

Energy access among the urban poor in Kenya

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The primary objective of the study is to carry out an assessment of the current status of modern energy supply among the urban and peri-urban poor in Kenya and to identify viable policy options that can assist in providing cleaner and more sustainable energy services to the rapidly growing urban population in Kenya. The study also assesses prevailing energy policies that address the challenges associated with supply of modern energy services to the urban poor. The study focuses on the example of energy consumption patterns of urban poor households in Kibera – often said to be Africa's largest slum – and the trends in energy use among small and medium enterprises (SMEs) in the area, providing an empirical basis for key findings of the study.

The findings of the household survey clearly demonstrate the role that kerosene, electricity, biomass and LPG can play in cooking and lighting in low-income areas such as Kibera, Nairobi. According to the survey findings, kerosene is the most important modern energy option for the poor for both lighting and cooking. Electricity also appears to be a relatively important energy option. Biomass in the form of charcoal and LPG appear to be consumed by a relatively small segment of the urban poor in the selected sample area. The results of this survey largely reflect the situation at the national level.

The study concludes by presenting central issues related to identified key energy options for the poor in Kibera (kerosene, electricity, biomass and LPG) and presents policy measures that could enhance modern energy services among the urban poor.

Key-words: urban poor, energy access, Kenya, Africa, kerosene, electricity, biomass, LPG, households, SMEs

1. Introduction

It is estimated that 40 % of Kenya's population is urban and nearly half of the entire population will be urban by the year 2020 [GoK, 2007; GoK, 2008]. Rapid growth of the country's urban population has led to rapidly growing demand for energy services, in particular, electricity, refined petroleum products and biomass. This often results in acute shortages and steep increase in prices.

The distribution of urban and peri-urban income in the country shows a large disparity between the poor and the non-poor. According to the government's definition, anyone with an income below Ksh. 2,913 (roughly (US)\$ 42, US\$ 1 = Ksh. in November 2006) per adult per month in urban areas is considered to be poor [GoK, 2007]. According to this definition, about 34 % of the urban population are considered poor and live below the poverty line. Poverty levels, which have a direct correlation with type and quantity of energy used, play a vital role in the access to energy services among the urban and peri-urban poor. Using the \$ 2 per capita per day threshold, about 80 % of the population in urban and peri-urban areas can be considered poor. If the \$ 1 per capita per day threshold is used, then about 49 % [GoK, 2007] of the urban population live below the poverty line. It is predicted that the proportion of urban population that is poor would increase in line with population growth [GoK, 2007].

The urban poor are expected to increase as the agricultural sector, which is the main source of employment and livelihood for the majority of the rural population, cannot meet the employment and aspirational needs of a young and growing population. This will accelerate rural-urban migration [GoK, 2005; 2006; 2007; 2008]. As Figure 1 shows, the proportion of the urban population has been growing over the decades.

Data on the government expenditure provides some evidence that a larger proportion of government financing, subsidies and international development aid is aimed at developing modern energy infrastructure (mainly electricity) that largely serves the needs of the urban-based formal sector, commercial and industrial sectors and medium- and high-income urban and peri-urban households [GoK, 2000; 2001; 2002; 2003; 2004; 2005; 2006; 2007]. Energy services for the poor in urban and peri-urban areas are not a high priority on the development agenda.

In spite of limited access to modern energy services, in comparison to the rural poor, the urban poor tend to carry out activities that are often more modern energy-intensive than their rural counterparts, both at the household and small and medium enterprise (SME) levels. These energy-intensive activities include:

1. domestic enterprises such as laundry services;
2. food kiosks;

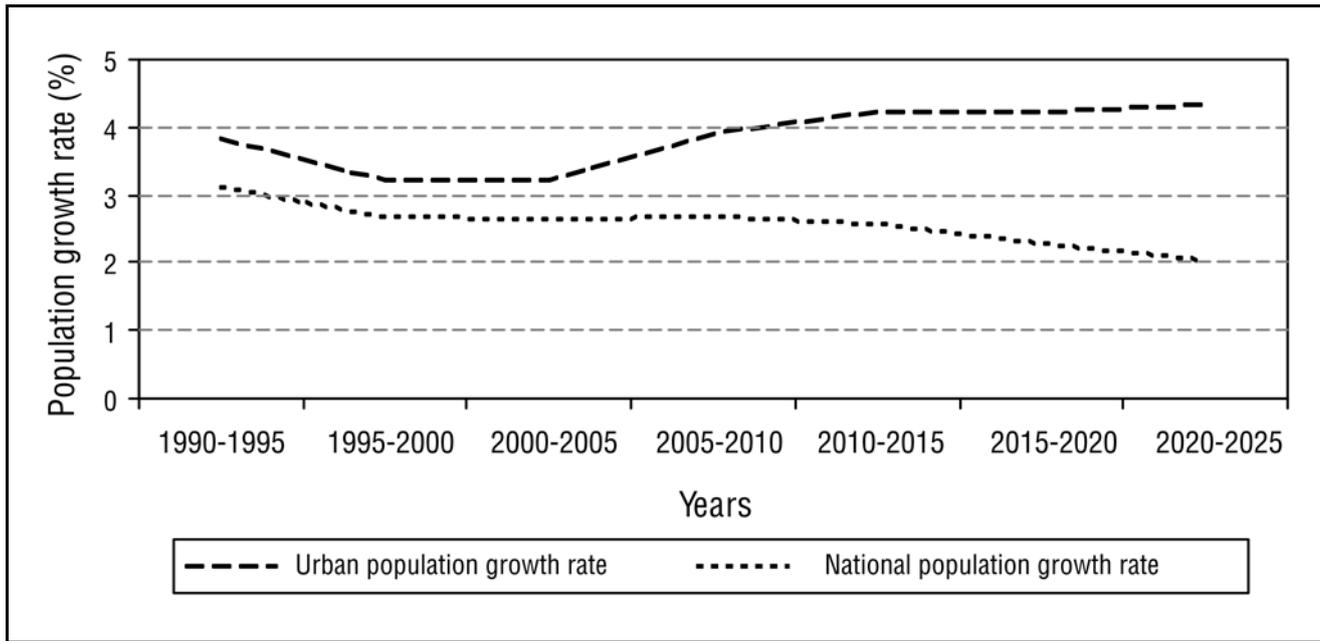


Figure 1. Urban and national population growth in Kenya (1990- 2025)

Source: WRI, 200

3. food vending;
4. welding and carpentry workshops;
5. garages; and
6. car washes.

