Sub-Saharan Africa • Ghana

Toyola Charcoal Stove: Improving the Environment and Health of the Poor in Ghana

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Sector • Fuel Efficient Stoves
Enterprise Class • MSME
Executive Summary

Toyola Energy Limited is a limited liability company that operates in Ghana. The company produces and distributes energy efficient charcoal stoves and solar lanterns for domestic users in the urban and rural parts of Ghana. Toyola entrepreneurs Mr. Suraj Wahab and Mr. Ernest Kyei – two artisans - have implemented an innovative business model that includes the poor along the whole value chain as suppliers, manufacturers, retailers and customers and accounts for positive economic, social and environmental effects.

The Toyola cook stove is fitted with a ceramic liner to improve fuel efficiency by 50% in comparison with the traditional coal pot. This technology is aimed at minimizing the rate of deforestation and carbon emissions. Users benefit from reduced indoor air pollution and from saving money. The efficient stove also creates employment – especially for the youth, and Toyola has trained and created employment for over 300 artisans nationwide. Employment is generated along the whole value chain which comprises scrap suppliers, stove manufacturers, distributors and retailers.

Toyola encourages artisans to specialize in producing one of the 26 parts that make up the coal pot. Wahab and Kyei estimate that this increased specialization helps to increase the productivity of the artisans by about six-fold.

Toyola delivers stoves to rural dwellers that largely depend on firewood and charcoal for their domestic cooking and also on kerosene for lighting. The Toyola products (stoves and lanterns) provide their users with cleaner, healthier and cheaper energy. Toyola often sells their products on credit to local market vendors who earn 10% commission from selling the product. Toyola sometimes also allows barter financing to give the most deprived access to their products. They do this because they believe that their most loyal ‘sales people’ are the users of the products.

Over the past three years of operation, the company estimates that it has supplied about 35,000 households (out of a total of 3,701,241 households in Ghana) with their products and has offset 15,000 tons of carbon dioxide emissions.¹

¹ Source: Interview with Mr. Suraj Wahab (Toyola), conducted on the 26 October, 2009. The company mentions that these estimates are based on a study by E+Co.
Case Study ● Toyola Charcoal Stove

Introduction

Over the past three decades various initiatives and policies have been adopted at international and national fora on sustainable energy use. For instance, under the European Bank for Reconstruction and Development (EBRD) Sustainable Energy Initiative, up to €1.5 billion was to be invested in energy efficiency, renewables and clean energy projects over a three-year period starting in 2006. Also in Ghana, the Ministry of Mines and Energy in 1989 developed the ‘Ahinbenso’ improved charcoal stove with the aim of improving the efficiency of the cook stoves used predominantly by poor households. This is indicative of the crucial role energy plays in the development agenda of nations. Hence, in seeking to minimize poverty and improve human development, access to affordable and sustainable energy services is essential. Wood continues to be the main domestic fuel for both urban and rural households in Sub-Saharan Africa, where it is relatively easily available and cheaper than modern fuels. However, the inefficient burning of these fuels is reported to result in very high concentrations of indoor air pollutants such as carbon monoxide and fine particulate matter. The most affected are women and children since they spend greater part of their time in the kitchen. Globally, indoor pollution as a consequence of burning biomass and coal for energy needs causes two million deaths annually, almost all in developing countries. Indoor air pollution (IAP) from biomass fuels has also been linked to increased rates of pneumonia in children and chronic obstructive pulmonary disease among adult women. There is also evidence of links to eye disease, tuberculosis and low birth weight.

Coupled with these major health concerns are the potentially devastating effects of greenhouse gas emissions and depletion of forest resources, aggravated by the fact that the demand of developing countries for their principal domestic fuel is expected to grow in proportion to population growth. The burning of biomass and other materials such as coal and diesel results in the emission of black carbon, a component of soot which scientists estimate to be the second or third biggest contributor to global warming after carbon dioxide. It has been estimated that unless African households adopt cleaner, more efficient fuels, the equivalent of 6.7 billion tons of

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2 Wood and Baldwin, 1985; Ardayfio-Schandorf, 1996
4 Smith et al., 2000; Smith and Mehta, 2004
5 Pokhrel et al., 2005; Lin et al., 2007; Mishra et al., 2004
carbon dioxide will be released into the atmosphere by 2050 (5.6% of Africa’s total emissions).\textsuperscript{7} Thus, switching to fossil fuels such as kerosene and liquified petroleum gas (LPG) or alternative energy sources such as wind and solar would reduce the amount of greenhouse gases emitted by African households. However, the cost implications put these energy sources beyond the reach of most people in Africa and other parts of the developing world.

It is estimated that in the last 50 years Ghana has lost about 70% of its vegetative cover with the rate of deforestation at about 3% per year.\textsuperscript{8} Thus, in a bid to address these concerns, various measures such as reforestation programmes, efficient energy transition programmes and the introduction of fuel efficient stoves among others have been widely implemented.

In Ghana, the effort by the State and development partners to encourage a switch from traditional cook stoves which burn fuel inefficiently, to the use of more efficient ones, has provided a business opportunity for a company that is committed to contribute to achieve this goal. Toyola Energy Limited is a success story of an effective collaboration between indigenous artisans and development partners committed to providing the poor with a cleaner, healthier and cost effective means of domestic energy. This case study is a narrative of the model adopted by the company and the impact it has had, largely on the informal sector, where actors in its value chain are drawn, as well as the benefits to the end-users, who are mostly the poor living in rural areas.

**Context**

**SOCIO-ECONOMIC CHARACTERISTICS OF GHANA**

**The macro-economy**

The management of Ghana’s economy has seen marked improvements since 2001. Gross Domestic Product (GDP) growth averaged about 4.7% over the period between 1995 and 2005, increased to about 6.2% in 2006, to 6.3% in 2007 and further to 7.3% in 2008. Ghana’s 2008 GDP was about US$15.65 billion. Using an estimated population of about 23 million for 2009, this 2008 GDP translates into a per capita GDP of about US$681.36.\textsuperscript{9}

**Population**

Based on the 2000 Population and Housing Census and an annual population growth rate estimated by the Ghana Statistical Service to be about 2.5%, the Institute for Statistical and Social and Economic Research(ISSER) projects Ghana’s population to be about 23 million in 2009.\textsuperscript{10}

\textsuperscript{7} Bailis, Robert; Ezzati, Majid; and Kammen, Daniel M.; Mortality and Greenhouse Gas Impacts of Biomass and Petroleum Energy Futures in Africa, Science 1 April 2005: Vol. 308. no. 5718, pp. 98 – 103

\textsuperscript{8} KITE, 2009


\textsuperscript{10} This is consistent with Ghana Statistical Service population projection for 2010. A summary of demographic characteristics is shown in the appendix.
Children account for a bulk of the population. Life expectancy at birth has declined from about 59 years in 1995 to about 54.4 years in 2003. Life expectancy for females has generally remained higher than for males. Adult literacy rates, which are higher for males than for females\textsuperscript{11}, increased between 2004 and 2007. Although the majority of the population lives in the rural areas, Ghana has experienced rapid urbanization, particularly over the last 20 years. For instance the rate of growth of the urban population is estimated at about 4.6% (between 1984 and 2000) whilst the entire population has grown at an average of less than 3%.

