

CASE

Briquettes from agro-waste (Kampala Jellitone Suppliers, Uganda)

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Supporting case for Business Model 1

Location:	Kampala, Uganda
Waste input type:	Agricultural farm waste/residues (saw dust, millet husks, ground nut shells, wheat bran, maize combs, coffee husks)
Value offer:	Briquettes (Clean cooking fuel), briquette burning stoves
Organization type:	Private
Status of organization:	Operational since 2001 (briquette business)
Scale of businesses:	Medium
Major partners:	Fuel from Waste Research Centre, Danish International Development Agency (DANIDA), United States Africa Development Foundation (USADF), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

Executive summary

Kampala Jellitone Suppliers (KJS) is a limited company located in Kampala, Uganda that produces non-carbonized briquette from agricultural residues. KJS has been operational since 1981 and at the time of the assessment employed over 100 people, 70% being women. The company started with roasting coffee using diesel burners, followed by a bakery that used firewood ovens. The baking and roasting propelled the need to look for an alternative fuel source and gave rise to the production of briquettes made from agricultural waste. This has led to KJS becoming the first large scale non-carbonized briquette producer in Uganda and winning the ASHDEN Global Green Awards in June 2009. Its clients now include institutional and commercial users who previously used wood fuel and charcoal for cooking and heating. KJS provides them with briquettes which have high heating value and consistent properties and burn longer than alternative cooking fuel, as well as selling efficient briquette-burning stoves. The company has also set up the Fuel from Wastes Research Centre (FWRC), an NGO which conducts innovative research and development in suitability of agricultural wastes for briquetting, briquette making, and designing and manufacturing of briquette burning stoves.

KEY PERFORMANCE INDICATORS (AS OF 2012)

Land use:	2.4 ha
Capital investment:	USD 698,964
Labor:	100 full-time workers and 400 external laborers along the value chain
Operation and Maintenance (O &M) cost:	0.240–0.260 USD/kg of briquette
Output:	1,680 tons of briquettes per year based on one shift operation
Potential social and /or environmental impact:	Savings to users of 0.08–0.32 USD/kg compared to charcoal, CO ₂ emission savings of approx. 6.1 ton CO ₂ /ton of briquettes, additional income to farmers – USD 3 to USD 14 per ton of input
Financial viability indicators:	Payback period: 14.5 years Post-tax IRR: 7% Gross margin: 10%

Context and background

Kampala Jellitone Suppliers, Kampala, Uganda was founded in 1976 to produce cosmetic products from petroleum jelly. KJS diversified into coffee processing and baking, using liquefied petroleum gas (LPG) as the fuel. In 1992, KJS started to look for cheaper alternative fuels. The production of briquettes was initially started to meet internal energy needs for coffee roasting and bakery, but KJS soon recognized the potential and became a large-scale producer of non-carbonized briquettes. As well as manufacturing briquettes which provides a cleaner, cheap and easy to handle cooking fuel, it also supplies efficient briquette-burning stoves. The initial business set up was supported by the Danish Embassy through Danish International Development Agency (DANIDA), which funded a feasibility study on biomass briquetting and assisted KJS to buy the first briquetting machine, and carry out research in briquetting technology. The company is now selling briquettes to 35 institutions including schools, hospitals and factories. It is financed by its founder and own income, as well as grants from DANIDA (USD 100,000) and the United States African Development Foundation (USADF) (USD 85,000) for developing business plans and staff training.

Market environment

Biomass is still the most important source of energy for the majority of the Ugandan population. About 90% of the total primary energy consumption is generated through biomass, which can be separated in firewood (78.6%), charcoal (5.6%) and crop residues (4.7%). 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 205,852 tonnes per year of charcoal as their main source of fuel for cooking. The urban household use accounted for about 70% of that demand while commercial establishments, such as hotels, accounted for 25%. The charcoal use is estimated to increase at 6% per year, which matches the rate of urbanization. High demand for wood fuels used inefficiently results in overuse and depletion of forests. About 90,000 hectares (equals 900 km²) of forest cover are lost annually, which leads to fuel wood scarcity in rural areas and increasing price levels of charcoal and fuel wood. The production of charcoal is carried out under primitive conditions with an extremely low efficiency at 10–12% on weight-out to weigh-in basis and an efficiency rate on calorific value basis at 22%. At the same time, households use biomass in a very inefficient way as the three-stone fire is still widely used.

