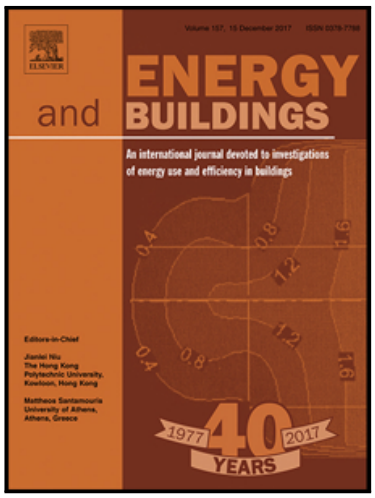

Ethnographies of Electricity Scarcity: mobile phone charging spaces and the recrafting of energy poverty in Africa

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Ethnographies of Electricity Scarcity: mobile phone charging spaces and the recrafting of energy poverty in Africa.

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Abstract

In this paper, we explore the practices and spaces of mobile phone charging in The Gambia and Sierra Leone through the lens of 'electricity scarcity' as a means to conceptualise electricity access in West Africa. The International Energy Agency (IEA) is seen as the leading authority on the state of global energy access, and is frequently cited by government and non-government bodies. We, however, suggest that the IEA's quantitative and binary framing of electricity access is analytically problematic for understanding energy poverty. Using ethnographic methods, including observation and semi-structured interviews, we provide insights into the changing socio-technological, socio-political and socio-economic dimensions of mobile phone charging including its relationship with the built environment. Comparing mobile phone charging in The Gambia and Sierra Leone, clearly shows that the notion of *absolute* electricity scarcity which is promulgated by IEA statistics only offers a limited picture of energy poverty, especially at the locale. Instead, drawing on political ecology scholarship, we propose a concept of *political* electricity scarcity as an approach enables a more human-centred and nuanced understanding of how energy poverty operates or is mitigated through community-based structures or at a household level. By reframing energy poverty issues through this lens, we are able to illustrate the role that political economy dynamics play in shaping the electricity flows in rural Sub-Saharan Africa and who ultimately gets what kind of electricity access.

Keywords

Energy poverty; mobile phone charging; scarcity; energy sufficiency; Sub-Saharan Africa; electricity access

Declarations of interest: none

1 Introduction

Electricity access statistics are often used as a proxy to map out global energy poverty. For example, the first indicator of the United Nations' Sustainable Development Goal 7 (SDG7) – which in effect seeks to eliminate energy poverty by 2030 – is measured as the "proportion of population with access to electricity" (indicator 7.1.1) (UN 2015). To inform this indicator, the United Nations (UN), like other major international agencies, draws on statistics produced by the International Energy Agency (IEA) (cf. Wu and Wu 2014). Electricity access, in these statistics, being defined as the *presence* of a direct supply of electricity, and *consumption* above a minimum threshold of 250 kilowatt-hours (kWh) per year in rural settings and 500 kWh per year in urban areas (IEA, 2015). Drawing on these statistical parameters, the IEA (2017) (and therefore, by proxy, the UN) currently estimates that 1.1 billion people in the world "lack access to electricity," mostly affecting populations residing in Sub-Saharan Africa and parts of 'developing Asia'. This geography of electricity access, however, is expected to change over the next decade with the IEA estimating that while globally there will be progress in terms of electricity access, electrification rates will struggle to keep pace with population growth in Africa. Therefore, by 2030, a projected "600 million out of the 674 million people without access to electricity [will] live in Sub-Saharan Africa, a majority of them in rural areas" (IEA 2017, p. 3). In short, the IEA's projections suggest that a lack of electricity access will be a defining characteristic of future energy poverty in Africa (also see Onyeji et al 2012).

Given its current, and likely future, prominence in African energy poverty debates, we argue that there is a critical need to theorise what 'electricity access' actually means in an energy poor African context. In doing so, we suggest that the IEA's binary and quantitative understanding of electricity access is analytically problematic, and risks presenting electricity access as a simple infrastructural issue. In contrast, we propose that electricity access should be understood as a more qualitative process that is shaped by a range of political, social, economic *and* infrastructural dimensions. For example, electricity usually flows and is stored in a range of complex dynamics in energy poor contexts: some buildings and households might have access to electricity due to selected grid connections, access to diesel generators or solar photovoltaic installations; electricity is stored in disposable or rechargeable batteries to power radios, torches or mobile phones; and electricity flows through direct current (DC) outlets in different vehicles. Electricity, thus, is not totally absent in an energy poor context. Instead, electricity is a part of localised energy cultures which shape who has access and who is excluded from these different 'electricities'. We draw on political ecology scholarship, specifically works that have engaged with socially constructed forms of 'scarcity', what Scoones et al (2018) term 'political scarcity', to propose the

idea of 'electricity scarcity' as a means to conceptualise the geographies of electricity access and flows in Sub-Saharan Africa. That electricity flows (or lack thereof) are not just a function of infrastructure, but rather are shape by a range of political, social and economic processes.

