



A Solar Off-Grid Software: The Making of Infrastructures, Markets and Consumers 'Beyond Energy'

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'I sometimes have the feeling that they sell them the plasma television, the radio, the fridge, the mobile phone, before they sell them the solar unit that provides the electricity for these things' (Sandra Rundall, 10 January 2021). This was the critical, perhaps even cynical, view of an international investment advisor based in Nairobi, on the developments in the solar off-grid sector in Kenya. With *they* 'who sell' she is referring to solar off-grid companies and start-ups and with *them* 'who buy' she means the so-called 'un electrified poor' who live with no or only partial connection to the electricity grid in Kenya.¹

¹ In order to protect the anonymity of my interlocutors, I have changed their individual names and also the name of the solar start-up that this article focuses on.

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Kenya has one of the largest markets for solar off-grid products in Africa, due in part to a favourable regulatory environment, effective government policies, and the high prevalence of smartphones that has gradually made Kenya into a favourite launchpad for mobile money-based services, including widespread availability of pay-as-you-go solutions, which offer an effective means for people to finance the purchase of solar products. Nairobi, frequently also referred to as the ‘silicon savannah’, has become a hotspot for digital innovation with a lively start-up scene. Here, under the auspices of the United Nation’s (UN’s) sustainable development goals (SDGs), national and international start-ups, investors, government agencies and NGOs engaged in the solar industry, are in the business to sell devices that are light, inexpensive, portable and minimal (Collier et al. 2018) for what has internationally been agreed upon as a minimum level of ‘affordable, reliable, sustainable, and modern energy for all’ (SDG 7). While grid coverage in Kenya at first sight appears relatively high in comparison to other sub-Saharan countries, reaching roughly 54% of the country’s population, the gap between electricity access among urban and rural households is wide and less than 20% of the rural population has access to the electricity grid. Furthermore, among those who are counted as having access to the electricity grid, many factually continue to live ‘under the grid’, unable to afford the high price for initial connection to the cables that run above them, or out of fear for volatile prices and unforeseeable blackouts. For this reason, the so-called solar home systems continue to be an iconic object of off-grid electrification efforts, all across Kenya (Dubey et al. 2020, p. 15).

Solar home systems come in different sizes, but typically they consist of a solar panel that charges an external battery and which, in turn, powers one or two lights and can charge one or more mobile phones each day. The box with the external battery also incorporates a control box through which the providers can track payments and in many cases also usage. These solar systems have become iconic ‘bottom of the pyramid technologies’ or so-called ‘small development devices’, that present themselves as *caring* commodities, able to meet people’s basic energy needs (Collier et al. 2018; Cross 2017). They further embrace a minimalist design ‘that emphasizes self-sufficiency of device and user’ and are not

embedded in wider attempts to engineer a complex system (Collier et al. 2018, p. 4). These solar products are marketed as renewable energy sources that serve to alleviate poverty at the same time as enabling countries' fast-paced energy transitions to less carbon-intensive futures. To borrow from Sørensen (chapter in this book), they are hereby marketed so as to make a notion as 'abstract' as climate change more 'concrete', and in turn users' participation towards its amelioration more 'do-able'.

As I will illustrate in more detail below, hereby also elaborating on Cross' (2013, 2017, 2019, 2020, 2021)² works, the solar home systems are made into 'goods' in a double sense of the term: designers design them to do well (financially) while doing good. They are 'goods' that primarily target populations understood to be 'infrastructurally marginalized', lacking connection to the electricity grid and living in energy poverty. But beyond these ethical commitments, they are also 'goods' inscribed with clear economic, for-profit motives (Collier et al. 2018; Cross 2019; Redfield 2012). The sceptical commentary by the investment advisor quoted above, wherein she suggests that solar off-grid products are sold merely so as to define new consumer subjects for new markets—reconfiguring 'their wants, needs and desires'—appears to suggest, as Cross (2020, p. 111) puts it, that the design and selling of these products could legitimately be understood as a form of 'predatory capitalism at a new humanitarian frontier'. Yet, as Cross (ibid.) further highlights, 'market *capture* can also be the extension of forms of *care*' (emphasis added). I follow him in this article in reflecting on the *practices* of solar entrepreneurs and their aims 'to do good', exploring how one in turn becomes witness not necessarily to 'contradictory logics' but rather to 'mutually enabling practices' (ibid, drawing on Ferguson 2015, p. 148).

In this article, I will engage with a small, German-Kenyan start-up that I have called 'Mkali Power' (mkali = bright in Swahili), that with the

² Jamie Cross has written extensively about solar lamps as so-called 'small development devices' or 'humanitarian goods'. With the rapid development and growth of the solar market in recent years, I would argue that 'solar home systems'—which entail a lamp but also more—have worked to replace the lamp as a first-purchase commodity for many who live off the grid. Particularly for they have become more affordable.

onset of the pandemic engaged in a strategic shift.³ It moved away from the ongoing design, manufacture and distribution of its own solar off-grid products and towards software development, more specifically, the development of a sales management app. Initially, Mkali Power sought to use the software to manage its own sales in a post-COVID era, but then soon saw in it the potential to be marketed and sold as a stand-alone software tool to other stakeholders in the industry.⁴ The conversations on which much of this article draws, took place when Mkali Power was at a point of putting the final programming touches on a beta version of the app.⁵ They enabled my insights into the workings of the app, by allowing me to set up my own virtual sales network. I installed the beta version from the google play store, set up my own company, ‘employed’ a regional manager, ‘hired’ a local sales force and finally added individual customer profiles. I received dummy QR codes—akin to those attached to the real-life solar products—which I could scan and hereby sell to the customer base I had established. In this beta version, the products included a radio, a smartphone and a solar home system. The result was a somewhat digital fieldwork peculiarity, namely the ethnographic navigation of an app for which Cousineau et al. (2019) have proposed the term ‘appnography’. Methodologically, by drawing on digital ethnography (Pink et al. 2015) more generally, appnography offers a means to analyse app development and discourses that develop around its usage, but also, as is my primary aim in this chapter, prompts one to scrutinize interface systems, features and affordances.

