A way of life: energy provision in Africa

Murefu Barasa

Charcoal is one of the most important yet least understood energy sources of the African continent. It is a leading source of livelihoods for village communities in rural areas and the preferred energy source for cooking and heating in urban areas. The production of charcoal provides employment in rural communities because more than 65 per cent of all households in the urban areas of East Africa use it as part of their energy mix. In rural areas hardly any charcoal is used, as communities opt for firewood instead[1]. Any practical alternatives will have to provide a viable income-generating option for rural areas and a competitive energy option for urban households.

After the global oil crisis of 1973, unsustainable use of traditional biomass energy, especially charcoal and firewood, became one of the trending topics in the energy sector at the global scale. Eckholm's publication in 1975[2] raised the profile of traditional biomass energy use in developing countries, and it was followed by a series of publications that linked all traditional biomass energy use with forest degradation and deforestation. By the 1990s, charcoal production and its use in developing countries was marked as a leading environmental threat, with negative impacts linked with deforestation, desertification and widespread soil erosion. This led to blanket moratoria on production and distribution across several countries. Due to the critical role played by charcoal, these measures were, needless to say, ineffective.

Enter Professor Emmanuel Chidumayo[3], whose empirical work published in the 1990s showed that charcoal production does not result in negative impacts in all cases. His work highlighted how the degree of forest or rangeland clearing for charcoal varies considerably between countries and between sites within each country. In some cases, the extraction of trees for charcoal, although significant, was below the ecosystem's natural regeneration capacity – its mean annual increment

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measured in tonnes per hectare. He observed that, contrary to the charcoal-crisis narrative, charcoal had little to no impact on the particular savannah ecosystem he studied.

The goal of these and other studies was in no way to downplay the widespread negative impacts of unsustainable charcoal production but to highlight possibilities, albeit marginal, for sustainable charcoal production. The findings helped to explain why the prediction of a total depletion and collapse of Kenya's forestry system by 1986 due to charcoal production was inaccurate. A study by the Beijer Institute in the 1980s had asserted that "if estimates of the consumption and growing stock are anything near correct, the trees will be depleted by about 1986; even if the volume estimates were doubled or tripled, the stock would still be exhausted by 1991 or 2005 respectively. Thus an acute shortage of woodfuel is imminent". The lack of accurate data on charcoal trends, however, remains a key challenge in managing the threat of unsustainable charcoal production – which is both widespread and harmful.

A complex value chain

No one aspires to be a charcoal producer, as it is a low-paying, physically intense and health-threatening undertaking, often done as a last-resort coping mechanism. Charcoal producers in villages are the factories that respond to market demands in many urban areas in East Africa as this is the preferred energy source for cooking and heating, solar-sourced cooking so far being a non-starter. Charcoal is not just an option for urban off-grid households but all households. Those that are connected to the electricity grid do not use electricity to cook (including myself); urban middle-classes typically use liquefied petroleum gas (LPG) in tanks and the rest use a mix that includes charcoal.

Besides the producers – who receive the least number of shillings per kilogram sold to the end user – charcoal has a complex value chain that includes brokers, transporters, wholesalers, retailers and recipients of unofficial payments along the chain. In 2014, the United Nations Environment Programme (UNEP) and Interpol estimated that unofficial payments and bribes to organised criminals, corrupt government officials and militia along the charcoal value chain were between US$ 14 million and US$ 50 million annually in Africa alone. More than 20 million tonnes of charcoal are consumed in Africa every year and this is expected to increase to 46 million

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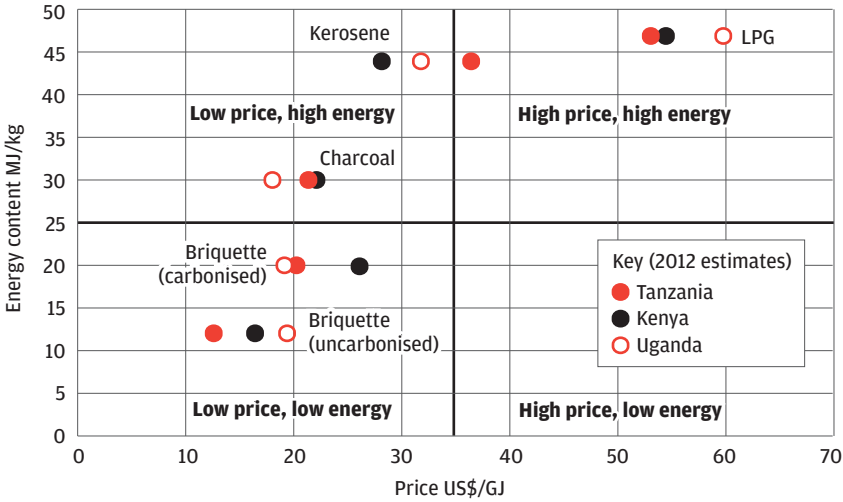
Figure 1 Comparing price and energy content[5]