**Poverty and Human Development Indicators**

The fifth round of the Ghana living standard survey (GLSS5) estimates that in 2005/2006 about 28.5\% of Ghanaians live below the poverty line.\textsuperscript{12} This represents a reduction from the 1991/1992 and 1998/1999 levels of 51.7\% and 39.55\% respectively. The incidence of poverty remains highest in the three northern regions, especially in the Upper Western Region. The trends in the incidence of poverty across regions indicate increasing spatial inequality across regions of Ghana.

The Human Development Index (HDI) which measures the average achievements in a country, based on long and healthy life, knowledge and a decent standard of living generally shows some improvement since the 1990s. For instance, the HDI for Ghana was about 0.468 in 1994 and by 2005 had increased to about 0.52. In 2007, Ghana’s HDI was 0.553 which meant that the country ranked 135\textsuperscript{th} out of 177.

**Energy Consumption in Ghana**

<table>
<thead>
<tr>
<th>Country</th>
<th>Total energy consumption per capita per annum (2007) [kgoe/a]</th>
<th>Country</th>
<th>Total energy consumption per capita per annum (2007) [kgoe/a]</th>
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<tr>
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<td>Ghana</td>
<td>400.2</td>
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</tbody>
</table>

*Source: International Energy Agency, World Development Indicators, The World Bank*

\textsuperscript{11} A 2009 YEN/IYF study puts the adult literacy rates for male and female in Ghana to be respectively 66.6\% and 49.8\%.

\textsuperscript{12} The poverty line for the last round of the Ghana Living Standards Survey was about GHC371 in January 2006 prices. This estimate represents about US$1.25/day in 2006.
It is estimated that Ghana’s energy consumption is about 6.6 million tons of oil equivalents (TOE) and per capita energy consumption in 2003 was 400.2 kilograms of oil equivalent per annum (kgoe/a). Ghana’s per capita energy consumption is similar to that of most Sub-Saharan African countries whose per capita energy consumption is less than 1,000 kgoe/a. As illustrated in table 1 above, most African countries - apart from South Africa, Botswana and Algeria - had a per capita energy consumption below 1,000 kgoe/a. Comparing the continent’s per capita energy consumption with the industrialized world highlights the low level of energy consumption in Africa. They are attributed to the non-industrialized nature of Africa’s economies. Also, most African countries have low levels of automobile and home appliance ownership per capita but consume high proportions of biomass.

In terms of energy demand, the household sector is the largest consumer of energy in Ghana, followed by transport and industry. Biomass, in the form of firewood and charcoal, constitute the largest source of domestic energy in Ghana responsible for almost 69% of the country’s total energy consumption. Estimates from the Ghana Living Standards Surveys indicate that as of 2006 about 84% of rural households in Ghana used firewood fuel as their major source of fuel for cooking. Additionally, about 13% of rural households depend on charcoal as their main fuel for cooking. All other sources, such as electricity, kerosene and liquefied petroleum gas (LPG) account for about 4% of the energy for cooking by rural households as illustrated in Figure 1, below. Figure 2 on the following page shows a comparison of Ghana, Senegal and Botswana in the use of LPG, which is considered a cleaner energy solution for cooking.

Figure 1  Wood and Charcoal Use for Cooking in Ghana


In 2000, an estimated 18 million tons of wood fuel was consumed in Ghana and this was mainly used for cooking and water heating. Electricity and kerosene constitute the main sources of energy for lighting in Ghana, with an estimated 60% of all households in the country (both urban and rural) using kerosene for lighting, while an estimated 45% to 47% of Ghanaians, including 15% to 17% of the rural population, have access to electricity. The distribution of households relying on electricity as their main source of lighting has a significant urban bias – about 78.5% of urban households rely on electricity as their main source of energy for lighting, while for rural households this proportion is only about 26.9%.

Figure 2 The Use of LPG for Cooking in Three African Countries

Given these facts, it comes as no surprise that Ghana is the largest per capita consumer of charcoal in West Africa and one of the countries in the subregion with very high rates of deforestation. Cooking with charcoal contributes to carbon dioxide emissions and indoor air pollution. Most Ghanaian families cook with charcoal in a coal pot that burns inefficiently. The efficiency of a traditional wood fuel cooking stove is as low as 10% to 12%, while that of a traditional coal pot is 18%. This compares unfavourably with a liquefied petroleum gas (LPG) stove, which has an efficiency of more than 40%. Some researchers have therefore raised the

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14 Asante and Clottey, 2006; This compare also with the Ghana Living Standard Survey 5 (GLSS 5) data, which shows that about 49% of households in Ghana rely on electricity as their main source of lighting.
15 GSS, 2008
16 Wood and Baldwin, 1985; Dzioubinski and Chipman, 1999
concern that the country’s high infant mortality rate of 60 per 1,000 live births, and the high incidence of tuberculosis could be traced to indoor air pollutants.17

Recognizing these health implications as well as environmental concerns, the Government of Ghana has in the past decade tried to promote a switch from charcoal usage to LPG for domestic purposes. The policy has entailed the distribution of free gas cylinders as well as subsidizing gas prices. According to a report from the Food and Agriculture Organization (FAO) of the United Nations, this initiative led to a pronounced increase in LPG consumption but with an urban bias. However, with a reduction in the amount of the subsidy due to the high cost of importing LPG, many users have reverted to the use of charcoal or wood fuel as they have not been able to pay for LPG at real prices.18