2. Energy sector – background

The key available energy supply options in Kenya include biomass (wood fuel and charcoal), petroleum, electricity (hydropower, wind, geothermal) and to a small extent, coal. Like in most sub-Saharan African countries, biomass dominates the country’s energy supply. Figure 2 shows the contribution of the aforementioned energy sources to the national energy supply.

On the demand side, the energy consumption sectors include residential (households), industry, transport, agriculture and forestry, commercial and public service, and other sectors. Figure 3 indicates that the residential sector is the largest energy consumer followed by the transport sector.

2.1. Biomass

In most urban areas in Kenya, biomass energy is mostly used in the form of charcoal. Urban households like charcoal because it does not produce a lot of smoke and its calorific value is twice that of wood and it therefore lasts longer, especially when used with improved cookstoves. Charcoal is considered to be relatively affordable, economical and convenient. Charcoal is sold, on average, at about \$ 5 per 36-kg bag.

2.2. Kerosene

Kerosene is the most common fuel among poor urban households, who use it for cooking, lighting, and water-heating. It is also used in the formal sectors of the economy for industrial and commercial purposes. Kerosene is popular among the urban poor because they consider it quick and easy to use.

2.3. Liquefied petroleum gas (LPG)

In the urban areas of Kenya, LPG is used as a supplement

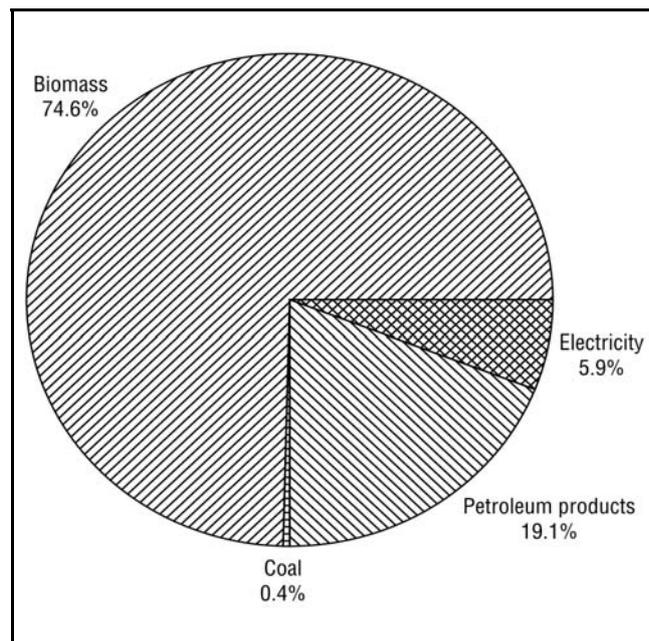


Figure 2. Energy supply by source in Kenya

Source: IEA, 2007

to electricity (among those who can afford it), kerosene and charcoal. In spite of the high upfront cost of LPG (for cylinders and appliances), its penetration has recorded some significant level of success, albeit among the middle- and high-income urban households. About one-third of the urban residents in Kenya use LPG as a source of energy [MoE, 2002]. LPG is provided in cylinders of sizes ranging from 3 kg to 15 kg for domestic applications, with the smaller cylinder sizes (3 kg and 6 kg) being the most common sizes among the urban poor such as those living in Kibera, a Nairobi slum that is often said to be Africa’s largest. LPG is mainly used for cooking, lighting and, to a lesser extent, for heating water.

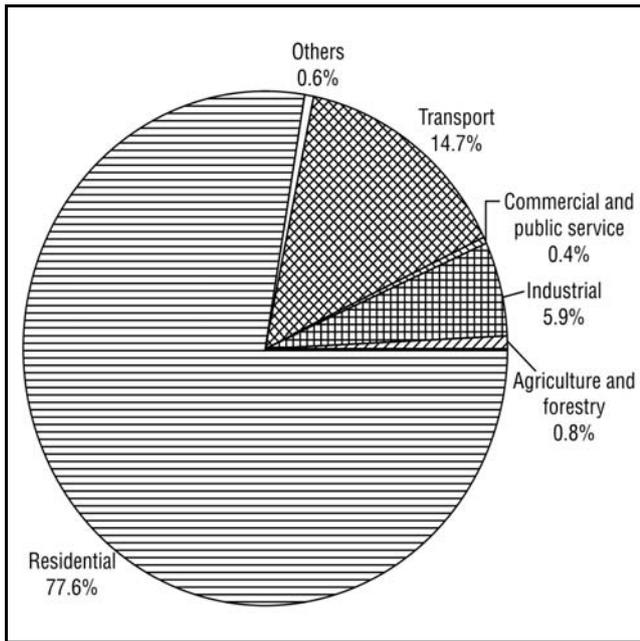


Figure 3. Energy consumption by sector in Kenya

Source: IEA, 2007

2.4. Electricity

Grid-based electricity registers the lowest level of access among the urban poor. There are several factors that hamper access to electricity among the urban poor population. Chief among them is the high upfront cost of components such as meter boards, circuit breakers and cabling.

3. Objectives, methodology and scope of study

The principal objectives of this study included the following:

1. assessing modern energy services available to the urban poor;
2. identifying the cost of energy services; and
3. identifying subsidies offered and policies for promoting energy access for the urban poor.

The study was a combination of both desk research and primary data collection. In 2007, a data and statistics compilation exercise was carried out to gather relevant data pertaining to the study. Supplementary secondary data was obtained from an extensive review of literature such as energy policy documents, energy acts and other relevant publications with related material or information on urban energy. Primary data was obtained from a 2004-2005 survey in Kibera, the selected area of study and an area that is largely inhabited by the urban poor.

