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Leapfrogging the Grid

Off-grid Solar, Self-reliance and the Market in Tanzania

Abstract: Around a third of Tanzanians light their homes with solar electricity. Foreign companies are building on the popularity and availability of solar to 'leapfrog' the classic state-led mains electricity grid infrastructure by attempting to create new off-grid infrastructural pathways. Central to such ambitions is the fostering of individual ownership of these off-grid infrastructures that builds on the idea of self-reliant energy long known to Tanzanians. Yet, such individual ownership, enacted through the hire-purchase device, is precarious, leading to an infrastructure that not only grows but contracts. As it does so, off-grid infrastructures illuminate the dependencies and tensions, including temporal ones, of other techno-social grids. These grids include both emerging digital financial infrastructures and other forms of kinship-based social organisation and property relations.

Keywords: electricity, kinship, solar, the market, utopia

It is nearing dusk when Samuel the solar company loan officer, two *mafundi* (maintenance workers) and their tag-along anthropologist alight from a 1990s Land Cruiser at a *boma*, a Maasai homestead in northern Tanzania.[1] The sounds of cowbells and the lowing of cattle hang in the air, as gentle as the coming encounter would be violent. The group walk to the only brick building, a two-roomed single-storey house, where a middle-aged woman is standing outside. Samuel greets her politely, then asks for her name and that of her husband. '*Hebu tuangalie*' ('Alright, let's see'), he mutters, pulling his finger down a piece of paper, now creased at the end of the day, on which are printed a list of customers and their outstanding balances. He locates the husband's name and asks the woman to take him and the *mafundi* to the home solar electricity system that is on hire-purchase from the company he represents.

Entering the house, Samuel reaches instinctively to the white plastic light switch tacked to the wall and flicks it. To his surprise, the bare bulb hanging above him illuminates. The customer has failed to keep up with his repayments and the remote monitoring set-up should have automatically disabled the system. It is obvious to everyone the system has been tampered with.

Samuel turns to the *mafundi*, instructing one to climb onto the house's corrugated iron roof to remove the solar panel. '*Chap, chap*', he says. Gesturing to the other *mafundi* to follow him, they go back inside the house, unplug the heavy battery and its bright yellow plastic controller and hurriedly carry the equipment out together. Busy squeezing the components into the back of the car, between the other equipment they had repossessed that day, they don't at first notice the

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> crowd of men growing behind them. Then they do. One visibly irate young man, whom they later learn to be called Namelok, addresses them in Kiswahili: 'Who gave you permission to take the system?' he demands.

This event unfolded within a recent and ongoing influx into Tanzania of off-grid solar power; that is, photovoltaic components designed to produce electricity independently from the mains electricity grid. Currently, around a third of the country's households light their homes this way (Ministry of Energy 2020) and it has become an increasingly popular energy source for appliances such as TVs, radios and mobile phones. With this solar unconnected to the mains grid, Tanzanians place it in a category of energy they call *nishati ya kujitegemea* – self-reliant or independent energy.[2]

Since the early studies of large-scale socio-technical systems (Bijker and Law 1992), infrastructures have proven to be productive objects for social scientific reflection. Those that have attracted most anthropological attention are the classic high-modernist state-led, and often grid-like, centralised and industrial-size infrastructural forms, including housing (Humphrey 2005), transport networks (Latour 1996; Harvey and Knox 2015), water systems (von Schnitzler 2008; Anand 2017) and national electricity networks (Winther 2008; Degani 2017). The state is so closely associated with infrastructure – although with some important exceptions (for example, Hughes 1993) – that Brian Larkin, in his seminal essay, suggests the poetics of infrastructure is the 'means by which a *state* proffers . . . representations to its citizens and asks them to take those representations as social facts' (2013: 335; emphasis added). In Tanzania, the national electricity grid infrastructure, constructed and maintained by the government parastatals Tanzania Electric Supply Company Limited (TANESCO), established in 1964, and the Rural Energy Agency (REA) formed more recently in 2007, is similarly associated by citizens with the state and its modernist, development planning. This planning also exhibits particular characteristics. Tanzania's electricity grid, for instance, has expanded slowly but unevenly over the national territory and is prone to frequent breakdowns. Such trajectories along temporal and spatial scales align with the view in the social scientific literature, as well as in the popular imagination, that infrastructures tend to expand across large areas of space and unfold and endure over long stretches of time (Howe et al 2015). For example, Soviet Russia's state apartment blocks, pipes, boilers and sewage systems, which were not swept away by the country's neoliberal reforms but had to be strategically incorporated into new forms of economic and political calculation (Collier 2011).

Inspired by the mobile phone, the efforts to build off-grid electricity infrastructures are coinciding and responding to appeals by scholars, activists and commentators of various political persuasions for countries in the global South to produce radically novel infrastructural futures. To do so requires the creative deployment of technological innovations, often originating from and developed

elsewhere, to chart alternative infrastructural pathways to those already known grid-inspired ones, in a process popularly known as 'leapfrogging' (e.g. Gupta 2015). The leapfrogging electrification ambitions, embodied in off-grid solar, are a form of utopian speculation, in ways not wholly dissimilar to H. G. Wells' belief that Vladimir Lenin envisaged the role of universal electricity for Russia in his GOELRO electrification scheme. As Wells wrote, 'Lenin, who like a good orthodox Marxist denounces all "Utopians", has succumbed at last to Utopia, the Utopia of the electricians' (quoted in Stites 1991: 49). Yet while there is nothing inherent in the idea of leapfrogging that precludes the state as a lead actor, in Tanzania today it is market actors, often with a social conscience, that have assumed for themselves the utopian responsibility for creating the novel pathways that they believe will lead to universal electricity (see also Cross and Street, this issue).