We ground this conceptual argument in empirical case studies of mobile phone charging in The Gambia and Sierra Leone. The focus on the simple task of charging a mobile phone allows us to explore and contrast the complex socio-technological, socio-political and socio-economic dimensions of energy scarcity in relation to electricity access. Ultimately, the rise of mobile phones in Africa illustrates the analytical limits of the binary 'electricity access' framing used by the UN, because the current estimates that around 43% of Africans own a mobile phone (GSMA 2017) makes a mockery of UN's claim that a vast majority of people in rural Sub-Saharan Africa "function without electricity" (UN 2017). The vast majority of African household *do function with electricity* – from the very simple fact that they need to find ways to charge their mobile phones. It is the political economy dynamics that surround this 'functioning' that is the interest and focus of this paper.

1.1 Framing electricity scarcity

Resource scarcity can be described as a resource that is "in short supply" - however, what causes the "supply" to become "short" is a key focus of resource scarcity debates. On the one hand, an influential body of work surrounding scarcity presents it as a largely arithmetic concern. In this Malthusian framing, scarcity is the product of population numbers versus the quantity of resources available (Homer-Dixon, 1996, 1999; Kaplan, 2000, 2001, 2012; Ehrlich, 1968; Smail, 2002). Scarcity thus occurs when population numbers outstrip the "carrying capacity" of a given resource. This framing of 'scarcity', however, has been the focus of critique by a broad body of work under the banner of political ecology, which explores the various social, technological, economic and political dimensions that shape environmental access, use, and other resources, across spatial and temporal scales (Robbins, 2012; Budds, 2008). In doing so, this work reveals the "winners and losers, hidden costs, and the differential power that produces social and environmental outcomes" (Robbins, 2012, 11). There is a particular emphasis on questions of "whose scarcity" to explore the social constructions of scarcity and their implications (Mehta, 2007; Budds, 2008). As such, a political ecology perspective sees resource scarcity as being the product of power-laden social dynamics as well as material availability (Scoones *et al*., 2018). As Melo Zurita *et al.* (2015, 172) note, from a political ecology perspective, the notion of scarcity "is not absolute or naturally-given, but rather it is considered to be socially produced. This is not to deny that scarcity is a function of physical conditions, rather it emphasises how it can also be a function of human actions, cultural

norms and perceptions, historical conditions, societal inequities, and the loci of control over ... critical resources" (also see Johnston, 2012; Swyngedouw, 2009; Mehta, 2010). 'Political scarcity' is thus understood as being shaped by variety of material and discursive processes.

Most political ecology work thus far has focused on resources that are directly available "in nature", for example water (Kaika, 2003; Bakker, 2003; Swyngedouw, 2009; Mehta, 2001, 2007; Budds, 2008), and non-renewable resources including fossil fuels, particularly relating to their potential relationship to conflicts (Le Billon, 2001, 2012; Peluso and Watts, 2001; Watts, 2004; Marriott and Minio-Paluello, 2012). Much of the work on water has demonstrated how hegemonic discourses of 'scarcity' have been mobilised to justify neoliberal approaches to governance, which is built on the logic that the market offers the optimal mechanism for the allocation of presumably scarce water resources (Swyngedouw *et al.*, 2002; Swyngedouw, 2009; Melo Zurita *et al.*, 2015). It is a logic that political ecology perspectives counter, as Swyngedouw (2009, 58) argues "true scarcity does not reside in the physical absence of water in most cases, but in the lack of monetary resources and political and economic clout" thus water scarcity is more of a production of "the economic and political power relations through which access to, control over, and distribution of water is organized." Water scarcity, therefore, is usually a product of *political* scarcity that is shaped by political economy dynamics, rather than *absolute* scarcity (*cf.* Scoones *et al.*, 2018).

