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Energy Justice and Off-Grid Solar Electrification in Africa: Trends, Narratives and Contestations

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1.1 Introduction

Access to sustainable energy remains a major challenge for energy policymakers in Africa. Based on estimates, 600 million people in sub-Saharan Africa (SSA)—about 57% of the population—are without access to electricity (IEA, 2019). Total electricity use for over a billion people in SSA (excluding South Africa) is less than that of Spain (*The Economist*, 2022). Power consumption per capita in SSA (excluding South Africa), estimated at 180 kWh, is very low, compared to 13,000 kWh per capita in the United States and 2000 kWh in other countries in the Global South (AfDB, 2019). According to estimates, in 2019, 90 million, 70 million and 58 million people were without access to electricity in Nigeria,

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N. Ojong (ed.), *Off-Grid Solar Electrification in Africa,* Energy, Climate and the Environment,
https://doi.org/10.1007/978-3-031-13825-6_1

Democratic Republic of Congo and Ethiopia respectively, and globally, they were the largest deficit countries (World Bank, 2021).

Additionally, in several countries in the continent even people who are connected to the national grid face frequent power outages. In the last three decades, more than 500 million people in the continent have experienced power outages, in over 20 countries, including Kenya (Kiprop et al., 2019), Nigeria (Babajide & Brito, 2021), Ghana (Amoah et al., 2019; Boamah & Rothfuß, 2020), and Cameroon (Amadu & Samuel, 2020; Landry, 2018; Muh et al., 2018; Njoh et al., 2019). In Liberia, over 50% of households connected to the national grid report that they never have electricity; in Uganda and Sierra Leone, more than 30% of households connected to the grid never have electricity, while in countries such as Burundi, Guinea and Zimbabwe, more than half of households connected to the grid receive electricity less than 50% of the time (Blimpo & Cosgrove-Davies, 2019). In Cameroon, power outages last at least 1000 hours per annum (Amadu & Samuel, 2020; MINEE, 2015).

Solar power is increasingly regarded as having an important role to play in tackling the continent's energy issues. The attractiveness of solar power is because its 'functioning depends on one of the continent's most abundant resources, namely solar radiation' and '[g]iven its location on the equator, Africa emerges as one of the world's sunniest continents' (Njoh et al., 2019: 17). This abundance of solar radiation in the continent has been used by advocates of renewable energy or solar energy to be more precise, to push for off-grid solar electrification in the continent.

Off-grid solar technologies, that is those solar energy technologies which function outside the national grid such as lanterns, pico-systems, solar home systems, micro- or mini-grids are increasingly being used in Africa to help reduce the electricity access gap as well deal with the limitations of the national grid. This push for off-grid solar electrification in the continent received renewed support, as it is in line with the Sustainable Development Goal 7 (SDG7) that aims 'to ensure access to affordable, reliable, sustainable and modern energy for all'. In SSA, sales of single-light lanterns and small solar home systems of 10 W or less, increased from less than half a million in 2011 to 11.3 million in 2015 (Africa Progress Panel, 2016). Sub-Saharan Africa accounts for 70% of

the total global sales of solar home systems (Kizilcec & Parikh, 2020). In East Africa, 2.43 million units of certified off-grid solar products, such as solar lanterns and solar home systems, were sold in the second half of 2019, an increase of 40% over the first half of that year (GOGLA, 2019). In West Africa, 182,000 portable lanterns and 124,000 solar home systems were sold in the second half of 2020 (GOGLA, 2021). In Central Africa, 92,000 portable lanterns were sold in the second half of 2020, that is a 261% increase compared to the first half of 2020 (GOGLA, 2021). After over a decade of using off-grid solar technologies in the continent, the time is ripe to take stock of the off-grid solar energy sector.