The scope of the study was to provide a brief assessment of key urban and peri-urban energy access issues in Kenya. The study paid special attention to the extent to which clean modern energy services are available to the urban and peri-urban population, particularly the poor in Nairobi city. The city of Nairobi was selected as it is the largest city, not only in Kenya, but also in East Africa as a whole. Nairobi's population is estimated at about 3 million [UNEP, 2007]. Nairobi is one of the largest cities in Africa and has a high population growth rate. Nairobi has established itself as a prominent city, both politically and economically, and is home to several leading multina-

tional companies and international organizations, making it a regional hub for business [GoK, 2007].

UN Habitat estimates that over 60 % of the population of Nairobi stay either in the slums or in informal settlements around the city [Adopt-A-Light, 2008]. These cumulatively account for only 5 % of the total land area of Nairobi [Warah, 2001]. Kibera is the largest slum in Nairobi and often said to be the largest in Africa. The estimated population of Kibera alone accounts for about a third of the population of Nairobi. Consequently, Kibera is the largest informal settlement in the country. It has a very cosmopolitan population consisting of people of different regional backgrounds and ethnicities. The majority of the population of Kibera are poor and live below the \$ 1 a day threshold. The energy use and demand patterns of Kibera's households largely revolve around household energy end-uses such as cooking and lighting, as well as energy services for home-based commercial and productive activities in SMEs [AFREPREN/FWD, 2004].

Kibera was an ideal location for the study for the following reasons.

- It is the largest slum where the urban poor live, hence findings here would be, in many respects, indicative of the situation among the urban poor.
- It is within very close proximity to the AFREPREN/FWD offices.

There are several key challenges that were faced in the course of the study. These included the following.

1. Small number of survey respondents. The survey sampled a total of 113 households. Therefore, the findings are only indicative and may not be a true reflection of energy access among the urban poor either within Nairobi or at the national level.
2. Limited resources. The time and financial resources allocated for this study were not sufficient to sample a much wider population of the urban poor to include other slum areas of Nairobi.
3. Limited coverage in literature. There have been very few energy studies that have been carried out on Kibera, therefore secondary data and information sources were unavailable for cross-checking the data for consistency and accuracy.
4. Lack of trust. Primary data collection was an important mechanism for obtaining key information. However, not all respondents were comfortable with providing information as they were unsure what the information would be used for. Other respondents found it difficult to take time off to respond to the questionnaire.
5. Respondent fatigue. Kibera is an area that interests a large number of researchers. Therefore, the residents of this slum area appear to be tired of too many research surveys including several opinion polls for the 2007 general elections.
6. Insecurity. Kibera is a high security risk area, hence difficult to conduct interviews in without fear of intimidation. This was compounded by the post-election violence of January 2008 which rocked the slum area, making it hard to conduct surveys in the locality.

The survey identified four energy options for assessment,

Table 1. Estimated expenditure on energy by urban poor households

Fuel	Unit cost (\$)	Estimated monthly consumption	Monthly cost (\$)
Electricity	0.08 per kWh	24 kWh	4 ^[1]
Charcoal	0.14 per kg	~36 kg	5
LPG	13 per 6 kg cylinder	1 cylinder	13
Kerosene	0.85 per litre (l)	10 l	8.5
Combination of fuel use	Total monthly cost (\$)	Urban poor monthly earnings (\$)	Energy expenditure as %age of income
Electricity and charcoal	9	42	21
Electricity and kerosene	12.5	42	30
Electricity and LPG	17	42	40

Note

1. Inclusive of standing charge, fuel and foreign exchange adjustment

namely: biomass energy, kerosene, liquefied petroleum gas (LPG) and electricity. There are several reasons for selecting these energy options for further analysis. The requisite infrastructure for the promotion and use of these energy options is already in place. For example, in Kibera, there are several transmission and distribution lines passing overhead that can be tapped for electricity distribution. Charcoal, kerosene and, to a lesser extent, LPG appear to have elaborate energy distribution networks in Kibera.

Although the distribution network of LPG is not as extensive as that of the other three energy options, it appears to be adequate. Most LPG users in Kibera indicated that they need to travel a maximum of 1 km to refill their cylinders.

The four fuels are appealing to the urban poor as they are relatively affordable (if the upfront cost of both electricity and LPG is not considered) in comparison with their average incomes. As of late 2006, the costs of the energy sources were as listed in Table 1.

4. Main analysis and findings

4.1. National Energy Policy

As part of the study, the National Energy Policy document was reviewed in order to identify the relevant policies that are supportive of provision of modern energy services among the urban poor. The National Energy Policy for Kenya was approved in December 2006 and is the main document that provides overall policy guidance to the energy sector in the country. The review of the National Energy Policy document revealed that it contained explicit policy statements that supported energy access for the urban poor. Some of the key statements are highlighted below.

“In light with the low electrification levels and subsequent low consumption of electricity in the country, the Government intends to increase the electrification levels in the country by at least 10 % per annum.”

“In line with the environmental effects caused by deforestation due to excessive logging, mainly in the indigenous forests the Government intends to widely promote the use of kerosene and LPG in households

as alternative sources of fuel, to improve the quality of household energy and mitigate the demand on wood fuels.”

“The ban on charcoal production by the Government seems not to have a major impact as illegal and inefficient charcoal production is still very rife in the country especially in the rural areas. In order to mitigate this, the Government intends to license charcoal production to encourage its commercial production in a sustainable manner.”

“Furthermore, in a bid to further increase biomass energy access in the country, the Government intends to promote public private partnership in biomass energy production, distribution and marketing.”

“The development of a retail network for the supply and distribution of petroleum products throughout the country and establishment of common user storage facilities where they do not exist. This will further widen and increase the distribution network across the country, therefore making petroleum energy more accessible.”

“Lack of an energy storage facility for LPG in the country has greatly hampered the distribution capacity and network in the country. In order to meet LPG demand, the Government intends to construct LPG import handling, storage and distribution facilities all across the country in relation to the rising incomes and demand.”

“The Government’s bid to counter the regional imbalances in the supply of petroleum fuels and to improve the level and pace of socio-economic development in the country; it intends to ensure that there always is adequate supply and distribution of petroleum products all over the country at the least cost.”

