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African energy poverty: a moving target

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Abstract

Historically, ‘energy poverty’ in Sub-Saharan Africa has been understood in relatively static terms and its solutions largely understood as a modernist state-led project of expanding centralised distribution to achieve a coordinated ‘transition’ from traditional fuels. In recent decades, however, political economies of energy in the region have exhibited considerable dynamism, changing what energy poverty looks like. The rapid dissemination of mobile phones, for example, has meant that most households now require near daily access to some form of electricity, inducing creative local responses. As well, with increased Sino-African trade, a plethora of cheap lighting products such as dry-cell battery torches and small-scale solar products have become widely available, reducing consumer interest in kerosene lamps and fuel. Finally, charcoal has emerged as a key cooking fuel for growing urban populations—introducing a new/expanded source of rural revenue while disrupting a decades long official campaign to induce ‘transition’ from firewood to LPG. We demonstrate how these particular changes are occurring through the example of dynamics in Sierra Leone in West Africa.

Introduction

In two recent influential African Energy Outlook reports, the International Energy Agency (IEA) describes Sub-Saharan Africa as facing ‘fundamental energy challenges’ [1, p. 22] and as ‘the epicentre of the global challenge to overcome energy poverty’ [2, p. 3]—a characterisation it supports with several broad statistical claims. In particular, it emphasizes how the region is home to ‘600 million people’ that do not ‘have access to electricity’ [1] and that four out of five people ‘rely on the traditional use of solid biomass (mainly firewood) for cooking’ [2, p. 15]. In addition, it expresses concern that households ‘typically spend 20%–25% of their income on kerosene’, the cost of which can be ‘600 times higher than that of compact fluorescent lights’ [2, p. 29]. What is of interest here, however, is not the specifics of these reports per se, but rather their exemplary articulation of a much broader consensus on contemporary African energy geographies [3–6]. In this narrative, elimination of Sub-Saharan African ‘energy poverty’ will be contingent on the provision of electricity to facilitate a transition away from expensive, hazardous and burdensome fuels such as firewood and kerosene.

Though this perspective has recently re-entered the limelight, it is important to note that it is not particularly new, and in fact the urgency of inducing an ‘energy transition’ in Africa has been a keystone of post-WWII ‘development’ discourses. Early expressions were most explicitly informed by Rostowian notions of linear socio-technological evolution and specifically emphasized the supply of modern forms of energy to the populace, especially in rural areas [7]. More recently, with rising concerns over global climate change the additional criteria of ‘sustainability’ has also been threaded in, engendering a particular focus on securing a ‘low carbon’ energy future for the developing world [8, 9]. Emblematic of the current push for this (now twin) transition is the United Nations’ Sustainable Development Goal Seven (SDG7), which overtly calls for ensuring universal access to ‘modern’ energy by the year 2030 as its core

1 This cost is calculated in /lumen hour.

2 In this conception the focus has been specifically on a combination of increasing electricity access in tandem with the displacement of ‘traditional’ cooking fuels (e.g. fuelwood) by ‘modern’ forms such as LPG [15].
objective while clearly emphasizing the ‘sustainability’ criteria of increasing the renewable energy share of production and improving efficiency of end use [10].

Unsurprisingly, the question of how such a ‘low carbon modernity’ is to be produced in Africa continues to be the subject of considerable debate [10–15]—much of which is focused on determining the roles of aid donors and African governments in promoting the desired transition [16–19]. In much of the literature on this topic, however, the energy poor themselves implicitly become subjects of ‘Development’ [20]—discursively produced as both statistical variables to be intervened upon and the passive ‘beneficiaries’ of this intervention [19, 21].

Indeed, geographies of ‘energy poverty’ are often presented as relatively static and homogenous, described by highly aggregated regional or even continental statistics obscuring not only the actual contexts of everyday energy sourcing, distribution and use, but also local diversity and dynamism. As Sokona et al [22, p. 5] note, this is problematic as although discussions on how to convert policy discussions into practical action are ‘progressing’, it is important to take stock of how actual energy geographies are evolving ‘on the ground’. What is striking in even a thorough survey of available literature is the general lack of specific, contextualised empirical observations (particularly ethnographic accounts) of what ‘energy poverty’ in Africa actually looks like [21, 23–25]. Indeed, binary electricity access statistics—defined by the IEA as the presence or absence of a direct connection with a consumption threshold—are often used as proxy for mapping energy poverty [25]. Here, however, we employ a broader definition of the term, which understands energy poverty as a situation in which inadequate access to energy (physically or financially) undermines service provisions that meet people’s needs and aspirations [26]. Thus, we recognise that large-scale investments in improving energy access (e.g. through electrical grid expansion projects) do not necessarily eliminate energy poverty due to its multi-dimensionality and dynamism.