In what follows, I engage with the development of this software, show how the different elements of the software connect as well as the manner in which these have been developed ‘to sit alongside of,

³ I have engaged with Mkali Power in the context of a DFG-funded research project concerned with ethnographically exploring ‘Life off the grid: the study of solar infrastructure and ethical subjects’ in rural Kenya. The project critically explores the nexus that is emerging between different efforts, pursued by a new generation of ‘development designers’, to connect the so-called ‘off grid populations’ to established grids (in an infrastructural, financial and economic sense).

⁴ This is entangled in more general efforts of humanitarian actors during the pandemic to explore the promises and pitfalls of ‘big data’ in humanitarian aid (Gazi & Gazis 2020).

⁵ Research for this article was conducted between October 2020 and April 2021. In addition, I draw on older, preliminary research conducted with a solar start-up in Berlin between January and August 2018.

on top of and interwoven with layers upon layers of the old' (Maurer 2015, p. 126). Hereby, the aim is to attend to the current challenge of needing to explore empirically—as also elaborated upon in the introduction of this volume—how renewable energy infrastructures fold in and upon other infrastructures. In this case, this encompasses the physical system for generating electricity off the grid, the wider mobile money payment services and a rapidly emerging financial infrastructure for consumer financing and debt (see also Cross & Neumark 2021). First, I ask: how does this new software in the making—a development that often appears to happen 'backstage'—come to constitute one of those 'initial moments/phases of structuration where new paths of extraction, circulation and consumption are charted [...]' (Degani et al. 2020, p. 4)?

Second, my goal is to explore some of the ends pursued by solar entrepreneurs when they set off to market solar home systems to the so-called 'un electrified poor' and how these often go 'beyond energy'. Solar entrepreneurs view their 'target populations' as belonging to the 'base of the pyramid', to whom solar power is provided in order to meet a basic need, a most basic level of human well-being, and simultaneously they see them as consumer subjects for new markets which hold the promise of profit and accumulation. Exploring the manner in which they are imaginatively conceived by developers, designers, engineers and solar entrepreneurs, draws attention to a central 'node' of the solar off-grid sector, where a *continuous tinkering* becomes necessary so as to make it hold together, work and expand (see also Korsby 2017).

Third, my aim is to explore through my engagement with the sales app, how the enrolment of solar customers into digital systems—which is often experienced and presented as a rather benign process—is also accompanied by a series of 'classification situations' (Fourcade & Healy 2013; Fourcade & Kluttz 2020, p. 1).⁶ Individuals before being sold

⁶ The enrolment in digital systems is, similarly to the development of digital solutions more generally, marked by an astounding techno-optimism that frames these as part and parcel of innovative environmental solutions, increased economic efficiency and a means to deliver on the promise of progress and modernity and as ultimately furthering energy independence (see also Quitzow & Rohde 2021). The former, however, often draws attention away from wider, more invisible 'processes' of planned and non-planned change and the manner in which the enrolment in digital systems also creates a particularly fertile space of experiments (on pay-go and the solar industry see also Kocieniewski & Finch 2022).

solar home systems are evaluated for their ‘creditworthiness’—being sorted and slotted into actuarial categories, predicting the probability that they will be able to repay the loan. When paying off the solar product, transaction data generated through payments and usage data transmitted by the device in itself becomes a ‘tradable object’ (Fourcade & Healy 2017, p. 11). The latter is data that will allow solar entrepreneurs, so they hope, to establish markets beyond solar and to, in the future, disburse the ‘right’ quantity of credit, for the ‘right’ customers. Further, this data and the classification that is derived from them, will determine the ability of solar users to purchase other consumer products on loan (Fourcade & Healy 2013; Mader 2016).

The Promise of Solar

‘Solar energy is a promise’, Szeman and Barney (2021, p. 1) write. It has become a means of ‘doing one’s share’ against global warming, has come to enharbour public sentiments of progress, has come to provoke a sense of modernity, and it instantiates a sense of coming closer to a prosperous, healthy and just life (see also Amin 2014; Appel 2019; Boyer 2015; Harvey & Knox 2013; High & Smith 2019). Hereby, ‘solar energy is also emerging as one of the sharpest and most powerful of ideologies, blurring concept, fantasy, and infrastructure together in a manner that makes it difficult to disentangle solar fiction from solar reality’ (Szeman & Barney 2021, p. 1–2). Put differently, the story to be told about solar home systems, is also a story about an ever further evolving imagination (Cross 2017, p. 38).