In Tanzania, the market-led off-grid electricity infrastructure is growing especially rapidly and is hopping to those isolated locales where, owing to resource constraints, the state grid is incapable of reaching, or sometimes unwilling to reach. These infrastructures are akin to traditional grids in that they are also vulnerable to breakdowns and power outs, yet their morphologies are dissimilar. They are marked not only by expansion but by contraction in terms of access to the very infrastructure itself (rather than what is allowed to flow through it), which can be removed either voluntarily, by customers, or involuntarily, in the case of repossessions. These infrastructures do not '"grow" incrementally' (Appel et al 2018: 12).

Focusing on the revitalisation of a particular market-centred credit/debt device, hire-purchase, this article argues that the unfolding of utopian aspirations of *off-grid* electricity in Tanzania illuminates the dependencies and tensions with *grid*-like techno-social formations (see also Donovan and Park, this issue).[3] These grids include not only the financial, and increasingly telecommunication and data-centric, market economy ones, but also those kinship ones that gesture toward alternative forms of property, ownership and obligation, as well as temporality. In focusing on the unfoldings and frictions in Tanzania of leapfrogging, utopian ambitions that promote an individual self-reliant and non-grid electricity, this article contributes to a growing body of literature that explores the social, political, economic and cultural dimensions of electricity in the global South (Winther 2008; Gupta 2015; Degani 2017; Phillips 2020; Cross 2019; Cross and Neumark 2021).

The encounter with Namelok was just one of the many encounters, as well as discussions and observations, on which the argument in this article is based. Between 2018 and 2019, I spent twelve months in northern and central Tanzania with staff, including sales officers, loan officers, data analysts, customer service representatives and higher-level executives, from three foreign off-grid solar companies. I sat with staff in the company offices, shops and warehouses, and accompanied them in private cars and buses as they visited their urban and rural

customers. During my fieldwork, I also stayed in villages and in towns, living among and talking with the customers.

Grids and Rural Electrification

In Tanzania's colonial period, the authorities assumed little responsibility, even on behalf of the European population, for the provision of electricity, making it somewhat distinct from other infrastructures such as roads, water and sanitation (Hasenöhrl 2018: 16). It was only on independence, when the new Tanzanian government led by President Julius Nyerere began planning for the electricity provision he deemed essential for the nation's economic growth and development. Central to such plans was the construction of hydroelectric power plants fed by large-scale dams, the symbolic and political value of which, as with other large-scale infrastructure, has long been known and articulated by political leaders across the globe. At the opening of one hydroelectric plant, Nyerere himself argued that 'Schemes such as this one are in fact the bricks and mortar evidence of the revolution which our country is deliberately and purposefully undergoing' (Hoag and Öhman 2008: 632). His well-documented attempt to produce a socialist revolution in Tanzania hinged on industrialising through processes dependent on electricity-powered heavy machinery, such as aluminium smelting, textile manufacturing, cotton ginneries and sugar processing (Havnevik 2019: 84–95).

What, then, of rural electrification? Long before Tanzania's independence, the British electrical company Woodhouse and Rawson published an advertisement in 1890 with the tagline, 'What is wanted in darkest Africa is the electric light'. Depicted in the accompanying, deeply problematic, illustration was Henry Stanley accompanied by indigenous African men. The scene is illuminated by an incandescent bulb hanging from a branch above the British explorer (Hasenöhrl 2018: 14–15). Yet, when Tanzania achieved independence in 1961, rural electrification played only a bit part. Nyerere's *Ujamaa* villagisation scheme included no clear plans to bring electricity to the rural hinterlands, and did not result in any attempts to do so. In intention, while Nyerere's electrification plans differed from those of Lenin, who desired to extend the benefit of electricity to everyone in socialist Russia in the early twentieth century, the results for both countries' rural population ended up similarly dismal (Coopersmith 1992).

In 1992, over a century after the Woodhouse and Rawson advertisement, a report by TANESCO and the Stockholm Environment Institute stated that the electricity grid had reached less than 1% of Tanzania's 8,600 villages and of those, less than 20% of households were actually connected to it (Kjellström et al 1992). State-led electricity planning, then, as well as the private small-scale precursors that also characterise the early history of electricity (Hughes 1993), was little burdened by the needs or desires for electricity of the rural populace in Tanzania, beyond inclusion, through employment, in large-scale industrial and agri-

cultural schemes. Like in the broader region of Africa, planners have for a long time considered the rural populace as lacking in both the desire for electricity and the capacity to pay for it (Hasenöhrl 2018). Such perceptions have begun to change as planners recognise rural demands and, to some extent, growing financial capacities to share in the country's modernist aspirations. Yet, despite the establishment of REA, and the doubling of its budget under the late President Magufuli to US$239 million (Eberhard et al 2018: 24), rural electrification in Tanzania still struggles to keep pace with demand. Many rural dwellers remain dependent on wood, charcoal and kerosene for their cooking and lighting, or on batteries and, occasionally, on diesel generator-driven electricity micro-grids established by local businesspeople.

