: none"> <li>• Eco-Fuel Africa (Uganda)</li> <li>• Green Bio Energy (Uganda)</li> <li>• Top DEEP Producers (Kenya)</li> </ul>	<ul style="list-style-type: none"> <li>• KJS (Uganda)</li> <li>• Chardust (Kenya)</li> <li>• EA Briquette Company (Tanzania)</li> </ul>	<ul style="list-style-type: none"> <li>• UIA Tender(Kampala, Uganda)</li> </ul>
	<b>&lt;20 tonnes / year</b>	<b>&lt;200 tonnes / year</b>	<b>&lt;2,000 tonnes / year</b>	<b>&lt;20,000 tonnes / year</b>
<b>Equipment</b>	<ul style="list-style-type: none"> <li>• 1 or 2 manual machines</li> <li>• <i>E.g. lever extruder / manual screw extruder</i></li> <li>• Single Drum Kilns</li> <li>• Sun-drying</li> </ul>	<ul style="list-style-type: none"> <li>• Motorised machines that are fabricated locally</li> <li>• <i>E.g. electric screw extruders</i></li> <li>• Sun-drying / solar driers</li> </ul>	<ul style="list-style-type: none"> <li>• Motorised machines that are imported</li> <li>• <i>E.g. roller press / large (flywheel) piston</i></li> <li>• Sun-drying / flash drier</li> </ul>	<ul style="list-style-type: none"> <li>• Large-scale industrial machinery, imported</li> <li>• <i>E.g. 8 t/hr hydraulic pellet press</i></li> <li>• Accelerated drying</li> </ul>
<b>Premises</b>	<ul style="list-style-type: none"> <li>• Often in entrepreneurs house and garden</li> </ul>	<ul style="list-style-type: none"> <li>• Can do at entrepreneurs residence or in a large garden</li> </ul>	<ul style="list-style-type: none"> <li>• Dedicated factory needed</li> <li>• Approx. 2 acres of land</li> </ul>	<ul style="list-style-type: none"> <li>• Large centralised factory based within Kampala city</li> </ul>
<b>Feedstock</b>	<ul style="list-style-type: none"> <li>• Typically charcoal dust, but also carbonised leaves, banana peels and garden wastes (this quantity is easily charred by a drum kiln)</li> </ul>	<ul style="list-style-type: none"> <li>• Mainly charcoal dust</li> <li>• Some agricultural wastes (but required quantity is too much to carbonise without heavy equipment)</li> </ul>	<ul style="list-style-type: none"> <li>• Charcoal dust</li> <li>• Non-carbonised agricultural waste</li> <li>• Carbonised agricultural waste (carbonising and transport become more economical at this scale)</li> </ul>	<ul style="list-style-type: none"> <li>• Dried organic municipal solid waste</li> </ul>
<b>Supply</b>	<ul style="list-style-type: none"> <li>• Collect from local charcoal vendors</li> <li>• Garden wastes</li> <li>• No shortage at required quantities</li> </ul>	<ul style="list-style-type: none"> <li>• Collect from local charcoal vendors</li> <li>• Agricultural waste bought from farmers (usually small-holders)</li> <li>• Small carbonisation kilns leased to farmers</li> <li>• Not economical to transport raw materials from afar</li> </ul>	<ul style="list-style-type: none"> <li>• Agricultural waste bought on bulk from farmers (contractual arrangements)</li> <li>• Collect most charcoal dust in vicinity and further afield</li> <li>• Transport network established</li> </ul>	<ul style="list-style-type: none"> <li>• Centralised collection through city waste collectors</li> <li>• Centralised sorting centres</li> </ul>
<b>Distribution</b>	<ul style="list-style-type: none"> <li>• Sell to neighbours and local domestic users</li> </ul>	<ul style="list-style-type: none"> <li>• Sell in a few fixed market outlets</li> <li>• Opportunistically at market days</li> <li>• hawking</li> </ul>	<ul style="list-style-type: none"> <li>• Sell to institutions who are often regular customers</li> <li>• Domestic users through organised retail network</li> </ul>	<ul style="list-style-type: none"> <li>• Sell through well-established retail outlets in Kampala</li> </ul>
<b>Investment Required</b>	< US\$1,000	US\$5,000 <i>assuming land is already owned</i>	US\$50,000 – US\$100,000	US\$2.2 million

While a few businesses of this size operate within the DEEP programme in Kenya (where further advancements have been made in local machine fabrication) there are not any DEEP entrepreneurs at this scale yet in Uganda, however a few other ventures have known to be started over the last year as the commercial potential for briquettes is starting to be realised. However, this middle-scale of production appears to face the most challenges; not having the investment to progress to using imported equipment and unable to produce enough output to justify some of the key production and supply chain processes such as transportation, carbonisation and accelerated drying. These challenges are discussed further in chapter 4.

To get production to multiple thousands of tonnes per year, imported machinery is required. This represents a big step up in investment and so far Kampala Jellitone Suppliers is the only company operating at this level in Uganda. A few others of this scale are operating around East Africa and profiles of these businesses are included later in the chapter. These larger businesses are each operating quite different business models, suggesting that a 'one-size-fits-all' model is not an option. Varying availability of feedstocks, differing markets and unique country economic conditions mean that a company of this size must explore models that will work in its local context.

An important note is that almost all of the 2,000 tonnes per year businesses in East Africa have benefited from grant funding to get them started and 3 out of the 4 largest have been set up by foreign participants. They also all entered the market at this scale of operation.

In 2010 the Uganda Investment Authority (UIA) put forward investment proposals for a 70-tonne per day (20,000 tonnes per year) manufacturing plant for briquettes made from municipal solid waste collected from households and surrounding markets in Kampala. At the time of writing, the UIA were unable to comment on the status of this tender, however their business plan analysis does suggest that there is potential for one industrial scale briquette plant to operate in Kampala.