Similar arguments can be seen with the political ecology scholarship relating to fossil fuels that has challenged 'environmental determinist' accounts of resource scarcity as a major cause of conflicts around the world (*cf.* Kaplan, 2000, 2001; Homer-Dixon, 1996, 2010). Peluso and Watts for example, in their edited collection *Violent Environments*, offer an incisive and direct critique of the Malthusian influenced environmental determinist accounts. They reject "automatic, simplistic linkages" that are made between notions of scarcity and violence, instead arguing that "violence should be understood as "a site-specific phenomenon rooted in local histories and social relations yet connected to larger processes of material transformation and power relations" (Peluso and Watts, 2001, 5). They further note that scarcity is surprisingly untheorized in determinist accounts, and that rather presuming or starting with scarcity, analyses of "violence should begin with the precise and changing relations between political economy and mechanisms of access, control, and struggle over environmental resources." They conclude that ultimately all forms of scarcity are historically and environmentally "produced expressions of these relations", and therefore it is flawed to use scarcity alone as the

starting point for analysis (Peluso and Watts, 2003, 93). Thus, similar to political ecology work on water scarcity, they see politically-crafted scarcity, rather than absolute scarcity as being the key analytical concern.

In this paper, we conceptually draw upon this political ecology scarcity scholarship, however our application to electricity is novel for two reasons. First, unlike water and fossil fuels, electricity (at least in its consumed form) is not found "in nature" but produced. Indeed, electricity is often the end product of exploited water (e.g., hydro-electricity) and/or mineral resources (e.g., coal, oil). Thus, biophysical factors have less influence in electricity geographies. Second, our focus is on everyday practices. Rather than grander questions of governance and conflict that has pervaded much of the political ecology literature, we are interested in the day-to-day geographies of electricity flows. As such, this paper contributes to a smaller body of emerging literature that explores electricity scarcity in the context of local energy cultures (e.g., Parks, 2016).

Framing electricity as scarce in Sub-Saharan Africa is a relatively straightforward proposition. For example, in 2015 the IEA estimated that Africa as a whole generated around 3% of the world's electrical supply, while it is home to around 16% of its population (IEA 2017). Even then, the 3% figure was predominantly made up from generating capacity based in South Africa and the more industrialised nations in North Africa (Sovacool *et al.*, 2016). These figures, at face value, represent an *absolute* scarcity of electricity across the continent, however, a critical question to ask is: to where, and to whom, does this limited electricity flow towards? Overall figures obscure the more complex geographies of electricity flows across the continent. And, problematically, they imply that the African electricity problem is solely an infrastructural one – a technical managerial problem that requires techno-centric solutions. Indeed, such framing has been discursively mobilised to promote neoliberal reforms, similarly to water scarcity issues. The privatisation of electricity generation, distribution and supply , especially during the 1980s and 1990s (Bhattacharyya, 2012), has been promoted as a 'solution' to combat electricity scarcity in Africa. And, despite the prediction that the reforms would bring an end to energy crises (Gore, 2009), electricity access problems remain pernicious following neoliberal reforms (Bhattacharyya, 2012). In Uganda, for example, privatisation has mainly succeeded in making electricity more expensive, rather than generating more widespread access, especially in rural areas (Gore, 2009, 2017; also see Brew-Hammond *et al.*, 2014). In contrast, by focusing on *political* scarcity of electricity a more complex political economy of electricity geographies can be revealed and thus it is refocused as a key energy justice concern (*cf.* Sovacool, 2012; Sovacool and Dworkin, 2004; Jenkins *et al.*, 2016, 2018; Munro *et al.*, 2017; McCauley, 2018). Here, the

opposite of scarcity is therefore not how to delivery abundant infrastructure, rather sufficient energy in the context of everyday practice - providing electricity is a political ecological, rather than solely technical, concern.

2 Methodology

The methodology for data collection across the two case studies of The Gambia and Sierra Leone are largely based on a range of qualitative (e.g., interviews, ethnographic observation) methods, with some complementary quantitative data collection (e.g., surveys). In The Gambia, field work has been part of a larger design action research project that includes phases of immersion and mapping. Regular field excursions since 2010 enable a longer-term perspective of changing energy practice including charging mobile phones. Relationships established with members of the Kartong community early on in the research have led to being hosted in a local family compound which enabled immersions and participation in local life. Immersions have been carried out throughout different times of the year including dry and rainy seasons as well as Ramadan to avoid 'season blindness', the limited understanding of local life based on experience of a single season (Chambers, 2012, 38). Immersion is supported by ethnographic methods including observation, photography and semi-structured interviews. The latter includes interviews with elders conducted as part of a recent collaboration with the National University of Ireland (NUI) Galway about past energy transitions. In addition, the research used mapping of infrastructure distribution across the settlement area to provide insights (also see Schiffer, 2016). This was carried out using Google Earth images and physically walking through the settlement area to record data such as electricity connections to compounds.