More precisely, we aim to take stock of off-grid solar electrification in Africa by examining how political, economic, institutional, and social forces shape the adoption of off-grid solar technologies, including how issues of energy injustice are manifested at different levels and spaces. Hence, with such a vast field before us, we ask a few guiding questions that will begin the debate. How do political, economic, institutional and social forces influence the adoption of off-grid solar technologies in Africa? What are the energy injustices associated with off-grid electrification? And how are these injustices manifested? These are important questions which need answers since off-grid technologies are now part of the energy landscape in Africa and energy systems affect people's lives. Notably, our focus on injustices in the off-grid solar sector in Africa is of particular importance since the energy justice framework is often applied to Global North-based case studies. As Lacey-Barnacle et al. (2020: 123) puts it:

> [T]here are few evaluations of particular energy justice issues or themes arising in developing country contexts, and which therefore either require new theoretical approaches, could start a dialogue to compare these themes with those arising in developed country contexts, or indeed which may offer new lessons for developed country contexts.

To begin, this chapter first focuses on the concept of 'energy justice'. I examine various approaches to energy justice, including engaging with western and non-western perspectives of the concept. The final section of

this chapter shows how the different chapters of this volume engage with our guiding questions in three parts: history and politics of off-grid solar electrification, manifestations of energy injustices and enabling uptake.

1.2 Off-Grid Solar and Energy Justice: A Conceptual Framework

As the benefits and impacts of energy systems, including off-grid solar technologies, are distributed highly disproportionately, 'energy justice' as a concept—rooted in environmental justice, that focuses on the uneven and unjust distribution of environmental effects such as pollution and climate change (Agyeman et al., 2002, 2003)—has gained rapid usage in energy-related social science (Jenkins et al., 2021; Sari et al., 2017; Sovacool & Dworkin, 2014). Energy justice focuses on the nexus between energy with respect to generation and delivery on the one hand, and justice on the other hand (Jenkins et al., 2016). It entails critical analyses of where (in)justice occurs within energy systems, including how justice might be attained, especially in the renewable energy sphere (Jenkins et al., 2016; McCauley et al., 2013; Sovacool et al., 2017). Injustices in the energy system may be related to issues such as class, race, ethnicity, age, gender or spatial and economic inequalities (Feenstra & Özerol, 2021; Healy et al., 2019; Hunsberger & Awâsis, 2019; Lee & Byrne, 2019; Ojong, 2021, 2022; Sunter et al., 2019).

Sovacool and Dworkin (2014: 13) define energy justice as 'a global energy system that fairly disseminates both the benefits and costs of energy services, and one that has representative and impartial energy decision-making'. This definition highlights three core elements: costs (i.e., how the hazards and externalities of energy systems are distributed unevenly), benefits (i.e., how access to energy systems and services are often uneven), and procedures (i.e., failure by energy projects to follow due process and representation with respect to decision-making) (Sovacool, 2013; Sovacool & Dworkin, 2014). Put differently, an energy-just community is one which 'promotes happiness, welfare, freedom, equity, and due process for both producers and consumers […]', 'distribute[s] the environmental and social hazards associated with energy

production and use without discrimination […]', 'ensure[s] that access to energy systems and services is equitable' and 'guarantee[s] that energy procedures are fair and that stakeholders have access to information and participate in energy decision-making' (Sovacool & Dworkin, 2014: 13).

Other scholars have defined energy justice as having three central tenets—distribution, recognition, and procedural justice (Heffron & McCauley, 2014; McCauley et al., 2013). Distributive justice focuses on inequities in the distribution of benefits and harms across an energy system (Jenkins et al., 2016; Walker & Day, 2012) and assesses where 'questions about the desirability of technologies in principle become entangled with issues that relate to specific localities' (Owen & Driffill, 2008: 4414). It seeks out injustices and attempts to address them (Jenkins et al., 2016; McCauley, 2018). These harms and benefits are found at various levels of energy systems, that is, extraction, production, consumption, and disposal (Fuller & McCauley, 2016). Framed this way, distributional justice is linked to issues of poverty, inequality, especially as they relate to people in marginalized communities. Here justice entails the distribution of what the influential social theorist, John Rawls (1971: 62), termed the 'primary goods' of 'rights and liberties, powers and opportunities, and income and wealth'. Rawls (1971) contends that these primary goods should be distributed in a manner a hypothetical person would choose if, at that time, they were ignorant of their own status in society. In other words, 'to ask whether a society is just, is to ask how it distributes the things we prize…A just society distributes these goods in the right way; it gives each person his or her due' (Sandel, 2009: 19). This points to 'justice as fairness' or justice as just distribution (Rawls, 1971).