What happens when solar home systems are marketed by local sales agents to those who live off the grid in rural Kenya? While the products are designed in Germany as ‘green energy’ solutions, with the promise to enable countries of the Global South to ‘leapfrog’⁷ straight to cleaner energy sources, solar entrepreneurs frequently suggest, that this ‘green’

⁷ The notion of ‘leapfrogging’ is concerned with enabling certain populations to bypass intermediate stages of technology through which other countries, particularly those belonging to the Global North, have historically passed (Amankwah-Amoah 2014; McKibben 2017).

dimension hardly comes to play a role for the end-users. As I am told by Bernd, the CEO of the Berlin-based start-up, ‘the “greenness” is almost completely washed off by the time the products reach and are marketed to off-grid populations’. Lutz, one of the three developers behind Mkali’s software, has a similar view. Reflecting on his ten years of experience in the industry, he rhetorically asks himself ‘Is sustainability or the green energy aspect important to them (solar off-grid costumers)?’ Answering his own question, he responds: ‘I’ve been in the field for many years now [...] and I think people simply have other problems. It’s about *social status* on the one hand, when one can say, “I have a solar system”. And on the other hand, it’s about *easy access*’. As Lutz underlines further, when solar local sales agents sell the systems, they sell these primarily as a ‘cleaner’, ‘safer’ and (in the long run) ‘cheaper’ alternative to kerosene lamps.

Further, solar energy is marketed as a means of meeting a set of basic needs and as having become (particularly through the SDGs) an internationally recognized benchmark for the most basic level human well-being. As Cross (2017, p. 37) highlights: ‘a life without light’ is presented ‘as a cause of suffering, equivalent to that endured by people without shelter, food, water, or basic primary health care’. A power point presentation for local sales agents in Nairobi in 2017 highlights yet again another promise. Solar, so it reads, offers those ‘under-served’ a ‘connection’. By being able to power radios and televisions, ‘a window into the wider world’ is opened up (see also Zollmann et al. 2017, p. 9). In the process of marketing and selling off-grid products on the ground, the image evoked of those who live off the grid resembles the imaginaries that also stand behind other ‘small development devices’—namely, these are devices produced to respond to basic human needs, they are ‘minimal technologies for living’ but are also ascribed the inherent (more general, utopian) ability to *transform* lives.

Buying Through Pay-As-You-Go

In the process of selling a solar home system to a customer, a local sales agent will next move from outlining how solar has the potential to change people's lives to explaining the payment scheme. Because customers can only in very rare cases afford the purchase of a solar home system through upfront payment in a single instalment, 'pay-as-you-go' has developed as the most promising means for solar companies and start-ups to enable widespread affordability of their products. The systems, which cost around 120–170 euros for the most common configurations are hereby sold to users against a small upfront payment, followed by regular, incremental 'top-ups' usually paid through low-cost mobile money services.⁸ Most contracts run for one to three years in a rent-to-own model. Start-ups require asset-backed debt vehicles to be able to roll out their products in this manner. However, they hereby face the challenge of raising debt and serving customers who lack a formal credit history (Bloomberg NEF 2016).

To address this, solar off-grid start-ups have developed their own credit assessment methodologies. Local sales agents, when meeting with a new, potential customer for the first time, are equipped with a digital questionnaire accessed through the aforementioned software app on their phone. They use this questionnaire not only to gather the basic demographic data about the household, what energy sources are being used so far and for what purposes, but also regarding the formal/informal employment status (if any), monthly income (if any), how much money is on average spent per week and whether the household owns livestock, land or any other physical assets. These are criteria used to establish customers' 'credit worthiness' and build on the more established and recognized practices of microfinance.⁹ It is another materialization of

⁸ Solar home systems of a medium size, supplying between 11–20 W peak (Wp) cost on average around 120 USD. Systems supplying up to 49Wp cost between 150–200 USD, Larger systems—from 50Wp upwards and which often include a television—can easily cost 400 USD.

⁹ Assessments by local sales agents vary from company to company: some businesses rely on agents' local knowledge, others rely primarily on the automated decisions produced by standardized questionnaires, and a few companies are exploring partnerships with alternative data companies to analyse call data records, mobile money top-ups, and mobile money transactions in an effort to predict repayment (Baer et al. 2013).

what Schwittay (2011) has termed the ‘financial inclusion assemblage’—an assemblage of a diverse set of subjects, technics and rationalities that come together in a movement across time, space and contexts and ‘premised on the assumption that the 2.7 billion poor people in the world who do not currently have access to formal financial services are in need of such services’ (ibid, p. 383; Waldron & Faz De Los Santos 2016).

The questionnaire picks up on the customer’s income but also a range of other money objects (from cash to cattle, to land, to airtime) and forms part of a process by which solar start-ups leverage the assets of those with extremely limited purchasing power. This is the first bundle of data that finds its way into the app.

What characterizes the pay-as-you-go model that is subsequently offered, on the basis of this assessment of the creditworthiness, is that it is a form of ‘nano financing’. A product or service is made affordable through small, daily sums of money, in cases where traditional financing and even microfinancing is too expensive or difficult to implement. Customers can make payments as small as 50 cents from their mobile phone when they have the cash to do so (Alderman 2019). As will become clearer below, company executives envision that the solar off-grid sector will, on this basis, be able to expand rapidly in the next few years, providing the infrastructure to market appliances such as televisions, fans, mobile phones, water tanks, refrigerators, but also to sell essential medications—including contraceptives, tuberculosis treatment or malaria—that in many cases don’t make the household budget cut (ibid.). Solar home systems, so they envision, become the first consumer product in an imagined chain of many more. The initial data collected to establish creditworthiness is with time made to connect with ‘born digital’ data that is directly created through users’ payments (and product use). Through ever new compositions of data, comes the capacity to sort and slot people anew, firstly resulting in a form of fragile ‘capital’ for solar customers, who now for the first time have a credit history that deems them creditworthy for future loans. Secondly, a ‘commodity’ of personal data develops for solar companies and start-ups, used to acquire more

investments, to fine-tune services and, in the future, also to ‘discriminate more easily between worthier and less worthy clients’¹⁰ (Fourcade & Healy 2013; Fourcade & Kluttz 2020; Mader 2016, p. 75).