Universal Electricity

National and international ambitions to provide universal access to electricity have become more prominent in recent decades, embodied in, for instance, the Sustainable Development Goal (SDG) 7 that seeks to 'ensure access to affordable, reliable, sustainable and modern energy for all'. It is also a goal that development actors and governments view as instrumental to the achievement of many others, including ending poverty, achieving good health and well-being, and securing quality education. In the twenty-first century, these goals, as well as other varied interests, have spurred new thinking, planning and investment that have resulted not only in the continued construction of electricity grids but also the building of non-grid, distributed, yet as I will go on to discuss, still networked, electricity infrastructures. Statistically, almost half of the total electricity consumption across the whole of Tanzania is now off the grid, with an increasing proportion from renewables (Eberhard et al 2018: 2).

In the global South, off-grid, renewable electricity, particularly photovoltaics, has emerged from processes beginning in the 1990s that have seen the confluence of economic liberalisation with new thinking and concerns, particularly among aid donors and multilaterals, about rural development and the climate. Throughout the 1990s and into the very early 2000s, however, photovoltaics were only a negligible technology in East Africa, confined largely to the rural or peri-urban middle-classes (Jacobson 2007). Further into the twenty-first century, massive reductions in the global production costs of photovoltaics, owing to favourable policies in East Asia such as land enticements, subsidised energy, grants and tax breaks, have led to what some commentators and academics view as a recent revolution in solar power. For instance, 99.9% of the world's photovoltaic modules and solar power plants have only been constructed in the last decade and a half (Mulvaney 2019: 1, 26).

Curiously, off-grid solar resembles the very early days of electricity both abroad and in Tanzania, when electricity was generated and distributed within small, independent networks as a private, rather than public, good. Yet off-grid

solar unfolds under very different circumstances. Not only is the national, state-led electricity grid now a long-established part of colonial and post-independent modernist ambitions in Tanzania, even if it has failed to deliver, but also electricity has lived, more recently, within a socio-political landscape in which many public goods have been privatised (Degani 2013; Eberhard et al 2018). Currently, the dominant model for the distribution of photovoltaics in Tanzania is according to principles commonly understood as underlying neoliberal economics: of individual responsibility, the desirability of profit, and particular temporal and spatial characteristics, such as a rapid pace and ambitions of a universal, often decontextualised, global reach.

Noticeably, such market tenets have accompanied and driven the growth of Silicon Valley-inspired humanitarian and development entrepreneurialism that aspires to bring the successes of tech innovation to electricity in the global South (see also Scott-Smith 2016). Take, for example, the three young Americans who in 2011 turned up to the office of a British solar expert based in the northern town of Arusha, the tourist gateway to the plains of the Serengeti. One of the Americans had already made a name for himself in the philanthropic current that runs through Silicon Valley, while another was a Kiswahili-speaking NGO worker who had previously been working in the town. They had all met while studying at a prestigious business school in Europe, where they had hatched a plan to establish a social enterprise bringing electricity to rural Tanzania. It would, they hoped, succeed where grid electricity had failed and electrify the unelectrified in Tanzania first, and eventually, they hoped, the billions more across the world. The company they formed, which after some experimentation eventually fell on the hire-purchase model, joined a collection of recently established foreign off-grid solar start-ups emerging around the same time. Many of these start-ups, some of which have transitioned into multinational companies, have targeted the continent of Africa, and particularly East Africa, attracting hundreds of millions of dollars in finance, from impact investment (i.e. designed to produce social and environmental impacts as well as financial returns) to private equity, and from the corporate social responsibility schemes of oil companies such as Shell and European electricity giants such as ENGIE and E.ON (Cross and Neumark 2021).

Leapfrogging the Grid

The market-led off-grid solar efforts in Tanzania, spearheaded predominately by foreign companies, have a resemblance to the humanitarian and development efforts that Peter Redfield (2012) has discussed, where specific technologies, such as an individual water filter, are designed to take the place of classic large-scale infrastructures, such as village-level water and sewage systems consisting of reservoirs, storage tanks, treatment plants and pipes. Here the aim is not to challenge the deficits and unevenness of large-scale infrastructure, but rather to design smaller, pragmatic solutions to specific human and development needs. As

a result, they are often viewed by their critics as embodying scaled-down political ambitions for a global or national community. However, as Redfield (2018 and also in this issue) has further argued, there are good reasons to consider how these technologies also harbour within them more ambitious, even revolutionary, aims. A case in point is off-grid solar.

Many of solar energy's advocates, including the companies themselves, have aspirations that stretch far beyond the design of solutions that might be described as 'for the meantime' (McKay 2018) – that is, as a stop-gap required before an imagined future situation in which development goals are achieved or classic large-scale infrastructure has arrived. Joining others under the moniker of leapfrogging, these advocates of new solar solutions imagine these renewable energy technologies to be a revolutionary change while having the intrinsic capacity to negate the very need for some of the large-scale infrastructures they deem *passé*. With solar technologies now more affordable and globally available, some, even anthropologists, are arguing that they may be used to chart new energy infrastructural pathways and skip out the stages of previously known ones – such as grids or the dirty fossil-fuels that animate electrons – while still bringing the same, and sometimes even greater, benefits of clean electricity to increasing numbers of people (Gupta 2015). Leapfrogging in this way, it is believed, will transport those living in rural and often hybrid energy (but low electricity) worlds consisting of wood, kerosene and diesel to an apparently enduring connection to endlessly flowing solar-powered and low-carbon electrons. In short, solar technology is considered by some scholars, journalists and solar companies as a way of producing alternative pathways to novel infrastructural futures that respond more adequately to our disquietude for the ecological, developmental and social maladies that characterise our contemporary world.