The supply and distribution models of businesses operating at each level of production differ, as do the challenges faced by each and these are described in more detail in chapter 4. The following case studies give an insight into some of the people working in these different sized briquette businesses.

### **Case Study: Production of <2 tonnes per year – Leonard Kalegua, Masaka District, Uganda**

Leonard Kalegua is a farmer who owns a smallholding near Kalungu in the Masaka district of Uganda, about 130 km south-west of the capital city Kampala. He was introduced to briquettes by GVEP in 2010, after which he was inspired to start making them as a part time business, encouraged by his personal concern for deforestation and the opportunity to supplement his income.

Prior to this, Kalegua earned a living for himself and his family primarily through subsistence farming and selling small quantities of bananas and coffee to local traders. However he now spends 2-3 days a week making briquettes – almost half his working week – and with the occasional help of his family. The rest of the time he still attends to his crops but feels that his briquettes can earn him more money in the long run.



Kalegua buys waste charcoal dust from vendors in the nearby village, which they sell to him for Ush 10,000 (US\$4) for a 75 kg sack. He carries this to his house by foot, where he turns it into cylindrical briquettes using a hand-powered screw extruder and starch as a binder; they are then sold in his village for Ush 1,000 (US\$0.40) per kg.

The amount of briquettes he makes per month varies greatly; in November 2011 he sold 145 kg but in December only 45 kg. Nevertheless, due to the success of his sales so far, Kalegua plans to enlist the help of two neighbouring ladies to help him produce more.



Having not attended school, Kalegua cannot write, so his neighbour and friend help him to keep records of his sales with the initial guidance from his GVEP business mentor. His lack of formal education has also given him motivation to learn briquette making as an additional skill that can help him earn a living.

***Leonard Kalegua receiving advice on record keeping by his GVEP business mentor***

**Case Study: production of <20 tonnes per year – Margret Kisakye, Sano Briquette Manufacturers, Masake District, Uganda**



Margret Kisakye, 32, runs a briquette making business from Kimaanya in Masake, Uganda. She decided to start her briquette business in Oct 2009 after receiving training from GVEP’s DEEP project. She began by making briquettes by hand out of charcoal dust, grass and cassava flour but has since expanded her operations through the purchase of a manual machine and a single drum carbonisation kiln. She employs one permanent and two casual workers. Margret estimates that her average sales are around 1,000 kg per

month and she sells to local households, institutions, schools and poultry farmers and attracts customers from as far as 20km away.

To promote her business, Margret gives out free samples to potential customers and will go house to house to talk to people about her briquettes. She also talks at local gatherings and community meetings to promote her business and displays her briquettes outside her shop by the road side where her workers will explain their benefits to interested people. GVEP taught Margret to keep records for her business. At first she was making a loss on her briquettes, but now she knows how to balance her books she has recalculated her pricing and can make 250 Ush (US\$0.10) profit on each kg.



Margret has also benefited from technical mentoring from IT Power, GVEP’s partner in the DEEP programme. She explains, “At first my briquettes gave off smoke and people were complaining. I would just mix all the ingredients together. The mentors showed me how to use the right measures. In 10kg of charcoal dust I use 1kg cassava flour and now my briquettes don’t produce smoke and my sales have increased”. Margret has since registered her business and opened up a bank account. She uses the profits to invest back into her business and has put up a store at her workshop and bought iron sheets for drying the briquettes. She also successfully applied for a loan from South Uganda SACCO under the guidance of GVEP.

“As a result of GVEP’s support, I got a loan worth Ush 2.5 million (US\$1,000), which I used to improve on the quality and quantity of briquettes production. Part of the money was used to procure a briquette-making machine. As a result, I have been able to transform from manual to mechanized production. I have opened up two branches in the towns of Kyotera and Kibimba [in neighbouring districts]. I have also hired the services of two more permanent workers, one in Kibimba and another one in Kyotera handling sales and marketing, and I have been able to increase my customer base by 70 more clients.”

### Case Study: production of <200 tonnes per year – Eco-Fuel Africa, Kampala, Uganda

Eco-Fuel Africa Ltd is a start-up enterprise based in eastern Kampala. Founded in 2010 by Moses Sanga, an experienced entrepreneur and graduate in Business Administration and having received a seed grant of US\$10,000 from the Government of Uganda, Eco-Fuel established itself making carbonised briquettes from agricultural wastes.

Using briquette machines developed in-house, Eco-Fuel has a production capacity of 250 – 400 kg of briquettes per day (around 100 tonnes per year). These are packaged in clear plastic bags printed with their logo and contact details before being distributed via a network of women retailers who buy each kilogram of briquettes for Ush 700 (US\$0.28) and sell them to domestic users in nearby slums and urban centres for Ush 500 (US\$0.20).



Eco-Fuel have successfully implemented a distributed supply chain, leasing carbonisation kilns to farmers trained in the production of char that they bring to collection points set up in market centres.

The company has ambitious plans for expansion and is seeking further commercial investment. However they face key challenges including being able to secure a consistent supply of feedstock (most farmers who lease their kilns are small-holders whose agricultural production is often seasonal) and being able to obtain higher-capacity machinery that is not imported.

## 3.5. Briquetting in East Africa – Notable Businesses and Projects

Several community based organisations, NGOs and environmental programmes have introduced briquette technology in rural East Africa as a way to tackle income poverty alongside environmental conservation and these are increasingly taking an enterprise approach. In addition to this Uganda, Kenya and Tanzania have seen a few large commercial enterprises being set up; interestingly, each with quite different business models adapted for their own context. A selection of these notable businesses and projects are presented here.

### **Kampala Jellitone Suppliers, Kampala, Uganda**

Kampala Jellitone Suppliers (KJS) is a limited company located in the Natete suburb of Kampala. With a history in coffee roasting, KJS diversified into making briquettes primarily to fuel their own requirements but expanded into Uganda's first large-scale briquette producer; now selling 2,400 tonnes per year to 35 institutions including schools, hospitals and factories at Ush 700 (US\$0.28) per kg. They remain the only factory in the region producing non-carbonised briquettes from agricultural waste, which they collect from four different districts. The company will pay a higher price for processed feedstock (already milled) and are seeking to supply farmers with milling machines in an attempt to improve transport efficiency.