Paying in Instalments

Once creditworthiness is established and an account is created in the app for this new customer, what is the software used for? As suggested above, the solar home systems are all equipped with a control box and a SIM card that work to transmit payment and usage data.

The solar home system is ‘unlocked’ for the customer as soon as the initial instalment has been paid. Through an automated software mechanism, the seller however retains the ability to turn the device on or off from afar when credit runs out, or payments are missed. This is referred to as the so-called ‘lockout mechanism’. Customers either prepay in fixed rates, or purchase daily energy credits for a small, fixed fee. Where these are missed, the device is turned off, reminding them to make another payment. Here, as Chad Larson, the finance director of M-KOPA (a leading solar off-grid provider in Kenya), put it in an interview published online, the mechanism serves the function of a ‘loan agent’. ‘Our loan officer is that SIM card in the device that can shut it off remotely’. ‘We know that it’s important for them to keep their lights on at night, so they can be counted on to keep paying’ (Faris 2015). Those at Mkali Power, in contrast, worked to somewhat de-politicize the *agency* that lay in this mechanism, in particular its function as a payment reminder. As Lutz, one of Mkali Power’s co-founders emphasized: ‘we (at Mkali Power) talk of the “juke box” mechanism. It’s similar to a juke box, in which you throw a coin, then it plays music for thirty minutes and then it switches off again’. With the analogy to the music playing juke box, the social and material politics of the mechanism are effectively moved a bit more out of view.

¹⁰ Solar entrepreneurs are all, in one way or another, in the data collection business, but often emphasize that they do not yet know what to do with it (see also Fourcade & Healy 2017, p. 16 on a similar observation).

Regarding the ‘lockout mechanism’, I asked Lutz how customers responded to this mechanism, when a sales agent would explain that the device can be turned off from afar in cases of non-payment. I added that on the one hand, solar was being marketed as providing a ‘window to the wider world’, ‘a form of connection’. In turn, how was the ease with which users could similarly be remotely *disconnected* experienced by off-grid customers? Lutz responded: ‘You know the only place where the fact that we can turn things off is considered a problem, is *here*’ (in Germany, emphasis added). ‘For those who buy these products it isn’t’. He adds: ‘A while ago I gave a presentation about this technology, and a few people came up to me after I had finished and confronted me with the question, “How can you do this?”’ Lutz, thinking back to this disgruntlement that his presentation had sparked, goes on to emphasize what appears to him to be a related point. Namely, the problematization of why ‘profit’ and ‘care’ should not be able to go hand in hand. The product sold is sold to unelectrified, poor income consumers with a humanitarian ethos—aiming to improve living conditions and standards. At the same time, it is not a ‘gift’ or a charitable donation. The constitutive logics of the development aid paradigm that have factually receded at the same time persist, so he suggests, and are rendered visible again and again in moments such as this one. Lutz goes on to emphasize that in such situations, they (solar off-grid start-ups) are not recognized as ‘a new kind of actor’. ‘It is not like we have somehow gone back to classical development aid. We sell products and for these products one naturally has to pay, and people *want* to pay, because in a sense they (the products) thereby acquire a different worth’. The ‘different worth’ that Lutz highlights, can (among other dimensions) be linked to the data that the purchase of the solar products produces—feeding into (potentially valuable) future classifications of being ‘creditworthy’.

Let me in brief also return to another point that Lutz made regarding the ‘lockout mechanism’, namely that users do not generally ascribe to it a discriminatory tenor. Reports published by consulting and advisory firms, similar to accounts by economic and energy specialists who design the products, suggest that this mechanism is designed to reconstitute users as ‘disciplined autonomous agents’ (see GOGLA 2020; Waldron & Faz De Los Santos 2016; Zollmann et al. 2017). Depending on the

pay-as-you-go model adopted, most companies will allow for a certain period of non-payment and inactivity vis their software *before* the device is repossessed (typically around 90 days). This, in turn, provides a form of valuable flexibility, so designers suggest. Solar can then be made to fit into users' budgets and can be used to spend some days in the dark when money is needed for other things (Zollmann et al. 2017, p. 19). Electricity is made available for those who on a daily basis work to stretch a limited, uncertain income to cover more goods and services than is factually possible. In this sense, in a manner that legitimizes the lockout mechanism, designers stress 'provisionality' as a prevalent reality for these populations (Myers 2011; Simone 2004), while simultaneously working as a reification of autonomy and self-management.

Baptista (2016), who explores the multiple rationalities implicated in the use of the electricity infrastructure via prepayment in the *bairros* of Maputo, suggests that what is analytically significant for understanding such disgruntlements as Lutz has experienced, is that prepayment effectively *inverts* the order between *consumption* and *payment* for a utility. It thereby challenges a default strategy of the 'modern infrastructural ideal', within which there has been little room for technical differentiation of utility provision in colonial and postcolonial contexts. If we follow Baptista along these lines, then it is through an emphasis on the realities of everyday estimation and calculation that energy researchers, humanitarian practitioners and entrepreneurs work towards deconstructing this ideal—an ideal 'that has for long served to order, control and discipline populations, both discursively and materially' (Baptista 2016, p. 1008). They render the lived realities of the unelectrified poor visible and legible in a new light, legitimate the inversion of consumption and payment and thereby establish ideals of 'autonomy' or 'control' as they relate to spending and consumption.