It could be argued that the claims to rapidly produce novel pathways and futures in Tanzania is hardly new. As Göran Hydén argued, Nyerere's regular use of the phrase 'we must run while others walk' was implicated in his broader political strategy to enact a transformation quickly without using 'the past as a source of guidance for the future' and by using policies not drawn from what is already known as being economically rational (Hydén 1979: 6). Yet, today's private-sector-led leapfrogging aspirations hardly challenge a market-economy status quo that elevates a particular understanding of economic rationality.[4]

Such dependence on a market rationality is encapsulated well by the German founder of one for-profit solar company in Tanzania. In his view, off-grid solar has a future beyond mere lighting, as was the case in the early days of the off-grid solar industry in the global South, and has instead the potential to power industrial machines, businesses and the apparent twenty-first-century necessities for a modern household. 'We believe that "Big is Beautiful"', he said in an press release (Mobisol 2015) likely playing subversively with the phrase made famous by his fellow countryman, the economist E. F. Schumacher – author of *Small is Beautiful* (1993), the book that inspired the often controversial late twentieth-century

appropriate technology movement (see also Hydén 1980). Yet, E. F. Schumacher's ideas were, like those of Nyerere and unlike the off-grid solar companies, not only about innovation in the technological sphere. As made clear in the full title of his book, *Small is Beautiful: A Study of Economics as if People Mattered*, technological innovation in the global South required a rethinking also of received and mainstream economic knowledge.

With their embrace of market rationality and relationships, off-grid solar companies endorse the philosopher historian Reinhart Koselleck's claim that 'A successful technical revolution, therefore, presupposes a minimum of stability, which in turn rules out sociopolitical revolution' (2004: 44). Hence, their utopian dreams of leapfrogging are necessarily selective. Private actors position themselves as the linchpin of innovation and as the ones with a monopoly on the capabilities, capacities and virtues necessary to drive leapfrogging revolutions. Yet their innovation depends for its success not on bypassing but on utilising existing infrastructures and social structures – from the supply chains that mine the crucial minerals, including copper, nickel and zinc to the global private and public financial networks that drive the industry, to the public and grid-like transportation infrastructures that facilitate the movement of goods (see also Mazzucato 2013). Hence, discourses of leapfrogging are often reliant on corporate public relations strategies that also leapfrog, as they purposely skip over the knowledge evidencing the necessary socio-political stability that the production of renewable energy depends on. Discourses of solar technologies as allowing for novel and viable but utopian energy pathways futures in Africa hang, therefore, on a selective reading of the past failures of states, grids and fossil-fuels.

Infrastructure for Hire

To implement their utopian schemes of universal leapfrogging electricity, companies aim to produce personal ownership of off-grid electricity infrastructures. Through the TV, radio, SMS messaging and flyers, solar companies promote this possibility to potential customers, for instance, with the tagline written on one flyer, '*Usiwe na shaka, miliki umeme wako*' ('Don't worry, own your own electricity'). The attraction being sold by the companies is for electricity self-reliance and thereby an uninterrupted flow of electrons, in an attempt to displace Tanzanian's dependence on the state-run TANESCO or REA to eventually build and connect or to maintain and fix the grid, which for many people I knew was a mere pipe dream.

In encouraging private ownership, these companies are slotting their electricity infrastructures into the Tanzanian category of *nishati ya kujitegemea*, self-reliant energy. In relation to solar, this encompasses both the separate components – the panels, batteries, wires and so on – that people buy outright or, of most relevance to this article, the packaging of those components together that

are then distributed through the high-purchase vehicle. However, while photovoltaics may still be new to many people in Tanzania, the concept of *kujitegemea* (self-reliance) has been an important once since the country's independence. The Arusha Declaration of 1967, which followed independence, stated that self-reliance at the individual level would help to produce the same at other scales, from smaller ten-house cells, to wards, districts, regions and finally to the nation. Yet, as the historian Priya Lal (2012) has argued, on the ground in rural Tanzania the concept came to be interpreted less as a state policy and more as a pragmatic reliance on those around you, such as wider networks of kin and others. In this interpretation, self-reliance, as Nyerere had also intended it, was intrinsically relational and intimate (see also Neumark 2017).

In the hands of solar companies and their hire-purchase contract, self-reliance takes a different, yet still relational, trajectory. In the concept of hire-purchase, individual customers enter into a contract with the owner (or an intermediary) of an asset, as part of which they will usually pay a deposit and agree on regular instalments so as to attain the right to use the asset. Once the instalments are completed, ownership rights are transferred to the hirer. If instalments are not completed, the right to use as well as to own the asset will be transferred back to the original owner.