The company has been financed by its founder and grants from the Danish International Development Agency (DANIDA), the United States African Development Foundation and the Ashden Awards. The initial grant from DANIDA helped to buy the first briquette machine, set up production and carry out research into briquetting technology but after that briquetting quickly become a self-sustaining part of the business; with production recently moving to a new, larger factory funded purely by the company's own income.

They currently operate two imported electrically powered piston machines with a combined capacity of 1.25 tonnes per hour (3,500 tonnes per year) as well as an industrial drier for drying feedstock. However these machines do not operate at full capacity, limited by the throughput of the feedstock drying process.

KJS conduct their own research in briquette making through the Fuel from Wastes Research Centre, a research NGO set up by the company. They also carry out research in collaboration with the Makerere University in Kampala. KJS have registered their venture as a CDM project in Uganda and with support from the Belgian Embassy are aiming to develop an appropriate methodology for carbon financing.

### **Chardust Ltd, Nairobi, Kenya**

Founded in 1999 and based in Nairobi, Kenya, Chardust is an alternative energy company that manufactures and sells over 2,000 tonnes of carbonised briquettes per year, mainly to poultry farms, restaurants, hotels and safari camps for space and water heating.

These are made from recycled charcoal dust collected from charcoal vendors around Nairobi. They salvage 8 tonnes of this waste per day before processing it into briquettes and distributing within the city limits. The company markets several different products targeted to different market segments. Their standard briquette is sold to urban (household and institutional) charcoal users. They also sell premium briquettes that are made from higher quality charcoal vendors' waste and packaged in smaller quantities.

These have lower ash content and are sold through supermarkets, certified by the Kenya National Bureau of Standards, for the higher-end domestic barbeque market. Standard briquettes sell for US\$0.14 per kg, while the premium briquettes sell for US\$0.43 per kg (both wholesale prices).

Chardust use roller press machines, imported from India as well as mechanical milling machines. While drying is done outdoors in the sun over 2 acres of land, they stock up to 100 tonnes of briquettes at a time to cover demand during the rainy periods when production drops due to slower outdoor drying.

The company has experimented with a large down-draft pit kiln for carbonising agricultural waste, but this has thus far been less economical than utilising charcoal waste. They are also trialling an agglomeration machine that makes higher-quality spherical briquettes.

Although consisting of more processing steps, Chardust's business model competes with regular charcoal mainly due to lower transport costs. This is possible as the production facility is situated within the city, close to both raw materials and the urban markets.

### **East Africa Briquettes Company, Tanga, Tanzania**

The East Africa Briquette Company has factories in Tanga, Northern Serengeti and Ngorongoro in Tanzania. The briquettes, which are branded "mkaa bora", are made with an Indian-made roller press fed by carbonised agricultural waste that is bought from people with a 'cash at the gate' policy, allowing them to develop a large network of people who provide a continuous supply of raw material. In 2010 the company, with a marketing campaign partly funded by USAID, was selling 60 tonnes of its pillow shaped briquettes per month. The main biomass materials used are coconut husks, cashew nut shells, maize stalks and cobs. In an interview with *The Charcoal Project* in 2010, owner Nicholas Harrison discussed plans to open up new factories on a franchise model.

### **Appropriate Rural Technology Institute (ARTI) – 'Waste to Wealth' Project, Dar es Salaam, Tanzania**

ARTI-TZ have been running their *Waste to Wealth* briquette programme since 2006 and in 2011 they received funding through the World Bank's Biomass Energy Initiative for Africa (BEIA) to conduct a pilot project that trains 1800 people in 60 villages in the 4 rural districts surrounding Dar es Salaam. As of December 2011 they had completed this training in two of the districts and are currently working to help these villages commercialise their enterprises.

ARTI's role is centred on developing the value chain. They do this primarily by training farmers to fabricate charcoal kilns with which they can produce char and equipping some with briquetting technology developed by the ARTI technology institute. By linking producers together to form 'community-based enterprises' they have been able to create a network for production, community sensitisation and sales.

ARTI have also assisted the high-potential enterprises further to access motorised machinery. This is done through an arrangement in which the organisation absorbs the initial capital cost of the machine but reclaims the cost from the producer through a low rate pay-back arrangement. The programme has seen producers sell briquettes for around US\$0.25 and making up to a 40% profit.

They have reported successes so far and their plan for the remaining part of the pilot programme includes further work to create sales networks through improved branding and marketing. ARTI-TZ also collaborate with a larger commercial partner based in Dar es Salaam, Joint Environmental Techniques (JET), which was originally set up by ARTI-TZ, to provide a buy-back guarantee for any char powder produced by the ARTI recruits. JET then processes the briquettes, packages them and sells them in the urban centres.



## Chapter 4: Challenges

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The outlook for briquettes as a commercially viable source of fuel seems positive; however the industry is not without its challenges. The current chapter presents a summary of GVEP's experience of the foremost challenges faced by micro and small scale briquette producers in Uganda. Many of these difficulties are similarly pertinent to producers throughout East Africa. Different levels of production present different barriers to growth, although there are some common challenges facing all entrepreneurs operating in rural and peri-urban fuel markets in Uganda.

### Product Quality and Standardisation

While the larger scale producers have more controlled production processes, the quality of briquettes among small scale producers varies greatly from one entrepreneur to the next. This is due to the differing methods of production, an absence of standardisation within the industry, a lack of technical knowledge and a want of quality control procedures. Addressing both the production quality (consistency between batches) and the performance quality (how the product compares to others and alternative fuels) is essential if consumers are to gain faith in briquettes as a replacement fuel.