In this paper, we argue therefore that there is a need to revisit standing assumptions regarding Sub-Saharan Africa’s manifold and diverse energy geographies. More specifically, based on evidence from the field we contend that while the IEA image of energy poverty presented in the introductory paragraph was broadly accurate (in aggregate terms at least) between the 1960s and 1990s, recent decades have seen considerable dynamism and past patterns have been notably reshaped in a number of different ways. As well, and perhaps still more importantly, many such changes are much less products of top-down interventions by external or regional policy actors but rather of changes in political economic and political ecological circumstances and the decisions of the ‘energy poor’ themselves—variously in response to and/or as (often quite determined) agents of such developments. To illustrate our argument, we present insights derived from a case study of Sierra Leone, West Africa detailing three key examples: (1) a shift from kerosene lamps to dry-cell battery torches; (2) the emergence of mobile phone charging stations; and (3) a movement from firewood to charcoal as a dominant cooking fuel.

To inform our analysis, we draw on two recent studies that the authors have been involved in. The first was funded over ten-months in 2011 by the European Union (EU) and The United Nations Food and Agricultural Organisation (FAO) under the Forest Law Enforcement, Governance and Trade (FLEGT) initiative (hereafter ‘the FLEGT project’). Focused on the production, distribution and use of cooking fuels, principal field research activities for the FLEGT project consisted of: (1) individual interviews with urban fuelwood vendors across Sierra Leone as well as with forestry staff, police, chainsaw shop owners, and a variety of other relevant stakeholders in the firewood and charcoal commodity chains; (2) focus group interviews with urban vendors to produce more nuanced discussion of the trade, and; (3) town hall discussions with residents of villages adjacent to and/or participating in production activities—identified via interviews with urban vendors. The second was a research project conducted in late 2014 and early 2015 as a part of the ‘Promoting Renewable Energy Services for Social Development in Sierra Leone’ (PRESSD-SL) project funded by the EU (hereafter ‘the PRESSD project’). In this case fieldwork focused on collection of wide-ranging data on urban household and commercial energy use across six of Sierra Leone’s (at the time 14) districts to establish baseline information guiding allocation of resources for installation of over 200 institutional and mini-grid solar photovoltaic (PV) systems. In total, 139 settlements were visited for the completion of 4500 household surveys and 198 interviews with owners of mobile phone charging stations. Households were randomly sampled across a diverse spatial geography in each 139 settlements, the populations of the settlements ranged between 1000 and 10 000 people.

Sierra Leone: a story of three energy transitions

In many ways, Sierra Leone can be seen as a quintessential energy poor nation. The International Energy Agency, for example, currently estimates that only 9% of the population has direct access to electricity [27] and the vast majority of connections are within the capital city Freetown and, to a lesser extent, district capitals. To be sure, there has been some progress in improving electricity access over the past decade. For one thing, despite problems with its construction, the completion of a hydro-electric dam in the north of Sierra Leone in 2013 helped to
improve grid supply to urban centres. As well, a number of off-grid projects—mainly using photovoltaic technologies—have modestly increased rural supply in some areas. Nevertheless, overall ‘progress’ from an electrical grid expansion perspective has been slow, and Sierra Leone still has one of the lowest per capita connection rates in the world [25].

Kerosene to batteries
As in the IEA report described in the introduction, most contemporary accounts present kerosene-fuelled lamps as the dominant household light source of rural Sub-Saharan Africa, and for much of the past century this was in fact the case. Written histories of the region give only scant attention to energy matters, but it appears that kerosene lamps and fuel were first imported to Africa on a large-scale by colonial actors sometime in the late 1800s. In Freetown for example, one account notes that in the 1890s the main source of lighting for the city was a set of around 60 kerosene lamps [28]. Over the next few decades, the technology diffused across the Sierra Leonean colony, becoming the standard light source for rural populations by the 1950s [29]. The dominance of this fuel continued after independence, moreover, and survey data indicate that 91.2% of rural and urban households relied on kerosene for their main lighting needs as recently as 1996 [30].

