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Energy Access among the Urban Poor in Kenya: A Case Study of Kibera Slums

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Abstract

Purpose: The bulk of the population in developing countries is poor and survives on non−commercial energy sources such as fuel wood, agricultural residues or animal dung which are the most easily available and can be gathered at almost zero private cost. The general objective of the study is to carry out a study on energy access among the urban poor; a case study in Kibera slums. The specific objectives were to establish the commonly used sources of energy by households living in kibera slums, to determine the factors influencing the use/adoption of particular energy sources by households living in Kibera slums and lastly to assess the environmental impacts of the use/adoption of particular energy sources by households living in kibera slums.

Methodology: The study used a literature review/desktop research.

Findings and Conclusions: The findings of the empirical review demonstrate that kerosene, electricity, biomass and LPG play an important role in cooking and lighting in low-income areas such as Kibera, Nairobi. According to the 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, charcoal and LPG as sources of energy appear to be consumed by a relatively small segment of the urban poor in the selected sample area services among the urban poor. The paper established that the factor that influence the adoption of various types of energy source include level of knowledge and awareness, level of income of households, and availability of substitute power. Results also indicated that the most obvious environment problems associated with charcoal production and use was the extent of vegetation and forest clearing estimated to range from 0.087 to 1.33 million hectares, depending of the sources of the wood. In addition, heavy dependence on wood for fuel has contributed to the rapid decline of Kenya‟s forests, with negative effects for the local climate, wildlife, water sources and forest dwellers, says the World Rainforest Movement.

Recommendations: The study recommends that Government should establish a dedicated institution similar to the Rural Electricity Authority, with the specific mandate of expanding the urban poor‟s access to modern energy services. As with the rural electrification programme, a levy in electricity and liquid fossil fuels can be a reliable source of finance for urban poor access programme.

Key-words: *Kibera slums, energy access, urban poor, low-income, kerosene, electricity, biomass, LPG,*

1.0 INTRODUCTION

Urbanization, commonly referred to as the increase in the proportion of people living in towns and cities is usually brought about by movement of people from the rural to the urban areas, in search of better living conditions. It usually entails changes both in production and consumption structures which alter energy usage patterns (Bennett, 2008). Urbanisation has been a common characteristic of developing countries and is occurring very rapidly in Kenya (Karekezi *et al.,* 2008).

Currently, Kenya‟s urban population is about 12.5 million which is over 32% of the total population (KNBS, 2010; Kenya Open Data, 2011). By 2050, it is projected that almost half of Kenya‟s population will be living in urban areas (UN, 2010). It is also estimated that 70% of urban population live in informal settlements (CESR, 2008). Nairobi is the capital city of Kenya and one of the most populous cities in East Africa. It is home to nearly a million households and has over 3 million residents (KNBS, 2010a; KNBS, 2010; Kenya Open Data, 2011). As with most Kenyan urban centres, Nairobi is characterized by a large number of slum villages (Adopt a Light, 2009) providing accommodation to the urban poor. It is estimated that 60% of the population of Nairobi stay either in the slums or in informal settlements1 around the city, which cumulatively, account for only 5% of the total residential area of Nairobi (Amnesty International, 2009; Karekezi *et al.,* 2008; Ministry of Housing, 2006; Florence, 2009; Moja Moja, 2012). Over the years the census statistics have always shown Nairobi city‟s population to be on constant upward trend

The study area - Kibera, is one of the slums in Nairobi, with cosmopolitan population due to the common movement of people from all rural areas of the country, for better standards of living. Kibera is one of the largest slums in Nairobi and in Africa in general (Amnesty International, 2009; Karekezi *et al.,* 2008; Mutisya & Yarime, 2011). Kibera houses a significant proportion of Nairobi‟s urban poor in a land area of about 0.5 % the size of the city, approximately 2.5 square kilometres, The majority of the population living in Kibera are poor and live below the USD 1.25 a day threshold (Karekezi *et al.,* 2008; World Bank, 2011). Kibera slum‟s large population density makes it an uphill task in the provision of basic infrastructure and services such as safe water, electricity, health services, and security among other services. The housing structures in the area are in a dilapidated state, they are normally made of mud, timber or metal sheets (Annabel *et al.,* 2007).It is also noted that a majority of the units are single rooms.