The industry already suffers from sub-standard products undermining its potential to tap into available markets. Many claims are made about the benefits of briquettes yet irregularities arising from alternating feedstocks and inconsistent mixing ratios often mean that customer expectations are not met. In some cases briquettes are even being sold at a higher price than regular charcoal and yet are offering a poorer burn. As a result, entrepreneurs have not been able to link their briquettes to the large urban markets in which consumers are more responsive to product quality.

The fuel market in Uganda is a non-standardised market, making standardisation of briquettes a challenging process. Locally developed standards for briquettes do not currently exist and in their absence GVEP is working to create informal 'DEEP' standards to promote quality and standardisation across the recipients of the DEEP programme with the aim that they can act as a benchmark for quality that others can adopt. The Uganda National Bureau of Standards indicate that they would use the South African Standards as a substitute, as is the case in Kenya, however these may be unsuitable and difficult to achieve when translated into a different context.

A further challenge is that the extra costs incurred in adhering to a national Standard could make the product uncompetitive in smaller local markets in which many small-scale producers sell and where a quality mark has a lesser impact on consumer choice. In order to develop these standards it is important to ascertain the quality and performance of briquettes that the industry is producing.

Experience has indicated that users often assess the benefits of briquettes and improved cooking stoves together and it is not always clear which fuel saving is attributed to which technology. GVEP is currently carrying out a series of tests and their results will help to decide steps to be taken to improve their quality and to identify appropriate standards to promote. Evidence of the efficiency and clean burning of briquettes is also essential if entrepreneurs are to communicate effective marketing messages.

### Access to Technology

Briquettes are a simple product to make by hand and have therefore been the focus of multiple development projects implemented by NGOs over the last decade aimed at providing affordable fuel and small income generation opportunities. Nonetheless, in order for quality briquettes to be produced commercially and at a scale for the industry to significantly impact the fuel market, producers need to have access to appropriate technology. Larger producers have been able to import machines from India and Europe however the narrow margins in the small-scale trade do not yet justify the cost of doing so. Innovations in locally made briquetting machines have been made in East Africa and the challenge that remains is to make these available to producers across the region.

A study<sup>11</sup> carried out by GVEP between February and April 2011 identified a lack of adequate equipment as the biggest challenge seen by a sample of briquette producers interviewed in East Africa. So in terms of increasing sales and improving the quality of briquettes, the fabrication and widespread adoption of briquette machines is a leverage point. Through the DEEP programme GVEP facilitates market linkages by collaborating with entrepreneurs in equipment sales and purchasing opportunities and advises about suppliers and buyers.

A technical study<sup>12</sup> carried out by GVEP in 2010 concluded that the locally available machines, largely the screw extrusion type, were unable to briquette non-carbonised feedstocks effectively. The consequence of this is an extensive use of charcoal dust as a feedstock and a reluctance to utilise agricultural waste. Effective carbonisation techniques remain largely unknown to many of the smaller businesses, which will need to have access to kiln designs and training in their use if they are to make use of the wider biomass resource.

### Production Bottlenecks

It has been seen that there is potential to increase the capacity of many briquette enterprises, where there is a suitable business case to do so, through the purchase of manual and motorised briquetting machines. This can raise production levels up to 1,000 kg per day. Yet evidence has shown that by the time a small-scale entrepreneur is producing briquettes with a motorised machine, their output becomes limited by other stages in the production process.

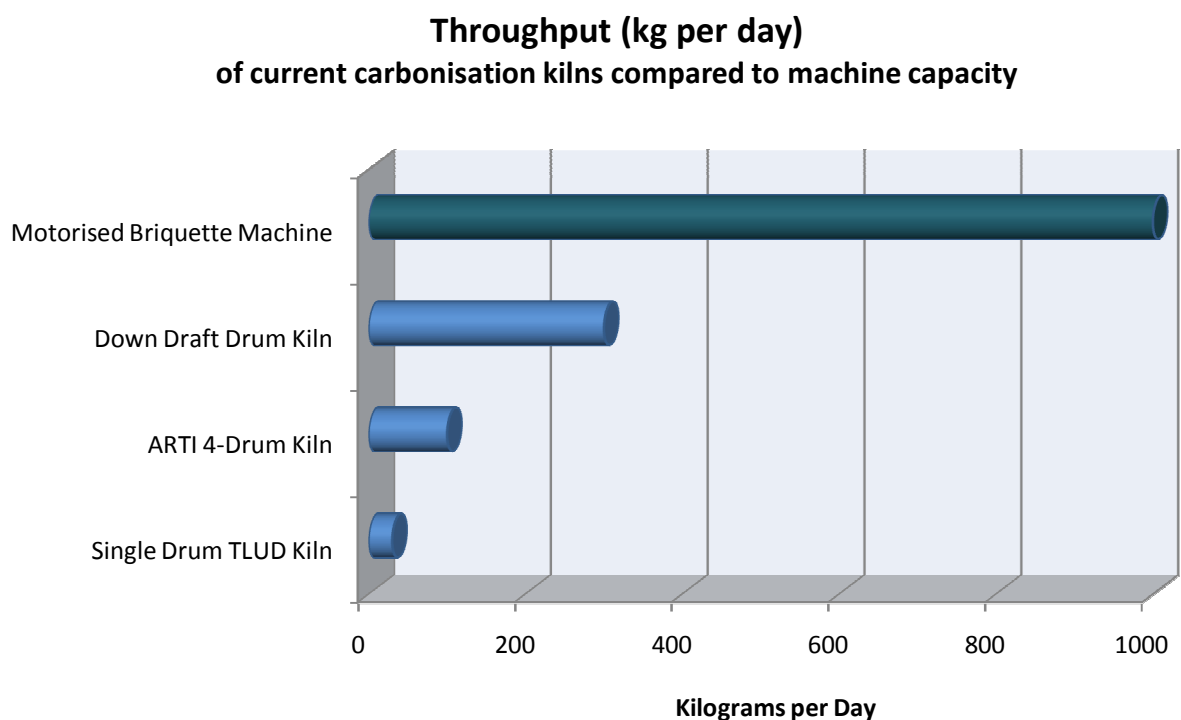
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<sup>11</sup> *Marketing Challenges and Strategies for Micro & Small energy Enterprises in East Africa*, Laura Clough, GVEP International, 2011