The review of the National Energy Policy document also revealed explicit policy statements that appear to be targeting favourable energy pricing for the poor. Examples of such statements are given below.

“Retention of a lifeline tariff, where domestic consumers who use less than 50 kWh of electricity on a monthly basis get a subsidised tariff on their electricity consumption.”

“To make electricity more affordable to the masses of

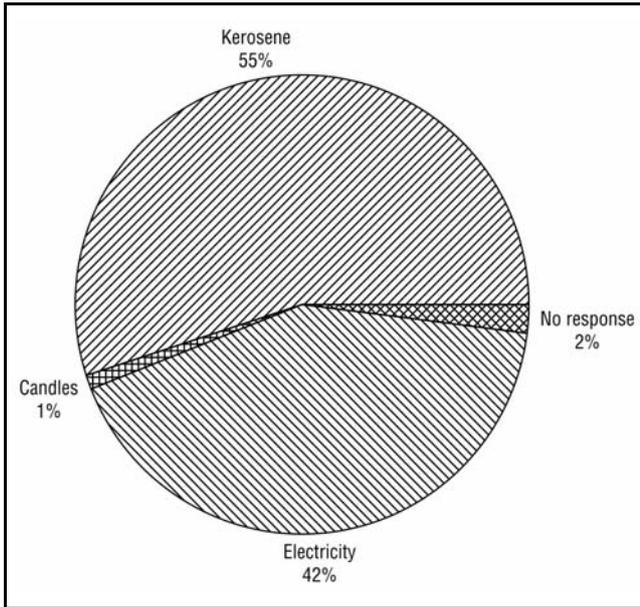


Figure 4. Most commonly used energy options for lighting in Kibera

Table 2. Reasons for using energy options for lighting^[1]

Reason	Kerosene	Electricity
	% of respondents	% of respondents
Cheap and affordable	46	22
Always available	19	49
No electricity or generator	23	-
Convenient	4	24
Has brighter light	2	22
Economical	6	9
Easy to use	7	2
No other source of lighting	17	-
Can be used for both lighting and cooking	2	7

Note

1. Most of the households surveyed made no mention of using LPG or any other energy source for lighting. The total number of respondents does not add up to 100 % because respondents gave more than one reason. Inadequate data was available for use of candles.

the population, the Government removed VAT on electricity consumption of less than 50 kWh per month.” “In line with spreading and disseminating renewable energy technologies to promote their widespread usage in the country, the Government allowed duty free importation of renewable energy hardware.” “Furthermore, in a bid to promote the widespread use of renewable energy technology, the Government provided tax incentives to producers of renewable energy technologies and their related accessories.”

4.2. Survey findings

In overall terms, energy use among households in Kibera can be categorized by two purposes: energy for lighting

and for cooking. For lighting purposes, the survey revealed there are three main energy options utilized among the respondents: kerosene, electricity and candles. For cooking, kerosene, biomass and LPG appear to be the key energy options in Kibera.

For lighting, as Figure 4 shows, kerosene is the predominant energy option. About 55 % of the respondents indicated that kerosene is the most commonly used lighting option in Kibera. While the survey did not capture data on the types of kerosene lamps used, the authors observed that the most common kerosene lamps used are the open-wick types and the wick type with glass enclosure. Pressure lanterns are used by extremely few households in Kibera largely due to their high upfront cost. Electricity is the next most commonly used energy option for lighting and meets the primary lighting needs of about 42 % of Kibera residents. The majority of the light bulbs are the incandescent type mainly because they are cheaper than compact fluorescent lamps (CFLs): incandescent bulbs cost about \$ 1 while CFLs can be purchased for about \$ 3. Candles account for a minuscule 1 %.

Table 2 highlights reasons given by the respondents for choosing either kerosene or electricity for lighting. For both energy options, affordability and availability are key factors taken into consideration.

With regard to cooking, again, kerosene emerges as the predominant energy option. According to the survey findings, nearly 90 % of the respondents indicated kerosene as the most commonly used cooking energy option. Charcoal is the next most popular option but accounts for only 11 % while LPG for cooking is a distant third accounting for 3 %. As was expected, electricity is not a commonly used energy option for cooking among Kibera residents. Figure 5 shows the most commonly used energy options for cooking.

Like in the case of lighting, the study probed the reasons for selecting different energy options for cooking. According to the survey findings (see Table 3), it appears that affordability was a key factor for household preference for kerosene, charcoal and firewood. The next most important factor cutting across all the energy options was effectiveness in cooking a meal fast and efficiently. This is probably linked to the fact that most urban residents are often time-constrained.

The study also assessed the different energy options used by the different kinds of SMEs that employ or are owned by the urban poor in Kibera. These enterprises range from household-based enterprises to fully-fledged and operational workshops, and food-vending enterprises. The SMEs can be classified into two distinct categories: (1) service-based enterprises which include shopkeeping (both wholesale and retail), vegetable- and fish-selling, tailoring shops, garages, electronic repair shops; and (2) production-based enterprises which include carpentry workshops, welding workshops, metal smelting and joinery workshops. These activities, on the basis of the survey findings, are not as energy-intensive as the heavy industrial processes undertaken in the more formal industrial and commercial establishments of the country. The activities