Note: *Briquette types vary greatly in design, mass, volume, shape, price and energy content. Uncarbonised briquettes typically have lower energy content averaging 12MJ/kg, compared to carbonised briquettes which average 20MJ/kg.*

tonnes by 2030, driven by sustained population growth, rapid urbanisation, and lack of practical and affordable alternatives[4].

Why the charcoal market?

When compared against other alternatives including briquettes, kerosene, LPG and electricity, charcoal out-competes most on several fronts (Figure 1).

The price of an energy option can be assessed using several metrics. Comparing the price of common energy sources for cooking and heating in Kenya, Uganda and Tanzania, based on an analysis of price per unit of mass (US$ per kilogram) and price per unit of energy output (US$ per joule), explains why some forms of energy are preferred and continue to out-compete other forms. For the first metric, an analysis of the levelling options

(incorporating all the costs of an energy-generating system over its lifetime: initial investment, operations and maintenance, cost of investment) based on mass (kg), compares un-carbonised briquettes, carbonised briquettes, charcoal, kerosene and LPG. The second metric levelling options, based on cost per unit of energy output, compares all the options above plus grid-based electricity. Energy density is also a significant metric, comparing the energy output per unit of mass (joules per kg), and is important in determining the portability of an energy form. This is paramount, especially in urban areas where cooking spaces are constrained compared to rural areas, and explains why charcoal is preferred to firewood, and kerosene to charcoal.

Although briquettes have a lower cost price per unit of energy output, they have much lower energy densities. They are comparable to charcoal in terms of price (less than US$ 30 per gigajoule) but cannot compete with charcoal on energy content per unit of mass, with charcoal having values higher than 25 megajoules per kilogram. Both briquettes and charcoal use similar energy conversion technologies (various forms of cook stoves), although briquettes are more difficult to ignite, have much higher ash content and are not so readily available. Additionally, briquettes vary greatly and the market lacks standards or guidelines that can inform purchase. Such advantages make charcoal the undisputed household energy of choice for a majority of urban households, and this has remained the same for several decades.

Some misconceptions

The failure of past renewable energy interventions has been based in part on the limited understanding of the processing of energy selection as well as a lack of viable alternatives to charcoal. Kerosene has a much higher energy content than charcoal and prices are comparable. Although not clean or renewable, this is the energy form that is most likely to compete effectively with charcoal in the urban centres of Africa. Others include mass-produced ethanol or subsidised LPG. The price of charcoal in Kenya is about US$ 22 per gigajoule compared to kerosene at US$ 28 per gigajoule, even though kerosene has up to 50 per cent more energy density.

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The rationale for energy choices at the household level is more complex and certainly goes beyond considerations of price and energy

density, although the two factors contribute the most towards informing energy choices. At the household level, energy consumption options and patterns for cooking and heating applications are influenced by price, energy content, ash content, smoke and fumes, the available cooking appliance, the availability of the fuel, the type of food (meal) to be prepared and the time of preparation. Additional criteria include the rate of energy extraction, availability, safety, fluidity and storage requirements.

A techno-utopian alternative to charcoal has to be matched by a social transformation that generates employment and viable income alternatives

Summary

The urban charcoal market is essential for East Africa because it remains a central part of household energy, and the data show what a techno-utopian competitor might expect to come up against – a societal structure that involves not only traditional forms of household energy provision for cooking and heating, but also embedded patterns of rural employment for charcoal production, and a livelihood influenced by shadowy interests along the value chain of charcoal for the urban market. The cautionary scenario is that a top-down techno-utopian solution could advance modern and alternative sources to charcoal as a primary energy source for cooking and living in the urban setting, thereby reducing air pollution and health problems, but that it has to be matched by a bottom-up social transformation that generates employment and viable income alternatives for the producers in smart villages.

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Author

Murefu Barasa is the Managing Partner at EED Advisory Limited, a boutique advisory firm with service offerings in the energy and environment sector. He is an experienced renewable energy and energy access consultant and holds a BSc in Environmental Studies from Kenyatta University and a Masters in Environmental Science from Yale University.
mbarasa@eedadvisory.com