In Sierra Leone, data and insights are derived from numerous research projects that have been conducted in-country since 2006. This includes twelve-months fieldwork in 2006-2007, three months in 2008 and six months in 2011 as well as 2012. During fieldwork, time was predominately spent working on and investigating energy projects in the north of Sierra Leone, across the districts of Kenema, Port Loko, Moyamba, Kambia, and Bombali. This has been supported by observation of energy practice as well as interviews with key stakeholders working in energy sector of Sierra Leone. Furthermore, an extensive survey of mobile phone charging stations was carried out as part of a European Union (EU) funded project in 2014-2015.

While originating in geography and design disciplines as well as being conducted over different timescales, the use of ethnographic methods across research in The Gambia and Sierra Leone allows for the comparison of both case studies as outlined below. With regard to energy in the built environment, the two case studies differ in terms of scenarios of infrastructural development. The Gambian case offers insights into changes to mobile

phone charging practice, including the move to domestic buildings with the introduction of grid electricity, whereas mobile phone charging in rural Sierra Leone is currently realised through a range of off-the-grid electricity options.

3 Case studies: mobile phone charging in the context of electricity scarcity

According to the IEA (2017), Sub-Saharan Africa has a 43% electrification rate. At the same time, the region is the fastest growing mobile phone market in the world. Between 1999 and 2004, which coincides with the introduction of mobile phones in The Gambia and Sierra Leone, mobile phone subscriptions on the continent leaped from 7.5 million to a staggering 76.8 million (Dowden, 2009, 518). Unique subscriptions continue to rise and are expected to reach half a billion in 2020 (GSMA, 2017).

The following case studies explore the interface between the lived experience of mobile phone charging and the socio-technological, socio-political and socio-economic dynamics that shape the context of increasing demand for mobile communication and electricity scarcity.

3.1 The Gambia: changing dynamics of phone charging with the arrival of grid electricity.

Kartong is a rural coastal community and border village located in the south of The Gambia with a population of approximately 3,300 people (GBOS, 2013). It has undergone drastic changes in infrastructure development over the past several decades, including road construction and connection to grid electricity (Schiffer, 2016). Kartong elders still recall when there were only few radios in the community to access news, when the sound of a drum was used to gather people for important announcements and when information was transferred to other communities using a small number of bicycles.

There was notable infrastructure development following the 1994 *coup d'etat*, in which Yahya Jammeh seized power. This included the launch of the first television station and the Gamcel mobile phone network in the late 1990s (Harvey and Sturges, 2010). Other mobile phone operators entered The Gambia after the Millennium, including Africell in 2001, Comium in 2007 and QCell in 2009. In the 1980s, during the previous government, landline infrastructure was introduced but there was a high cost associated with getting connected and the technology was superseded by the mobile phone. As one *Kartonka* explains: "Frankly …. the landline usage … was dropped significantly because of the introduction of the mobile phone. Since you have your mobile in your

hand you don't need to use the landline. As mobile companies started coming up, the Gamtel line started collapsing because you don't need it anymore" (Personal Communication, Jan 2018).

Until 2013, when grid electricity became available in Kartong, mobile phones were charged off-grid. One of the two mobile phone masts (Africell) that continues to directly serve Kartong was located on the southern edge of the settlement area back then and powered by a large diesel generator (Fig 1). Those residing nearby could come here and charge their mobile phones for D5 (€0.09, US$0.11). The other phone receptor mast (Gamcel), which was powered by solar, was not accessible. However, the local health centre just across the road also had a solar installation where people charged phones. Perhaps the most popular charging locations were so-called video clubs, a form of local cinema that typically shows films and football. On top of the entrance fee to watch what was on the screen, people could pay D5 (€0.09, US$0.11) to have their phone charged. In other words, mobile phone charging provided additional income generation for businesses or their employees. At the same time, buildings that performed specific services such as providing health care or entertainment, also supplied electricity for the informal mobile phone charging sector.

In addition, some businesses also charged mobile phones for free. Examples included a tailor who used a generator to power sewing machines, several light bulbs and a radio and recharged an estimated 25 mobile phones owned by local residents a day (Personal Communication, April 2013). Others may have had access to domestic solar cells or small diesel generators in extended family compounds though these were few and far between. As a result, electricity needs were largely met by batteries while people used fewer electronic equipment and gadgets.