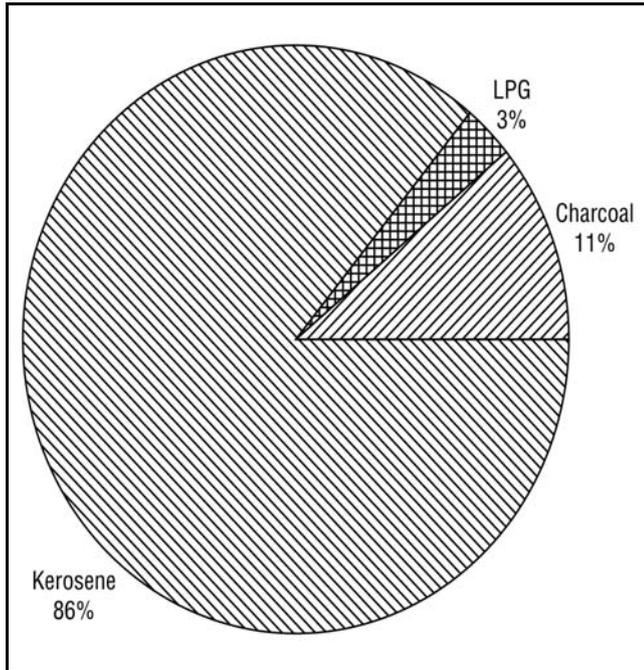


Figure 5. Most commonly used energy options for cooking in Kibera

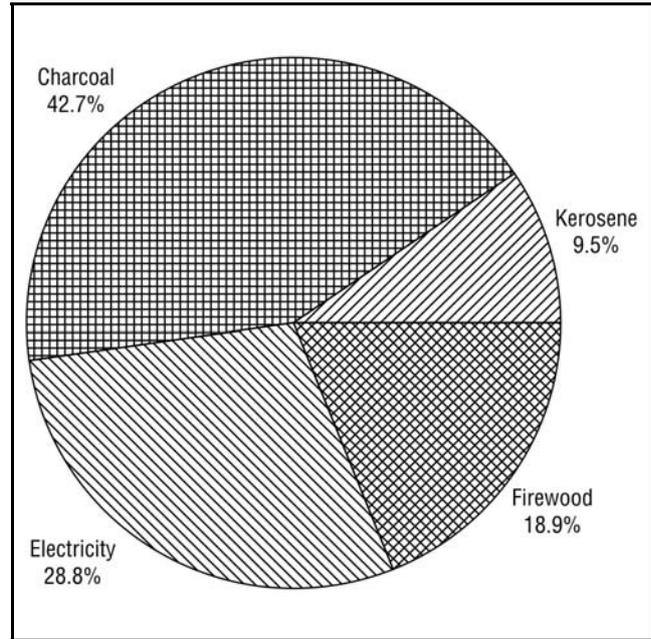


Figure 6. Most commonly used energy options among SMEs in Kibera
Source: Survey for this study

Table 3. Reasons for using energy options for cooking

Reason	Kerosene	Charcoal	Firewood	LPG	Electricity ^[1]
	% of respondents				
Cheap/ affordable	51	49	19	1	-
Fast and efficient	29	12	12	41	33
Always available	14	3	4	7	-
Easy to use	9	2	8	17	33
Economical	8	9	1	7	-
Convenient	8	7	4	1	67
Clean	3	2	-	17	-
Does not smoke	2	2	-	17	-
Lasts longer	3	5	4	3	-
Keeps cooking pots clean	-	2	-	1	33

Note
1. Most of the households surveyed did not use electricity for cooking but merely expressed their perception of the benefits of doing so. However, the few households that used electricity for cooking (but not as the main energy option for cooking), either had illegal connections or only used it for quick cooking work such as making tea or for heating food or water. The total number of respondents does not add up to 100 % because respondents gave more than one reason.

are many and of varied nature. Tables 4 and 5 present the main energy input and principal energy devices used by SMEs found in Kibera.

Energy consumption patterns among SMEs in Kibera differ markedly from those of household energy consumption. Nearly half (42.7 %) of SMEs in Kibera use charcoal, the most commonly used option, compared to only 11 % at household level. Kerosene, which is the most prevalent energy option among households, appears not to be used as much in SMEs (see Figure 6). In addition, use of firewood is not mentioned much in the household survey but nearly 20 % of SMEs use this energy option. Furthermore, there is no mention of LPG use among

SMEs because of its high upfront cost.

The domination of charcoal as the fuel of choice among the SMEs could be attributed to its availability, low cost, economy and the facts that it lasts longer (when used with improved technologies) and that it does not produce a lot of smoke compared to firewood. The relatively low levels of electricity use among SMEs, especially home-based enterprises, is largely due to the high cost of electricity, particularly the upfront cost of connection.

Home-based SMEs with access to electricity can enjoy the subsidized lifeline tariff offered by the utility for electricity consumption below 50 kWh per month. This subsidy is meant to encourage electricity use among the poor.

Articles

Table 4. Service-based activities employing or owned by the urban poor of Kibera

Activity	Main energy input	Energy devices used
Food kiosks	Charcoal, kerosene	Stoves
Small restaurants	Charcoal, kerosene, electricity, gas	Stoves, electric cookers, electric incandescent/fluorescent lamps
Small shops	Kerosene, electricity	Refrigerators, stoves, lanterns, electric incandescent/fluorescent lamps
Laundries	Charcoal, electricity, solar	Flat iron, washing board, electric incandescent/fluorescent lamps
Tailoring	Human labour, electricity	Sewing machines, flat irons, electric incandescent/fluorescent lamps
Beer bars/ halls	Kerosene, electricity	Refrigerators, stoves, electric cookers, electric incandescent/fluorescent lamps
Informal video halls	Electricity	Television, video players, electric incandescent/fluorescent lamps
Taxi service	Petroleum	Petrol and diesel engines
Commercial pick-up transport	Petroleum	Petrol and diesel engines
Vehicle repair	Electricity, gas, human labour	Welding equipment, grinders, compressors
Electrical goods repair	Electricity	Soldering equipment, electric incandescent/fluorescent lamps
Butcherries	Human labour, electricity	Electric incandescent/fluorescent lamps
Tyre puncture repair	Kerosene, petrol	Heaters, petrol-powered compressors

Source: AFREPREN/FWD, 2001

Table 5. Production/manufacturing activities employing or owned by the urban poor in Kibera

Activity	Main energy input	Energy devices used
Metal works	Electricity, gas	Welding equipment, lathe machines, grinders, electric incandescent/fluorescent lamps
Metal household goods	Charcoal, electricity	Heaters
Pottery/ clay products	Human labour, wood	Rollers
Woodwork and furniture	Human labour, electricity	Cutting and planing equipment
Basket making	Human labour	Sewing machines, flat irons
Construction	Electricity	
Grain milling	Electricity, diesel	Electric motors
Paint manufacture	Human labour, electricity	Mixers, electric incandescent/fluorescent lamps
Bakeries	Electricity, human labour	Mixers
Fabric manufacture	Electricity, human labour	Motors
Coffee processing	Electricity, firewood	Heaters, blowers, motors

Source: AFREPREN/FWD, 2001

However, it has a significant limitation as the subsidy is also enjoyed by the non-poor. Furthermore, the majority of the electrified population is non-poor, hence the bulk of the subsidy is captured by this group, which is not the intended target.