More recent data produced in 2014/15 as part of the PRESSD project, however, paints a distinctly different picture. In the survey of 139 rural villages, only 0.3% of households named kerosene lamps as their main source of lighting and kerosene vendors have become far and few between. In less than 20 years, the once ubiquitous kerosene lamp has all but disappeared, suddenly displaced by an array of dry-cell battery powered lights.3 Given the recent dominance of kerosene and the fact that torches/flashlights and other battery powered lamps have been available for many decades, the nearly wholesale shift from the one technology to another so radically different in nature requires explanation. Interestingly, the answer is quite simple: during our own field research, interview participants noted several key issues with kerosene (including the risk of fire and burns, production of smoke and smell within the home, along with increasing kerosene scarcity and the already high cost of the fuel) as long-standing disincentives to its use. As a result, when post-civil war economic recovery brought a flood of low-cost items—most notably much cheaper versions of hand-held LED lights and their batteries even into rural village markets—people switched away from kerosene en masse. A important driver of this transition has been the rapid increase of Sino-African trade—between 2000 to 2014 the bilateral trade volume between China and Africa has increased 21 fold [31], and relatively cheap Chinese-made goods have become ubiquitous, even in relatively remote markets [32]. Interestingly, the wide dissemination of these imports has even left an imprint on (the local lingua franca) Krio itself: torches and lamps are now locally known generically as ‘Chinese lights’.

The sudden emergence of these ‘Chinese lights’ in Sierra Leone can be traced back to 1999. The graph below (figure 1) shows how the transition has occurred in six out of the (then) 12 districts of Sierra Leone. The graph lines—each representing a district—are drawn from the PRESSD project household surveys (n = 4500) and summarise participant responses regarding what year they switched from kerosene lamps to torches. As well, the overlaid bar graph shows kerosene imports into Sierra Leone (for the years 2000 to 2011) sourced from the national government’s Petroleum Unit [33]. During this same period—Sierra Leone’s diesel imports increased, from 20 000 metric tons in 1999 to 134 000 metric tons in 2011, to an eventual high of 224 000 metric tons in 2014. The latter trend—caused by continuous growth in fossil fuels consumption due to post-war economic growth in the context of poor grid electricity supply—emphasizes the direct causal relationship between the uptake of ‘Chinese lights’ and the reduction in kerosene use [34]. What is perhaps most important in the patterns the data describe relates not to the question of kerosene dominance, nor the matter of shifts between energy sources per se. Rather, we argue, it is the way in which they illustrate the importance of understanding energy geographies not as sectorally isolated, generic and static but as spheres of activity linking local agents and their life-worlds with various scales of regional and international dynamics. Ultimately, it was neither national policy nor donor initiatives that induced this shift, but rather a host of other factors—most notably the decisions of Sierra Leonean business people and consumers in interaction with the interlinkage of local socio-political developments, the political ecology of kerosene itself and broader political economic trends across West Africa—not least the gradual but sometimes precipitous erosion of European colonial legacies and China’s increasing economic influence.

Mobile phones and charging stations
Another notable shift in Sierra Leone’s energy geography has an even clearer relationship to broader Sub-Saharan political economic dynamics—the proliferation of the mobile phone, which has been even more dramatic than the spread of battery-powered lamps. In 2004, only around 2% of the population owned mobile phones, and these were mainly among the urban elite due to limited network coverage outside major settlements and the fact that phones and credit could only be purchased in US dollars [35].

3These numbers also align closely with the 2015 Sierra Leone national census, which recorded 1.4% of rural households using kerosene, and 93% using battery-powered torches [33].
Fast-forward one decade to 2014 and more than half the population own a mobile phone while network coverage has been extended deep into remote rural areas [36, 37], serving a wide range of people of all levels of income. While the boom has continued and the bulk of the population have at least access to a phone and some amount of network coverage, the extension of grid electricity services has been lacklustre and the direct household electricity connection rate in rural Sierra Leone is still estimated to be under 1% [38, 77]. In fact, although some progress has been made, much residential electricity in both urban and rural areas (such as there is) is supplied fully or in part by small private generators.