In the renewable energy sphere, justice as just distribution is complex and plays out differently depending on the geographical and historical contexts. The embeddedness of an energy system in these contexts produces injustices. For instance, marginalized people may give away their land to make way for small-scale renewable electricity systems projects, hence depriving them of income generation opportunities (Ojong, 2022; Osunmuyiwa & Ahlborg, 2022). Deprivation of income generation activities could render access to energy services unaffordable (Osunmuyiwa & Ahlborg, 2022).

Beyond issues associated with land ownership and dispossession as they relate to solar projects, justice as distribution encompasses aspects such as financial burdens of off-grid solar technologies which are shouldered by low-income populations (Grimm et al., 2020; Muchunku et al., 2018), post-acquisition support (Davies, 2018; Rolffs et al., 2015; Samarakoon, 2020; Tillmans & Schweizer-Ries, 2011), and disposal of these off-grid technologies (Cross & Murray, 2018; Samarakoon et al., 2022). Distributive justice engages with critical questions of 'local skills, system maintenance, product longevity, and the environmental impacts of mass consumption' (Cross & Murray, 2018: 102). This conception of distributive justice recognizes the mechanisms that increase energy injustice at multiple scales: landscapes of material deprivation, geographic underpinnings of energy affordability, vicious cycles of vulnerability, and spaces of misrecognition (Bouzarovski & Simcock, 2017).

Recognition justice is another tenet of energy justice. Recognition justice considers people whose views are side-lined in an energy system and how they should be recognized (Jenkins et al., 2016). It recognizes that certain populations, such as the chronically poor, ill, or the unemployed may need affirmative action, and 'seeks to ensure the acknowledgment of marginalized and/or disadvantaged groups in relation to energy systems' (Lacey-Barnacle, 2020: 3). From this perspective, recognition justice gives attention to the ways and degree to which different forms of knowledges are valued and incorporated into an energy system (McCauley et al., 2013).

A lack of recognition may manifest itself not only as a failure to recognize, but also as misrecognizing—a distortion of people's views that may appear demeaning or contemptible (Schlosberg, 2003). In other words, it is vital to acknowledge the divergent perspectives rooted in geography, history, cultural, social, racial, gender and ethnic differences (Fraser, 2014; Munro et al., 2017; Schlosberg, 2003). This framing rejects the expert-driven conception of energy access that excludes perspectives of populations who are the beneficiaries of renewable energy projects (Chatti et al., 2017; Munro et al., 2017).

Procedural justice, a third tenet of energy justice, centres on whether decision-making processes regarding energy systems are fair (Jenkins et al., 2016; McCauley, 2018; Yenneti & Day, 2015). It is concerned

with equitable procedures that engage all stakeholders in a non-discriminatory way (McCauley et al., 2013; Walker, 2009). As Sovacool et al. (2019: 582), put it:

> [A]ll major socio-technical transitions require open and democratic participation by a wide range of actors (including firms and consumers, as well as civil society groups, media advocates, community groups, city authorities, political parties, advisory bodies, and government ministries) to minimize unwanted impacts.

This is important since democratic decision-making is fundamental to justice and the production of just outcomes (Young, 1990). Democratic decision-making requires meaningful involvement of all regardless of gender, race, class, religion, sexuality, and income (Buckingham & Kulcur, 2009; Bullard & Johnson, 2000; Schlosberg & Carruthers, 2010).