Creating a Record of Usage and Payment Data

Back again to the software and the local sales agents. Once a local sales agent has successfully sold solar home systems to a significant number

of households, how does he/she continue to make use of the software? Clicking through the app, a local sales agent is given an overview of his/her customer base in the region, can see how the products are being used, visualize sales progress with graphics and charts, detect current late payments but also anticipate late payments and motivate customers to pay on time. Further, the sales agent can pull out sales and revenue metrics by date, region, product and payment type. For the executives of Mkali Power who sit in Nairobi or in Germany, the insights are similar, with merely a few more levels being added. These include visualizations of local, regional and countrywide sales performances, and the option to drill down to a detailed observation of an individual customer's behaviour, and his/her payment and usage data. The connection of solar home systems through Machine-to-Machine (M2M) modules, cloud computing and data analytics techniques is not only what enables them to be remotely locked/unlocked, but also draws attention to faulty products or theft. Further, it allows energy activities to be monitored in real time, for example regarding battery charging and power consumption—from afar and for each individual household.

Much of the value of the software rests on so-called application programming interfaces (APIs) established to connect to existing mobile money infrastructures, including in Kenya's case, Safaricom's M-Pesa, which is the most widely used mobile money platform.¹¹ Every payment a customer makes via mobile money is managed and thus automatically registered in the app, including the amount and date of payment. With time, a payment history emerges, which, as software designers suggest,

¹¹ Kenya has witnessed a somewhat unique development of mobile money loans. Soon after M-Pesa was introduced in 2007, a conflict emerged between Kenya's formal banks and Safaricom, the monopoly telecommunications firm that stands behind M-Pesa. From the beginning, this was, as Breckenridge (2019, p. 93) highlights, a conflict between different types of credit market: 'On the one hand, the banks [...] were looking to build credit reporting systems and new government registration arrangements that would allow individuals and firms to formalize non-fixed assets, like vehicles and livestock'. The banks however were opposed by Safaricom and eventually also the Kenyan state, 'who championed a simple and effective system for delivering unsecured, high-interest microloans that did not require collateral registers' (ibid., p. 94)—establishing algorithmic credit scores for instance on airtime purchases and mobile money transactions. Over the years, it was a rift between the banks and Safaricom that has opened up an experimental space also for mobile money loans.

can be used at a later stage to calculate the overall purchasing power of each customer (a point I shall return to below).

All payments made by a customer for a solar product through M-Pesa or another mobile money platform are recorded and become accessible through the app. As Bernd, the CEO from a solar start-up in Berlin, explains: ‘We gain certain insights from the transactional behaviour, and with the formal financial history that is established—which the unbanked so far have never had—they can then access loans and other credit products’. He added: ‘There is much energy going towards these issues of developing algorithms and data analysis that can define customer’s ability to also repay in the future’. On the one hand, the vision is to enable customers to climb the energy ladder and take out loans for larger systems and appliances. In addition, through economic techniques and narratives about ‘boosting’ peoples’ purchasing power, the *payment space* that is created in itself works towards formatting new consumer markets (Elyachar 2010; Cross 2020, p. 119; Maurer 2012, p. 590). The digital payment data are a by-product of the relationship between the technology and the solar start-ups, but also further fuel for them (Mann 2018, p. 2).

Forging Consumers by Digitizing the ‘Unelectrified’

How does the image of the unelectrified poor alter when the aim of solar off-grid industry is expanded beyond the initial focus on electricity to wider interests in the development of infrastructure, the establishment of new markets and the production of ‘proper market actors’ (see also Meagher 2016)? Maurer (2012, p. 598) suggests that through the *provision* and *extension* of mobile money services, the client is progressively treated as a ‘firm, a profit seeking and profit-making enterprise, who is weighing the costs and benefits of adding a new piece of machinery to its operation’. ‘The poor’ are formatted, so he suggests, as ‘millions of tiny capitalist firms’, underscoring their entrepreneurial capacity supposedly unleashed by their access to mobile money, credit histories and pay-as-you-go loans. Probing in conversations with those who work at Mkali

Power as to what defines the solar off-grid customer in their eyes, Lutz paints the following picture:

Well, if I were to describe our end-user, it would be along the following lines: hard working, someone who works, and someone who is euphoric. 'Euphoric' because, in a sense, his environment is currently in the process of changing completely. There are things approaching that you never even imagined before [...]. So, you find it exciting, and you want more, you want to grow. (PAUSE) Well, I wasn't alive then and didn't experience the Second World War, but the way I imagine the post-war phase to have been, is similar. He feels that 'change is imminent, and I want to be part of it'. 'I want change, yes'. [...] 'I want to wake up', so to speak. (PAUSE) And yes, always hard working, earns money, and takes care of every business, just every business. [...] Hardworking and yes, lives in such a euphoric phase of life where everything is changing, and this person wants to participate.

This is a heuristic image of the sort that we can picture the team behind Mkali Power engaging with, discussing and disagreeing over, and is, akin to the narratives that Maurer (2012, p. 595) discusses, not 'descriptive of a "real" story being told by any particular individual'. The 'un electrified poor', so this image suggests, similar to the ideals of 'bottom billion capitalism'¹² more generally, are able to 'better their lives for themselves by relying on their own entrepreneurial skills' (Schwittay 2011, p. 75).