The nature of business, to some extent, dictates the kind of fuel used. Only 10 % of production-based enterprises in Kibera rely on the use of charcoal as their main energy source. On the other hand, service-based enterprises, which are the most prevalent in the area and not as energy-intensive, rely largely on charcoal. An estimated 86 % of these enterprises consume charcoal as their pri-

mary source of fuel. Some of the service-based enterprises such as hair salons and barber shops mentioned that they use electricity for their daily operations. Very few other SMEs mentioned that they used electricity for their daily operations.

A detailed analysis of the biomass use in one food kiosk was carried out for the duration of one week in the course of the survey to determine the energy consumption patterns of the SME. It established that on average, the food kiosk bought 2.5 kg of charcoal per day at a cost of about Ksh. 40 per kg for its operations. This translates to an annual fuel bill of nearly \$ 600.

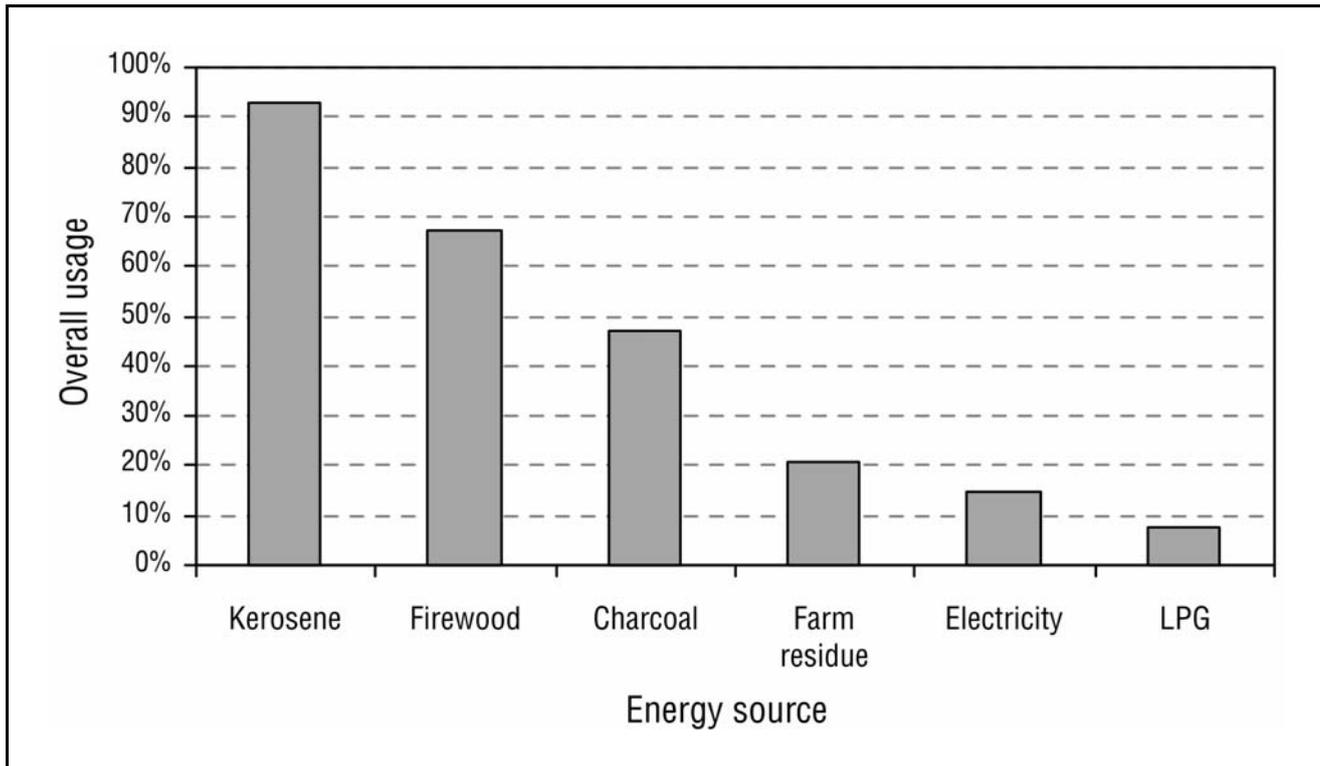


Figure 7. Percentage of households using different energy sources in all of Kenya

Source: MoE, 2002

Kerosene was mainly used by service-based enterprises with a majority of users being food kiosks, laundries and home-based enterprises, and they mainly used it for cooking, heating water and provision of light. Although the cost of kerosene is high (the price of kerosene is linked to the world oil price), the consumption of kerosene among SMEs in Kibera is relatively high. However, Kibera has an extensive and highly sophisticated kerosene distribution system that can deliver kerosene in very small quantities which are commensurate with the very low daily incomes of the urban poor.

In relation to the gender of business owners, most of the businesses were female-owned, accounting for nearly 70 % of all businesses surveyed. Charcoal was mainly used in the female-owned businesses because most of these businesses were related to food preparation.

Only a very small percentage (less than 1 %) of the SMEs that the study surveyed used LPG for their operations. The use of LPG in the SMEs is mainly centred on cooking and provision of light. The main reasons given by the SMEs for the use of LPG were that it cooks faster, and it can be used both for lighting and cooking.

The household survey findings clearly demonstrate the role of kerosene, electricity, biomass and LPG in meeting the energy needs of the urban poor of Kibera in Nairobi. To summarise (see Figure 7), kerosene is the most important modern energy option for the poor both for lighting and cooking. Electricity also appears to be a relatively important energy option. Biomass, primarily charcoal, and LPG appear to be consumed by a relatively small segment of the urban poor in Kibera.