During the rainy season in 2013, the first 19 households in Kartong were connected to the electricity grid. At the time few could afford the D3,000 (€54; US$64) connection fee, as income generating activities are concentrated in the dry season and the connection also coincided with the end of Ramadan which is associated with large expenses to provide food and clothing (Schiffer, 2016). Despite the relatively low initial uptake of grid electricity the mobile charging businesses disappeared almost immediately. Close ties across the community means people help each other out. Therefore, a household that has access to grid electricity will share the said commodity with extended family, friends and those in need around it. With the arrival of grid electricity in Kartong mobile phone charging rapidly shifted from buildings associated with services to domestic dwellings.

The grid in Kartong only covers the more established parts of the settlement area leaving large parts disconnected.[1] Few line extensions have been made since 2013 and these are predominately to large new residences of European expatriates and a wealthy politician. However, the majority of compounds in the area covered by grid are now connected. Consequently, domestic energy practices have changed as people have become accustomed to using electric kettles, fridges and televisions. In a context of continually distinct gender roles the home is traditionally the sphere of women who are benefitting as chores become less time consuming due to now available electrical gadgets. Some are also finding new ways to generate income, for example, by producing and selling local juices which are chilled in fridges. However, until recently women's education was seen as less important than that of men and therefore many women are illiterate (Greene and Schiffer, 2018). Not being able to read means these women are more likely to be excluded from the benefits associated with information and communication technologies (ICTs) such as mobile phones. The increasing demand for smartphone technology among the literate demographic since the introduction of grid electricity to Kartong exacerbates this. Therefore, moving electricity charging into domestic dwellings has arguably done little to address this type of access inequality. It also suggests that women's education and the alleviation of energy poverty in relation to ICTs needs to go hand in hand.

Those who own mobile phones in Kartong often have two or more sim cards, multiple phones or dual-SIM handsets to get the best deals from different operators and overcome reception black spots. Choice of operators may also be influenced by additional services such as internet access or the ability to make payments for grid electricity top-ups locally known as 'cash power'. In addition, recharging mobile phones, which is more frequent for power hungry smartphones, is somewhat impacted by so-called load shedding - planned blackouts which are a symptom of the country's limited electricity generation capacity.

[1] In 2015 The Gambia had an estimated electrification rate of 40% with rates in the Western Division of The Gambia, where Kartong is located, at 22%. (Blodgett and Marett, 2015).

Fig 1. Off-grid mobile phone receptor mast powered by a diesel generator.

3.2 Sierra Leone: the social enterprise of the phone charging station

Mobile phone services first arrived in Sierra Leone in the wake of the country's civil war (1991-2001), with the telecommunications companies Celtel and Millicom (the latter known locally as "Buzz", then "Tigo") setting up operations in 2000. Initially, mobile network coverage was limited, and operating costs were high – phones and credit had to be purchased in US dollars. Thus, by 2004, only around 2% of the population, a small urban elite, could afford to own and use mobile phones (Sesay 2004). The market, however, rapidly expanded in 2005 with the arrival of two new operators, Africell and Comium, and by the end of 2005 an estimated 14.3% of the population owned a mobile phone (Bello-Bravo *et al.*, 2017). Indeed, like in The Gambia, during this time it was not uncommon for people to own multiple mobile phones (or mobile phones containing dual sim cards) as different networks offered different advantages: some operators had greater coverage (e.g., Celtel), while others offered cheaper call rates (e.g., Africell). Since the mid-2000s, Sierra Leone's mobile market has continued to be dynamic: Millicom ("Tigo") was bought out by Africell in 2009; Comium went bankrupt in 2014; and Celtel has been through multiple acquisitions, most recently being bought by (and being renamed as) Orange, a French telecommunications company, in 2016. The Cypriot telecommunications operator "Smart Mobile" launched mobile services in Sierra Leone in 2014, while the Sierra Leonean (and former public company) landline operator SierraTel and The Gambian operator QCell are both in the process of introducing 4G services in 2018. Sierra Leonean mobile phone ownership is now claimed by over 50% of the population, while network coverage (over 80%) is widespread (Sam, 2015; Samarakoon *et al.*, 2017). Mobile phone ownership and use rates will almost certainly continue to increase, as the influx of cheap smartphones from China, along the relatively low cost of pre-paid data plans, has enabled greater accessibility to poorer (although perhaps not the poorest) socio-economic households (Sam, 2015).