**The Poor and Energy Use in Ghana**

The income level of a household at every point in time largely determines its energy type and consumption level. This, coupled with other factors such as fuel availability, fuel prices, distribution network proximity, cultural preferences, demographic distribution and physical environment (rural or urban) determines the dominant type or combination of energy type used by a household at any point in time. Experts in the energy sector assert that as a household’s level of income improves, it will go through an energy ladder for cooking which will progress from traditional fuels (in the order of: dung, crop residues, wood, charcoal and coal) to modern fuels (in the order of: kerosene, LPG and electricity).19 The Energy Ladder’s fuel order corresponds to increased technological efficiency, decreased carbon dioxide emissions and particles, and increased capital costs. Thus, in the developing world, households tend to shift from fuel wood to charcoal and from charcoal to LPG to electricity as their income improves.20 Opponents of this view, however, argue that households do not strictly move along the energy ladder. Rather, based on prevailing factors, a household will choose a combination of energy types for cooking or may even ‘leapfrog’ some steps of the ladder. The emerging perspective on household energy choice points towards a portfolio choice instead of a ladder. Hence households’ energy portfolio can be described by their size, composition, and diversification.21

The case in Ghana points to a situation where many poor households cannot afford modern and efficient fuels and the majority of the poor continue to use fuel wood for their most intensive energy use: cooking. Even though successive governments have enacted policies to increase household access to fuels such as kerosene, gas and electricity, the high costs associated with the

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17 Quagraine and Boschi, 2005
18 FAO, 2005
19 The use of alternative energy sources such as solar power and wind power that are not considered part of the traditional energy ladder is growing. There are companies and NGOs that offer such energy solutions for poor households that are combined with access to microcredit so that the households can afford these solutions. When the system is paid off the households have the energy for free.
20 Meikle and Bannister 2003
21 Heltberg, 2003; Prasad, 2008
use of these energy types have acted against such policies. For instance, most poor households, when first connected to electricity, use it for lighting, TV and radio and few other appliances. They will not use it as much for more energy intensive use such as cooking and heating of water. Poorer households remain multiple fuel users because they cannot afford electricity even if they would have preferred its use on a more intensive scale. For the very poor, particularly in rural areas, fuel wood remains the major cooking fuel simply because it can often be collected free, with the only expenditure being their own time and labour. Indeed a recent multi-country study of fuel switching in developing countries indicated that Ghana had the least tendency towards fuel switching even in the urban areas.

The decision by the majority of households in Ghana to opt for the cheapest form of energy comes with a high opportunity cost in the form of adverse health implications and environmental destruction. This makes the need to increase the efficiency of biomass use vital.

The Toyola Business Model

Toyola Energy manufactures and sells energy efficient cook stoves in urban and rural Ghana. The stoves use charcoal but are 40% more efficient than the traditional stoves used in the country. Due to a reduced amount of charcoal needed, users save money and reduce carbon dioxide-emissions, also lowering indoor air pollution of the home environment for better health.

The company was founded by two entrepreneurs, Mr. Suraj Wahab and Mr. Ernest Kyei, who were part of 78 artisans trained by EnterpriseWorks Ghana in 2002 under a programme sponsored by the United States Agency for International Development (USAID). Under this programme, the artisans were trained to produce fuel efficient cook stoves to help minimize the rate of deforestation and carbon dioxide emissions in Ghana. The USAID programme ended in 2003. Thereafter, in 2006 the two entrepreneurs approached the Kumasi Institute of Technology and Environment (KITE, Ghana) under the African Rural Energy Enterprise Development (AREED) project, which provided assistance with the development of a business plan. With this thought out plan, they were able to secure an initial loan of US$70,000 from E+Co, which enabled the company to buy its first truck for the distribution of the cook stoves in the rural parts of Ghana.

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22 The price of LPG as at February 2010 was about GHC0.84 (US$0.6) per kg whilst price of kerosene was GHC0.91 (US$0.65) per litre. These compare with charcoal which (in February 2010) cost between GHC0.18 (US$0.13) – GHC0.25 (US$0.18) per kg.
23 see inter alia Edjekumhene et al, 2006; Prasad, 2008
24 Heltberg, 2003
25 Essentially the stoves use less charcoal to cook the same amount of food. Based on numbers provided by Toyola and included in a presentation by KITE at a conference in Brussels in November 2009; if the household normally uses US$1 to cook with the traditional stove, then they will only require about US$0.6 with the Toyola stove.
The business model was designed to encourage individuals to specialize and – having found their ‘niche’ work for themselves in the manufacturing and distribution process of the cook stoves. According to the entrepreneurs the three key ingredients in their model are:

1. **Increased specialization**: The business model includes various manufacturers as suppliers of stove parts. The idea to increase specialization in the value chain evolved over time, as productivity was low in the beginning of Toyola’s operations. Now, manufacturers specialize on a certain part of the stove – instead of producing the whole stove themselves. This enables manufacturers to work more efficiently. As a result, productivity increased from initially five (5) stoves per person per day to thirty (30).

2. **Incentives**: Toyola designed the manufacturing process in a way that the people included are offered incentives. “[The manufacturers of the stove parts] work for themselves and so the more effort they put in the more money they make,” confirms Suraj Wahab. Manufacturers are also offered incentives for training apprentices to produce stove parts; while the self-employed manufacturers get money for the parts produced by their apprentices, Toyola pays the individual apprentices a daily allowance of GHC6 (US$4.16) over a period of three months. Thus, all benefit: the manufacturers profit from an increased income, the apprentices receive a salary as well as a three-month long training that enables them to become self-employed manufacturers, and Toyola benefits from being able to provide larger quantities.

3. **Pre-financing operations** throughout the value chain “We subcontract with local market vendors who purchase our product on credit for sale in their shops. This helps our company expand its distribution base without having to contract new staff,” confirms the entrepreneur Wahab. Again, both sides benefit: the vendor minimizes his/her risk and does not have to anticipate the costs and Toyola has access to a larger distribution network at low costs.

All the stoves or stove parts produced by the specialized manufacturers are bought by Toyola to support the communities. Encouraging entrepreneurship not only among manufacturers, but also among retailers, Toyola provides various forms of employment for the local people. This strategy enabled the company to produce and sell as much as 20,000 stoves in the first year - as against their own projection of 6,000. In 2009, (i.e. as of October, 2009) Toyola was able to produce and sell about 40,000 stoves, again above the estimated output of 30,000 for the year. Toyola projects an output of 100,000 stoves for the year 2010.
Toyola has five production centres in the country namely, Achiansa (the biggest) in the Eastern region, Kumasi in the Ashanti region, Tamale in the Northern region, Wa in the Upper West region and Sarpeiman in the Greater Accra region. They also have sales depots throughout the country, and component production centres in Asamankese and Akosombo both in the Eastern Region of Ghana.