The results of this survey largely reflect the situation

at the national level. For example, a national survey conducted in 2002 by the Ministry of Energy [MoE, 2002] revealed that kerosene is, in overall terms, the energy source used by the highest percentage of households – a finding confirmed by the Kibera survey. In addition, like the Kibera survey, the Ministry of Energy's survey also found LPG to be the energy source used by the lowest percentage of households (see Figure 7).

There are, however, some major differences between the findings of this study and the situation at the national level. These differences largely arise from the variance in energy consumption patterns between rural and urban households and the extent of development of energy supply chains in rural and urban areas. For example, the main fuel for cooking is fuelwood in rural areas, while kerosene is the main cooking fuel in poor urban households, largely reflecting the excellent kerosene supply chains in urban areas in contrast to the poor kerosene supply network in the rural areas.

Table 6 summarizes the key survey findings in Kibera highlighting the reasons for use of the various different energy sources and the issues raised related to each fuel. The table also includes the authors' comments and observations on problems and the response options to the problems in relation to each energy source.

5. Barriers to wider use of various energy options

To sum up, this section discusses the barriers to the use of the identified energy options, namely kerosene, electricity, biomass and LPG. There are other challenges that not only have a direct impact on the use of the aforementioned energy options, but also present serious challenges

Table 6. Summary of key survey findings

Energy source	Reasons for use	Issues related to the fuel (comments from respondents and authors' observations)	Problems/response options (authors' comments)
Charcoal	<ul style="list-style-type: none"> • Cheap and affordable when bought in bulk • Easily accessible • Easy to use • Economical • Convenient • Lasts longer (when used with improved stoves) 	<ul style="list-style-type: none"> • Charcoal production is an illegal activity that has not been licensed by the government. • There is a ban on logging that has affected the supply of raw material for charcoal production. • Too costly owing to the small quantities in which it is packaged • Takes too long to light • Health hazard mainly due to the high carbon monoxide emission of charcoal, necessitating use in an open and well-ventilated room 	<p>Problems</p> <ul style="list-style-type: none"> • Illegal logging • Unsustainable production practices <p>Response options</p> <ul style="list-style-type: none"> • Use of energy-saving charcoal cooking stoves • Efficient distribution mechanism for improved cookstoves • Policy for sustainable charcoal production
LPG	<ul style="list-style-type: none"> • Quick and efficient • Easy to use • Clean • Does not produce smoke • Economical • Mostly available • Can be used for both lighting and cooking 	<ul style="list-style-type: none"> • Upfront cost of typical equipment plus the cylinder are too high for the urban poor • Price of the gas (refill) is always prone to high world oil price fluctuation. • Inadequate national storage • Safety concerns • Sale of half-filled cylinders 	<p>Problems</p> <ul style="list-style-type: none"> • Sale of half-filled gas cylinders • Lack of standardized gas cylinders <p>Response options</p> <ul style="list-style-type: none"> • Effective distribution channels • Liberalized petroleum sector • Introduction of 6 kg and 3 kg gas cylinders mainly targeting the poor • Introduction of weighing scales at refilling stations
Kerosene	<ul style="list-style-type: none"> • Cheap and affordable when bought in bulk • Easily available • Convenient to use • Low access to electricity • High cost of electricity • Has dual functions of both cooking and lighting • Easy to use • Economical • Quick and efficient 	<ul style="list-style-type: none"> • Purchased in small quantities from small distributors resulting in high retail price • Traditionally, subsidies provided by the government have also been captured by the non-poor. • Safety aspects related to use and storage 	<p>Problems</p> <ul style="list-style-type: none"> • In the past, shortages of kerosene supply were common. <p>Response options</p> <ul style="list-style-type: none"> • Deregulation of the petroleum industry has seen small-scale kerosene pumping stations opened. These are delivering kerosene in a cheaper and safer way than kiosks.
Electricity	<ul style="list-style-type: none"> • Cheap and affordable (once upfront costs are paid and if used only for lighting) • Always available • Convenient • Easy and convenient to use • Has bright light • Can be used both for lighting and cooking • Quick and efficient • Does not produce smoke • Lasts longer 	<ul style="list-style-type: none"> • Electrification levels among the urban poor are still very low and most of the households connected either acquired electricity communally or through illegal connections. • Electricity connection is still very expensive for the urban poor. • There are sudden and frequent blackouts, making it at times an unreliable source of energy for use both domestically and in SMEs. • Safety of the energy source is a main concern mainly due to high number of cases of electrocution and death caused by misuse of or tampering with the supply. 	<p>Problems</p> <ul style="list-style-type: none"> • Illegally tapping electricity from the supply lines exposing user to potential risks and inefficient use of electricity by not employing energy efficiency and saving measures <p>Response options</p> <ul style="list-style-type: none"> • Use of energy-saving devices at both household and SME levels, avoiding wastage of electricity and employing energy efficiency measures • Introduction of communal electrification programme • Introduction of floodlighting in slums

to the urban and peri-urban poor. These are highlighted below.

5.1. Kerosene

Firstly, there is the problem of kerosene storage in homes. Most of the residents of Kibera normally purchase and store kerosene in soda water bottles. These can easily be mistaken for a beverage and as a result incidents of children accidentally drinking kerosene are not uncommon. Secondly, kerosene being a highly flammable liquid, it is normally not advisable to store kerosene in large quanti-

ties in the house, especially in the typically crowded settings of Kibera, where entire families share one room.

The price of kerosene has been on the rise over the last few years. The main cause is the rising cost of crude oil in the world market. Recently, the world crude oil price rose to a record high of over \$ 140 per barrel. The sharp rise in the crude oil prices has a direct impact on the local cost of kerosene, making it more expensive for a majority of the urban poor population.

Given the importance of kerosene in meeting energy

needs of urban poor households, targeted and time-limited subsidies for kerosene stoves and lamps could expand the kerosene market, widen access among the urban poor, lead to local investment in kerosene stove and lamp manufacture and reduce overall energy costs. It is noteworthy that kerosene lamps do not provide quality light as electric lamps do. However, local manufacture of kerosene lamps could enable, for example, the availability of low-cost wick-type lamps with glass enclosure. Such a development could encourage the use of safer, much better kerosene lighting devices compared to the open-wick type which have poor lighting characteristics and pose a health risk owing to the high levels of smoke emission.