1.2 Problem Statement

There is some evidence that a larger proportion of Government financing, subsidies and international development aid is aimed at developing modern energy infrastructure that largely serves the needs of the urban-based formal sector, commercial and industrial sectors and the medium and high income urban and peri urban households. Energy sources for the poor in urban and peri-urban areas is not of a high priority on the development agenda.

Urban electrification levels in the country are still very low. Only 47.5% of the entire urban population (nearly the entire medium and high income population) has access to electricity (World Bank, 2006). The limited available evidence indicates that the situation is worse in low-income urban households and in most peri urban areas. This is particularly troubling since the low-income areas are usually not very far from major electricity transmission and switching stations. Low-income areas are often close to the city centre and are densely populated, thus the associated

transmission and distribution costs of electricity extension are not high. In many cases, the costs are lower than the cost of extending electricity to low-density high-income areas.

In spite of limited access to modern energy sources, the Kibera slums tend to carry out activities that are energy intensive both at the household and SME level. Some of the
energy intensive activities include cooking, lighting, car wash, food vending, food kiosk, space heating, garages and domestic energy enterprises such as laundry services. Despite this, there is limited access for modern energy services in Kibera. This serves as a motivation for the study on energy access among the urban poor and more specifically in Kibera slums.

1.3 Objectives of the Study

i. To establish the commonly used sources of energy by households living in Kibera slums
ii. To determine the factors influencing the use/adoption of particular energy sources by households living in Kibera slums. iii. To assess the environmental impacts of the use/adoption of particular energy sources by households living in Kibera slums.

2.0 LITERATURE REVIEW

2.1 Theoretical framework

The study presents various theories that inform the variables underlined in the current study. These theories include

2.1.1 Rogers diffusion of innovation Theory

A conceptual framework for analyzing adoption of technology patterns is provided by Everett Rogers'(1995) theory of the diffusion of innovations, which defines diffusion as "the process by which an innovation is communicated through certain channels over time among the members of a social system". The four main elements are the innovation, communication channels, time, and the social system. (Rogers, 1995) defines an innovation as an idea, practice or object that is perceived as new by the individual and diffusion as the process by which an innovation makes its way through a social system. For our purposes, the innovation is instructional technology for adopting modern energy, and diffusion is the extent to which all urban poor has adopted this innovation. Because individuals in a social system do not adopt an innovation at the same time, innovativeness is the degree to which an individual is relatively earlier in adopting new ideas than other members of a system.

According to Rogers'(1995) theory of the diffusion of innovations, the factors that influence innovation adoption include;

Relative Advantage; Rogers (2003) defined relative advantage as “the degree to which an innovation is perceived as being better than the idea it supersedes” (p. 229). The cost and social status motivation aspects of innovations are elements of relative advantage. To increase the rate of adopting innovations and to make relative advantage more effective, direct or indirect financial payment incentives may be used to support the individuals of a social system in adopting an innovation. Incentives are part of support and motivation factors.

Compatibility: In some diffusion research, relative advantage and compatibility were viewed as similar, although they are conceptually different. Rogers (2003) stated that “compatibility is the

degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters" (p. 15). A lack of compatibility in IT with individual needs may negatively affect the individual‟s IT use (McKenzie, 2001.

Complexity; Rogers (2003) defined complexity as "the degree to which an innovation is perceived as relatively difficult to understand and use" (p. 15). As Rogers stated, opposite to the other attributes, complexity is negatively correlated with the rate of adoption. Thus, excessive complexity of an innovation is an important obstacle in its adoption

The last characteristic of innovations is observability. Rogers (2003) defined observability as "the degree to which the results of an innovation are visible to others" (p. 16). Role modeling (or peer observation) is the key motivational factor in the adoption and diffusion of technology (Parisot, 1997). Similar to relative advantage and compatibility, observability also is positively correlated with the rate of adoption of an innovation.