**INCLUSION OF THE POOR**

The business model of Toyola includes the poor along the whole value chain as scrap metal suppliers, component suppliers, metal frame suppliers, stove manufacturers/assemblers, retailers and customers (see figure 3 below). Toyola’s effort at training more artisans and engaging more people in the value chain is aimed at increasing output to meet the demand by the increasing number of end-users. In addition, the entrepreneurs realize that inclusion creates significant positive impacts on the socio-economic well-being of the people in their value chain.

*Figure 3  Toyola Value Chain*

Scrap/Component Suppliers and Manufacturers

The metal scrap suppliers go around scavenging or buying the scrap to sell it to Toyola. However, when they come across large quantities of scrap metal which they cannot afford to buy, they contact Toyola to buy it directly and the scrap dealer/supplier is paid a commission of approximately 10% of the value of the scrap metal. The scrap metal constitutes an important component of the cook stoves.

The Toyola cook stoves are manufactured by three categories of artisans namely, the component suppliers, the metal frame suppliers and those who assemble the components. A number of artisans produce various components of the stove using their own scrap metal. In the end, the components are sold to Toyola to be assembled by a group of artisans who specialize in assembling the stoves.
This model has enabled Toyola Energy to have over 300 people in its value chain, but only about five (5) people on its payroll (including two drivers, one secretary and two employees who help at the main office). This is a direct result of the company’s model of training the artisans (component suppliers, metal frame suppliers and manufacturers/assemblers), encouraging self-employment and pre-financing the production of the stoves. The artisans are thus not limited to a specific salary, but are paid for their output. The model used by the company assures scrap suppliers and artisans (who produce and supply parts or entire stoves) a ready market and minimizes the incidence of locked up capital.

Through its apprenticeship model, which provides incentives for experienced manufacturers to train apprentices, the company has been able to engage over 200 basic school leavers, preventing them from peddling petty trade on the streets of urban areas. While the older artisans earn an income on the stoves they manufacture together with their team of apprentices, the individual apprentices are given daily allowances of GHC6.00 (US$4.16).\(^\text{26}\)

**Sales Agent/ Retailers of Toyola Cook Stoves**

Toyola’s work is regarded as completed only when the end product reaches the users. Hence, the company has established a number of distribution channels to achieve this goal. Firstly, the company acquired vans and trucks that distribute the stoves to the various depots throughout the country. These depots supply the retailers interested in selling the product as well as directly to end-users. The retailers can obtain the products on credit. Secondly, the company operates a mobile delivery system to sell some of the stoves directly to users especially in the remotest parts of the rural areas. In other words, when they get to very remote parts they sell directly to households (sometimes on credit).

The payment system of sales agents is based on incentives. They are assured of a 10% commission instead of a fixed salary, which may have been smaller. The company estimates that about 50% of sales are done by these retailers while the remaining sales are done by the company’s salesmen.\(^\text{27}\)

One of Toyola’s trustworthy retailers is Mrs. Gina Kwarteng, a local market woman who has her shop at Dome Satellite market, located at the outskirts of Accra. She had her first encounter with Toyola in 2003.

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\(^{26}\) Exchange rate as of January 2010 is GHC1.00 = US$ 1.44

\(^{27}\) These salesmen are not on the payroll of Toyola. They sell and get paid on commission. Indeed the entrepreneurs are themselves Toyola’s corporate salesmen.
when the delivery van parked close to her retail stall at the market. The entrepreneurs Suraj Wahab and Ernest Kyei were attracted by her vantage location in the market. They approached her and enquired if she would be interested in selling some of their cook stoves in addition to the drinks she sells at the market. She was interested in selling but had no money to buy the stoves, so the entrepreneurs applied their business model of ‘hire purchase based on trust’, and gave her two cook stoves to sell.

She sold the two stoves within a day and went back to the company to get five (5) additional stoves, still on hire purchase. The number of stoves sold later increased to 50, and subsequently to over 100 per consignment. Currently, she sells on average about 10 stoves a day and has stopped selling soda. She makes a profit of GHC1.00 (an equivalent of about US$0.69) per stove sold. Thus, on average, she makes a profit of GHC10.00 (US$6.94) a day. She indicates that demand for the stoves increases when there is shortage of liquefied petroleum gas (LPG) in town.

Her partnership with Toyola over the past six years has been very good and she attributes this to the good customer relations of the entrepreneurs. This has motivated her to develop good relations with her customers. She often tries to convince her customers to try the energy efficient stoves instead of the traditional coal pot (which she stocks to satisfy those not willing to change). As a user of the stove herself she also educates her customers on the handling of the stoves which she indicated could last between 4 – 5 years if handled properly. She also advises her clients not to dispose of the stoves when they find cracks in the ceramic liner but rather entreats them to return it for replacement. According to her, Toyola changes the ceramic lining for their customers at no extra cost.

The good relationship with the company made her resist attempts by other stove producers to entice her to buy their products which she described as ‘fake’ (due to the inferior quality of the ceramic liner). She also indicates that others have tried to sell cook stoves using the Toyola brand. According to Mrs. Kwarteng, “in the past, some people have tried to get me to sell some fake Toyola stoves. I however did not agree to this but rather alerted Toyola about this development. You could even see from the ceramic linings that the fake stoves were of inferior quality.” Having been alerted about the attempts to introduce fake Toyola stoves into the market, the company has taken steps and succeeded in curbing the infiltration of inferior products on the market.

Mrs. Kwarteng sums the socio-economic impact of her association with Toyola as follows: “The sale of the Toyola cook stoves has really helped me since I am able to save to cater for my family.” Entrepreneur Wahab attests to how this particular agent’s socio-economic status has improved since she started selling their cook stoves; “She was able to rent a bigger accommodation for her family. They were initially cramped in a small place but they can now afford to rent the upper storey of their house as well.”

**End-Users**

The end-users of the stoves include both poor households and also middle-income households. However, the majority of end-users are the very poor households. Indeed, it is part of Toyola’s
strategy to target very poor households. According to a United Nations Environment Programme (UNEP) study conducted in 2008, which interviewed five users of the stoves, all five indicated that they were very satisfied with the product. They had bought the stove as they gave credence to the effectiveness of Toyola’s advertisement through word of mouth testimony of users about the effectiveness of the cook stove. Toyola believes in this rather ‘unpredictable’ advertisement through their consumers, whom they call their ‘evangelists’ - which is in fact their main promotion channel. According to Toyola, some of these evangelists become salespersons and get a commission on what they sell. The users interviewed had used the product for a duration ranging from 18 months to five years and indicated that, with the daily use of the stove, the greatest benefit to them is the use of less charcoal. They however could not indicate the exact savings they made as they did not keep records. A further inquiry about the additional benefits of the product revealed that the respondents were aware of the environmental and health benefits associated with the use of Toyola cook stoves. Four out of the five people interviewed indicated that the use of the product minimizes the greenhouse gas emissions and consequently provides a cleaner and healthier environment for cooking. Generally, the five users of the cook stoves were very satisfied with the product.