Non-carbonized briquettes serve as a replacement to natural firewood and raw biomass fuel. They offer greater energy per unit weight than wood or raw biomass but release as much smoke. Consequently, these are more appropriate for industrial/commercial processes or institutions where emissions can be controlled. Customers like the convenience of buying, handling and storing briquettes. The cooks like

the reduced smoke, heat and charcoal dust, and faster cooking. Table 5 shows the prices of briquettes and other competing fuels in Kampala. The financial savings are significant where charcoal has been used in the past. One primary school now spends USD 24 (51,000 USh) per day on briquettes, instead of about USD 32 (69,000 USh) per day on charcoal.

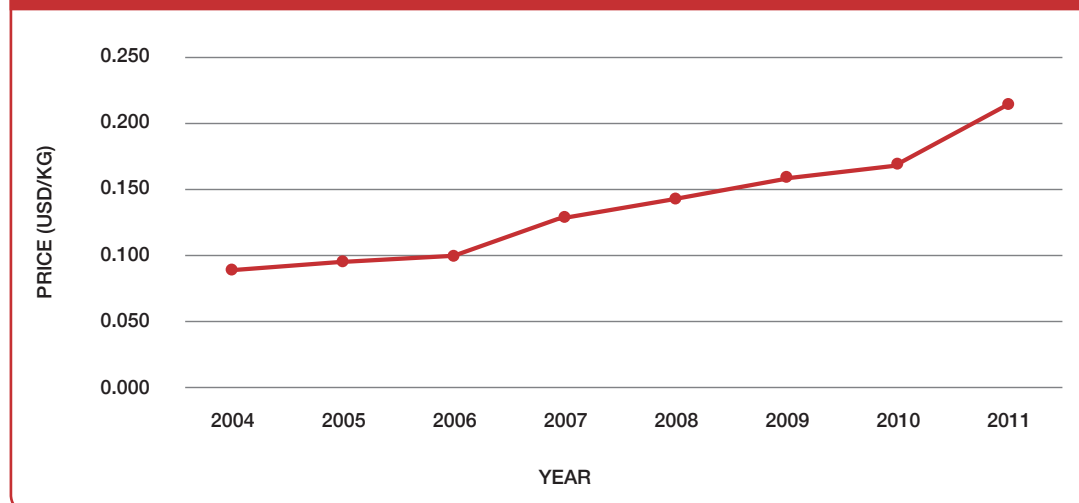
TABLE 5. PRICES OF BRIQUETTES AND ALTERNATIVE FUELS (DEC 2011)

FUEL TYPE	PRICE (USD/KG)
Eco-Fuel Africa briquettes	0.17
Firewood	0.24
Kampala Jellitone Suppliers Ltd. briquettes	0.28
Informal producers briquettes	0.40
Charcoal	0.60

Source: Ferguson, 2012; Personal communication with Eco-Fuel Africa; Personal communication with KJS

In Uganda, there are 180,000 schools and a wide range of agricultural and food processing businesses that could use briquettes. Institutional stoves cost around USD 740 (1.6 million USh). About 65% of customers pay KJS for the stove in installments, others pay the full cost at the time of installation. KJS recently dropped the domestic users due to lack of briquette stoves on the market to match the briquettes whereas for the other segments, the briquettes can be used without modifications in the existing stove. Hence, there is a considerable opportunity and scope to expand production and supply the existing client base. Recent increases in charcoal prices, as shown in Figure 7, have created an opportunity for briquette businesses to serve these users.

FIGURE 7. CHARCOAL PRICE IN KAMPALA, UGANDA, 2004–2011



Source: Uganda Bureau of Statistics, 2010 and 2012.