Therefore Rodgers theory of the diffusion of innovations can assist in study on energy access among the poor in Kenya.

2.1.2 Theory of Reasoned Action

According to Brown, Massey and Burkman, (2002) the theory states that both attitude and subjective norm are important determinants of people‟s intention to adopt and use technology in enterprises. Further the intention to adopt and to continue using technology is influenced by ones attitude. The theory states that an individual behavior is influenced by his or her behavior`s intention which is influenced by his or her attitude towards behavior of subjective norm (Venkatesh *et al.,* 2000). Behavioral intention measures a person's relative strength of intention to perform a behavior. Attitude consists of beliefs about the consequences of performing the behavior multiplied by his or her evaluation of these consequences (Fishbein & Ajzen, 1975). Subjective norm is seen as a combination of perceived expectations from relevant individuals or groups along with intentions 25 to comply with these expectations. In other words, "the person's perception that most people who are important to him or her think he should or should not perform the behavior in question" (Fishbein & Ajzen, 1975). To put the definition into simple terms: a person's volitional (voluntary) behavior is predicted by his attitude toward that behavior and how he thinks other people would view them if they performed the behavior. A person's attitude, combined with subjective norms, forms his behavioral intention. Fishbein and Ajzen suggest, however, that attitudes and norms are not weighted equally in predicting behavior. "Indeed, depending on the individual and the situation, these factors might be very different effects on behavioral intention; thus a weight is associated with each of these factors in the predictive formula of the theory. For example, you might be the kind of person who cares little for what others think. If this is the case, the subjective norms would carry little weight in predicting your behavior" (Miller, 2005). This theory is relevant to the current study since it will depend on the attitude and behavior of an individual to adopt modern sources of energy.

2.2 Empirical Review

2.3.1 Commonly used sources of energy by households living in kibera slums

Karekezi, Kimani, and Onguru (2008) conducted a study on energy access among 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 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. Though the study focused on the energy accessed in urban area ,it failed to look on the environmental effects of the energy sources thus presenting a conceptual gap.

Ramachandran (1991) conducted a study on Energy for Low-income Settlements in developing countries. The study found out that the bulk of the population in developing countries is poor and survives on non commercial energy sources such as fuel wood, agricultural residues or animal dung which are the most easily available and can be gathered at almost zero private cost. The situation of most urban poor is no better than that of the rural population. Since many slum dwellers and squatters in Africa, Asia and Latin America are rural migrants with inadequate resources, they try to satisfy their energy needs in the same way as they had done in rural settlements: firewood and charcoal are the most commonly used fuels for cooking and heating in the semi rural squatter settlements on the outskirts of large urban settlements. The study recommends that Strategies are, therefore, urgently required for implementation which address the issues of making increased energy available to the rural and urban poor and using available energy efficiently. This study focused on Africa, Asia and Latin America in general but the current study narrows it down to Kibera slums.

2.3.2 Factors influencing the use/adoption of particular energy sources

Ng‟eno (2014) conducted a study on the factors affecting the adoption of solar power technology for domestic power usage in Kenya. A descriptive survey design was undertaken in the study. A stratified random sampling was used to identify a sample and data was collected using questionnaires. A sample of 365 households was studied from a target population of 6733 households. Only 300 household heads responded which represented 82.5% of the targeted population. The findings indicate that the community has not adopted much solar technology with only 32% using solar in the region. the research hypotheses concluding that there was a significant relationship between the level of knowledge and awareness, level of income of households, availability of substitute power source and the adoption of solar technology. The results indicate that the level knowledge and awareness has a positive effect on adoption of solar technology, level of income of households has a negative effect, while availability of substitute power source does not positively influence the adoption of solar technology. This study focused on the factors affecting the adoption of solar power technology for domestic power usage thus presenting a conceptual gap.