**Pricing**

Besides the retailers that mainly operate in urban areas, the company also distributes the stoves to retailers in the rural areas of Ghana through its mobile delivery system. The stoves are often sold to the end-user on credit with a 20% down payment, and users are expected to pay for the stoves with the savings they make from using less charcoal. This credit scheme also applies when Toyola sells to retailers. There are no timelines for payment but the entrepreneurs emphasized that users often try to pay for the stoves as quickly as they can. Toyola sometimes even gives out the product on barter terms, and they recover their money by selling the items (food crops) acquired through the barter to their commercial users such as the chop bar operators and other traditional caterers. The company charges relatively higher prices for the products they give out on credit. For instance, the medium-sized stove (which constitutes about 90% of stoves produced), is sold between a price range of GHC7.00 and GHC9.00 (about US$4.86 and US$6.25). Those who buy on credit and pay by instalments pay higher rates (compare Table 2 below).
Table 2 Prices of Toyola fuel Efficient Cook Stoves

<table>
<thead>
<tr>
<th>Size of Cook Stove</th>
<th>Price for direct payment</th>
<th>Price for product bought on credit</th>
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<tr>
<td></td>
<td>GHC</td>
<td>US$</td>
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<td>Small</td>
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<td>Commercial large</td>
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**Toyola’s Financial Model**

The main components in the cost build-up of the Toyola stove are the ceramic liners, scrap used to produce the handles and the metal frame, the stove assemblers and the distributors of the stoves. The costs of these various components are given as follows:

- Toyola purchases the handles from the producers at GHC0.1 even though it costs GHC0.04 to produce these. They also pay GHC2.00 for the metal frame (here also the cost of producing the metal frames is GHC1.00).
- The ceramic liner costs GHC2.00 per stove on average. The assemblers are paid GHC 0.4 per stove and the distributors get a 10% commission per stove sold.
- They also include 20% overhead to cover the cost of running their (rather ‘lean’) office.

With these and with the price of the stove to the retailer at GHC 8, Toyola makes a profit of about GHC1.1 per stove sold. However, there are other risks which impose implicit costs to the company and which we attempt to capture in models 2 and 3. These potential scenarios captured the risks associated with giving away the stoves on credit to their retailers. We assume that these costs are about 10% or 5% of the price of the stove in models 2 and 3 respectively. Once these costs are factored in the profits per stove reduce to GHC 0.3 and 0.7 respectively. In other words, Toyola still makes a profit even if they take into account a risk component of 10% (please refer to table 4). A key concern for Toyola is the rising costs of scrap metal. Increasingly they are competing with other users of the scrap metals.

Microfinancing of the operations of the various actors in the value chain has become an important part of the company’s operations as banks do not offer consumer credits or loans to the poor. This might largely be due to the informal nature of the operations in Toyola’s value chain. The basis of the interaction between Toyola and the actors in their value chain (suppliers, manufacturers, retailers) is based on trust. Bureaucracy and documentation of their interaction is kept to a

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28 It needs to be mentioned here that the cost of the scrap metals are embodied in the cost of the handles and the metal frames. In other words, even though Toyola purchases the scrap for this end of their value chain, then deduct this from the payments made to the producers of the handles and metals frames.
minimum. So far results have been satisfactory as Toyola has almost a zero default rate. Consequently, Toyola pre-finances the operations of almost all the actors in its value chain.

**Constraints and solution strategies**

Toyola faced major constraints when the company started operating. Its model has therefore evolved from the need to overcome these constraints:

**Low levels of productivity** – After training artisans in the production of the stoves, Toyola realized that their production levels were low. Each manufacturer was making an average of five stoves a day. They therefore decided to increase the level of specialization in the production process. They encouraged people to specialize in the making of the 26 different components of the stoves. This increased production from about five (5) to about thirty (30) stoves per person per day.

**Lack of knowledge and low level of skills** – With an increasing demand for the Toyola stoves, the entrepreneurs perceived the need to train more people and consequently increase the output. However, given that individuals got paid by the number of ‘stove parts’ they made plus the fact that “each person worked for him/herself”, it was initially difficult to get people to commit to train others. They therefore established an apprenticeship model which closely linked an individual’s effort to train with some reward. In this model the more experienced artisans are tasked to train some trainees (mostly basic school drop outs). The payments for the parts produced by the trainees go to the trainers. Toyola, in turn, pays the trainees a daily allowance of GHC 6 (about US$4.16) for a three months training period. By this apprenticeship model the interest of the trainees are sustained and the trainers are also happy to give the training. This has enabled Toyola to train over 300 artisans in the production of the improved cook stoves with individuals specializing in the production of the various components of the stoves. This has consequently enabled the company to expand at a very fast pace.

**Financial constraints** – Like many entrepreneurs starting operations in a developing country, Toyola faced challenges with respect to financial resources. This has manifested itself in two main ways. First, the artisans who work for Toyola are unable to pre-finance their production as they have limited access to loans from banks. Therefore, making finances available to these artisans through pre-financing is a key component of their business model as it helps to overcome the raw materials constraint they would have faced otherwise. Until today, Toyola managed to overcome this supply-side financing constraint by seeking assistance from energy sensitive institutions like KITE and E+Co, who assisted with loans, which enabled Toyola to pre-finance the operations of scrap suppliers and other production units in the various production centres across the country. Secondly, the majority of their consumers and sales agents cannot afford to pay for the stoves creating a demand bottleneck. Thus, they manage to sell the product on credit to the poor. The credit scheme is solely based on trust. According to the entrepreneurs, “our business is based on the principle that poor people are good people.”
Use of inferior material – Toyola was initially outsourcing the production of the ceramic liner for the stoves, but later realized that quality had been compromised and the standardization of the product was in question. As a result, Toyola stopped outsourcing and invested in setting up a ceramic subsidiary called KT Ceramics at its Achiansa production centre in the Eastern Region of Ghana. This ceramic subsidiary is the sole producer of the ceramic liner for all Toyola cook stoves in the country and they produce an average of 6,000 ceramic liners per month. The ceramic subsidiary employs three potters who meticulously follow several processes to mould the ceramic liner for the cook stoves. In the words of one of the entrepreneurs, Mr. Kyei; “much care is taken in getting the right proportions of two different kinds of clay and sieved sawdust, so quality is not compromised as the quality of the liner distinguishes the product from the traditional coal pot.”