Framed in terms of decision-making processes, procedural justice takes into consideration a particular set of principles. For example, Sovacool et al. (2017: 687) proposed ten principles: (1) availability (sufficient energy resources of high quality); (2) affordability (stable and equitable prices); (3) due process (ensuring stakeholder participation); (4) transparency and accountability (promoting high quality access to information about energy as well as accountable and transparent forms of energy-related decision-making); (5) sustainability (promoting the sustainable use of resources that minimize waste and adverse impacts on the environment); (6) intra-generational equity (fair access to basic energy services among different communities); (7) intergenerational equity (distributive justice between present and future generations); (8) responsibility (duty to protect the natural environment and minimize energy-related social and environmental costs); (9) resistance (actively oppose energy injustices); and (10) intersectionality (encompassing new and evolving identities).

Beyond the three pillars and principles of energy justice, the conception of energy justice in this book highlights 'not only where and how the benefits and burdens' of off-grid solar energy technologies are

'distributed, but also when and who experience these' (Malakar et al., 2019: 17). With respect to 'who', that is, adopters of off-grid solar technologies, their use of these technologies should not be detrimental to others, as such a scenario goes against the *Ubuntu* philosophy.

Ubuntu is a moral theory of humanness (Akinola & Uzodike, 2017; Metz, 2007; Ramose, 1999; Tutu, 2012) and a theory of justice and fairness (Kgatla, 2016; Moeketsi, 2014). According to the *Ubuntu* philosophy, personhood is formed interdependently through community (Battle, 2009; Mupedziswa et al., 2019), and the wellbeing of individuals cannot be 'divorced from communal imperatives' (Petersen, 2006: 55). In other words, a communitarian ethic is foundational to Ubuntu (Biko, 1987; Mandiva & Chingombe, 2013; Mbigi & Maree, 1995; Mkhize, 2008; Ramose, 1999). Common principles and values rooted in the *Ubuntu* philosophy include mutual caring, reciprocity, respect, harmony, shared responsibility, solidarity, trust, generosity and compassion, dignity, deliberative and consensus decision-making, and inclusivity (Broodryk, 2008; Burgess, 2017; Chigangaidze et al., 2022; Kgatla, 2016; Mabvurira, 2020; Ramose, 1999; Tavernaro-Haidarian, 2018; Tutu, 2012).

With respect to off-grid solar electrification, people's use of energy services should not take precedence over communal world. *Ubuntu* stresses 'living well together' (Deneulin & McGregor, 2010 cited in Norren, 2014: 256), 'with the stronger helping the weaker members of the community' (Munyaka & Motlhabi, 2009). Thus, the uneven distribution of the benefits and harms of energy services goes against community cohesion which is central to *Ubuntu* (Chibvougodze, 2016; Sanusi & Spahn, 2020). Also, the uneven distribution of benefits and harms of energy services, including the marginalization of certain individuals/groups in decision-making or failure to consider views (re)produces inequalities in communities. Munyaka and Motlhabi (2009) emphasize that according to the *Ubuntu* philosophy, all people have *isidima* (dignity) and 'no one is either superior or inferior in humanity'. In sum, this conceptual framework engages with western and non-western perspectives of energy justice.

1.3 About the Book

Off-Grid Solar Electrification in Africa contributes to the emerging gaps in energy justice by examining case studies of injustices in the off-grid solar sector in low-income, non-western societies. Thus, the book takes a historical, contemporary and projective outlook. This positions the aim of this book as one that (1) provides novel and non-western examples of how political, economic, institutional, and social forces shape the adoption of off-grid solar technologies, and (2) considers how issues of energy injustice are manifested at different levels and spaces. In executing this project, we bring together real-world experiences from pre- and ongoing electrification communities in countries such as Ghana, Kenya, Rwanda, Sénégal, Malawi, Tanzania and Nigeria.