Macro-economic environment

The biomass has historically been a cheap and accessible source of fuel for Uganda's population but this is unlikely to continue. The FAO reported that between 1990 and 2005 Uganda lost 26% of its forests (78% in areas around Kampala), and the National Environment Management Authority (NEMA)

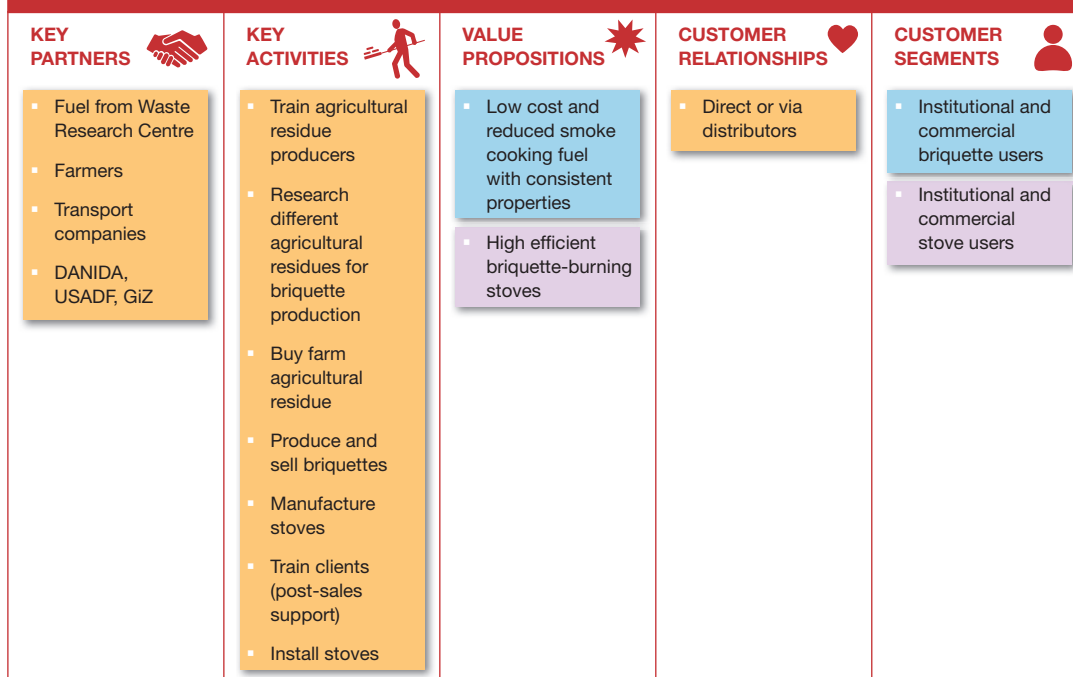
State of the Environment Uganda 2008 report predicts that this deficit will lead to complete depletion of the nation's forests by 2050. The unsustainable levels of the charcoal production operations are increasingly a source of environmental concern, especially considering that slow-growing, hard-wood tree species are targeted without plans for replacement planting.







The contribution of firewood and charcoal to Uganda's GDP is estimated at USD 48 million and USD 26.8 million respectively (UNIDO, 2015). The fact that the biomass wood industry represents a significant economic activity implies that wood fuel will continue to be the dominant source of energy in Uganda for the foreseeable future. This has implications for briquette business as the success of briquette business depends on its price competitiveness to the wood fuel/charcoal. In terms of employment, biomass production creates nearly 20,000 jobs for Ugandans.

Business model

KJS implements a value-driven business model. The establishment and partnership with the Fuel from Wastes Research Centre has enabled KJS to be innovative in its use of varieties of agricultural waste, in making consistent quality briquettes and in designing efficient stoves (Figure 8). Briquettes are sold via distributors while briquette stoves are customized and installed at the user's site. The company provides its briquette and stove customers pre-sales and post-sales support by giving a training/ demonstration on how to use the products. It also conducts sensitization and training workshops for farmers on the best ways possible to preserve the agricultural wastes by milling it before delivery to allow the transport of larger quantities as well as for end users on how to use the briquettes and stoves effectively and efficiently to get value for their money. Thanks to these practices, KJS has been making profits for the last five years and has plans to scale up its operations by targeting industries which rely on biomass for industrial energy supply, such as cement factories, bricks, tile production, etc.