Low awareness level of the stove in rural areas – After the USAID-sponsored training by EnterpriseWorks in 2002, Toyola had assistance of a marketing team under the programme that helped promoting and selling the stoves for three years. However, when the programme ended, they started incurring losses even though at the time, Toyola felt the market was still virgin. They consequently leveraged the strength of the poor by engaging local sales people in various regions. Closely linked to this strategy is Toyola’s readiness to give their products out on credit since demanding outright payment will deter a lot of their target users – namely the rural poor - from using this energy efficient product. The entrepreneurs emphasized that this strategy of trust has greatly enhanced their operation since they do not advertise their products but the customers, whom they describe as ‘evangelists’ attest to the efficiency of their products to others. „We allow the vendors to offer their customers the opportunity to pay by instalments, so they can pay over a period of a few weeks or months. Word of mouth marketing helps our business sell its products – satisfied users are appointed as canvassers. We call them ‘Evangelists’ because they are believers in the efficiency of our products and they are spreading the word to others.”

Lack of infrastructure - As with many economic agents in Ghana, the generally poor infrastructure adversely impact on Toyola’s operations. In particular, two examples in the case of Toyola are worth mentioning. First, the lack of access to electricity at their Achiansa site where they manufacture the ceramic linings has forced the entrepreneurs to purchase a generator for use. The cost associated with the use of the generator is much higher than using electricity from the mains. A second source of concern with respect to infrastructure relates to transport infrastructure. Poverty in Ghana is a rural phenomenon with the poor living in the hinterland. Access to the poor, who provide the bulk of the demand for the Toyola stoves, is very poor. Toyola has therefore purchased tricycles which it uses for some of these places. Also it is in the
process of purchasing a boat which they believe will help improve their access to the poor in some of the remotest parts of Ghana.

**Actors**

The entrepreneurs attribute their success to the various actors in their value chain and emphasize the important role played by end-users. Through the testimonies and word-of-mouth marketing of the end-users of the Toyola products more people were attracted to buy the fuel efficient stoves. However, without a number of institutions that supported Toyola from the beginning, the success of the company would not have been possible (compare table 3):

<table>
<thead>
<tr>
<th>Actors</th>
<th>Role</th>
<th>Impact on Toyola’s operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>EnterpriseWorks</td>
<td>• Provided training in the production of the stoves</td>
<td>• This provided Toyola with the know-how to produce the fuel efficient stoves</td>
</tr>
</tbody>
</table>
| KITE         | • Advised and helped with business plan development  
               • Advised on the need to bring a gender dimension into their operations  
               • Helped Toyola secure a loan for its operation | • The loan has helped Toyola to implement its business model  
                                                       • The marketing of the stoves has improved significantly with the purchase of the truck  
                                                       • The use of females in their operation will go a long way to improve quality and efficiency |
| E+Co         | • Provided assistance with a US$270,000 loan | • Has enabled Toyola expand its operations  
                                                       • Enabled Toyola pre-finance operations of its suppliers |

**EnterpriseWorks** has been active in the domestic energy subsector since the mid-1980s. In 2002, with USAID and Shell Foundation funding, EnterpriseWorks organized a training workshop for 78 local artisans on the production of fuel-efficient cooking stoves. It was from this training that Toyola emerged.

**Kumasi Institute of Technology and Environment (KITE)** is a not for profit organization based in Ghana. Its operational bases are in Accra and Kumasi. KITE’s objective is to facilitate the deployment of sustainable energy systems and services through appropriate technologies for productive application in rural and peri-urban areas. KITE was approached by Toyola to help them prepare a business plan which enabled Toyola secure a loan from E+Co.

**E+Co** is an international non-profit organization that seeks to empower local small and growing enterprises that supply clean and affordable energy to households, businesses and communities in developing countries. In 2006, E+Co assisted Toyola by providing a loan of US$70,000 for the
purchase of Toyola’s first truck. Subsequently, Toyola has received two more instalments of US$100,000 from E+Co. Cumulatively the company has received US$270,000 in total as loan from E+Co. The loans are being paid back over a five-year period; Toyola is currently in its third year of payment. Repayments of loans have been on schedule and it is expected that Toyola will repay the loans in 2011. E + Co also provided funding for re-roofing of a major scrap supplier’s premises in Accra.

**Impact of Toyola**

The two entrepreneurs describe themselves as having great interest in preserving the environment. They therefore set out to undertake a business in the energy sector. The business had to meet two important criteria (in addition to being in the energy sector). First, it had to be economically sustainable as a business. Secondly, it had to provide an important social good. The two social goods that the business contributes to are cheaper energy for the poor and a cleaner environment. Given that the bulk of biomass consumption takes place in the rural parts of the country, Toyola aims to serve all rural communities with its energy efficient cook stoves. More specifically the main outcomes for the Toyola business can be summarized as follows:

**ENVIRONMENTAL RESULTS**

The environmental impact of the Toyola cooking stove is two-fold: First, it reduces emissions of carbon dioxide into the atmosphere, which has adverse effects on global warming. Second, because the Toyola stoves save about 40% to 50% on the amount of charcoal used, it helps in reducing the rate of deforestation and desertification in Ghana. According to Mr. Suraj Wahab, one of Toyola’s entrepreneurs, “*a study done by E+Co estimates that Toyola cook stoves have saved about 51,000 tons of carbon emissions.*”

**SOCIAL RESULTS**

*Increasing Income and Job Opportunities* – Part suppliers and manufacturers of Toyola are normally people who would have been unemployed or have very low incomes – people who would otherwise be categorized as poor or even extremely poor. However, as a result of Toyola, these people get significantly higher incomes. For instance, an apprentice at Toyola (the least paid in the value chain) makes about US$4 a day - a salary which is double the minimum wage of about US$ 2 a day.29 Also, for most informal apprenticeship programmes in Ghana, the trainee pays to be trained as opposed to being paid. Through their apprenticeship program, the company has been able to engage over 200 basic school leavers, preventing them from peddling petty trade on the streets of urban areas.

*Savings on Household Expenditure on Energy* – KITE estimates that the improved cook stove has an efficiency of about 39% with a payback period of six months. This improved efficiency is in relation to the regular charcoal cook stoves. Given that the average household will normally

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buy the medium sized stove, the savings that the household makes as a result of buying and using the cook stove is US$30 over three years. This translates to a savings of US$10 per year—about 0.6% of the family income for a four-member household that lives on the poverty line of US$450.