<sup>12</sup> *Biomass Fuel Briquetting in East Africa: Technical Report into the Capabilities and Limitations of Small-Scale Production*, Chris Cleaver, GVEP International, 2010

For example the drying of both raw material and finished briquettes is highly dependent on the space available to the entrepreneur. In many cases experienced, the throughput of motorised briquetting machines exceeds the area available to dry and store briquettes, and so many businesses are not operating their machine at full capacity. Accelerated drying methods prove to be uneconomical on a small scale.

A second limitation is the rate of carbonisation that can be achieved with current kilns and charring techniques. A single 200-litre drum kiln can produce char at a rate of around 30 kg per day and larger multi-drum kilns can reach a rate of 100 kg per day. This falls short of the 1,000 kg per day required to sustain continuous operation of a motorised briquette machine.



**Figure 14:** Comparison of the output of the carbonisation kilns currently used by East African briquette businesses

While improvements are continuing to be made in briquetting machines, the bottlenecks in (and costs associated with) drying and carbonisation represent a crucial technical challenge that must be overcome.

### Access to Finance

One of the major challenges that micro entrepreneurs face in expanding their business is accessing the appropriate finance. Most micro entrepreneurs lack the capital to engage in marketing activities, research and development or to purchase equipment that would help their business to expand.

There are many challenges to bringing finance to micro- and small-scale entrepreneurs at the base of the pyramid. A lack of collateral, high transaction costs, small loan requests and immature technologies discourage lenders, while limited access to bank accounts, high interest rates and illiteracy put off many borrowers. Indeed for many of those that are not highly literate, especially among women, a formalised process of borrowing seems complicated and often some form of training or motivation needs to be provided. On top of this, many micro- entrepreneurs lack the ability or the motivation to make regular savings in order to invest in their own businesses or are unable to plan far enough in advance to do so.

Larger businesses looking to expand their production from 200 or 2,000 tonnes per year tend to be better placed to receive loans as the people running them are typically better educated and their business structures proven. Nonetheless they still face many challenges in obtaining capital. At this scale, a large step-up in investment is required to move from utilising locally fabricated machines to imported ones and organic growth is an unlikely route to achieving this.

Reflecting on the few successful larger commercial businesses in the East Africa region, almost all have benefited from grant funding by government and non-government organisations. While commercial investors are still too risk adverse towards this young industry, it would seem that seed grants are still required to fuel growth. Evidence from businesses that have been linked to finance through GVEP's DEEP programme demonstrate that investment from commercial institutions can indeed lead to a financially sustainable energy enterprise.

Most finance requirements are for the purchase of a machine (or one of a greater capacity) or for the expansion of premises. Smaller amounts of investment are sometimes also needed for the construction of drying racks or a motorbike for transporting goods and materials.

To increase the availability of credit for small energy enterprises, a Loan Guarantee Fund was started in 2010. GVEP has played a role in developing loan products with banks and financial institutions that reduce the default risk to the lender as well as interest rates (and thus cost) to the borrower. In some cases these are also being used to facilitate consumer credit arrangements.

So far 67 businesses have benefitted from this programme, of which 27 have been Ugandan briquette businesses. The scheme is being pioneered in Uganda, as well as in Kenya and Tanzania, and seeks to establish a methodology, that with further support can be extended throughout the region.

An important lesson learned through the DEEP programme has been the need to differentiate true entrepreneurs from people who simply seek to generate an income for livelihood. While a true entrepreneur will be able to quickly grasp the importance of a loan, the latter may resist further growth of the business.

## Business and Marketing Skills

The business skills of many micro-scale briquette entrepreneurs are often rudimentary and the DEEP mentoring activities continue to provide targeted support to briquette entrepreneurs to run their businesses better. Mentors are professionals in various fields of business and have been recruited to provide assistance in record keeping, management, business planning, costing and pricing and customer care amongst other skills.

Many micro-entrepreneurs lack the necessary marketing skills to promote their products. A Marketing Challenges study<sup>13</sup> carried out by GVEP in 2011 surveyed a number of energy entrepreneurs in East Africa. Of those interviewed, 33% of briquette producers identified marketing as their greatest business challenge, making it the second largest challenge after a lack of adequate equipment.

The study indicated that competition, both from charcoal and other briquette businesses, was seen as the main marketing challenge identified by micro-entrepreneurs. Further challenges encountered include knowledge of marketing techniques, finance for marketing material and taking time away from main business activities. Advertising using local media is often too expensive for small enterprises to fund themselves but strategies such as product demonstrations, giving away of free samples and carrying out door-to-door promotions have seen to be effective.

Entrepreneurs aren't always able to recognise different market segments in order to customise their products to meet differing market requirements. This makes it harder for them to engage with new customers. Marketing is vital component in creating growth in micro and small briquette businesses and entrepreneurs need to be encouraged to put more emphasis on this activity.

## Business Premises

A crucial factor in the success of a briquette business is the size and location of its premises with respect to both the source of feedstock and potential points of sale. This is particularly significant in the case of micro-scale producers who rarely have access to private transportation. For the urban population, demand is high but the micro-entrepreneurs lack the capacity to access the market as they produce in too small quantities to justify the cost of transportation to large towns.

Having sufficient space to dry briquettes is too often a limitation in production and in order to maintain continuous production a drying area of at least 3 days output is needed (the typical sun-drying time). Many micro- and small-scale entrepreneurs are often reluctant to move their business premises, even when there is a valid business case to do so. This is usually because of personal attachments to their current location or an absence of ambition to do so. In urban areas high rent and business rates can also make a business unviable.