While the story of mobile phones in Sierra Leone has been a boom, the story of electricity access has been lacklustre. Since 2000, the year mobile phones were introduced, and while the country has attempted to recover from its civil war, the supply of electricity has remained a "consistent and economically pernicious problem" (Munro *et al.*, 2016, 29). Overall, the vast majority of grid electricity connections are limited to the capital city of Freetown and district capitals, leaving the rest of the country predominantly with little or no grid access (Munro *et al.*, 2016). The IEA (2017) estimates that only 9% (12% urban, 6% rural) of the country's populace have direct access to electricity. Due to this severe national energy deficit, electrification projects have inevitably been focused on providing demand for urban centres – notably with the completion of the Bunbuma Dam project in 2009 – and plans for improved rural electrification remain largely aspirational (MEWR, 2009;

Pushak and Foster, 2011; Munro *et al.*, 2016). Given the contrasting stories of rapidly expanding mobile phone ownership, and the stuttering of grid electricity provision, an ongoing quandary for many Sierra Leonean residents has been to find ways to recharge their mobile phones. Even the small amount of electricity required to recharge a mobile phone has become a precious commodity, readily sought out by a majority of the country's households.

Fig. 2 Inside view of a charging station in the town of Blama, Kenema District, Sierra Leone. Photograph taken by Energy For Opportunity (EFO).

The answer to the mobile phone charging quandary has been answered in many rural contexts with the rise of small energy kiosks known as mobile phone "charging stations". Usually set up by local entrepreneurs, these charge mobile phones for a tariff between 1,000 to 2000 Leones (€0.11-0.22; US$ 0.15-0.30). These charging stations are most commonly powered by small diesel generators, and use a mess of cables and plug extensions to maximise the number of phones that can be charged (see Figure 2). Most charging stations also include a light bulb placed in a prominent position on the exterior, and a large stereo blasting music (often by local artists) across the village. These are clearly visible and audible signs of electricity: the light bulbs so people can see

where electricity is available at night, the stereo so people can hear where electricity is during the day. As such the charging station operators have manipulated the sights and sounds of village life to attract their customers.

Fig. 3 Charging Station in the Diamond Mining town of Sewafe, Kono District, Sierra Leone. Photograph taken by Energy For Opportunity (EFO).

The charging station is a precarious business because the cost of purchasing diesel in most cases eats up more that 50%, and in some cases more than 80% of revenue. While the most popular energy source are small generators made by the tiger company – nicknamed the *Kabba Tiger* as a provocation of a former Sierra Leone's government inability to address electricity access issues (Sam, 2016) – these are ultimately stretched to operate for more than 12 hours each day to maximise revenue. Such constant use has its consequences and generator repairs have the potential to send operators broke. As one charging station operator from Sierra Leone's Kono District noted – generator problems often mean "closing the station for a day or two" which ultimately results in "losing customers".

Charging mobile phones in Sierra Leone thus is a precarious negotiation that has shaped the dynamic political economy of electricity access. Households constantly need to find revenue, in many cases, up to 5% of a

household's income, to ensure their mobile phones are operational. This is an increasing concern as people in Sierra Leone gradually shift from using Nokia and similar type 'brick phones' that require relatively irregular charging, to energy hungry smartphones (Samarakoon *et al*., 2017). At the same time, mobile charging station operators have to contend with the precarities of affording diesel fuel and generator maintenance to sustain their beacons of electricity supply for the rural energy scarce populace

The days of the diesel-powered charging stations could well be numbered, due to new entrants into this energyscape. Non-government organisations and aid donors have increasingly co-opted the charging station but with one important difference: they are setting up mobile phone charging stations powered by built-in photovoltaic energy systems (Kemeny *et al.*, 2014). These new – sometimes community-run, sometimes privately-owned – charging stations can effectively operate with minimal operating costs given their energy source is sunlight, although replacement batteries will present a future expense (see Kemeny *et al.*, 2014). Some local entrepreneur charging stations are following this lead, buying their own photovoltaic modules to replace their diesel generators. However, this is a small minority, as the upfront cost of photovoltaic modules is prohibitive for most. Most rural Sierra Leoneans have limited access to large (or even moderate) amounts of financing, and therefore the smaller upfront cost of *Kabba Tiger* is more financially viable, despite its high operational costs. Furthermore, household-level pay-as-you-go small solar products, with international venture funding, are also emerging in Sierra Leone's markets, providing technical and financial innovations to make mobile phone charging accessible (Wogan, 2013; also see Rolffs *et al.*, 2015). Despite these recent trends, electricity will still be scarce in rural contexts, though who will own and profit from the commodity of electricity in the context of mobile phone charging will likely shift dramatically. The scarcity will be shaped by changing political economy dynamics.