FIGURE 8. KAMPALA JELLITONE SUPPLIERS LTD BUSINESS MODEL CANVAS



	<div>KEY RESOURCES </div> <div><ul style="list-style-type: none">Financial resourcesLaboratoryResearch expertiseLand, building, equipment, laborAgricultural residueTrainingName, brand, ASHDEN, reputation</div>		<div>CHANNELS </div> <div><ul style="list-style-type: none">Direct or via DistributorsPre-sales awareness and after-sales support to users</div>	
<div>COST STRUCTURE </div> <div><ul style="list-style-type: none">Investment cost (Land, building, briquetting machines)Environmental impact assessment costOperational cost, marketing and packaging costTax = 18% VAT and 6% withholding for all governmental institutions KJS suppliesR&DStove installation services</div>	<div>REVENUE STREAMS </div> <div><ul style="list-style-type: none">Sales of briquettesSales of stoves</div>			
<div>SOCIAL & ENVIRONMENTAL COSTS </div> <div><ul style="list-style-type: none">Laborers' health risk due to handling of waste and/or inorganic/foreign particles such as glass and plasticLoss of jobs (livelihood) for charcoal and wood fuel traders</div>	<div>SOCIAL & ENVIRONMENTAL BENEFITS </div> <div><ul style="list-style-type: none">Contribute to reduction of deforestationReduction of environmental pollutionReduction of open burning of agricultural residuesEnergy savingCreation of jobs/additional income for farmersImproved household/users' health</div>			

Value chain and position

KJS is overlooking all the activities across the value chain from research, supply of inputs to final sales of briquettes and stoves (Figure 9). KJS conducts its own research in briquette making and stove manufacturing through the Fuel from Wastes Research Centre, a research NGO set up by the company.

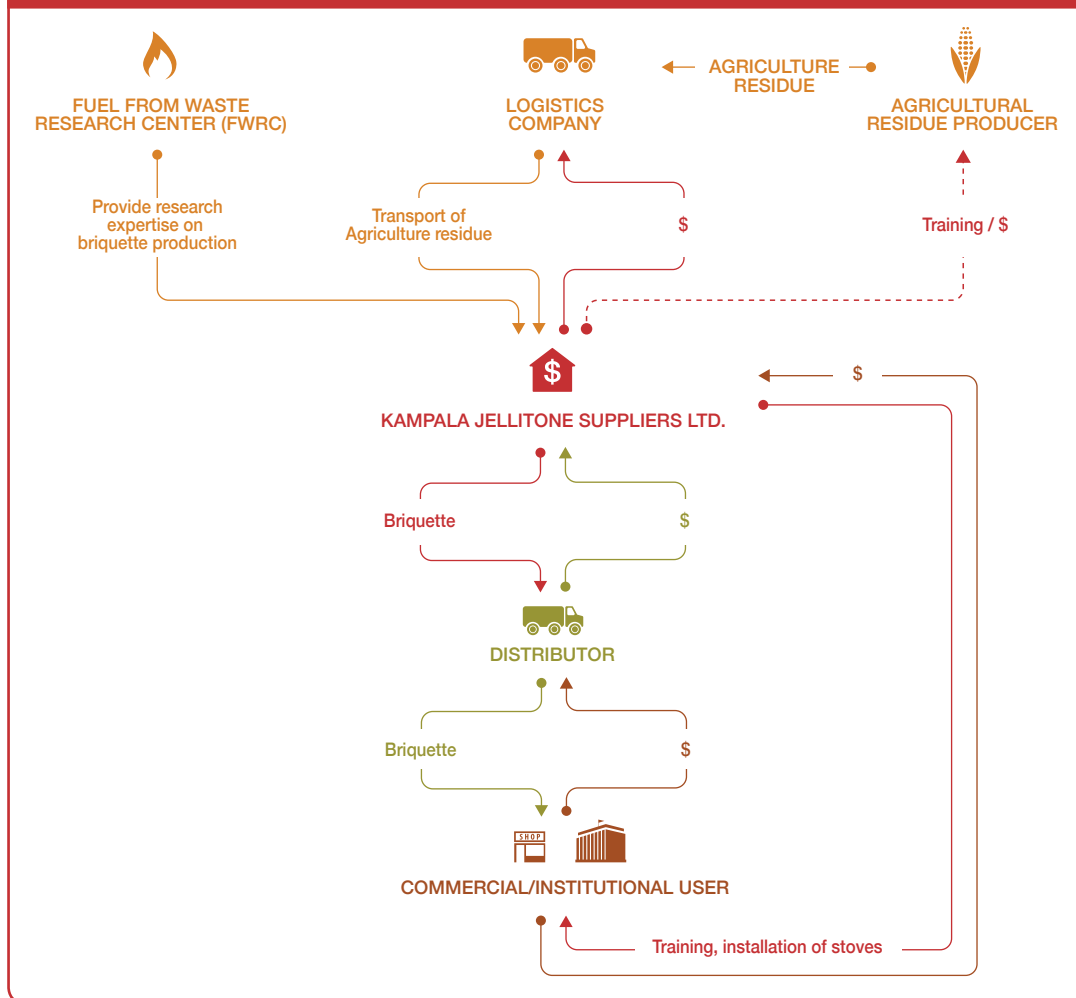
KJS's customer segments include institutional and commercial users which previously used firewood for cooking and heating. Although prices of firewood are high which gives briquettes a competitive advantage, buyers can easily shift back to firewood as briquettes are used without modifications in the