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<sup>13</sup> *Marketing Challenges and Strategies for Micro & Small energy Enterprises in East Africa*, Laura Clough, GVEP International, 2011

Until a level of production is reached where industrial drying techniques become feasible, the available land area will largely remain the limitation to the output of most of these businesses.

## Supply Limitations

Many micro-enterprises are producing in such small quantities that getting enough feedstock from locally available waste is not at an issue. However, for an increasing number that are seeking to increase their production it is becoming more of a challenge.

Many briquette producers use waste charcoal dust as the primary feedstock, which is a limited resource and already businesses supported by GVEP are finding that the availability is not enough to scale up their production to the levels necessary to meet the demand. In addition to this, charcoal vendors are becoming ever more conscious of the commercial potential of their waste and as a consequence are raising the price at which they sell. The result is renewed attention being given to alternative biomass and agricultural residues.

However this gives rise to new challenges associated with availability and collection of raw materials, often determined by the willingness and capacity of waste owners or producers to collaborate in a briquetting venture. Although the production levels of agricultural residues are high, the geographic spread of many of the small holders willing to contribute makes collection difficult and expensive. The challenge is finding a single large enough source of feedstock to supply a medium-sized enterprise. Residue producers often attract competing uses for potential feedstocks such as animal fodder and fertilisers as well as rural industries that fuel biomass boilers with raw biomass.

It was noted in *Chapter 1* that the total production of briquettes (from biomass waste products) is limited ultimately by the national quantities of waste production. Therefore it seems inevitable that competition for feedstocks will increase as the industry expands. However the industry is still in its infancy and there is a long way to go before this becomes a problem.

## Consumer Awareness

Despite being around for a number of years, knowledge of briquettes and how they differ over firewood and regular charcoal is largely unknown among populations in Uganda. In rural towns in particular, consumers have not yet been sensitised to evidence of potential fuel savings and health benefits that can be achieved through the use of briquettes. A benefit of some carbonised briquettes is a longer burn time over charcoal, which is an advantage not immediately apparent to a would-be buyer when faced with a higher initial price. Without sufficient marketing, and often costing more per unit weight than charcoal, the product is not likely to sell. Consumers often use non-carbonised briquettes in the same quantities that they do wood despite their higher density and ability to pack better into the stove. The result is that the stove burns too hot, which has been seen to discourage users.

This has meant that the domestic markets have been the hardest to penetrate, and while enough opportunities exist to supply institutions, the health and lifestyle benefits that briquettes can bring to households are yet to be fully realised.

Demonstrations have been found to be an effective method for improving public perceptions and are regularly organised by GVEP through market days and fairs to which entrepreneurs are invited to participate. To address this further, GVEP organised a media campaign on the CBS Radio Station in Uganda that took place in January 2012. Three chat shows, one of which was dedicated to the subject of briquettes, were aimed at informing the audience of cleaner and more affordable alternatives to traditional forms of energy and raising awareness of environmental issues associated with the use of biomass for cooking and heating.

The Commissioner for Renewable Energy also made an appearance in an effort to raise people's awareness. The success of this promotion was evident from the number of calls received in response. Two DEEP entrepreneurs who took part in the show together received 90 phone calls after the airing, and one of them, Jude Kabanda, who produces briquettes in Kampala, reported an increase of sales of 600 kg immediately after being featured.

# Chapter 5: Opportunities

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The briquette industry in Uganda is still young; nevertheless appropriate interventions can enable it to expand to a scale that can significantly impact the fuel market. Opportunities exist for all scales of business to grow and tap into the available markets and with targeted support the Ugandan briquette industry can be developed from a sporadic spread of small enterprises into a widespread and self-supporting industry. Areas of intervention include improving the available technology, fostering the skills of entrepreneurs, facilitating capital and developing the delivery network.

## Opportunities for Growth



Referring to Table 6 in Chapter 3, there is an opportunity to grow the hundreds of micro-entrepreneurs from producing 2 tonnes per year to 20 tonnes and then 200 tonnes. Indeed through DEEP, GVEP has been nurturing these entrepreneurs by developing their basic business skills and linking them to technology and finance. Most barriers to growth appear at a production level of around 200 tonnes per year, and while some will be able to overcome these challenges and grow, it is more likely that production in the region of 2,000 tonnes per year will be achieved by new entrants who have the necessary resources and commercial experience to open a dedicated factory. Here it is necessary to attract investment and seed funding to get a business of this scale off the ground.

Kampala is the only place in the country where there is a centralised waste collection large enough to supply a 20,000 tonne per year factory, so it is likely that there could only ever be one at this size. As an alternative, up to ten 2,000 tonnes per year enterprises could operate in different boroughs utilising locally collected municipal solid waste. Separate from this, there is scope for several 2,000 tonne per year producers operating in the larger towns throughout the country supplying the urban markets, while there would be room for dozens of small-scale (200 tonnes per year) producers to serve the rural and urban fringe markets.

It is recognised that many people who engage in micro-scale operations in rural and peri-urban areas cannot be developed into highly entrepreneurial business people if it is not what they want to do. Through the DEEP programme, GVEP categorises enterprises according to their potential for growth. This enables targeted support at a level appropriate for the needs of the energy entrepreneur.



The high potential entrepreneurs are linked with loan providers and equipment suppliers as it is they who would benefit most from powered machinery and extra capital. Medium potential enterprises are those that show willingness to produce quality briquettes but are unlikely to grow and are best helped by supporting them to produce and sell high standard products. Low potential enterprises can't or won't produce quality briquettes for a variety of reasons and more impact can be gained by directing resources at others.

## Securing Supply

For larger producers of both carbonised and non-carbonised briquettes a reliable and consistent source of feedstock is vital. Large agricultural producers, forestry projects and industries need to be willing to offer and enter into business arrangements with briquette manufacturers. While competition for raw materials is certain to increase, contracts with waste producers can secure a reliable supply.

