



Original research article

The good payers: Exploring notions of ownership in the sale of pay-as-you-go solar home systems

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ABSTRACT

Pay-as-you-go financing models have been heralded in the solar off-grid industry as the solution for making access to clean, renewable energy affordable. Further, they are understood by the solar sector as an engine for financial inclusion and as an opportunity to also fashion new consumer subjects for new markets 'beyond energy'. This paper engages with notions of ownership in relation to pay-as-you-go solar home systems, exploring both with what motives and to what ends solar off grid companies sell the products as well as, in turn, the various registers and meanings of values that consumers attach thereto. Drawing on ethnographic interviews with consultants, investment advisors, employees and customers of off-grid solar companies, the paper argues that to gain a deeper understanding of how solar home systems are sold to off grid customers and what these products are 'made to be' as they are bought and put to use, a more fine-grained engagement with the wider significances of 'creditworthiness' is necessary. The various accounts discussed, foreground that products are valued for the basic form of electricity they provide, but have, at the same time, also become important symbolic markers of new consumerist practices and the establishment of creditworthiness more generally.

1. Introduction

As the brochure of the global association of off-grid solar energy (GOGLA) reads on the last page: 'Off-grid solar is another child going to college. A seamstress powering her sewing machine. A village socializing at night. An affordable solar system. A policy in place to free millions from toxic kerosene. Clean Air. A way to pay the bills. Money in the bank. A change. Optimism. Acceleration. It's doing what needs to be done' [1]. Much contemporary scholarship on solar energy in anthropology begins with the recognition that businesses that sell solar products to off-grid populations are exemplars of philanthrocapitalist entrepreneurs seeking to marry finance capital with a moral commitment 'to do good'. Globally circulating brochures such as the one by GOGLA quoted here, as well as annual company reports, website texts, and policy briefings across the sector continue to emphasize similar commitments. This paper aims to highlight – as other authors writing on the 'renewable energy economies' have similarly done (see [2,3]) – that while solar entrepreneurs' social and moral commitments should be recognized, they are at the same time 'not invulnerable to the limitations of market-based solutions' ([4], p.2), and the establishment of consumer

markets remains an important ideal (see [4–6]).

On the one hand, more nuanced studies are needed to understand the logics, assumptions, principles, and practices of those who market and distribute off-grid solar products. This includes the manner in which providing access to off-grid energy solutions is firmly understood as: a means of simultaneously improving the lives of those living in chronic energy poverty; a way to contribute to an alleviation of our current ecological crisis by reducing the reliance on conventional fuels; and an engine of corporate value and commercial promise. On the other hand, another ethnographic challenge is to explore the many reasons why consumers adopt solar power, how they make sense of the wider market conditions – including the rapid development of a mobile banking and credit infrastructure – and what meanings they attach to these very consumer products, which in many respects are often more than commodities that provide a basic form of electricity. This essay sets out to provide new insights into both realms by turning the focus to a particular element in the relationship between producers and consumers, namely the 'pay-as-you-go' financing model, through which solar products are purchased on credit.

The paper first explores the logics and principles that define how

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solar entrepreneurs sell solar home systems based on pay-as-you-go contracts, also rendering tangible the ongoing negotiations around the alignment of social, environmental, and commercial values. We ask: with what motives and to what ends do off-grid solar companies sell their products on a pay-as-you-go basis, i.e., providing access to products on credit in exchange for small, regular payments? Subsequently, we engage with how users come to relate to these solar home systems that are installed in their homes and paid for in incremental instalments. What meaning is attached to the sense of one day 'owning' this solar home system? How are the purchase of off-grid solar products and the accompanying debt perceptions shaped by and constitutive of particular consumerist aspirations as well as feelings of social belonging?