existing stoves. Threat from existing briquette businesses or new entrants is low. KJS is the first large-scale non-carbonized briquette producer in Uganda. The majorities of briquette producers in Uganda are small-scale and are targeting household customer segment. Furthermore, a high investment cost is required to start up a large-scale briquetting business.

Input suppliers (farmers) are key partners as KJS depends on their reliable supply of agricultural waste. The processing of commercial crops generates large volumes of biomass residues including rice husks, coffee pulp and maize stalks. These, along with sawdust from sawmills and furniture factories, often go to waste. Residues are usually simply dumped in large heaps which are then burned to dispose of them. 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.

KJS briquetting business has created employment opportunities and has generated additional incomes to its agricultural residue input suppliers. KJS employs about 100 staff at the factory, and also uses contractor to collect the residues from the agricultural processors and sawmills and other

FIGURE 9. KAMPALA JELLITONE SUPPLIERS LTD VALUE CHAIN



haulage companies to deliver briquettes to customers. The residue producers are paid between USD 3 and USD 14 (6,000 and 30,000 USh) per ton of residue and earn extra income from something that was once regarded as waste. KJS pays a higher price for processed feedstock (already milled) and are seeking to supply farmers with milling machines in an attempt to improve transport efficiency.

Institutional environment

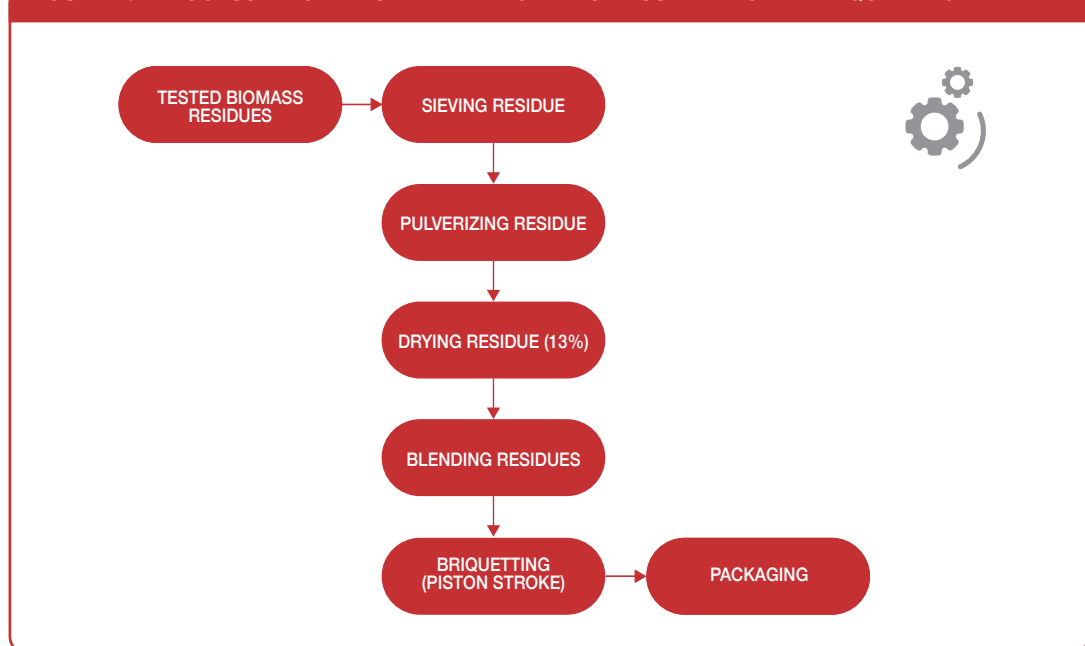
In order to support alternative clean energy initiatives, government strategy on the demand side is dissemination of more energy efficient technologies (Renewable Energy Policy, 2007). Furthermore, with support from the UNDP, the government is implementing key interventions in charcoal production which includes increasing the charge that the National Forestry Authority levies on charcoal burners. This provides an opportunity for alternative fuels to compete further with the cost of charcoal.

Several initiatives to conserve biomass resources have been undertaken by government and the private sector, including NGOs. These include the promotion of improved stoves and afforestation. However, the impact of these efforts is still limited.

Technology and processes

