SAMSET brief on Energy Efficient Cooking

This briefing note has been designed for use by city officials and planners working in sub-Saharan Africa. It is a practical guide, which identifies easy to achieve energy interventions that will save money (for cities, businesses and households), promote local economic development, and enhance the sustainable profile of a city. This note is specifically aimed as a support tool to achieve the implementation of key interventions within municipalities across sub-Saharan Africa.

African municipalities need to be prepared to deal with an explosion in demand for services from burgeoning populations caused by two factors – high population growth in Africa as a whole, and rapid urbanisation. An interesting feature of population growth in sub-Saharan Africa is that it is expected to take place mostly in small and medium sized cities, rather than capitals (UN-Habitat, 2010). These changes are taking place at a time when many countries are devolving administrative powers to local governments, yet municipal authorities lack the skills and expertise to address challenges, to manage resources, and to implement and enforce policies.

Energy is only one of many services that municipalities need to address in the face of increasing urbanisation, but it is crucial to any form of urban development – planned or otherwise. People need energy as part of their every-day lives. The supply of energy is closely linked to economic development, health and individual wellbeing, as well as to local and global environmental sustainability.

Recognising the emerging role of municipalities, with limited capacity, in addressing energy provision in urban centres, the "Supporting African Municipalities in Sustainable Energy Transitions" (SAMSET) project seeks to build capacity and develop a practical and effective knowledge exchange framework for supporting actors involved with municipal energy planning. This note is an output of the SAMSET project.

The purpose of the note is to give planners an idea of the range of energy interventions that it is possible for them to implement at the municipality level. It provides enough information to give a basic understanding of different energy technologies – enough to start making enquiries and engage in discussion. More detailed technical expertise will, however, be needed in order to design a bankable project.

Full guide can be found at africancityenergy.org/uploads/resource_101.pdf

More info can be found at africancityenergy.org/

More project info can be found at samsetproject.net

Overview

Hazardous Cooking Practices

The traditional African way of cooking is on a three stone wood fire. Clearly this is not an ideal practice in urban areas where wood is not readily available, so charcoal tends to be the fuel of choice. Although urban residents tend to have greater access to modern fuels for cooking, such as LPG and electricity, the majority still rely on biomass. Even in households that use modern fuels as their main cooking fuels ,they will also use a variety of other fuels either at certain times or for certain purposes – this is known as fuel stacking.

2.6 billion people across the globe rely on biomass for cooking. Although most of these people live in Asia, reliance on biomass is highest in Africa – 80% of people in sub-Saharan Africa rely on biomass for cooking. Although the proportion of people accessing modern cooking fuels is expected to increase, high population growth rates in Africa means the absolute number of people relying on biomass is still expected to increase in coming years, placing increasing strain on biomass reserves.

In previous decades, the motivation to improve the efficiency of cooking was driven by environmental concerns – deforestation and global warming. More recently, we have begun to understand the impact of cooking on health, especially for women and children. 4.3 million people die worldwide from illnesses linked to cooking with solid fuels (most biomass). Diseases include stroke, heart disease, chronic obstructive pulmonary disease (COPD), pneumonia, and lung cancer.

Another hazard associated with cooking include fires and burns; burn deaths are estimated at 300,000 a year globally. Densely populated slum areas are particularly vulnerable to fires caused by spilt fuels, because construction materials are not fire resistant, and because they lack access routes for fire engines.

Extensive use of biomass in urban areas results in deforestation of neighbouring areas. Then suppliers have to travel further to source charcoal, and prices increase. Burning biomass, especially on open fires and inefficient stoves, produces greenhouse gases that contribute to climate change at a global level.