Gitonga (1999) conducted a study on Energy Provision for the Urban Poor in Kenya. The study collected both secondary and primary data. The study found out that Although kerosene and

welding gases, acetylene and oxygen, are available, energy supply is facing several constraints. A key constraint is the monopoly of the distribution by the company that supplies welding gases. One has to register with the company and pay a monthly fee even if cylinders are not filled-up, as is common practice in industrialized countries. These requirements increase dramatically the costs. Heath problems associated with the utilization of the various fuels are not listed as a priority although there is a concern about their impact. This might be due to the priority given to energy access at affordable prices. The utilization of electricity is almost nonexistent and gas is a very unpopular fuel for many poor urban dwellers apparently because of the damage that fire can cause to informal structures. However further analysis revealed that cost is the main reason for not using gas. Apart from the lack of income, which is in itself a hindrance to the provision of energy, the absence of property rights limits dramatically energy access for poor urban people. The fact that they live in the informal settlements makes it difficult for them to access to electricity or to use LPG safely as risk of fires is great. This study presents a conceptual gap Farsi *et al.* (2007) find that income is one of the main factors that prevent households from using modern and cleaner fuels in an application for India based on a household expenditure survey. Additionally, they find that the education level and gender of the household head as well as LPG prices impact fuel choice. In contrast to Heltberg (2004, 2005) the authors use the fuel that provides the highest share of total useful cooking energy as the dependent variable and order the fuels in terms of efficiency, comfort and ease of use, strictly in line with the energy ladder.

2.3.3 Environmental impacts of the use/adoption of particular energy sources

Senelwa, Ekakoro, Ogweno and Okach (2005) conducted a study on the Environmental and socio-economic implications of charcoal production and use in Kenya. Surveys of charcoal producers, transporters, vendors and consumers were conducted in Makueni, Kitui, and Machakos, Uasin Gishu and Narok districts; and in two urban centers - Eldoret and Nairobi. The data collected included socio-economic characteristics, charcoal production processes and types of kilns used, problems resulting from charcoal production, charcoal trade, combustion appliances, charcoal quantities and availability. The study found out that the low recoveries of the earth kilns have a negative influence on the profitability and livelihoods of producers, limiting the income generating and social activities. For users, it provides „easily" accessible energy in the form and quantities that are affordable to the majority of the poor even though charcoal use applying the two common appliances (the Kenya ceramic and the traditional metallic stoves) exposed residents to high levels of carbon monoxide emissions (4166–6147 mg/m3) and other products of incomplete combustion. The most obvious environment problems associated with charcoal production and use was the extent of vegetation and forest clearing estimated to range from 0.087 to 1.33 million hectares, depending of the sources of the wood. This study presents a conceptual gap since it focused on the effects of charcoal on the environment while the current study focuses on the broader concept of energy access in urban poor. This study used survey methodology while the current study uses literature review/desktop study thus a methodological gap exists.

Schwebel, Swart, Hui, Simpson and Hobe (2009) conducted a study on Paraffin-related injury in low-income South African communities: knowledge, practice and perceived risk. The study used a sample of 238 individuals who were randomly recruited from low-income housing districts near Cape Town, South Africa in 2007. Trained research assistants interviewed participants to explore their knowledge about paraffin-related safety and their perceived risk of injury from using paraffin.

Researchers inspected participants‟ homes to evaluate paraffin safety practices. Descriptive and correlation analyses were conducted. The study found out that Participants had relatively low levels of knowledge about paraffin-related safety. They had high levels of unsafe practice and their perceived risk of injury was moderate. Knowledge of paraffin safety and safe practices were positively correlated with each other. Greater knowledge showed a negative correlation with the perception of being at risk for injury, but safe practices showed no correlation with perceived risk of injury. Formal education, the number of children in the home and frequency of paraffin use were positively correlated with knowledge but not with safe practices. The only significant correlate to safe practices was greater income, perhaps a reflection of the impact of financial resources on paraffin safety practices. To develop successful paraffin safety interventions, it is necessary to understand baseline levels of knowledge, practice and perceived risk of injury among at-risk populations. Our findings could be of value for designing interventions that will increase knowledge, improve safe practices and lead to the accurate perception of the risk of injury from using paraffin. This study presents a contextual gap since it focused on low-income housing districts near Cape Town, South Africa. In addition the study used administration of questionnaires thus presenting a methodological gap. Also there exists a conceptual gap since the study focused on the perceived risks of paraffin while the current study looks at all sources of energy access in urban poor.