A study conducted by KJS funded by DANIDA in 2002 identified 16 possible agricultural farm waste/residues, such as coffee husk, rice husk, sawdust, wheat, groundnut husks, etc., that could be used for making briquettes. Before production takes place, the agricultural waste undergoes intensive tests to ascertain different characteristics including burning characteristics, ash content and the calorific value (Figure 10). At the factory, the residues are sieved (to remove large pieces, glasses and stones), pulverized using a hammer mill and dried to a moisture content of 13% using a flash drier in addition to sun-drying. Each agricultural residue is then blended by pouring it into a separate hopper which feeds it into a mixing machine to get a homogeneous mixture of different materials with the required

FIGURE 10. PROCESS DIAGRAM OF KAMPALA JELLITONE SUPPLIERS LTD BRIQUETTING



proportions. The mixed biomass is fed into the briquetting machine which compresses it using a piston stroke. KJS operates 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. Under pressure, the natural lignin in the agricultural residues binds the particles together to form a solid block and thus the use of binders is not necessary in this process. Finally, the agricultural wastes are compressed into a solid particle with a heat value of about 14.5 MJ/kg and packed in sacks (40 kg) ready for delivery. The sacks are held in a dry store until delivery to the customers. KJS has also designed an efficient briquette-burning stove, for institutions such as schools and colleges and for food processing industries. The stove is made from fired bricks with a grate and combustion chamber and a chimney to remove the smoke and is constructed on site by KJS staff.

Funding and financial outlook

The total investment cost is estimated to be USD 698,964 (Table 6). The owner invested own cash towards 85% of the total investment and the remaining was obtained from donors. Operational cost including cost of input, labor, utilities, operating and maintenance is estimated to be approx. 238 USD/ton. Marketing and packaging costs are estimated to be approx. 16.3 USD/ton. To meet growing demand, the enterprise plans to expand production. For this it needs to procure 5 briquetting machines with production capacity of 750 kg/hr, trucks to deliver farm residues, agricultural milling machines and other equipment. The whole project requires about USD 2 million. The United States African Development Foundation (USADF) promised to finance about 12.5% (USD 250,000) of the total capital needs.

KJS produced and sold about 1,530 tons of briquettes at a price of 282.8 USD/ton and installed 1,309 institutional stoves for USD 740 in 2009. KJS's sales are estimated to be 1,680 ton of briquettes at a price of 282.8 USD/ton (Table 7).