While this scenario is one of frustration for mobile phone users in need of regular ‘charges’, it is also one of opportunity for small-scale businesses who have discovered a brand-new market to serve. As a result, a prominent structure in the geography of most rural towns and villages in Sierra Leone is now the mobile phone recharging station [25]. Usually set up by young local entrepreneurs, these ‘charging stations’ charge mobile phones for around 1000 to 2000 Leones (15 to 30 US cents) and an array of other small electrical devices (e.g. radios, laptop computers, car batteries) for a similarly affordable prices. Using custom-fabricated messes of cables and hardware to maximise the number of available outlets, the kiosks are most commonly powered by small diesel generators, although photovoltaic power is starting to gain some popularity [39]. Most kiosks feature external light bulbs and large stereo blasting music, projecting the presence of ‘electricity’ as far as possible to attract potential customers. Since the rapid spread of mobiles in Sierra Leone from 2000, the proliferation of charging stations illustrated in figure 2 challenges the notion that the vast majority households in one of the world’s poorest countries ‘live without access to electricity’ [2, p. 3]. Although the forms and quantities are clearly far from ideal, most people do find ways to enjoy some amount of electric lighting and power phones, DVD players and various other small electric amenities via creative consumer and entrepreneurial responses to broader political economic and socio-political dynamics. In the process, they create and re-create new geographies of electricity provision in Africa that operate beyond national grids, large-scale utility operations and, indeed, the policies and or activities of the state per se.

Firewood and charcoal

The third major shift observed in Sierra Leone is not clearly linked to regional or continental developments economics but rather emphasizes the critical importance of even extremely localised socio-political and economic developments. As in most of Sub-Saharan Africa, biomass is the main source of cooking fuel in Sierra Leone. The use of firewood, in particular, is undoubtedly many centuries old and even its commercial sale dates back to at least the 15th century when coastal populations began exchanging goods with passing Portuguese merchant ships [40]. Indeed, firewood remained a dominant cooking fuel even in urban centres until the end of the 20th century [41, 42] while charcoal—despite its considerable advantages for the end user remained largely peripheral and uncommoditized—produced and consumed mainly by rural blacksmiths [43].

During Sierra Leone's violent civil war (1991 to 2001), however, a variety of population movements resulted in technological transfers that gave birth to a commercial charcoal subsector, radically transforming urban household energy markets across the country. In the context of relocation to Internally Displaced People (IDP) camps near Freetown, displacement over the borders to Liberia and Guinea, and interaction with Liberian refugees (and in one case Liberian prisoners of war) based in different camps across Sierra Leone, a wide range of Sierra Leoneans learned both the techniques of charcoal making and its potential profitability. Following the end of the war, a great many brought this new knowledge back during resettlement to start production in their home villages. Furthermore, since the war, Guinean traders and semi-nomadic charcoal making teams have stayed in or near many Sierra Leonean villages in the border regions, teaching the trade to a considerable number of people, particularly in the north of the country [43]. Since the end of the civil war, the transformation has been dramatic. Village-level production of charcoal for urban markets has become widespread across many areas of the country, particularly in areas within reach of major transportation routes. As a result of creative responses to the random interactions and opportunities produced by a turbulent and chaotic socio-political crisis, charcoal production, distribution and sale has become a multimillion-dollar industry. The fuel produces considerable urban-rural economic transfers and now dominates urban (and increasingly rural) kitchens across Sierra Leone [14, 43]. Freetown is exemplary of this change: in 1960, only an estimated 0.9% of the populace used charcoal, rising to 37.6% in 1981 [44]. By 2015, however, the figure had risen to 87.4% of the capital’s households [33]. Similarly, in the country’s secondary urban centres charcoal use has risen from around zero in the 1980s to more than 50% in recent years [33].