¹² Theories about global poverty alleviation at the 'base' or 'bottom' of the pyramid (BoP) are so complex in their history that a more detailed discussion would go beyond the scope of this paper. Schwittay (2011) provides a comprehensive contextualization, exploring in particular how road maps for how to capitalize on the fortune at the bottom of the pyramid have been guided by C. K. Prahalad's seminal work (2009) on how corporations can eradicate poverty through profit. Popularized through his writings was the idea that 'As an aggregated mass, these billions represent a huge market potential for transnational corporations (TNCs), which by going after this "fortune at the bottom of the pyramid" will also eradicate world poverty' (ibid.: 71).

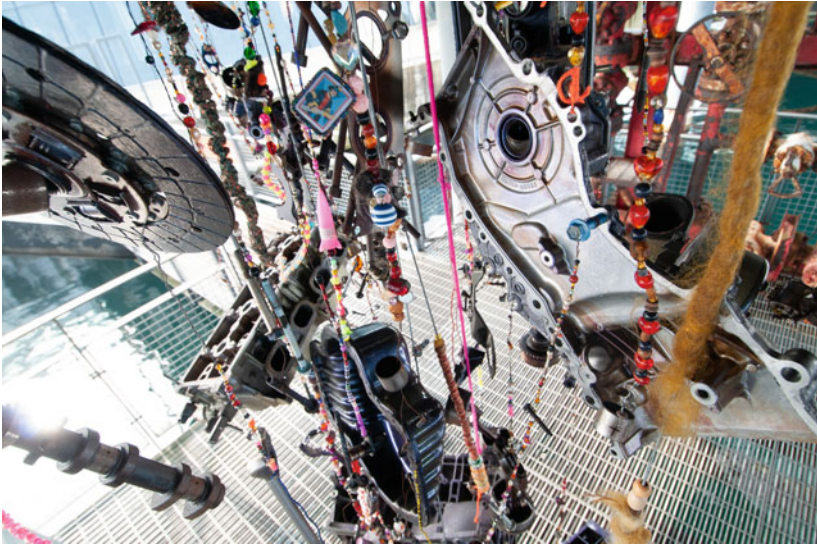
Concluding Remarks: Off-Grid Solar and Its Digital Record

My aim in this article has been to explore how in the process by which solar entrepreneurs work to define the place for themselves within this newest instantiation of philanthropy, development and capitalism, the notion of the unelectrified poor becomes a central ‘node’ that requires constant tweaking and tinkering. The ‘humanitarian-corporate complex’, as others (see Johnson 2011) refer to it, is a manifestation of the ‘after-lives of development’ (Rudnycky & Schwittay 2014), and is in itself always evolving, constantly bringing forth novel conceptualizations of the ‘poverty problem’. The understandings of the unelectrified poor takes on different forms, as I have shown here, depending on what basic access to electricity is perceived to enable—at times most strongly tied to the marketization of a ‘minimal’ technology for living (Redfield 2012), at other times, foregrounding its centrality in ‘public sentiments of progress, modernity and wellbeing’ (Amin 2014, p. 138), then again as privileging people’s evasion and autonomy from the grid and thereby also from the state (Jansen 2014), and finally also as a stepping stone to enable the transformational power of entrepreneurship (Schwittay 2011). Significant is that distinct images of the user, the customer and modern, desiring consumer are made to coexist in one and the same software.

With the marketing of solar off-grid products, also comes the ‘entice-ment and enrolment into digital systems’ (Fourcade & Klutz 2020, p. 1). The tracking of payments, as well as the tracking of usage data, results in ‘classification situations’ (Fourcade & Healy 2013) that permit the creation of data that is a commodity in its own right—a commodity through which solar entrepreneurs seek to bring about ‘subsequent exchanges in the market’ (Elder-Vass 2016, p. 176). Inscribed in the notion of the solar good in a double sense—as a consumer *good* to be sold, and the *good* as an expression of care for distant others (Cross 2019)—is thereby also a form of obligatory ‘reciprocity’, central to different forms of digital capitalism more generally (Fourcade & Klutz 2020; see also Datava’s exploration (in this book) of how digitization is often treated as secondary to more prominently contested issues in renewable energy transitions).

The establishment of ‘creditworthiness’ and the vision to, in future, make available consumer credit for the ‘un electrified poor’ that goes ‘beyond energy’ is—akin to the very marketing of solar off-grid products—draped in a veil of neutrality regarding the uses to which it is put. Access to both are framed as paradigmatic of ‘chances at a (modern, consumerist) life that gets associated with the aspirational normativity’ (Allison 2013, p. 223) that the ‘un electrified poor’ have felt excluded from. Solar home systems become an instrument to, in the future, purchase new things on credit that one can also pay for over time.

Solar entrepreneurs who design and market solar home systems for so-called ‘off-grid populations’ underline that solar is just the beginning, and that other modern energy appliances, including televisions, fridges and mobile phones can soon follow. The ‘lockout’ mechanisms in all these devices, will allow them to be switched off from afar, as soon as top-ups can no longer be made. As Cross (2017, p. 42) suggests, for the off-grid industry, ‘access to the market’ and ‘access to light’ are working to be established as equivalent human needs. Conceptualizations of who those are that live beyond the grid and what constitutes the ‘basic requirements for their dignified living’, are precisely the ‘nodes’ along which solar executives, entrepreneurs and software designers work to establish this equivalency in any successful form. The points at which actors engage in definitions and re-definitions, as one of many forms of delicate tinkering, are points at which the layering of infrastructures becomes visible, and which also make clear where new relations are generated. These are points of structuration where ‘new paths of extraction, circulation and consumption are charted’ (Degani et al. 2020, p. 2). In the most literal sense of the term, ‘working’ with different images of the ‘un electrified poor’, are practices *infrastructur ing* (explicitly understood as a verb rather than a noun)— through which also software designers work to mould, connect and expand the infrastructure of which the software is a part. Exhibition Fig. 3 follows this chapter.