Potential Solutions

The ESMAP 2015 report gives a helpful typology of clean cooking solutions:

- Improved cooking solutions – modern fuel cookstoves, renewable fuels, improved and advanced biomass cookstoves.
- Clean cooking solutions – appliances with low total emissions (ISO Tier 3-4)
- Modern fuels – LPG, natural gas, kerosene, electric stoves

Image © Ar Livre

Case study:

The Wonderbag

The Wonderbag is just a well insulated bag. Food is brought to the boil and cooked as normal for a few minutes. The pan is then transferred to the Wonderbag, where heat retained in the pan and the food completes the cooking

Wonderbag claims that using a Wonderbag over a year can save:

- 1.7 trees
- 1,000 litres of water (through reduced evaporation from the pan)
- $36 of disposable income
- 1,200 hours spent collecting firewood
- 1 ton of carbon emissions.

The company's mission is to get 100 million Wonderbags into homes across the globe.

If you buy a Wonderbag from a developed country, you pay twice the price, so another bag is donated to the Wonderbag Foundation, which distributes bags along with appropriate training to families in developing countries. Wonderbag use Facebook campaigns to raise awareness and drive sales in the USA.

A number of multinational companies have teamed up with Wonderbag and 'bought' large numbers of bags that can be distributed in innovative ways. Genel Energy (Iraq) donated 2,500 bags that were distributed in Somaliland in 2014. In 2011 Unilever bought 100,000 bags that were given away as a free gift with purchases of a Unilever curry powder product.

The Wonderbag was awarded a VCS (Voluntary Carbon Standard) certificate by Germanischer Lloyd Certification GmbH. This means the carbon savings from using a Wonderbag have been confirmed, enabling Wonderbag to enter into partnerships with other companies that want to buy carbon credits on the international carbon market.

Image© Guardian.co.uk

- Renewable fuels – ethanol and other plant based liquids / gels, biogas, solar (including solar electric), retained heat devices.
- Improved cookstoves (ICS) biomass appliances offering better thermal efficiency that traditional technologies
- Basic Chimney ICS (also known as 'legacy' cookstoves)
- Basic portable ICS -unvented stoves e.g. ceramic jiko.
- Intermediate ICS – have some design feature to improve thermal efficiency and may be either unvented or combined with chimneys.
- Advance cookstoves (ACS) – fan assisted or natural draft biomass gasification cookstoves achieving reduced emissions (but still poorer than modern fuel cookstoves).

Rather than focusing on efficiency of combustion, there are a range of cooking appliances that focus on efficiency of cooking. For example, rice cookers tend to be low power yet highly insulated to minimise energy consumption.

The best type of cookstove depends on what your priorities are. Much of the early work on improved cookstoves focused on thermal efficiency but health, climate change, deforestation, and fire risk have all been mentioned as important factors. The 2012 International Workshop Agreement Guidelines for evaluating cookstove performance laid down performance standards so that appliances could be 'scored' (from Tier 0 (worst) to Tier 4 (best)) according to four aspects of performance: efficiency, indoor emissions, total emissions and safety.

Many improved cookstoves provide only limited health benefits. Modern and renewable fuels and gasifier stoves can provide both health and environmental benefits, but renewables are the only options that provide completely clean cooking solutions (zero environmental emissions).

The Case

Charcoal and, to a lesser extent, wood are the cooking fuels of choice in urban areas of sub-Saharan Africa. As urban populations increase, so does demand for charcoal, and annual production has been increasing steadily. It is widely recognised that the current trajectory is not sustainable.

The industry could become sustainable if wood were harvested from woodlots where new trees are planted to replace cut trees. It is possible to get Forest Stewardship Council (FSC) certification for charcoal, but this is a time consuming process. The reality is that consumers do not regard local deforestation as a problem, so there is no demand for sustainably sourced charcoal.

Any form of improved cookstoves that reduce biomass consumption will play a part in slowing the rate of increase in demand for charcoal, and therefore, the rate at which local deforestation takes place. They will also help reduce CO2 emissions, and their impact on global warming. Where biomass is sourced from managed woodlots, new growth absorbs the CO2 released by burning biomass. Note that there is a timelag here, meaning that CO2 is released on the day it is burnt, but it then takes several years for a growing tree to absorb an equivalent amount of CO2, resulting in higher levels of CO2 in the atmosphere, even if it is a temporary state of affairs.