The origins of hire-purchase lie outside Tanzania and took place a century before the first photovoltaic silicon cell was invented. In the 1850s, monthly payment plans were advertised by piano dealers in New York City. The Singer Company, with its headquarters based next door to these dealers, borrowed the concept, labelling it 'hire-purchase' (Calder 2001: 164). It was not until the 1950s, however, during British colonial rule, that the idea of hire-purchase was introduced to Tanzania. After its introduction it expanded significantly, quickly facilitating access to a range of products including consumer goods, industrial and agricultural equipment, and commercial vehicles, such as buses and trucks (Picciotto and Whitford 1969; Smith 1969).[5] In 1966, a newly independent Tanzania introduced its own Hire Purchase Act, the first in the East African region. However, it was only after the liberation of the Tanzanian economy in the 1980s and 1990s brought to an end Nyerere's *Ujamaa* experiments that hire-purchase would be allowed to become the prominent feature it is in the current moment.

Further changes since then, notably the shift globally towards market-led development, extensive mobile telecommunication networks and the mobile money system in Tanzania, have led to off-grid companies revitalising this hire-purchase device. The fundamentals for the solar companies in Tanzania, and across East Africa, are broadly the same. A salesperson, conventionally working on commission, meets a customer at their home, in the local area or in the company shop. The customer, after providing personal details, waits for their hire-purchase application to be approved. At the time of fieldwork, many companies were granting approval by replicating strategies from microfinance and the wider mobile money sector in East Africa. This sector has in recent years turned to Big Data and algorithmic predictive technologies to assess the likelihood of a

particular applicant having the current and future capacity to service their debt (see Donovan and Park 2019 and in this issue). If approved, the customer signs a contract and makes a deposit using either cash or, now more commonly, a mobile money service, after which the system is installed in the customer's house. In the company's ideal scenario, the next few years will see the customer paying regular instalments until their debt is settled, at which point they are transferred the legal ownership rights for the solar power system. However, if at any point they fail to make a payment, the system will automatically disable, cutting the connection between the sun's rays and their lights and appliances. As some of my interlocutors said, '*taa zimezimwa*' ('the lights have been switched off'). This technical feature allows the company to disable a household's solar systems by connecting it to their online monitoring surveillance system made possible by the country's expanding mobile telecommunications network. The flow of electrons into the household is now more intimately tied to the flow of money out of it according to the terms of the hire-purchase contract. In principle, only the payment of a certain amount will reactivate the system. But some customers, like Namelok, have been able to hack the system, a problem well known to the companies and which has led both to a recursive design process, as they attempt to stay one step ahead, and attempts to dissuade customers through financial, legal and moral arguments. At the time of fieldwork, the companies had reduced hacking substantially, keeping the ostensibly off-grid electricity infrastructures connected closely to growing and novel digital and financial grid-like infrastructures.

The unenviable responsibility for enforcing the hire-purchase contract falls to the often precariously employed loan officers. Across Tanzania, these officers travel by public transport, motorbikes and sometimes by car around their allotted areas, issuing verbal and written warnings in an attempt to encourage repayment. When such coercive measures fail and if it appears to the loan officers that there is scant possibility of the customer restarting and catching up with their repayments, the infrastructure (the photovoltaic panel, battery, controller, TV, bulbs, even the wires and switches) will be physically repossessed, ending up in the company's warehouses.

These activities offer us a picture of private infrastructure that is somewhat dissimilar to classic state-led public infrastructures. Classic infrastructures, despite their appearance of permanence or at least extended longevity, regularly break down or become obsolete and thereby always require repair and maintenance as well as always being in a process of making (Jackson 2014). Even more so in the global South, infrastructures are often understood as marked by breakdown, ruination and unequal access (Simone 2004; Geissler et al 2017; Appel et al 2018: 223). In this there is little to separate grids and the apparent self-reliant off-grid. But this off-grid infrastructure is further characterised by a morphology of expansion and contraction as they are distributed and repossessed according to the principles of the market and the exigencies of life for those with often very low incomes.

Moreover, the introduction of hire-purchase makes solar different from some electricity grids that allow customers to be indebted for their electricity bills, and from other popular forms of financial debt, such as microcredit, in the global South.[6] Life on the grid rarely means losing proximity to the infrastructure itself, leaving it as a form of latent and hopeful infrastructure that holds the potentiality of reactivation. And, for those caught in the webs of conventional microcredit, only the amount of outstanding debt will be lost. For off-grid hire purchase, failure by a customer to service a debt leads to the loss of their initial deposit, the amount they have repaid and the entirety of the solar electricity system. This makes hire-purchase contracts a far more violent mechanism for the construction of off-grid electricity infrastructures.

An Attempted Repossession

Let us return to the encounter with Namelok. By focusing on this encounter, I aim to show how contemporary market-led efforts to produce a self-reliant electricity infrastructure are unable to adequately cope with ideas of self-reliance that do not centre on the individual as the locus of property rights. As I show, the frictions they generate raise to the surface matters relating to relationality, obligation and temporality.