The shifting terrain of ‘Energy Poverty’: new geographies, new challenges, new opportunities

These ‘transitions’ are not exclusive to Sierra Leone, in fact they are somewhat exemplary of dynamics witnessed across Sub-Saharan Africa, although
nuances of country and local contexts shape the specific dynamics of these transitions. Mass increase in charcoal production, for example, has featured in many countries across the region as attested by recent research in Malawi [45], Uganda [46, 47], Mozambique [48, 49], and Ghana [50–52]. The rise of dry-cell batteries and lamps has also been observed in various contexts. Johnson and Bryden [53] note their rising presence in rural Mali (2012), for example, while across the continent Mills et al [54] observe that more than one million units are sold annually in Kenya (2015). Similarly, in their wide-ranging comparative study of Benin, Burkina Faso, Mozambique, Rwanda, Senegal, Tanzania and Zambia, Bensch et al [55, p. 22] observe the ‘soaring consumption of [non-rechargeable] dry-cell batteries in non-electrified areas’ due to the ‘massive increase’ in the use of LED Lamps.

Mobile charging stations are also present across Sub-Saharan Africa as noted by a number of observers [cf 25, 56, 57]. The precipitous drop in the price of photovoltaic products has meant that solar-household systems and pico-solar products, often linked up with Pay-As-You-Go technologies and other financing mechanisms [see 58–61] are becoming increasing available to even poorer households. East Africa is a case-in-point, where a thriving market in both generic and branded photovoltaic modules are promoted by a wide range of businesses [46, 62–66]. Indeed, a recent Global Off Grid Lighting Association (GOGLA) reports estimate that Uganda and Kenya’s markets for off-grid photovoltaic products—both in terms of volume of products sold and financial value—were second and third, respectively, only to the vastly more populous nation of India [67, 68]. Current trends suggest that this ‘photovoltaic turn’

![Figure 1. Growing in battery-powered torch use across six Sierra Leonian districts (sourced from PRESSD project) and Sierra Leone’s kerosene imports (sourced from the United Nations Development Programme).](image1)

![Figure 2. Number of charging stations founded per five years. Data collected as part of the PRESSD project.](image2)
in East Africa is likely to shift to other parts Sub-Saharan Africa [69]. For example, GOGLA records that in the first half of 2019 around 15,800 off-grid solar products were sold in Sierra Leone, while this is a relatively small number compared to the near million products sold during Kenya in the same period, it nevertheless a substantial increase on earlier years [70]. Intriguingly, the increasing proliferation of these small-scale solar products has the potential to sound the death-knell for charging stations, as household are able to individualise their recharging with personal photovoltaic products. Indeed, though currently widespread, the market for charging stations may prove to have been only an ephemeral phenomenon filling a temporary (10 to 15 year) gap between the arrival of ‘cheap and accessible mobile phones’ and advent of ‘cheap and accessible photovoltaic products’.

Conclusions

While Africa’s energy geographies exhibit much novelty and innovation, these dynamics are not eliminating ‘energy poverty’ issues per se but changing its characteristics and spatial patterns [71]. The question is therefore not one of engendering simple transitions from one scenario to another as suggested by most interventionist agencies, as ‘energy poverty’ itself is not static but a moving target. Moreover, these energy transitions while offering offer some improvements also present new challenges. Battery-powered torches offer a higher quality of light, and reduce risk of indoor-pollution, fire and skin burns. Charging stations have helped to spread electricity access to remote locations, and charcoal is classified as an ‘improved’ fuel relative to firewood due to its more efficient and cleaner combustion. At the same time, cheap disposable batteries and small-scale products present new pollution hazards—there is a general lack of recycling facilities in most African countries to be able to handle this waste [72]. Charcoal production is often ill-viewed within broader environmental debates regarding landscape management and conservation [13, 43, 73], but it is also entangled with broader dynamics of SSA’s forest governance—not least with the increasing exportation of African timber to China [74, 75]. Meanwhile access to mobile phones and pico-solar products is still uneven, with the poorest groups being the most marginalised [69]. Nevertheless, what all these developments emphasize is that energy production, dissemination and use in Africa is dynamic, and any attempts to intervene in their ongoing evolution needs to be informed by nuanced understandings of actual local and regional contexts [25, 76], rather than aggregate statistics and outdated assumptions. As Africans are already crafting their own energy futures ‘on the ground’ any efforts to shift these in new directions should be designed to be constructive and complementary to, rather than at odds with, the goals of ‘beneficiaries’.

Data availability statement

The data that support the findings of this study are available upon reasonable request from the authors.

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