Smoke from biomass stoves is estimated to cause over 600,000 deaths a year in sub-Saharan Africa, and almost half of these are among children under 5. As well as the economic cost at the household level from losing a breadwinner, there is a cost to a national economy due to lost productivity associated with deaths and disease. This is estimated to be up to US$12 billion a year across all of sub-Saharan Africa.

There is emerging evidence that people using improved stoves are still exposed to unsafe levels of particulates. This is due to two effects – firstly, people remain exposed to smoke from neighbouring houses, and secondly, only the highest quality forced draught appliances perform within the WHO guidelines for particulates.

Data on the amount of cash people spend on biomass fuels is not terribly reliable, but the total expenditure on biomass cooking fuels across sub-Saharan Africa has been estimated at US$12 billion in 2010, and is predicted to rise to US$29 billion by 2020. A good deal of this expenditure could be saved by using improved biomass cookstoves. Modern fuels tend to be more expensive, so a shift to modern fuel appliances might not necessarily result in any cost savings to the household.

One of the opportunity costs of cooking with solid fuels discovered by the World Bank was the economic costs associated with wasted time – both in collecting fuel, and slow cooking times of basic ICS. This was estimated at US$30 billion across sub-Saharan Africa. Note that this is almost three times the amounts actually spent on fuels! These figures are based on loads of assumptions, but the principle remains that improved efficiency of cooking can potentially release people (mostly women) to spend more time making money.

At a household level improved cookstoves save

money. The amount of money they save depends on how they are used (e.g. how many people are in the household, how often meals are cooked). Nevertheless, one study suggests that low cost charcoal stoves ($5 - $10) can have a simple payback period of less than four months. More expensive stoves can have payback periods within two years. And this is on top of the health, convenience, and safety benefits. So, if these stoves easily pay for themselves; then why are they not universally adopted? The answer may lie in resistance to changing cooking behaviours, or access to finance.

Potential for Rollout

Urban residents pay more for cooking fuels: Overall, households spend roughly 7% of their total expenditures on fuels (for both cooking and lighting - it is not possible to disaggregate the two). Urban households pay 30% more than their rural counterparts. Poorer households generally pay a higher proportion of their household expenditure on fuels. Expenditure tends to be highest among urban slum dwellers, who spend up to 25% of household expenditure on fuel. The price of improved cookstoves ranges from around $15 – 70 depending on design and quality. High initial price is often quoted as a barrier to adoption. This presents a real opportunity in urban areas, where almost all people pay at least something for their cooking fuels, even woodfuel, because fuel savings have a direct cost saving.

Fuel price trends: Charcoal prices are only going to rise, primarily due to increasing pressure on local forests. Increasing charcoal prices will reduce the payback period on buying improved cookstoves. In the long term, the price of oil related fuels (including LPG and kerosene) is also likely to increase, but at a slower rate. This will similarly reduce the payback period associated with changing to modern cooking fuels.

Donor support: Recognising the impact of unsustainable cooking practices, there is huge support for clean cooking initiatives from the international donor community. At the end of the last decade there were over 160 programmes promoting ICS, promoting different designs, different financial mechanisms, and supported by different donors. Launching of the GACC by Hilary Clinton in 2010 gave the improved cookstove business a boost to its image, and helped bring cookstoves (and cooking) back into development dialogue. The GACC also introduced serious targets – adoption by 100 million households by 2020. Although many governments have introduced energy policies and electrification targets in particular, targets are rarely set for improved cooking.

Size of the market: Just over one third of cookstoves in rural areas of Africa were estimated to be 'clean' (using gas, electricity, renewables, or advanced cookstoves), and stove markets are growing strongly. Sales of basic and intermediate biomass stoves are growing fastest, whereas growth in LPG and electricity stove numbers is slower – these are more susceptible to country specific policy such as fuel subsidies and quality of the electricity grid.