Esipisu (2012) conducted a study on Garbage-fed community cooker cuts wood use, energy costs in Kibera The study found out that more than 80 percent of Kenya‟s urban dwellers, many of whom live in poor, informal settlements, use charcoal made from wood as their primary source of energy, according to government statistics. Their heavy dependence on wood for fuel has contributed to the rapid decline of Kenya‟s forests, with negative effects for the local climate, wildlife, water sources and forest dwellers, says the World Rainforest Movement. On average, burning 2 kg of dry wood emits 1 kg of stored carbon, according to Vincent Onguso Oeba, head of the biometrics division at the Kenya Forest Research Institute (KEFRI) Considering that charcoal is largely made of carbon, it becomes environmentally friendly to substitute it with rubbish, because it saves a substantive amount of carbon from entering the atmosphere," the research scientist said. This study focused on Garbage-fed community cooker cuts wood use, energy costs in Kibera thus presenting a conceptual gap.

3.0 SUMMARY OF RESEARCH GAPS

3.1 Gaps on the Objectives and Expected Findings (conceptual gaps)

Ng‟eno (2014) conducted a study on the factors affecting the adoption of solar power technology for domestic power usage in Kenya. This study focused on the factors affecting the adoption of solar power technology for domestic power usage thus presenting a conceptual gap. Senelwa, Ekakoro, Ogweno and Okach (2005) conducted a study on the Environmental and socioeconomic implications of charcoal production and use in Kenya. This study presents a conceptual gap since it focused on the effects of charcoal on the environment while the current study focuses on the broader concept of energy access in urban poor. This study used survey methodology while the current study uses literature review/desktop study thus a methodological gap exists. Schwebel, Swart, Hui, Simpson and Hobe (2009) conducted a study on Paraffinrelated injury in low-income South African communities: knowledge, practice and perceived risk thus there exist a conceptual

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3.2 Methodological Gaps

Gitonga (1999) conducted a study on Energy Provision for the Urban Poor in Kenya. The study collected both secondary and primary data. The primary data was collect by visiting several organizations who are stakeholders in the energy sector Information was also collected from opinion leaders and development and community workers in the urban poor areas. The study presents a methodological gap since it used secondary and primary data while the current study uses literature review/desktop research. Senelwa, Ekakoro, Ogweno and Okach (2005) conducted a study on the Environmental and socio-economic implications of charcoal production and use in Kenya. This study used survey methodology while the current study uses literature review/desktop study thus a methodological gap exists. Schwebel, Swart, Hui, Simpson and Hobe (2009) conducted a study on Paraffin-related injury in low-income South African communities: knowledge, practice and perceived risk. The study used a sample of 238 individuals who were randomly recruited from low-income housing districts near Cape Town, South Africa in 2007.The study used administration of questionnaires thus presenting a methodological gap

3.3 Gaps on the Scope and Geographical Context (contextual gaps)

Ramachandran (1991) conducted a study on Energy for Low-income Settlements in developing countries. This study focused on Africa, Asia and Latin America in general but the current study narrows it down to Kibera slums. Schwebel, Swart, Hui, Simpson and Hobe (2009) conducted a study on Paraffin-related injury in low-income South African communities: knowledge, practice and perceived risk. This study presents a contextual gap since it focused on low-income housing districts near Cape Town, South Africa.

4.0 CONCLUSION, PROPOSED MODEL AND POLICY IMPLICATION FOR FURTHER STUDY

4.1 Conclusions

In light of the above literature review, the study concludes that the people of Kibera slums kerosene is the most important modern energy option for Kibera slum dwellers for both lighting and cooking. Electricity also appears to be a relatively important energy option though not largely used. 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. Firewood and charcoal are the most commonly used fuels for cooking and heating in the semi rural squatter settlements on the outskirts of large urban settlements.