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.

TABLE 6. KJS INVESTMENT AND OPERATIONAL COST OF THE BRIQUETTE UNIT

ITEM	AMOUNT (USD)
<i>Investment cost:</i>	
Land	232,200
Buildings	227,272
Machinery / equipment	234,492
Environmental impact assessment	5,000
Total investment cost	698,964
<i>Operational costs:</i>	
	USD/ton
Input cost	129.2
Labor	23.52
Operating and maintenance	41.92
Utilities	42.16
Marketing	12.16
Packaging	4.16
Vehicle maintenance	1.00
Depreciation	8.00
Total operational costs	262.12

TABLE 7. FINANCIAL SUMMARY OF KJS BRIQUETTE BUSINESS (YEAR)¹

ITEM	AMOUNT (USD/YEAR)
Total revenue from briquette sales (1680 ton @ 282.8 USD/ton)	475,104
Total production cost	440,362
Net income	34,742
Net cash flow	48,182
Payback period (Year)	14.5
Internal rate of return (IRR) (%)	7%

Socio-economic, health and environmental impact

In agriculture-based countries like Uganda, there is a vast natural supply of biomass found in the form of agro and forest residues. Often these residues are simply burned in the fields. This is not only an unfortunate waste of an energy source, but it is also a cause for increased pollution in local regions. In combination with an energy-efficient stove, briquette use contributes to reduction of deforestation, helps fight climate change and enables the end user to save money. This business reduces the amount of biomass waste that is discarded, decreasing the incidence of fires and its associated risk and avoids the release of methane due to its decomposition. The briquettes manufactured from the agricultural waste are much cleaner to burn than coal. This business further provides communities with economical and safer sources of energy for cooking. The sale of agricultural wastes by farmers to the factories creates additional source of income thereby improving the incomes of the farmers.

A study by the University of Makerere estimated that 1 ton of briquettes replace 1.2 tons of firewood and 0.3 tons of charcoal. KJS's annual production of 1,680 tons would replace about 2,016 tons of firewood and 504 tons of charcoal. Assuming CO₂ emissions of 1.55 tons and 14.02 tons per ton of firewood and charcoal respectively, this is equivalent to saving emissions of 3,125 tons of CO₂ from wood equivalents and 7,066 tons of CO₂ from charcoal equivalents.

Scalability and replicability considerations

The key drivers for the success of this business are:

- Regulations against cutting down trees.
- Increased charge that the National Forestry Authority levies on charcoal burners.
- Rising prices of charcoal and fuelwood.

KJS is a promising business case with significant potential for scaling-up and replication in Uganda and in other low-income countries where there are regulatory frameworks on use of firewood/charcoal. This business could potentially be up-scaled and replicated in urban centres where access to both raw material and high potential markets for the briquettes exist and charcoal prices are high. KJS's existing clients have a consumption estimated at 1,200 tons per month. KJS's production is just 140 tons per month. There is considerable scope to expand production to 1,060 tons per month from a new briquetting factory and supply the existing client base. KJS has more demand than it can address, mainly because of limited drying capacity. The company is in the process of moving to a new and larger factory to increase production. The project is labor intensive involving the collection of agricultural residues that were formerly burnt as more and more farmers are taking benefit of added income.

Summary assessment – SWOT analysis

The key strength of KJS is application of strategic practices such as conducting its own research in briquette making and stove manufacturing, which enables it to make briquettes with high energy value and consistent properties (Figure 11). KJS maintains good partnership with its input suppliers and good customer relationship. In addition to that, the fact that it won the ASHDEN award will boost its image. The weaknesses of KJS are its challenge to meet market demand due to its inability to maintain consistent supply of briquettes. Opportunities arise from the fact that there is increasing government support for renewable energy and increasing prices of substitute products which result in significant potential demand for briquettes in the future. KJS aims to reduce deforestation and GHG emissions and this presents opportunities for KJS to earn carbon credit sales by registering the business as a CDM project. Competition from alternative fuel providers and availability of and competition for needed raw materials are the largest external threat.