**Health** – As the traditional cook stoves permits smoke to escape, and require more charcoal which produces more smoke they cause health problems for household members—especially for women who do most of the cooking and the children that are with them. The use of charcoal increases their exposure to indoor air pollutants and contributes to the high incidence of tuberculosis and high infant mortality.\(^{30}\) Consequently, a key benefit of the Toyola stoves is that it reduces the level of pollution and therefore the level of exposure of household members to these harmful pollutants.

**Gender effects** – The implication of the Toyola operations on gender are two-fold. First, the adverse health effect of the use of traditional cook stoves was disproportionately on women and children. Therefore, the increased use of Toyola stoves helps improve the health of women and children. Second, women are employed predominantly in the downstream side of the value chain, particularly in the retailing end. However, Toyola has begun to involve more women in the production process. This significantly improves the empowerment and welfare of women in Ghana.

**ECONOMIC RESULTS**

In addition to making a contribution to the betterment of the environment and to social aspects, Toyola makes a profit—which greatly impacts the Ghanaian economy as a whole.

To assess the financial sustainability of Toyola’s business model, an internal rate of return (IRR) analysis is undertaken and shown in table 5.\(^{31}\) The key assumptions made in this table are that the initial loan of about US$270,000 will be repaid over a five-year period.\(^{32}\) The interest charges on the loan are assumed to be 15% (or 20% depending on the scenario\(^{33}\)). Other assumptions applied in the scenario analysis include the growth of 10% in the number of stoves sold per year\(^{34}\) as well as different assumed profits for the stove (according to repayment/default rate—see Table 2).\(^{35}\)

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\(^{30}\) Quagrine and Boschi (2005)

\(^{31}\) These scenarios were developed by the case writer, Robert Osei and the assumptions are based on numbers from the case and numbers from existing studies. SMEs do get loans for this range of interest rate or sometimes lower when it is from Government or NGOs. However, the market rates are much higher.

\(^{32}\) Indeed this is what Toyola says is the period over which the loan was given to it.

\(^{33}\) This is based on the interest rates that apply normally to SMEs that benefit from government credit schemes. These are obtained from an unpublished Bank of Ghana study that evaluates Credit schemes for SMEs in Ghana, May 2007

\(^{34}\) This is a very conservative estimate when compared to the growth of about 100% in 2009 and the also the expected growth for 2010.

\(^{35}\) The different profit levels are discussed under Table 2 but merely seek to reflect the fact that if and when one builds in some risks for default, it will affect the bottom-line of the company.
With these assumptions, Toyola is assumed to start making profits after year five. Already in year six, the company should be making profits of about US$33,000 under scenario 3.

Another key result from table 3 is that the internal rate of return (IRR) on this investment should be positive over a 15-year period. The IRR ranges from 2% to about 11% under the scenarios presented in table 5. The results also show that some of the variables which can put Toyola under strain in terms of financial sustainability are the interest rates and the profit per stove. In the view of Toyola, the risks to the company’s financial sustainability are mainly supply-side issues. They feel there is excess demand which will not go away soon.

These results suggest that the financial sustainability of Toyola is not in jeopardy. Indeed, the entrepreneurs estimate that they make a profit of about 40% on each sale. This is much higher than the profits assumed in the IRR analysis.

**Table 4** Profits of Toyola (in GHC)

<table>
<thead>
<tr>
<th>Costs</th>
<th>Model 1: stove sold on credit are paid back</th>
<th>Model 2: 90% of the stoves sold on credit are paid back</th>
<th>Model 3: 95% of the stoves sold on credit are paid back</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceramic Liners</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Handles</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>metal frames</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Assemblers</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Distributors</td>
<td>0.8</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td>Overheads (20%)</td>
<td>1.6</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>Risks 1 (10% of costs)</td>
<td>/</td>
<td>0.8</td>
<td>/</td>
</tr>
<tr>
<td>Risks 2 (5% of costs)</td>
<td>/</td>
<td>/</td>
<td>0.4</td>
</tr>
<tr>
<td><strong>Total Costs</strong></td>
<td>6.9</td>
<td>7.7</td>
<td>7.3</td>
</tr>
<tr>
<td><strong>Profit/stove</strong></td>
<td>1.1</td>
<td>0.3</td>
<td>0.7</td>
</tr>
</tbody>
</table>

**Table 5** Financial Sustainability of Toyola

<table>
<thead>
<tr>
<th>Scenario 1: Low Interest rate (15%); Low Profit per stove: (US$0.21)</th>
<th>Scenario 2: High Interest rate (20%); Low Profit per stove: (US$0.21)</th>
<th>Scenario 3: Low Interest rate (15%); High Profit per stove: (US$0.5)</th>
<th>Scenario 4: High Interest rate (20%); High Profit per stove: (US$0.5)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Initial loan</strong></td>
<td>US$270,000.00</td>
<td>US$ 270,000</td>
<td>US$ 270,000</td>
</tr>
<tr>
<td><strong>Period over which loan will be repaid</strong></td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td><strong>Interest rate</strong></td>
<td>0.15</td>
<td>0.2</td>
<td>0.15</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>US$140,795</td>
<td>US$174182.4</td>
<td>US$ 140,795</td>
</tr>
</tbody>
</table>

36 The two scenarios are developed by Robert Osei, the case writer. They are just a combination of the two interest rates (15% and 20%) and the two profits (0.21 and 0.5). The difference in the interest rate is due to the fact that sometimes SMEs do benefit from credit schemes (from government, NGOs and private microfinance institutions) with different interest rates.
### Outlook

#### CHALLENGES AND OPPORTUNITIES FOR SCALING UP

Toyola pre-finances most aspects of its production and is also prepared to sell its product on credit. This consequently poses cash flow problems to the company, particularly in the face of expanding its operations. However, getting credit is not always easy and Toyola is concerned that getting commercial loans from banks will mean increasing prices of the stoves that are meant for the poor. The company’s position is to continue to look for cheaper loans than what the formal financial sector can offer.

Toyola sees an opportunity in venturing into microfinancing in the future to overcome the major constraint of pre-financing the part suppliers and stove manufacturers. The company also intends to go into briquetting of sawdust and charcoal wastes, as they count on their goodwill to sell these to the users of their products. They have also identified the need to manufacture special cooking stoves for school kitchens and other large scale users since their current biggest size fails to meet the needs of such large scale users.