> When Namelok had asked who granted permission to take away the solar power system, Samuel, the loan officer, replied that he had spoken to Joseph. This, it transpires, is Namelok's brother. But it does little to appease Namelok, who insists that his brother should be present if the company is to take away the system. The sun had now dropped below the horizon, but with the equipment now in the car, Namelok and his kin would be left without light. Among the many pastoral Maasai I met during my fieldwork, the primary benefit of solar was commonly argued not to be related to entertainment or communication, and nor to domestic lighting, but to their livelihood. The arrival of solar had allowed the Maasai to place electric bulbs by their corral with the effect of warding off hyenas and protecting their animals from attack. Men had now been freed from the burdens of regular rotating guard watches at night, allowing longer periods of uninterrupted sleep that many found beneficial. Without this light, conventional watches would likely have to resume.
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> 'What's the problem?' Samuel asks. 'The problem is', says Namelok, 'you've come in here without permission. No one can just come in here without permission. Put the battery back!' Then, growing increasingly irate, he says, 'Why do you insult us like this?' He uses the term *madharau* which, as well as to insult, means contempt or rudeness. 'Return the battery, you don't want this quarrel', he continues. Samuel and one of his two colleagues, who is also Maasai like Namelok, attempts, in vain, to appease him, but he isn't finished, 'You've entered here like it's just a toilet', he says. Later he also complains that Samuel and his colleague hadn't even *kubisha hodi*, which translates as 'to knock', but

connotes a social norm in which people must literally call out *hodi* before entering a home or *boma*.

At this point, Samuel begins to dig deeper into the argument around what they are all calling the *mamlaka* (authority) for repossessing the solar equipment. He asks Namelok, 'And the owner of the solar? Who is the one who signed up with our company?' Namelok evades the question, saying 'You've come with your insults, if you come with a problem, you should be coming to where the elders of this *boma* are, saying that you want to take the system'.

'Wait', Samuel says, 'When we installed this system, did we inform everyone we were installing it?'

Namelok explains how all the elders in the *boma* were present when the solar system was installed, thereby implying that this system was enmeshed in a form of ownership not adequately appreciated by the hire-purchase contract. Samuel, in response, suggests that the reason why Namelok's brother, Joseph, did not tell all the elders that the company were coming today was because he in fact considered the solar system to be *his* property, because he was the named customer, and he was the one paying back the debt.

Namelok is unambiguous in his response. 'I don't know what he has done, but what I do know is that the property which is in this house is all of ours. It can't be taken without us knowing'. He elaborates: 'What we do is we're protecting property like it's the property of the *boma* . . . we're supposed to receive some sort of notice that there are people coming and taking something'.

It may be added to the oft-cited, but erroneous, argument that infrastructures are invisible until they break down, that they become especially visible when they expand and contract, as is happening across the solar hire-purchase regime in Tanzania. But they become visible only momentarily. The executive of one company told me of 10,000 repossessed batteries now hidden away from the public, sitting on the shelves of different zonal warehouses dotted across Tanzania. Therefore, these infrastructures disappear in a meaningful sense, unlike large-scale grid-like ones, which, as I mentioned earlier, remain as a latent infrastructure that may generate among people hopes for its reactivation and repair.

However, perhaps most importantly here, and as Namelok made clear, what are also being made visible in these repossession encounters are different forms of social organisation, property relations and obligation. Specifically, Maasai gendered and generational kinship-based norms in which the male elders' possessions (*imaali* in Maa), traditionally women and cattle, but now apparently also private energy infrastructures, are protected by the younger men (Spencer 2004). Another way of looking at this is to consider temporal concerns.

Unfolding in this attempted repossession was a clash of temporalities, or what economic sociologists have called the 'problem of coordination' between these intersecting time frames or temporalities in global flows of capital and commodities (Miyazaki 2003: 256). On one hand, the energy infrastructures I explore are premised on their promised capacity to include people rapidly and permanently in an electrified world, but yet depend on slow, often cumulative,

long-term debt relationships which are always in danger of being broken and thus reversing inclusion. On the other hand, if long-term debt relationships are seen as a stretched-out market-exchange, then we also encounter a problem of coordination between what Parry and Bloch (1989) called the short-term transactional order and the longer-term reproduction of kinship. The market-based hire-purchase energy infrastructure had clearly been absorbed into the Maasai kinship relations and could not be extracted as easily as Samuel had hoped. The infrastructure's shorter-term transactional nature could not, in other words, be pulled away from the longer-term temporality of the *boma*.

The contemporary solar infrastructural regime is unable to respond to or even recognise such nuanced clashes. Hire-purchase agreements can be adapted to local temporalities – for instance, by incorporating payment holidays to coincide with the lean periods of the agricultural cycle. However, the contractual specificity of the loan agreement cannot accommodate any other understanding of ownership than that connoted by the terms of individual private property.

Namelok claimed that he would sell one of the cattle of the *boma* at the next market, and this did enough to appease Samuel. But as I followed this case over the ensuing months it became clear that this was unlikely to take place. Market transactions around cattle would require far more negotiation with the *boma* than Namelok let on, and his intention in making such a promise was likely to put the company off the repossession. In fact, during my fieldwork, Samuel never returned, moving on instead to customers in the town. He argued that they were easier to access and make repeated visits to, and thereby reach his targets. It was not that in the town the encounters he had with customers, which I also observed as I spent time with him, did not result in clashes and modes of resistance. They presented their own problems, but they did not hinge on a negotiation of the very terms of the capitalist property relations and social organisation that the encounter with Namelok displayed.