FIGURE 11. SWOT ANALYSIS FOR KJS

	HELPFUL TO ACHIEVING THE OBJECTIVES	HARMFUL TO ACHIEVING THE OBJECTIVES
INTERNAL ORIGIN ATTRIBUTES OF THE ENTERPRISE	STRENGTHS <ul style="list-style-type: none"> Research expertise and innovation through blending of different residues Product diversification by selling complementary stoves Strong partnership with suppliers of input Good customer relationship through training and installing briquette stoves onsite Simple substitute for wood without stove modifications Good image due to winning of the ASHDEN award Briquettes less expensive than wood and charcoal 	WEAKNESSES <ul style="list-style-type: none"> Loss of household customer segment due to lack of briquette stoves Failure to maintain consistent production, performance quality and supply of briquettes High transportation cost of agricultural residues from rural areas Initial start-up cost Dusting and high noise levels in production areas Lack of finance required for expansion
EXTERNAL ORIGIN ATTRIBUTES OF THE ENVIRONMENT	OPPORTUNITIES <ul style="list-style-type: none"> Significant potential demand for briquettes and briquette stoves Increasing price, diminishing supply and high demand of substitute products – charcoal and fuelwood Unused agricultural waste Carbon credit – registering the business as a CDM project Government support for renewable energy Cooperation with rural groups and support from local councils 	THREATS <ul style="list-style-type: none"> Competition from suppliers of raw materials and other dry fuel suppliers, especially from price-driven enterprises Lack of financing Customers' behavior – Habitual excess fuel loading Unstable grid power A lack of appropriate regulatory, framework and policy A lack of standards and quality assurance Domestic markets remain difficult to penetrate due to the lack of awareness (and acceptance) among household consumers and difficult distribution in rural areas

Contributors

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References and further readings

- Ashden awards case study/Kampala Jellitone Suppliers Ltd., Uganda / Summary. <https://www.ashden.org/winners/kampala-jellitone-suppliers> (accessed 6 Nov. 2017).
- Ferguson, H. 2012. Briquette business in Uganda: The potential for briquette enterprises to address the sustainability of the Ugandan biomass fuel market. London: GVEP International.
- Kampala Jellitone Suppliers Ltd. Business plan.
- Kampala Jellitone Suppliers Ltd. 2012. www.jellitone.com (accessed Oct. 29, 2012).
- Musisi, A. 2014. Interview with A. Musisi (KJS) by Solomie Gebrezgabher via online questionnaire. Kampala, Uganda. March 19, 2014.
- Sanga, M. 2012. Interview with M. Sanga (Eco-Fuel Africa) by Charles Niwagaba via Skype. September 5, 2012.
- Sebitt, A. 2005. Project Idea Note (PIN) for Kampala Jellitone Suppliers Ltd. Makerere University Kampala.
- Uganda Bureau of Statistics. 2012. Statistical abstract. www.ubos.org/onlinefiles/uploads/ubos/pdf%20documents/2012StatisticalAbstract.pdf (accessed Nov. 5, 2012).
- Uganda Bureau of Statistics. 2010. Statistical abstract. www.ubos.org/onlinefiles/uploads/ubos/pdf%20documents/2010StatAbstract.pdf (accessed Nov. 5, 2012).
- United Nations Industrial Development Organization (UNIDO). 2015. Baseline report of clean cooking fuels in the East African community: Draft report. open.unido.org/api/documents/4677132/download/Baseline%20Report%20of%20Clean%20Cooking%20Fuels%20in%20the%20East%20African%20Community (accessed Nov. 6, 2017).

Case descriptions are based on primary and secondary data provided by case operators, insiders, or other stakeholders, and reflect our best knowledge at the time of the assessments 2015–2016. As business operations are dynamic, data can be subject to change.

Note

- 1 KJS has recently introduced additional briquetting line which produces carbonized briquettes to support clients who prefer carbonized briquettes as a replacement to charcoal. However, data was not available to incorporate cash flows into the business case.