Scrap metal is an important ingredient used in the production of Toyola stoves. According to the entrepreneurs, their biggest challenge is how to meet the growing demand for their products. This is often hampered by the inadequacy of scrap metal supply for which Toyola faces competition from companies like Tema Steel Works and other scrap dealers who export scrap metals to China. Toyola is also considering the option of securing an additional loan from E+Co to enable them to import sheet metals to augment their local scrap supply. The company prefers the use of scrap to other more expensive metals in order not to increase the price of the products, which are mostly patronized by the rural poor.

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37 The profits are taken from Table 2. In the table the numbers are in GHC and so they were converted to US$ using the exchange rate of US$1 to GHC1.4. The profit per stove under models 2 and 3 in Table 4 are respectively US$0.21 and US$0.5.
The choice of the appropriate technology also remains a challenge for Toyola. On the one hand, the use of labour intensive techniques limits the scale of operation (in terms of the number of stoves produced in a day). On the other hand, a move to more capital intensive production could have adverse employment effects for people who would otherwise be stuck in extreme poverty. Although Toyola is doing all it can - including buying a boat to enable it get better access - to reach the very remote parts of the country, distribution still remains a challenge. However, the road infrastructure to some of these places is very bad to the extent that sometimes the ceramic lining in the stoves develops cracks even before they get to their destination.

LESSONS LEARNED/ CONCLUSIONS

The poor can be part of efforts to improve the environment – the Toyola model shows that the poor can be an effective partner in the fight to save the environment. Indeed the poor are able and willing to chose for, purchase and use energy efficient end-products. However, they need to be made aware of the availability of the improved technology and the practical benefits of it. Also they need an appropriate financing scheme to enable them purchase these technologies.

A successful business model must always look at the bigger picture – an understanding of the key players in the value chain as well as the constraints that each of the players face is crucial for a successful and sustainable business. In the case of Toyola, the entrepreneurs were not only concerned with the profits of their business, but also how their business would impact on the lives of people – their income and health - and the environment. Thus, entrepreneur Wahab concludes: “Our passion for the environment drives us to do more each day and as we do this, the poor also benefit.” They also appreciated that their success depended on whether their business could have the desired social and environmental impact. For instance, households have been making the switch to Toyola stoves because it offers them significant savings.

In spite of the challenges that Toyola still faces, the outlook is very positive. These two entrepreneurs do believe and have the ability to continue to grow their business and impact positively on poverty, the environment and the health of the poor in Ghana.
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- Mr. Suraj Wahab, founder of Toyola
- Mrs. Gina Kwarteng, local market woman

PUBLICATIONS


Quagraine, V. and Boschi, N., (2005); A Few Behavioral Changes Can Go a Long Way to Improve Indoor Air Quality in Ghana


Sefa-Bonsu Atakora, Biomass Technologies in Ghana. Kumasi Institute of Technology and Environment (KITE)


WEBSITES

## Annex

### Summary Demographic Statistics for Ghana

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Data</th>
<th>Year</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>23,951,519</td>
<td>2010 (Est)</td>
<td>GSS 2005</td>
</tr>
<tr>
<td>&lt; Male</td>
<td>11,867,372</td>
<td>2010 (Est)</td>
<td>GSS 2005</td>
</tr>
<tr>
<td>&lt; Female</td>
<td>12,084,147</td>
<td>2010 (Est)</td>
<td>GSS 2005</td>
</tr>
<tr>
<td><strong>Age structure</strong></td>
<td></td>
<td>2010</td>
<td>GSS 2005</td>
</tr>
<tr>
<td>0-14 39%: Male 4,702,391 : Female 4,676,701</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-64 56%: Male 6,670,653 : Female 6,843,891</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65+ 4%: Male 494,328 : Female 563,475</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Median age</strong></td>
<td>20.7 years</td>
<td>2008</td>
<td>World Factbook</td>
</tr>
<tr>
<td><strong>Percent population 15-34 years old</strong></td>
<td>33%</td>
<td>2010</td>
<td>GSS</td>
</tr>
<tr>
<td><strong>Population growth rate</strong></td>
<td>2.5%</td>
<td>2007</td>
<td>WDI, 2007, NDPC, 2007</td>
</tr>
<tr>
<td><strong>Ratio male/female</strong></td>
<td>98:100</td>
<td>2010</td>
<td>GSS 2000</td>
</tr>
<tr>
<td><strong>Urbanization rate</strong></td>
<td>4.6%</td>
<td>1984-2000</td>
<td>GSS, 2000</td>
</tr>
<tr>
<td><strong>Birth rate</strong></td>
<td>Crude birth rate =33/1000</td>
<td>2001-2003</td>
<td>GDHS 2003, GSS, NMIMR &amp; ORC 2004</td>
</tr>
<tr>
<td><strong>Mortality rate</strong></td>
<td>Maternal mortality rate = 224 per 100,000</td>
<td>2007</td>
<td>NDPC, 2007</td>
</tr>
<tr>
<td><strong>Life expectancy</strong></td>
<td>54.4</td>
<td>2003</td>
<td>WDI, 2007, NDPC, 2007</td>
</tr>
<tr>
<td><strong>&lt; Female</strong></td>
<td>58</td>
<td>2005</td>
<td>WDI, 2007, NDPC, 2007</td>
</tr>
<tr>
<td><strong>Fertility rate</strong></td>
<td>4.4</td>
<td>2001-2003</td>
<td>GDHS 2003, GSS, NMIMR &amp; ORC 2004</td>
</tr>
<tr>
<td></td>
<td>Children Aged 1 mortality: 50/1000</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Literacy rate</strong></td>
<td>61.7</td>
<td>2007</td>
<td>WDI, 2007, NDPC, 2007</td>
</tr>
<tr>
<td><strong>&lt; Male</strong></td>
<td>66.4</td>
<td>2006</td>
<td>WDI, 2007, NDPC, 2007</td>
</tr>
<tr>
<td><strong>&lt; Female</strong></td>
<td>49.8</td>
<td>2006</td>
<td>WDI, 2007, NDPC, 2007</td>
</tr>
<tr>
<td><strong>Population under the poverty threshold</strong></td>
<td>28.5%</td>
<td>2005/2006</td>
<td>GSS 2007 (GLSS V)</td>
</tr>
</tbody>
</table>

*Source: Yen-IYF Study (2009)*
January 2010

The information presented in this case study has been reviewed and signed-off by the company to ensure its accuracy. The views expressed in the case study are the ones of the author and do not necessarily reflect those of the UN, UNDP or their Member States.

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Design: Suazion, Inc. (NJ, USA)

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