To tackle this, there needs to be a comprehensive study into what biomass is practically available, where it can be sourced from and in what quantities it is produced. Government data on crop and waste production levels can give an estimate but not useful in determining commercial viability. In 2004, the Shell Foundation funded a study into the feasibility of utilising agricultural wastes in Kenya. This was carried out by Chardust Ltd and Spectrum Technical Services in Nairobi<sup>14</sup> and created a methodology that assessed the availability and collection logistics of each waste product. A similar study in Uganda would be of great value. The following considerations (edited from the study) need to be taken into account:

- **Availability:** Existence and accessibility of biomass in bulk; seasonal variation; degree of centralisation; competing uses; clarity of ownership
- **Conversion Potential:** Physical suitability for the briquetting technologies available, their cost, efficiency and environmental performance
- **Fuel Quality:** Energy value and performance for desired use
- **Enterprise Potential:** Willingness and capacity of the waste owner or producer to collaborate in a briquetting venture

Municipal solid waste (MSW), which in Kampala consists of over 80% organic material such as vegetable matter and plant cuttings, offers a promising source of raw material for briquetting. The waste collection services in Kampala are decentralised and privatised however the City Council maintains a fleet of garbage collecting trucks and through their proposal for a US\$2.2 million briquette plant, have indicated that they can assist in arranging contractual agreements with collectors. Kampala is likely to be the only place in Uganda with the necessary infrastructure for MSW collection but it offers a so-far untapped opportunity for briquette production.

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<sup>14</sup> Results published in *"The Use of Biomass Wastes to Fabricate Charcoal Substitutes in Kenya"*, Chardust Ltd and Spectrum Technical Service, Nairobi, 2004

Many medium-scale producers (200 – 2,000 tonnes per year) who serve domestic markets use locally sourced charcoal dust as a feedstock in an attempt to avoid the inefficiencies of transporting and carbonising raw biomass from agricultural wastes. It could therefore be beneficial to process (carbonising, milling and sieving) biomass at its source rather than in a centralised location. Maintaining control of feedstock quality remains a challenge of this distributed model, however at this scale the lack of low-capital carbonisation techniques and poor economies of transportation means that building a supply network of small-holders and subsistence farmers is proving to be a more successful model than operating centralised system to process agricultural wastes.

Such a model has been pioneered in East Africa since 2010 by the commercial enterprise Joint Environmental Techniques (JET) in Dar es Salaam, Tanzania, in collaboration with the NGO ARTI-TZ. The success of this model has led to it being replicated throughout the region, seeing networks of dozens of small-holder farmers equipped with charcoal kilns and training in the carbonisation of dry biomass to supply commercial briquette manufacturers. This is commonly done through collaboration with NGO's who assist by purchasing the kilns and providing training, however more commercial implementations have also proved to be successful; here the kilns are been leased to farmers with a low pay-back rate (Eco-Fuel in Kampala is an example – see their case study in chapter 3). By providing a buy-back guarantee of all char powder produced, the producer can then organise collection through either 'cash-at-the-gate' policies or collection centres to then process, package, and sell the briquettes.

## Market Opportunities

The highest potential for stimulating demand comes from restaurants and institutions such as schools and hospitals, which have need for large quantities of fuel and whose cooking requirements are suited to briquettes (as they are longer burning). They can be targeted by direct marketing techniques and will offer reliable custom to the larger scale producers.

Domestic markets on the other hand remain difficult to penetrate due to the lack of awareness (and acceptance) among household consumers. Media campaigns are an effective way to reach consumers and promote awareness of briquettes; however advertising via local media is often too expensive for small businesses to fund themselves. Therefore it will be necessary for external funding to assist in publicising briquettes as an alternative fuel.

While carbonised briquettes are preferable for urban domestic consumers due to their smokeless use and compatibility with charcoal stoves, there are largely untapped opportunities for non-carbonised briquettes. These can be a more appropriate product for institutions and restaurants where indoor air pollution can be properly controlled. Indeed carbonisation can be a costly and energy inefficient process for applications where smoke can be controlled. Non-carbonised briquettes can also serve as a replacement for domestic firewood (still used by 82% of the population) but these would need to be sold in combination with compatible stoves.

Difficult distribution and low consumer awareness in rural areas present further barriers to exploiting this market. An additional constraint at a small scale is that locally made machinery is ineffective at compacting non-carbonised material, so these opportunities are best realised by larger producers who can import appropriate equipment. Kampala Jellitone Suppliers are the only producers in Uganda that are producing these products on a large scale.

Chardust Ltd in Kenya has explored the urban market in Nairobi and comment on the opportunity presented by middle-class consumers. This is a market segment that is growing quickly, is less sensitive to price and can be exploited by marketing products for barbeque or garden fuel and selling through supermarkets.

A further opportunity worth exploring is fuel supply to small scale industries. Rural industries are increasingly making use of raw biomass as fuel for boilers and biomass cogeneration plants. Uganda Clays use raw coffee husks to fuel their brick firing kilns and Kakira Sugar Works and Kinyara Sugar Works, two of the largest sugar factories in the country, produce electricity from boilers fuelled by raw bagasse. In industrialised countries briquettes are preferred for use in biomass boilers as they offer superior and well controlled burning characteristics. In Uganda however, where unprocessed biomass is available in large quantities, it is generally more economical to burn it raw. Despite the extra expense of a processed fuel and the need for compatible boilers, increased attention to energy efficiency may make a case for briquettes. This is an area that requires more detailed market research and analysis.

### **Machine Fabrication**

There are hundreds of micro-scale producers making briquettes with manual equipment and many of these entrepreneurs are seeking to scale up their production but there is short supply of locally fabricated motorised briquette machines. In Kenya further advancements have been made in machine fabrication and GVEP regularly links entrepreneurs with these suppliers, however this is not the case in Uganda. Reliable compaction machines with capacities of 800-1000 kg/day are required. This presents a huge opportunity for machine fabricators who can develop machines and lease or sell them to smaller entrepreneurs. Equipment suppliers can play a pivotal role in the briquettes value chain and it is important that they can increase their visibility and to market themselves.