Integration into Grids

The encounter with Namelok drew attention to a friction between the idea of self-reliant electricity infrastructures as individual affairs, embodied in the hire-purchase contract, and as more mutual ones that accord to always shifting norms of Maasai kinship. But this does not mean that off-grid solar in itself is not relational. Not only is this because, as anthropologists know well, property is a relationship between persons with respect to things, but also because the solar companies are bringing people into new grid-like infrastructures that they are increasingly dependent on.

One element of the solar power systems that is advertised by the companies as a benefit to customers is the customer service and warranty. Customers may easily phone the customer service team and report problems. One new customer,

John, was particularly excited when I met him one evening in his village in central Tanzania to show me, through an impromptu demonstration, how easy it was to speak to a customer representative to check his balance. A few weeks later, John also had his faulty TV replaced, although it turned out only after a few days and a lot of phone calls and anxiety. Other customers I met were not especially enamoured with the same solar company's terms or operation. They often equated the company with its representatives, dismissing them as *wahuni* (gangsters), and not only because they repossess equipment. When the warranty period comes to an end, villagers are aware that any replacements under warranty will use second-hand components, often from repossessions. As one of the neighbours of a family I knew well in central Tanzania told me, the company will 'replace your battery with someone else's that has just got to the end of the warranty period, so it'll last for two days then it breaks'. Customers are therefore ostensibly offered support for their self-reliance, in exchange for a hefty mark-up on the price, and yet in reality this support turns out to be minimal.

But perhaps more pernicious are the ways in which off-grid solar hire-purchase contracts, even when defaulted and resulting in the loss of the infrastructure, consolidate grid-like forms, those that James Scott (1999) has understood as a way of making legible to authorities what are complex local social realities. While Scott drew attention to how this was achieved by the state in Tanzania through *Ujamaa*, the contemporary moment sees private actors drawing on mobile money infrastructures, and as mentioned earlier, data collection and algorithmic analysis to know their potential customers more intimately. Similarly, Donovan and Park (in this issue) show how digital finance providers are relying on knowledge of their customers and their kinship and personal networks to generate profit. Yet, as we have seen with Namelok, we must consider not only how these might be resisted, but also how certain forms of knowledge, such as those concerning kinship-based forms of ownership and obligation, cannot so easily be incorporated into market knowledge, even if they can be challenged or ignored by a powerful state-backed capitalist political economy.

One company I followed had a bank of almost three hundred questions that they could potentially ask those applying for a hire-purchase contract, including ones as diverse as how many spouses one has, the value of the land owned, where drinking water is accessed, the yields of crops sold up to two seasons ago, whether one has debt and its value, and even whether one sleeps under a mosquito net or not. The same company also accesses an applicant's credit score details in the Credit Reference Bureau, licensed by the Bank of Tanzania to the Icelandic company CreditInfo, and is expected, in turn, to subsequently report to them any debt defaulting by customers who are approved for and enter into a hire-purchase contract. Many rural Tanzanians value the ability to access financial capital for solar power, but also for land, agricultural inputs and consumer items such as televisions and mobile devices. Yet it is rarely clear to them what the full implications are for accessing capital through debt, like hire-purchase,

if repayments are not kept up, nor is it made clear to them by the companies at the time of sign-up. During fieldwork, few applicants appeared in the Credit Reference Bureau database, partly as a result of never before having taken a loan or because they have repaid the debt as required, or because of technical reasons in which loan applicants provide different details, such as phone numbers or names. This situation is likely to change in the future as more people find their way into debt due to its ease of access, as is the case in neighbouring Kenya where digital lending has increased dramatically (Donovan and Park 2019), and as technical issues of identification are eased through state-led digital biometrics that are connecting people with state ID numbers and cards and their mobile phone numbers.

Critical scholars may, understandably, remain wary of the state and its growing relationship with private financial actors. But while Tanzanians extensively and thoroughly critique solar, the substance of their concerns are different. While solar customers have become entangled with state-market hybrid financial and digital assemblages, many also fear a disconnection from the state and its classic grid infrastructures that they have long viewed as integral to what Tanzanians know as *maendeleo* (development) (Dean 2020; Cross and Neumark 2021). They view themselves as having been left by the state to struggle with private solar energy infrastructures that, in comparison with the state's grid, offer not simply poor-quality electricity but a type of energy they do not even view as *proper* electricity. This energy, understood as *udhaifu* (weak), has largely been experienced in the form of Direct Current and generated by low-wattage photovoltaic panels. When households do convert it to Alternating Current, through an inverter, the power produced has been adequate only for domestic or small appliances and not for heavy machinery, processing agricultural produce or construction that Tanzanians view as essential to *maendeleo.* Moreover, they believe, through hard experience, that off-grid solar electricity uses components that are *feki* (fake). Such beliefs are part of wider public discourse in Tanzania that views the country to be the recipient of inferior, even used, goods produced overseas. Such is the prevalence of this discourse that it was unsurprising, although ironic in its timing, that when watching TV in the evening at a friend's house in a village in central Tanzania, the solar system malfunctioned, cutting off mid-way a news programme's segment concerning the government's attempt to crack down on the import of used underwear from abroad.