4 Discussion

The dynamic geographies of mobile phone charging in Sub-Saharan Africa illustrate how energy poverty in the region is not necessarily, as implied by the UN (2017) and other sources, about people "functioning without electricity". Instead it is a more qualitative question of *how* people find different ways to function *with* electricity in attempting to meet their livelihood demands. What is effectively a non-existent cost in most wealthy countries,[2] the charging of mobile phones for many Sub-Saharan Africa households is a substantial

[2] One study, for example, estimated that people spend around US$0.24 a year on their daily charging of their smartphones in the United States (Helman, 2013). For a comparison, the same amount of phone charging in rural Sierra Leone would cost around US$95.

financial burden (up to 5% of income) and requires a constant negotiation of the changing political economies of electricity flows in rural contexts. The comparison of the case studies of The Gambia and Sierra Leone illustrates these nuances. While Kartong in The Gambia 'gained' access to the grid electricity network in 2013 and rural Sierra Leone largely remains off the grid, the two case studies do not show a simple binary of access/inaccess to electricity that pervades representations of energy poverty. Electricity is almost always present and flowing in energy poor contexts, it is what shapes these flows that deserves our analytical attention.

The comparison of mobile phone charging in The Gambia and Sierra Leone ultimately provides a critical perspective of how energy poverty plays out at the local level and relates to wider economic, technological and political trends. The mobile phone charging sectors in both countries clearly demonstrates that everyday energy practice operates not in *absolute* electricity scarcity contexts, but rather contexts where relative scarce electricity flows are shaped by a range of different economic, social, cultural and political dynamics.

Table 1: Overview of different models for mobile phone charging

	The Gambia	**Sierra Leone**
Business type	Existing business or operation e.g. video club with additional charging facility	Charging station with optional additional business
Feasibility of business	Largely replaced by grid electricity	Viable business for now
Power source	Off-grid: Mainly diesel generators; some solar charging; On-grid: costly as mainly based on imported fossil fuels	Mainly off-grid diesel generators. With some limited applications of photovoltaic power.
Accessibility	Illiterate women and older men excluded from benefits	Based on socio-economic ability to be able to "pay" for the recharge.
Smartphones	Becoming popular since introduction of grid electricity	Increasing need for charging that benefits business
Other features	Used to purchase 'cash power' credit	Used to purchase pay as you go solar credit
Mobile phone operators	Gamcel, Africell, QCell, Comium	Africell, Orange, Sierratel, Smart Mobile, QCell (coming in late 2018).

On the one hand, there is a straightforward *economic* dimension to the flows of electricity, whereby mobile phone charging has effectively become a commodity in parts of Sub-Saharan Africa. It has become a business transaction, a for-profit opportunity for owners and/or operators of buildings that have some form of off-grid access to electricity. In The Gambian case, prior to grid access, these were structures which already serve

another purpose – for example that provided entertainment, mobile phone reception or healthcare – and were subsequently able to generate additional profit through charging mobile phones. Sierra Leone, in contrast, businesses had mobile phone charging as the central economic activity with specifically designed charging stations, although often these charging stations would frequently engage in additional income generating services such as selling drinks. Owners of these mobile charging businesses – whether they be charging stations in Sierra Leone or businesses with off-grid electricity in The Gambia – often needing to negotiate the fluctuations of both diesel supply and the challenges of generator maintenance. A precarious, nevertheless effective economy of accessible charging spaces for mobile phone users emerged in these electricity scarce contexts.

The charging of mobile phones, however, is not a solely economic exchange. Access to charging was also a *social* transaction in both case studies. The lack of direct access to electricity infrastructure for many was mitigated through social structures that emphasise the sharing of available resources. For example, in The Gambia the tailor opted to recharge (around 25 a day) mobile phones for free, thus not viewing charges as a direct commodity. In Sierra Leone many residents, on occasion, find ways to recharge their mobile phones beyond the charging station economy, whether during trips in 'bush taxis' (using DC outlets) or if they work at and/or visit an office with an operational generator. The arrival of the grid in The Gambia, although only reaching a small minority of households initially, immediately disrupted the dynamics of recharging, notably through the notion of extended family compounds. Since grid electricity became available in Kartong in 2013, the sense of sharing with friends and family has led to the shift of mobile phone charging from non-domestic structures to domestic dwellings, from an economic exchange to a social one. As such, mobile phone charging including the built environment in which this takes place, needs to be seen in wider socio-cultural (sharing) and socio-political (infrastructure development) contexts. Here, mobile phone charging has become less of a commodity and more of a socially shared resource.