Beyond the diverse nature of these countries in terms of their geographical location in West, East and Southern Africa, each is quite unique in terms of its colonial history, economic and institutional infrastructure, and level of adoption of off-grid solar technologies. For instance, Kenya, a former British colony, is the largest market in Africa for off-grid solar products (GOGLA, 2019; USAID & Power Africa, 2019), and according to the country's National Electrification Strategy, off-grid solar technologies have a vital role to play in achieving electricity access for all Kenyans (Lighting Africa, 2018a). Based on estimates, 10 million Kenyans have adopted off-grid solar technologies, up from less than a million in 2009 (Lighting Africa, 2018b). Unsurprisingly, the East African country is regarded as a leader for renewable energy in Africa. Sénégal, a former French colony, has hosted the 'largest number of international interventions, bilateral or multilateral, in the field of renewable energy' (Minvielle, 1999: 63 cited in Trompette et al., 2022). Additionally, as Trompette and colleagues note in their chapter in this volume, this West African country has one of the largest mini-grid portfolios in SSA. Malawi is one of the poorest countries in the world and about 50.7% of its population lives in poverty (World Bank, 2022). It has the lowest average population access to electricity (7.2%) in Southern Africa (McCauley et al., 2022), and one of the lowest population access to electricity (13.4%) in Africa (IEA, 2020). Just 3.9% of rural residents in Malawi are connected to the grid (NSO, 2019). Rwanda is recognized as

one of the most vibrant SHSs markets in East Africa (Bisaga & Parikh, 2018), with over 20 SHSs providers. Over 800,000 solar products have been sold in the country since 2014 (USAID, 2019). In 2017, SHSs providers in the country received over US$30 million in investments from for-profit investors (USAID, 2019).

The first part of *Off-grid Solar Electrification in Africa* provides historical, political and institutional perspectives on off-grid solar energy in the continent. The second part then engages with real-world manifestations of injustices in the off-grid solar sector. In the third and final part, the book adopts a projective outlook by identifying opportunities and constraints to the uptake of off-grid solar technologies.

1.3.1 History and Politics of Off-Grid Solar Electrification

This first part of the book sheds light on the history and politics behind the growth of off-grid solar electrification on the continent. It begins with Chapter 2, which uses a historical perspective to critically examine the rapid growth of the off-grid solar sector as an influential response to acute energy poverty across SSA. In particular, the chapter delves into the origins of key players, financial flows and critical junctures in the sector's journey to date. It interrogates the degree to which the social mission that catalyzed the expansion of the off-grid solar sector is being undermined by broader structural dynamics of the capital investment upon which it is reliant. The chapter questions the triumphalist narrative of off-grid electricity access success presented by the sector, with a particular emphasis on how its ideological commitment to market-based solutions create inequitable outcomes.

Chapter 3 examines the politics of off-grid electrification in Sénégal. It scrutinizes the role of public policies in shaping the plural landscapes of rural, off-grid electrification in Sénégal in the last two decades, during which successive proactive policies of so-called 'rural electrification' have taken place. The chapter analyses the way in which these policies and their regulations have shaped different market segments involving a diversity of actors (transnational and local small and medium size

enterprises) alongside the state-based electricity leader, Société nationale d'électricité du Sénégal (SENELEC), making offers that combine or compete locally. It argues that opening the sector to private operators who, as the neoliberal narrative goes, are more efficient and well placed to accelerate electrification, has paved the way for an unequal geography with significant territorial disparities in both service provision and pricing. The chapter also argues that these inequalities have given rise to social and political controversies, including internal conflicts among the country's political and economic elites.

Chapter 4 is another example of how policies, institutions and regulation shape the diffusion of off-grid solar technologies. It assesses the last decade of the off-grid solar sector in Rwanda and the critical milestones that have steered its shift from a fragmented and unregulated market of solar products to an important contributor to the country's energy access efforts it is at present. It argues that policies put in place have enabled a significant percentage (60%) of the population to have access to electricity in 2021, compared to just 10% in 2010, with almost 16% of households accessing electricity through off-grid energy systems, mostly solar. The chapter takes a closer look at the country's National Electrification Plan and identifies issues related to procedural justice and recognition justice.