Conclusion

The solar efforts explored in this article offer material through which to consider more closely the utopian attempts to build, ostensibly, non-state, non-grid and non-fossil-fuel energy infrastructures in the global South. Unlike many other small-scale humanitarian and development technologies, off-grid solar cannot be

easily cast as an unambitious, piecemeal solution for a specific problem and nor can its own benefits and possibilities be dismissed.

It is important to recognise how solar has also been sometimes tentatively and partially welcomed by some in Tanzania for its ability to bring entertainment through television and artificial light to ease domestic life, help children to study, even ward off creatures of a natural – or supernatural – kind. When solar appears in more grid-like forms, such as when it hops to villages in the form of micro-grids, it also brings promises and inevitable disappointments of modern life and some of its trappings (see also Winther 2008).

It is also difficult to attribute the same sorts of harm to off-grid solar as those caused by classic types of infrastructure, such as dams, roads or even large-scale wind and solar plants. While the solar industry's implication in extractive industries and ecological harm globally cannot be ignored, in Tanzania, off-grid solar has not, for instance, been responsible for mass forcible displacement of people. Off-grid solar therefore raises questions rather than offers ready-made answers. Yet, as with any ambitious utopian quest, it cannot escape critical scrutiny.

Self-reliant, off-grid electricity infrastructures in Tanzania are being constructed by private companies and their indebted customers. Perhaps because of a wider emphasis within anthropology on the state rather than on corporations (Benson and Kirsch 2010), this role of profit-making actors in infrastructural schemes has generally received less attention. This is not to say, of course, that anthropologists have ignored how material infrastructures are brought into and respond to the introduction of liberalised market economic reform, and their cultures of audit and transparency, around the world (von Schnitzler 2008; Collier 2011; Bear 2015). They have explored how infrastructural innovations, such as water or electricity meters, might embody, transform and mediate relationships between the state and its citizens (von Schnitzler 2013). Yet private infrastructures, rather than privatised public ones, appear to have escaped much anthropological examination. This is at a time in which these private infrastructures, particularly the renewable energy ones that I explore, are becoming more widespread across the global South.

While aiming to accord with Tanzanian's recognition of self-reliant energy and their experience of a failed state grid, the unfolding of an off-grid solar industry that furthered the principles of individual ownership illuminates how off-grid infrastructures are dependent on and in tension with grids. As off-grid solar power expands and contracts, it reveals forms of contestation that point to alternative forms of social organisation and property relations that hinge on different temporalities. But it is not only in their particularly individualist ideas of self-reliance that off-grid solar may cause frictions in rural Tanzania. It also promises an experience of self-reliance that turns out to be hardly non-relational. The beating of new societal energy paths that involve non-grid decentralised, consumer-based and self-reliant solar electricity infrastructures in Tanzania are tying people, often already low of income, into emerging grid-like digital data

and financial credit/debt infrastructures. These raise the spectre of economic violence and an often unsatisfactory experience of consumer protection. It is little wonder, then, that people often remain hopeful for the state's grid, and its 'real' electricity, to appear.

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Notes

1. All interlocutors and companies have been anonymised. I have also combined details of the companies in order to preserve their anonymity.
2. This category also includes other important sources of energy such as firewood.
3. As Ferdinand de Jong and Brian Valente-Quinn have written, of a very different utopian scheme in Senegal, 'Universalism has remained a utopian promise, its legacy still thwarted by the particular demands of local development' (2018: 340).
4. The dominance of the for-profit model for the distribution of solar has been a particular feature of mainland Tanzania, in contrast to Zanzibar, where until recently NGOs have taken on a much larger role (Dean 2020). But the solar entrepreneurs were far from the first to think that the private sector was essential to Tanzania's electricity futures. The privatisation of Tanzania's still heavily state-controlled electricity grid infrastructure began in the early 1990s, on the heels of the liberalisation of its economy following the end of

its socialist *Ujamaa* period, as privately financed Independent Power Projects entered into agreements to provide TANESCO, the state utility company, with power (Gratwick et al 2006). However, currently solar energy still remains a negligible part of this state national grid, as the government, with considerable support and encouragement from foreign donors, continues to pursue large-scale, fossil-fuel – particularly gas and coal – electricity generation (Jacob 2017).

5. Hire purchase has been reported to have been present in South Africa much earlier, at least from the 1920s (James 2014: 97).
6. But also see the important literature on metering (von Schnitzler 2008, 2013; Wuebben et al 2017).

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Au-delà du réseau : l'énergie solaire hors réseau, l'autosuffisance et le marché en Tanzanie.

Aujourd'hui, environ un tiers des Tanzaniens éclairent leur maison à l'électricité solaire. Des entreprises étrangères profitent de la popularité de l'énergie solaire pour « sauter » au-delà du réseau, une infrastructure classique gérée par l'État, et construire de nouvelles infrastructures électriques hors réseau. Ces entreprises visent à encourager la propriété individuelle de ces infrastructures hors réseau, et s'appuient sur l'idée d'une énergie autonome connue depuis longtemps par les Tanzaniens. Cependant, cette propriété individuelle, mise en œuvre par le biais du système de location-vente, est précaire et conduit à une infrastructure hors réseau qui non seulement s'étend mais se contracte. Ce faisant, elle sape d'autres formes de relations de propriété, tout en liant les gens à des infrastructures financières en réseau souvent indésirables.

Mots clés : Afrique de l'Est, électricité, énergie solaire, infrastructure, Tanzanie