Manufacturing capacity: The vast majority of cookstoves are made by individuals in the informal sector. They tend to have little or no formal training, and use local materials such as clay and sheet metal. Quality control is almost completely absent. At the other end of the market, recent years have seen the advent of a small number of international organisations offering high cost, high quality products. Organisations are headquartered in US/Europe, with local offices across Africa. Manufacturing and assembly can be split between US/Europe, China, and local factories, depending on local manufacturing capability (and economics). These organisations face difficulties in distributing products to disparate and low density markets.

Implementation Barriers

Unwillingness to pay premium for ICS:

In rural areas people may gather woodfuel at no cost, so there is no cost saving associated with using an improved cookstove. Traditional gender dynamics mean that the value of women's time saved in fuelwood collection is rarely recognised, and neither is reduced exposure to health and safety risks. However, in urban areas, most people pay for their fuel, even paying something for wood.

Research and pilot programmes suggest there is a substantial minority of people who are not interested in adopting improved stoves, and modern fuel appliances, irrespective of the price. This suggests that, for some people, issues related to behaviour change are acting as barriers rather than financial barriers.

High appliance prices: The highest quality appliances are manufactured overseas and imported to Africa. Manufacturing costs in overseas countries such as the USA are high, and import duties make retail prices still higher.

Case Study: Kenya Ceramic Jiko

The Kenya Ceramic Jiko (KCJ) is a simple, low cost design of charcoal cookstove. It comprises a bowl shaped liner made of fired clay, set inside an hour glass shaped metal casing, with a thin lining of cement between the two. It may have triangular brackets that fold down over the clay liner to support smaller pans above the fire. The design originated in some of the early research into improved stoves in the 1970s.

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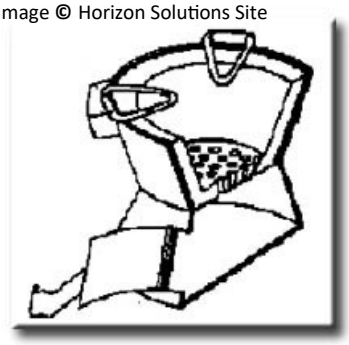

The KCJ was originally made by Jerri International, a formal private sector company with centralised production. Stoves were relatively expensive, at $15 a piece. A little later, the manufacturing process was decentralised in order to take advantage of the reach and number of local artisans already involved in the manufacture of traditional, metal stoves. They were taught how to make the metal casings, and to assemble the stoves. Local potteries were able to make the ceramic liners. This brought the price down to around $3. Increased competition from local artisans on brought costs down, but also encouraged some artisans to cut costs by using inferior materials.

The stove is partially recyclable. The ceramic liner tends to wear out, so old stoves can be traded in to artisans who can then repair the metal casing, fit a new liner, give it a new coat of paint, and resell it.

The KCJ was most popular among urban households, who pay for their charcoal. The KCJ can reduce fuel use by 30-50%. Its success is credited to these cost savings, especially due to continually increasing charcoal prices.

The KJC was promoted by the Kenya Energy and Environment Organisation (KENGO), starting in 1982. Since then it has evolved through the efforts of a range of international organisations such as CARE, UNICEF, USAID, GTZ. The KCJ has flourished through the private sector. No manufacturer has received subsidies; support was channelled through training of artisans and awareness campaigns.

Although the KCJ remains most popular in Kenya, similar designs have been transferred to other African countries, especially in East Africa.

Some companies are addressing this by importing components and assembling in country, then progressing to manufacturing as many components as possible in country. The success of this depends on the manufacturing capabilities available locally, as well as quality control processes.

Local small enterprises tend to struggle to access capital to develop their businesses, and face high interest rates if successful, which pushes up prices for consumers.

Poor quality appliances: There are problems with people selling counterfeit versions of high quality stoves, but of greater concern to most consumers are people selling badly made local designs using poor quality materials. These appliances will not last long, and may not even deliver an improved performance. Every bad consumer experience makes it more difficult to successfully promote improved cookstoves.