1.3.2 Manifestations of Energy Injustices

Part II explores real-world examples of injustices in the off-grid solar sector. Chapter 5, based on a critical review of the scholarly literature on SHSs in Africa, maps out injustices along multiple dimensions. It argues that the upbeat and mobilizing narratives around the use of this off-grid solar technology often obscures the multiple injustices which are noticeable in their inner workings. It highlights distributional, recognition and procedural injustices with regards to energy access. These injustices are manifested at various levels and spaces, including within households. The chapter also engages with the philosophy of *Ubuntu* as it relates to energy access, hence combining western and non-western philosophical notions of energy justice.

Chapter 6 provides examples of distributive, recognition and procedural injustices in the off-grid solar sector in Malawi. It critically investigates the shift in responsibility for energy provision from the state towards households. In particular, it examines the justice implications of the commoditization of electricity as reflected in a two-tiered off-grid solar market—comprised of both certified and uncertified products. It details how end-users experience these two tiers in terms of issues of affordability and quality, consumer literacy and protection, as well as repair and disposal. While recognizing the limitations of a market-based approach to addressing energy poverty, the chapter concludes with recommendations that could help Malawi's off-grid solar market deliver more just and sustainable outcomes for underserved populations.

Chapter 7 draws on a case study from rural Tanzania to investigate the energy justice implications of off-grid solar in relation to gender and low-income households. It shows that there is equality in the adoption of of-grid solar technologies across female-headed and low-income households; however, this does not imply there is equity in the off-grid solar sector. The chapter contends that although these solar technologies do not seem to actively disadvantage women, their deployment is not a clear win for gender equality as was previously promised. It argues that SHSs are promoted as technologies which increase the quality of life and economic prospects for women, children and low-income groups, but, in practice, solar systems beyond lanterns remain out of reach for these segments of the population.

Chapter 8 provides examples of injustices in the grid and off-grid sectors in Kenya. It shows that even though Kenya is regarded as a shining example due to its impressive results in terms of on-grid and off-grid electrification, there are still segments of the population without access to electricity. The chapter identifies segments of the population without access to both the national grid and off-grid solar technologies and shows why these segments of the population are 'left behind'. It shows that the impressive statistics regarding households connected to the centralized grid conceals the fact that, in practice, some of these households do not have access to electricity. Similarly, the chapter notes that while sales data are often used to estimate how many people have access to solar systems, there are still many unknowns, such as how many

of the household-level systems are functioning and how many hours per week do people get from energy services such as powering light bulbs, powering a television, charging a mobile phone and powering kitchen appliances.

1.3.3 Enabling Uptake: Constraints and Opportunities

Part III of this volume adopts a projective outlook by examining the constraints and opportunities related to the adoption of off-grid technologies among people without prior solar energy access experience. Chapter 9 draws on a case study in rural Nigeria to examine the constraints and opportunities associated with the adoption of off-grid technologies. It shows that the low-income status of end-users and economic situation of a given location in terms of economic activities influence the likelihood of adopting off-grid solar technologies. It notes that although most rural households expressed willingness to adopt off-grid solar technologies, their economic condition makes it challenging for them to do so. The chapter shows people did not want to adopt SHSs, since installing the solar panels on roofs renders water, often collected from roofs contaminated. It notes that this is a major constraint to SHS adoption since people use water collected from roofs for cooking and other household activities. The chapter also shows that some people were unwilling to adopt off-grid technologies, as doing so would transfer responsibility for electricity provision from the state to individuals.

Chapter 10 draws on a case study in urban Ghana to explore the constraints and opportunities linked to the adoption of off-grid technologies. It shows that various factors such as affordability, availability of solar products on the market, government incentives, product quality and recommendations from other users influenced the likelihood of people adopting off-grid solar electrification technologies.

In sum, the chapters in this book all speak to the issues of energy justice with a particular focus on off-grid solar technologies. As I show in the concluding chapter (Chapter 11), the different case studies covered

in this book render it possible to compare and contrast the manifold manifestations of injustices. This 'compare and contrast' exercise enabled the identification of similar transmission mechanisms for off-grid solar energy policy, and it equally brought to the fore similarities and differences with respect to the application of energy justice theorizing. Thereafter, the chapter critically assess the transformative potentials of renewable energy technologies in general and off-grid solar systems in particular.

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