### **Market Segmentation**

Institutions, households, restaurants and farmers all have different heating requirements and by meeting those needs briquettes will become more attractive to them. Customisation through blending feedstocks will also provide briquettes with a competitive advantage over conventional charcoal. Better market research is required to assess consumer requirements across the main market segments in order to tailor briquette products for their use.

## **Diversification**

Improved charcoal cook stoves (ICS) and briquettes are complementary products and by selling the two together can accelerate the propagation of briquettes as a domestic fuel. Many of the larger briquette producers are already selling stoves and water boilers that can utilise their briquettes. A diversification strategy is being promoted among smaller producers within the DEEP programme, in which there are currently 108 ICS entrepreneurs in Uganda, and these can offer valuable channels for briquette distribution.

## **Micro-Scale Production**

Making briquettes is simple to do by hand and with manual extruders. Very little capital is required at this level and there is no shortage of raw materials from garden wastes and charcoal dust in these quantities. While not having an impact on the wider biomass situation, this is still a good income generating activity for individuals to engage in and offers an opportunity for rural employment. Selling briquettes is often more profitable than other rural professions.

## Chapter 6: Conclusions

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As has been seen, briquettes alone will not solve the sustainability problems of wood fuel use in Uganda. It was noted that a maximum of 6% of the country's total wood consumption and up to 50% of the charcoal trade could be replaced by briquettes from biomass waste, limited by the national quantities of waste production; in reality, far less than this will be commercially possible. Nevertheless, this can still be significant and if support and capital investment can be channelled to the sector, the briquette industry can certainly be an important part of the solution. Indeed, there is large scope for growth from an industry that is starting from a very low base. Other initiatives will of course be needed, for example further proliferation of improved cook stoves, better management of forests and improved regulation of the charcoal industry.

Stimulating the growth of micro- and small-sized enterprises has been core to GVEP's Developing Energy Enterprises Programme (DEEP). The consequence has been an increase of income generated for the entrepreneurs, extra jobs created in their businesses, further access to energy products and services for the public and a positive impact on the environment. An important lesson learned through DEEP has been the need to differentiate true entrepreneurs from people who simply seek to generate an income for livelihood. While a true entrepreneur will respond positively to support, the latter may resist further growth of the business.

While there is certainly value in supporting over a hundred micro-businesses to increase their income by small amounts, this approach will not significantly impact the approaching biomass crisis in Uganda. Instead, helping a small number of the most promising entrepreneurs to increase their production to a much larger scale of multiple tonnes per day will have bigger results.

Referring to Figure 13, these few businesses are already responsible for the majority of the total briquette production within the DEEP programme and will be the ones capable of turning their briquette operations into a scale sufficient enough to substitute a sizeable part of the unsustainable charcoal market. By helping a few of these enterprises to grow into bigger businesses and strengthening the chain of market linkages, DEEP has laid foundations for these briquette producers to expand; although the further support and investment required is beyond the scope of the current programme.

If 20 small businesses in Uganda could be developed to produce over 3,000 tonnes of briquettes per year they would be substituting around 10% of the charcoal used. For this scale, equipment and machinery can represent up to 70% of the total investment needed and capital of between US\$10,000 and US\$100,000 is required for the purchase of necessary machines, kilns and working space. Organic growth is an unlikely route to achieving this.

There are currently five or six plants in the region with this kind of production level, all of which have been started with either grant funding from government and non-government organisations or opened by a foreign participant with the necessary resources. In most cases the seed funding has been used for the initial purchase of machines to get operations started, after which they were able to become self-sustaining businesses.

GVEP views private capital as the appropriate solution and seeks to help mobilise. Evidence from businesses linked to finance through GVEP's Loan Guarantee Fund demonstrates that investment from commercial institutions can lead to financially sustainable energy enterprises. However commercial investors are generally still risk adverse towards this young industry, and experience would suggest that seed grants are still required to fuel growth.

While supporting just a few businesses to grow into bigger entities, there still remains an opportunity to employ hundreds of smaller 'Base of Pyramid' entrepreneurs in order to build the required retail and distribution networks.

Observations of the most successful commercial producers in the region can offer important lessons. Firstly, high charcoal prices are a pre-requisite for the sustainability of a briquette enterprise. Chardust Ltd in Nairobi, Kenya, suggests a cut-off point of around US\$200 per tonne of charcoal sold by the sack at the point of delivery to urban wholesalers. Charcoal prices in Uganda have certainly surpassed this mark in recent months offering a key opportunity for briquettes. Secondly, operating out of large urban centres can offer the most economical access to both raw materials and high potential markets. Thirdly, a briquette venture is more likely to be viable if appended to an existing enterprise where land, infrastructure and administrative staff can be efficiently shared. Finally, it is vital to create a business model that is appropriate for the local context of operation. Varying availability of feedstocks, differing markets and unique economic conditions across the region means that businesses will have to have extensive local knowledge.

This report summarises findings from a study undertaken by GVEP International (Global Village Energy Partnership) under its Developing Energy Enterprise Programme East Africa (DEEP EA) implemented in Kenya, Uganda and Tanzania to support micro-businesses engaged in servicing the energy needs of poor communities in those countries.

Of the energy enterprises currently active in the programme, biomass briquettes have emerged as one of the top three energy products dealt with and Uganda has seen the greatest concentration of producers.

This report presents an overview of GVEP International's work with 139 briquette micro-enterprises in Uganda and examines the key challenges they face as well as their potential for growth. The report gives an outline of the wider briquette industry in Uganda, including case studies of micro and small-scale entrepreneurs and profiles of some of the most prominent briquette businesses and projects in the East Africa region.

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