5.2. Electricity

The most significant barrier to access to electricity among the poor is the connection fee. Currently, the minimum electricity connection fee for a household is in the range of \$ 105-225 which covers the cost of meter, distribution conductors and poles. The connection fee excludes internal wiring of the house, circuit breaker unit, circuit breakers and meter box. In addition, a deposit of about \$ 37 is required by the electricity distribution utility. Total upfront cost is in the region of \$ 142-262, equivalent to about 3-5 months' estimated household income in Kibera.

The analysis of the cost of electricity reveals that the actual cost of electricity paid by the consumer includes several components:

- the base electricity tariff;
- value added tax (VAT);
- adjustments for foreign exchange rate fluctuations;
- fuel consumption (and cost) adjustments;
- rural electrification levy; and
- a levy to finance the Electricity Regulatory Board (ERB).

In spite of the base tariff remaining relatively low and unchanged for nearly a decade, over time, as the cost of each of the other tariff components rises, cumulatively, the resultant actual cost of electricity is high, making it unaffordable by a significant proportion of the urban poor population.

Electricity safety has become a major concern among the users in the surveyed area. There have been several incidents of electrocution and electricity-related fires owing to the poor handling of electricity and overloading of electric sockets.

5.3. Charcoal

In Kenya, charcoal production is still considered an illegal activity. Consequently, charcoal is produced in an uncoordinated fashion and using very low-efficiency technologies. This often leads to massive waste of the biomass feedstock, hence accelerating the rate of deforestation.

There are health hazards associated with the use of charcoal. When charcoal is burnt, it produces carbon monoxide. If charcoal is used in a room that is not well-ventilated, it could lead to high concentrations of carbon monoxide. Carbon monoxide is a poisonous gas that can lead to death if it gets into the blood circulation system in large quantities.

Usually, charcoal is relatively low-cost and affordable.

But because the poor buy it in small quantities, it ends up being more expensive in the long run when compared to buying it in bulk, e.g., as a 36 kg sack of charcoal. An analysis of the expenditure on charcoal, shown below, demonstrates that buying charcoal in small quantities can be about 4 times more expensive than buying it in bulk.

Cost of charcoal in bulk (36 kg sack) = \$ 5 per sack

Hence, unit cost of charcoal in bulk = \$ 0.14 per kg

Retail cost of charcoal in 0.4 kg tins = \$ 0.55 per kg

5.4. LPG

Liquefied petroleum gas (LPG) is increasingly seen as an option with significant potential for enhancing access to modern energy services among the poor. However, incompatible LPG cylinders allow oil companies to lock in customers and charge higher prices. If customers could retain the same cylinder and have the flexibility to change LPG suppliers, the cost of LPG is likely to come down.

One of the key barriers to wider use of LPG among the poor is the high upfront cost of cylinder acquisition. Targeted and time-limited subsidies for reducing the cost of small cylinders can expand the LPG market size among the poor and would in time reduce the cost of LPG cylinders through economies of scale.

In terms of safety, there are several concerns linked to the use of LPG. There have been cases of LPG cylinders exploding and causing serious damage to both property and human life. This is mainly caused by misuse of cylinders (i.e., not adhering to the safety standards for use of LPG) and faulty cylinders and valves supplied by the oil companies.

There have also been cases of sale of half-filled cylinders by unscrupulous dealers in the market. This practice in the low-income areas such as Kibera has greatly affected the credibility of the LPG option.

Kenya lacks adequate storage facilities for LPG at both the national and local levels. This at times greatly hampers the supply and distribution of LPG leading to shortages.

6. Recommendations

On the basis of the findings of the survey in Kibera, the study recommends the following.

1. Past pro-poor incentive strategies have been exclusively focused on kerosene. While reduction in tax on kerosene has resulted in motor fuel adulteration, it is believed that if similar incentives were targeted at kerosene appliances, the benefits to the poor would be higher and would minimize the possibility of any diversion to unintended uses. Taxes are a key determinant of the retail price of both kerosene and its related technologies, mainly stoves. Key taxes include import duty, excise duty, value added tax and the petroleum development levy. While kerosene has in the recent past enjoyed tax reduction and/or waivers, this has not been true for its appliances, in particular kerosene stoves. The current taxation on kerosene stoves stands at 35 % import duty and 16 % value added tax, which totals 51 % for imported kerosene stoves. This has made stoves inaccessible to the poor. Therefore, until

local companies and/or SMEs can produce high-quality and affordable kerosene stoves, taxes should be reduced on imported efficient and improved kerosene appliances in order to make them more accessible and affordable to a majority of the population.

2. The subsidized electricity lifeline tariff which is intended for the non-poor appears not to benefit the poor. The bulk of the subsidy is captured by the non-poor. Therefore, a review of the lifeline tariff is required in order to better target the subsidy so as to enhance electricity access for the urban poor. An option would be to use the resources currently directed to electricity subsidies to lower the upfront cost of connection for the urban poor.
3. Since biomass (charcoal) plays an important part in the lives of the urban poor, issues affecting its access and dissemination and use, i.e., the ban on logging and production of charcoal in traditional low-efficiency earth kilns, should be addressed so that it can be produced, promoted and distributed in a sustainable and efficient manner, within the formal economy.
4. Promotion of more sustainable biomass (charcoal) use should be pursued in tandem with improved charcoal production and use of improved cookstoves in order to keep its demand in check. In addition, in the light of some of the safety issues posed by charcoal, as well as forestry conservation concerns, there is need for promotion of other forms of sustainable biomass options such as ethanol gel.
5. Innovative financing mechanisms, or subsidies targeting the poor, should be created and targeted directly to the poor, to enable them to purchase LPG cylinders and the related accessories.
6. A penalty system should be established whereby LPG suppliers are compelled to pay a hefty fine for any

cylinder found to be underweight and for failure to adopt common cylinder regulators/valves. This would instil confidence in LPG among the urban poor. The Ministry of Energy of the Government of Kenya recently published its intention to standardize LPG cylinders in the country – a policy measure that would encourage expanded LPG use. ■

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