Exhibition Fig. 3 Detail view of ‘Uro’ installed at the Norwegian Petroleum Museum (Source Rune Egenes and Norwegian Petroleum Museum [used with permission])

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References

- Alderman, Jessica. “The Next Big Thing for Pay-as-You-Go”, *Stanford’s Social Innovation Review*, 2019. Accessed 2 February 2021 at https://ssir.org/articles/entry/the_next_big_thing_for_pay_as_you_go
- Allison, Anne. “Indebted intimacy”. *HAU: Journal of Ethnographic Theory* 3.1 (2013): 221–224.

- Amankwah-Amoah, Joseph. "Solar Energy in Sub-Saharan Africa: The Challenges and Opportunities of Technological Leapfrogging." *Thunderbird International Business Review* 57.1 (2014): 15–31.
- Amin, Ash. "Lively Infrastructure." *Theory, Culture & Society* 31.7–8 (2014): 137–161.
- Appel, Hannah. "Conclusion: Energy Ethics and Ethical Worlds." *Journal of the Royal Anthropological Institute* 25 (2019): 177–190.
- Baer, Tobias, Tony Goland, and Robert Schiff. "New Credit-Risk Models for the Unbanked. *McKinsey & Company*," April 2013. Accessed 22 April 2022 at <https://www.mckinsey.com/business-functions/risk/our-insights/new-credit-risk-models-for-the-unbanked>
- Baptista, Idalina. "We live on Estimates": Everyday Practices of Prepaid Electricity and the Urban Condition in Maputo, Mozambique. *International Journal of Urban and Regional Research* 39.5 (2016): 1004–1019.
- Bloomberg NEF. "How Can Pay-as-You-Go Solar be Financed?" *Bloomberg New Energy Finance*, 7 October 2016. Accessed 22 April 2022 at https://www.bbhub.io/bnef/sites/4/2016/10/BNEF_WP_2016_10_07-Pay-as-you-go-solar.pdf
- Boyer, Dominic. "Anthropology Electric." *Cultural Anthropology* 30.4 (2015): 531–539.
- Breckenridge, Keith. "The Failure of the 'Single Source of Truth About Kenyans': The NDRS, Collateral Mysteries and the Safaricom Monopoly." *African Studies* 78.1 (2019): 91–111.
- Collier, Stephen J., Jamie Cross, Peter Redfield, and Alice Street. "Preface: Little Development Devices/Humanitarian Goods." *Limn*, 9 (2018): 2–6.
- Cousineau, Luc S., Harrison Oakes, and Corey W. Johnson. "Appnography: Modifying Ethnography for App-Based Culture." In *Digital dilemmas*, edited by Diana Parry, Corey W. Johnson, & Simone Fullagar. Cham: Palgrave Macmillan, 2019: 95–117.
- Cross, Jamie. "The 100th object: Solar Lighting Technology and Humanitarian Goods." *Journal of Material Culture* 18.4 (2013): 367–387.
- Cross, Jamie. "Off the Grid: Infrastructure and Energy Beyond the Mains." In *Infrastructures and Social Complexity*, edited by Penelope Harvey, Casper Bruun Jensen, & Atsuro Morita. London: Routledge, 2017: 198–209.
- Cross, Jamie. "The Solar Good: Energy Ethics in Poor Markets." *Journal of the Royal Anthropological Institute* 25 (2019): 47–66.
- Cross, Jamie. "Capturing Crisis: Solar Power and Humanitarian Energy Markets in Africa." *The Cambridge Journal of Anthropology* 38.2 (2020): 105–124.

- Cross, Jamie. "Viral Solarity: Solar Humanitarianism and Infectious Disease." *South Atlantic Quarterly* 120.1 (2021): 123–136.
- Cross, Jamie, and Tom Neumark. "Solar Power and its Discontents: Critiquing Off-grid Infrastructures of Inclusion in East Africa", *Development and Change* 52.4 (2021): 902–926.
- Degani, Michael, Brenda Chalfin, and Jamie Cross. "Introduction: Fuelling Capture: Africa's Energy Frontiers." *The Cambridge Journal of Anthropology* 38.2 (2020): 1–18.
- Dubey, Sunita, Ehui Adovor, Dana Rysankova, and Bonsuk Koo. "Kenya-Beyond Connections: Energy Access Diagnostic Report Based on the Multi-Tier Framework," 2020. Accessed 1 February 2021 at <https://openknowledge.worldbank.org/handle/10986/35268>
- Elder-Vass, Dave. *Profit and Gift in the Digital Economy*. Cambridge: Cambridge University Press, 2016.
- Elyachar, Julia. "Phatic Labor, Infrastructure, and the Question of Empowerment in Cairo." *American Ethnologist* 37.3 (2010): 452–464.
- Faris, Stephan. "The Solar Company Making a Profit on Poor Africans: M-Kopa Plans to be a \$1 Billion Company by Selling Solar Panels to Rural Residents—And Providing Them with Credit", 2015. Bloomberg Businessweek.
- Ferguson, James. *Give a man a fish: Reflections on the New Politics of Distribution*. Durham, NC: Duke University Press, 2015.
- Fourcade, Marion, and Kieran Healy. "Classification Situations: Life-Chances in the Neoliberal Era." *Accounting, Organizations and Society* 38.8 (2013): 559–572.
- Fourcade, Marion, and Kieran Healy. "Seeing Like a Market." *Socio-Economic Review* 15.1 (2017): 9–29.
- Fourcade, Marion, and Daniel N. Klutzz. "A Maussian Bargain: Accumulation by Gift in the Digital Economy." *Big Data & Society* 2020: 1–16.
- Gazi, Theodora, and Alexandros Gazis. "Humanitarian Aid in the Age of COVID-19: A Review of Big Data Crisis Analytics and the General Data Protection Regulation." *International Review of the Red Cross* 102.913 (2020): 75–94.
- GOGLA and Lighting Global. "Off Grid Solar Market Trends Report 2020," 23 March 2020. <https://www.gogla.org/resources/2020-off-grid-solar-market-trends-report> Accessed 1 April 2020 at <https://www.gogla.org/resources/2020-off-grid-solar-market-trends-report>
- Harvey, Penny, and Knox, Hannah. "The enchantments of infrastructure", *Mobilities* 7.4 (2013): 521–536.