The study also concludes that the utilization of electricity is almost nonexistent and gas is a very unpopular fuel for Kibera slum dwellers apparently because of the damage that fire can cause to informal structures. However further analysis revealed that cost is the main reason for not using gas. Apart from the lack of income, which is in itself a hindrance to the provision of energy, the absence of property rights limits dramatically energy access for poor urban people. The fact that they live in the informal settlements makes it difficult for them to access to electricity or to use

LPG safely as risk of fires is great. Also rural poverty, aggravated by fuel shortages is driving the Kibera slum dwellers to shift to foods that require less fuel for cooking.

Lastly the study concludes that more than 80 percent of Kenya‟s urban dwellers, many of whom live in poor, informal settlements, use charcoal made from wood as their primary source of energy, according to government statistics. Their heavy dependence on wood for fuel has contributed to the rapid decline of Kenya‟s forests, with negative effects for the local climate, wildlife, water sources and forest dwellers.

4.2 Policy Implication

This study provides implications for both policy and practice. Regulatory; Price control mechanisms that protect consumers from exploitation and over-pricing for modern energy services such as LPG should be put in place. The government should formulate standards for urban slum houses to ensure basic amenities like electricity are provided. The government should also ensure standardization of LPG cylinders. Institutional; it is recommended that the Government should establish a dedicated institution similar to the Rural Electricity Authority, with the specific mandate of expanding the urban poor‟s access to modern energy services. As with the rural electrification programme, a levy in electricity and liquid fossil fuels can be a reliable source of finance for urban poor access programme. Subsidy: The government should develop energy subsidies aimed at reducing the upfront cost of access to electricity and LPG and end user equipment costs, hence making it affordable and more accessible to a majority of the urban poor population. It is recommended that subsidizing low capacity LPG cylinders which are normally bought by the urban poor will ease LPG access in Kibera. While governments continue to subsidize rural electrification and irrigation, the viability of renewable sources of energy remains doubtful: thus, in some cases, it might be necessary to use subsidies to encourage either the development or the use of new techniques **4.3 Area for Future Studies.**

In the foreseeable future, all the above mentioned fuels are likely to continue being important energy options for the urban poor. However, there are several areas that need further research in order to make the fuels more accessible and affordable to a wider proportion of the population. The following areas could be examined further in future research studies.

Efficient and sustainable charcoal production: Charcoal production in the country is carried out using traditional technologies that are very low efficient and end up losing lots of energy in the process. This leads to the massive waste of wood, the raw biomass feedstock used for charcoal production. This normally leads to high production costs for charcoal subsequently affecting market retail price as well as contributes to deforestation. Future studies could investigate, in detail, efficient and sustainable ways of charcoal production in order to the address these related issues. Energy Use in SMEs run and operated by the urban poor. There are very few uncoordinated research studies on energy use among the numerous SMEs run and owned by the urban poor. Although individual energy consumption of the SMEs could be insignificant, cumulatively, their energy consumption is significantly high and they could influence the energy consumption patterns in the country. In spite of the SMEs playing a vital role in the energy supply and consumption patterns among the urban poor, detailed analysis of the kind of energy sources used, sources, the cost of energy sources as well as the urban poor‟s consumption patterns at the SME level, needs to be analyzed in depth. Potential Benefits to The Urban Poor of Standardizing LPG gas Cylinders

and Accessories, Currently, in the Kenyan market there are several multi-national oil companies producing LPG for local consumption. Each of these companies produces LPG cylinders to their specifications, meaning that LPG regulators are not interchangeable amongst the cylinders from the various different suppliers. A study looking at the potential benefits of standardizing LPG cylinders regulators and its benefits to the urban poor also needs to be analyzed in depth in future studies. An in depth analysis and study on the Kerosene marketing and distribution in urban poor areas .The main barrier to the supply and distribution of kerosene in Kibera is the long supply chain which is filled with numerous middle men. A detailed analysis of the Kerosene supply chain and its effect on the kerosene pricing among the urban poor could be analyzed in order to propose measures that would drastically reduce the price of kerosene hence increase its availability among the urban poor.

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