Some countries such as Kenya are introducing performance and quality standards, based on efficiency, emissions, and safety. They are also setting up centres with skills and equipment to carry out certification. These need to be accompanied by labelling schemes, and awareness campaigns that inform consumers on how to understand the labels. However, certification is costly, which presents yet another barrier to small enterprises making low cost appliances.

Tradition: People often give a number of socio-cultural reasons why women are reluctant to adopt improved cookstoves. One example is the flavour that smoke fires allegedly impart to the food, which often gives rise to impassioned debate. Research is currently under way to explore some of these types of issues. Changing behaviour depends on good design (taking into account more than just technical considerations), and consumer awareness.

Awareness of health hazards: People tend to be quite highly motivated to shift away from burning wood because the smoke is really unpleasant – it is thick, has a strong smell, and stings the eyes. However, they are less inclined to shift from charcoal to modern fuels because charcoal, once lit, it does not appear to produce any smoke at all. People need to be made aware of the health hazards associated with burning charcoal, which produces pollutants well above the WHO air quality guidelines.

Women: Women are the dominant users of cookstoves, so it makes sense to involve women in all stages of the value chain. Designs will be more appropriate if user-centric. Women entrepreneurs can be involved in the manufacture, distribution, and repair of appliances – they can make better sales people. Women, and local champions in particular, can raise awareness within their own communities.

Charcoal industry: Charcoal is an important sector in national economies, employing 7 million people across sub-Saharan Africa, and estimates suggest this figure should be doubled when including the fuelwood sector, making it possibly the highest source of employment among all economic sectors. Charcoal is an important way of keeping out of poverty.

Implementation

Awareness campaigns: Many people are not aware of the health risks from burning biomass. Women may be acutely aware of the unpleasant smell, and stinging eyes caused by wood smoke, but they may not be aware that charcoal stoves also produce harmful levels of pollutants. More importantly, men need to be made aware of the benefits of ICS, as they tend to be decision makers regarding household purchases.

Small business support: Financial and technical support for cookstove manufacturers is more a responsibility of national government. There may be some ways in which municipalities could support local retailers and suppliers to ensure that products are available in local markets.

Consumer Finance: If upfront cost of cookstoves is a problem for consumers, then there is scope for working with microfinance organisations to provide the kind of microloans needed to enable households to make these purchases. Municipalities may be able to play a role in brokering such partnerships.

Case Study: International standards

Consumers are faced with a confusing choice of cookstoves, all of variable quality and durability. How do they know which is best?

In 2012 Guidelines for evaluating cookstove performance were published. This international agreement was on a path to comprehensive cookstove standards. ISO Technical Committee 285 has since been set up, and is working, with the aim of publishing an International Standard.

Technical Committee 285 now comprises experts from 36 countries and 8 international organisations. A meeting in Kenya in 2014 set up the following 4 Working Groups and 2 Task Groups: Harmonized Laboratory Protocols, Conceptual Framework for Testing, Guidelines for Field Testing, Social Impacts, Fuels Task Group and Communications Task Group.

The standard addresses 4 indicators: efficiency, indoor emissions, total emissions and safety.

A stove is allocated a tier for each of these indicators, where Tier 4 is the highest performance, and Tier 0 is the poorest.

GACC's key milestone is "100 million households adopting clean and efficient stoves and fuels by 2020". But what do they mean by "clean" and "efficient"? Their answer refers directly to these standards:

"Stoves/Fuels that meet Tier 2 for efficiency or higher will be counted as efficient;

Stoves/Fuels that meet Tier 3 for indoor emissions or higher will be counted as clean, as it relates to potential health impacts; and

Stoves/Fuels that meet Tier 3 for overall emissions or higher will be counted as clean, as it relates to potential for environmental impacts."

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Supporting Sub-Saharan Africa's Municipalities with Sustainable Energy Transitions