There is ultimately a *political* dynamic to these flows – there are some clear divisions in terms of *who* can access electricity for charging their mobile phones and the manner in which this is accessed. There is a socio-economic dimension in the sense the poorest households are likely to be financially excluded due to the prohibitive costs of paying for charging station fees or, in the case of Kartong, paying to be connected to the grid. Wealthier households are also more likely to have family members working in (electrified) offices, own vehicles or use personal generators and therefore can live beyond the necessity of financing a daily mobile phone charge. Politics also influences the flows of electricity infrastructure and supply. The arrival of the grid in

Kartong did not translate to direct electricity access for all, rather the grid extension had a political and economic geography, with infrastructure only reaching parts of the settlement area and extensions focused on initially focused on wealthier or politically influential households - (electrical) power flows to the (economically and politically) powerful. Load-shedding, the decision to supply limited electricity production to different locations at different times also plays into this dynamic – the Government ultimately prioritise some populations (and industries) with electricity supply. The presence of a grid in Kartong, for example, does not guarantee the presence of reliable electricity flow. There are deeper structural factors at play.

There is also a *gendered* dimension in that women, especially women with poor literacy skills, are likely to be excluded from the benefits of mobile phones. Different forms of energy poverty continue to exist *within* households, even if they have financial capability to pay for mobile phone charging. Indeed, GSMA (2017, 2) estimates that women in Sub-Saharan Africa are 17% less likely to own a mobile phone than men, and they are 23% less likely to have access to internet. A household might own a mobile phone and be able charge it, but that does not mean all members have equal access – there are gender, and even ageist (i.e., illiterate elderly people of both genders being excluded) dimensions to these flows.

Finally, the links between technology, infrastructure, social practices and economies are quite striking between the two case studies (see Table 1). Technologies (e.g., smartphones, photovoltaic power) are mediated by the contexts into which they are thrust (Campbell *et al.*, 2016), new technologies in particular have multiple and often unexpected uses that are intimately entangled with socio-cultural practices and processes involving questions of gender, politics, knowledge, meaning, value and ethics (Sovacool and Drupady, 2012). For example, unlike Sierra Leone, the informal mobile phone charging sector in The Gambian case did not benefit greatly from the introduction of smartphones that need more frequent charging as it roughly coincided with the arrival of grid electricity. Instead, the sector became obsolete while most buildings continued to fulfil their primary function. A notable exception is the structure associated with the diesel generator of the Africell receptor mast which lost its purpose as the mast was relocated within the settlement area and connected to the grid. However, Gambian grid electricity continues to rely predominantly on imported fossil fuels while the trend in Sierra Leone is moving from off-grid fossil fuels to off-grid solar. Here, the mobile phone charging sector is able to adapt to some extent, continuing to provide a community-based service and potentially inspiring off-grid solar systems in the home, at which point the charging station buildings need to change their primary purpose to remain relevant. Smartphones, electricity sources and social process are entangled in a range of different ways across the two case studies.

A question that remains is whether or not electricity solutions lift people out of energy poverty more broadly. Providing enough energy to charge mobile phones, is at a par with electricity to power electric light bulbs. In isolation, these are 'limited opportunity models' that do not take into account the aspirations of people and the associated future energy use, thereby providing insufficient energy in the long run (Bhushan and Kumar, 2012, iv.; Schiffer, and Cadena, 2016). In the Gambian case, the availability of grid electricity has quickly led to the accumulation of more gadgets and equipment such as kettles, fridges and televisions at household level. In Sierra Leone this trend will likely follow as electricity becomes available at household level, mobile phone charging is integrated into the home and demand for other devices rises.

5 Concluding remarks

Comparing mobile phone charging in The Gambia and Sierra Leone clearly shows that the binary concept of *absolute* scarcity which is promulgated by the IEA is ill-suited in providing a detailed picture of energy poverty at the locale. Drawing on Scoones et al.'s (2018) notion of 'political scarcity', we have shown how electrical scarcity is shape by a range of political economic process across different scales, spaces and temporalities. Ultimately paying attention to these dimensions offers a more human-centred and nuanced understanding of how energy poverty operates or is mitigated at household and community level. This includes how structures are purpose-built or appropriated for mobile phone charging and how their energy function changes as new technology or infrastructure becomes available and communication culture changes.

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