- High, Mette M., and Jessica M. Smith. "Introduction: the Ethical Constitution of Energy Dilemmas." *Journal of the Royal Anthropological Institute* 25 (2019): 9–28.
- Jansen, Stef. "Hope For/Against the State: Gridding in a Besieged Sarajevo Suburb." *Ethnos* 79.2 (2014): 238–260.
- Johnson, Cedric. "The Urban Precariat, Neoliberalization, and the Soft Power of Humanitarian Design." *Journal of Developing Societies* 2.3–4 (2011): 445–475.
- Kocieniewski, David, and Finch, Gavin. "Tesla-Backed Startup Made Cheap Power a Debt Burden for the World's Poorest", Bloomberg, 7 April 2022. Accessed 10 April 2022 at: <https://www.bloomberg.com/news/features/2022-04-07/how-pay-as-you-go-solar-made-the-world-s-cheapest-new-energy-unaffordable>
- Korsby, Trine M. "The Brothel Phone Number: Infrastructures of Transnational Pimping in Eastern Romania." *The Cambridge Journal of Anthropology* 35.2 (2017): 111–124.
- Mader, Philip. "Card Crusaders, Cash Infidels and the Holy Grails of Digital Financial Inclusion." *Behemoth-A Journal on Civilisation* 9.2 (2016): 59–81.
- Mann, Laura. "Left to Other Peoples' Devices? A Political Economy Perspective on the Big Data Revolution in Development", *Development and Change* 49.1 (2018): 3–36.
- Maurer, Bill. "Mobile money: Communication, Consumption and Change in the Payments Space." *Journal of Development Studies* 48.5 (2012): 589–604.
- Maurer, Bill. "Data-Mining for Development? Poverty, Payment, and Platform." *Territories of Poverty: Rethinking North and South* 2015: 126–143.
- McKibben, Bill. "The Race to Solar-Power Africa. American Start-ups Are Competing to Bring Electricity to Communities That Remain Off the Grid", *The New Yorker*, 26 June 2017.
- Meagher, Kate. "The Scramble for Africans: Demography, Globalisation and Africa's Informal Labour Markets." *The Journal of Development Studies* 52.4 (2016): 483–497.
- Myers, Garth. *African Cities: Alternative Visions of Urban Theory and Practice*. Zed Books, London, 2011.
- Pink, Sarah, Heather Horst, John Postill, Larissa Hjorth, Tania Lewis, Jo Tacchi. *Digital Ethnography: Principles and Practice*. Thousand Oaks, CA: Sage Publications, 2015.
- Prahalad, Coimbatore K. *The Fortune at the Bottom of the Pyramid. Eradicating Poverty Through Profits*. Revised and Updated 5th Anniversary Edition. Philadelphia, PA: Wharton School Publishing, 2009.

- Quitrow, Leslie, and Friederike Rohde. "Imagining the Smart City Through Smart Grids? Urban Energy Futures Between Technological Experimentation and the Imagined Low-Carbon City." *Urban Studies* 2021: 00420980211005946.
- Redfield, Peter. "Bioexpectations: Life Technologies as Humanitarian Goods", *Public Culture* 24.1 (2012): 157–184.
- Rudnycky, Daromir, and Anke Schwittay. "Afterlives of Development." *PoLAR* 37.1 (2014): 3–9.
- Schwittay, Anke. "The Marketization of Poverty." *Current Anthropology* 52.3 (2011): 71–82.
- Simone, AbdouMaliq. "People as Infrastructure: Intersecting Fragments in Johannesburg." *Public Culture* 16.3 (2004): 407–429.
- Szeman, Imre, and Darin Barney. "Introduction: From Solar to Solarity." *South Atlantic Quarterly* 120.1 (2021): 1–11.
- Waldron, Daniel P., and Xavier Faz De Los Santos. "Digitally Financed Energy: How Off-Grid Solar Providers Leverage Digital Payments and Drive Financial Inclusion," 2016. *The World Bank*: 1–4. <http://hdl.handle.net/10986/24566>.
- Zollmann, Julie, Daniel Waldron, Alexander Sotiriou, and Anne Gachoka. *Escaping Darkness: Understanding Consumer Value in PAYGo Solar*. Forum. Washington, D.C.: CGAP, December, 2017.

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