Particular 'frictions' are seen to emerge between producers and consumers, which, in line with our argument, link back to the way consumers turn these particular products into a particular form of prized personal possession. In making this point, we echo a series of arguments made by Igor Kopytoff [7], James Carrier [8,9], Hans Peter Hahn and Hadas Weiss [10], and others and explore the manner in which objects sold as consumer products rarely remain fungible commodities characterized by 'abstract relationships between anonymous people and postulated objects' ([11], pp. 120–121). Consequently, the proposition is that also notions of ownership, including the very idea of what it means to 'own' a particular object, are deeply entangled with the social/cultural nature of objects. Identity relations, which develop between a person and an object as a result of individual transactions over time, work to redefine, if not supplant, the more abstract use and exchange values that characterize an object's initial state as an anonymous commodity. By focusing on solar home systems as 'things-in-motion', the paper aims to illuminate the contexts through which such systems become invested with various registers of meaning and value, and thereby to explore notions of ownership from the perspective that there exists a processual nature of value creation surrounding these commodities [12,13].

The off-grid solar sector has over the past ten years grown to encompass a US\$ 1.75 billion annual market that is currently serving 420 million users ([13], p.2).¹ At a time when solar companies are seeking to extend their operations further and the off-grid solar sector continues to grow, attention to the more mundane notions and practices of ownership promises to provide new glimpses into the meanings that solar products have for off-grid populations. Much like consumers of any sort, those who buy off-grid solar products 'do not simply swallow whatever marketers throw at them like so many mindless automatons', but rather 'create their own meanings out of the products with which they choose to surround themselves' ([14], p.490) Taking this aspect into account provides important insights into some of the new socio-material fault lines that emerge and the particularities of "inclusion, exclusion and 'adverse incorporation'" ([15], p.904) that become explicit as companies cater to what solar entrepreneurs frequently refer to as a 'much neglected consumer population' – namely, poor rural households without access to grid electricity, who have limited spending power but a strong unmet demand for energy products.

1.1. Notions of ownership

The perspective that we employ to explore notions of ownership, drawing in particular on the work of James Carrier [8,9], assumes that initially commodities and commodity relations are characterized by abstract and impersonal frames of value, but that these are subject to change as people select commodities in relation to particular aspirations and complex processes of self-identification. In turn, we follow the anthropological inclination to explore notions of ownership in terms of

people's 'relationship with objects' and what people 'do with objects', without reducing the relationship to sheer utility (for an overview see [9]). Understanding notions of ownership as they apply to off-grid solar products, so we argue, requires us to explore more than rights, duties, privileges, and 'no-rights' [16,17] and rather to see the object traded in this relationship between producers and consumers as 'a culturally constructed entity endowed with culturally specific meanings and classified and re-classified into culturally constituted categories' ([7], p.68). The aim in this paper is precisely to render tangible some of these classifications and re-classifications as they apply to solar home systems. To do so, we find useful Carrier's notion of 'appropriation', with which he has drawn attention to the fact that until objects are sold, they are largely construed and considered in commodity terms: 'What demand is there for it?'; 'How much can it fetch?'; 'How much can and are people willing to pay for it?' ([9], p.110). Once the object is bought, the purchaser in turn engages in efforts to turn the object from a 'commodity' into a different cultural category, namely that of a 'possession'. This is the work of appropriation, meaning the initiation of an enduring relationship of identity with the object [8,9,18]. In this process of appropriation, the object becomes invested with various new registers of meaning and value. Akin to Marcel Mauss's [19] notion of 'inalienability' and 'inalienable things', the ensuing relationship between possessor and possession may 'reside in the mind of only one person and be a matter of individual psychology', although in practice 'it is likely to exist in the minds of several people and so be a social understanding of the object' ([9], pp.24-25).

1.2. Pay-as-you-go

As will become clearer below, the pay-as-you-go mobile money loan model, through which customers buy solar home systems, is central to providing a nuanced account of people's notions of ownership. In this section, we want to briefly elaborate on this link between mobile payment systems and the sale of decentralized solar energy, particularly in East Africa. Further: what exactly are solar home systems, technically speaking, and how are they different from other off-grid solar products? And what is the nature of the pay-as you-go payment schemes for these systems?

Solar home systems exist in a range from small to large products and range from so-called 'multi-light' systems, which primarily provide lighting to replace kerosene lamps and offer limited USB charging, to so-called solar-powered 'mini grids', which serve multiple customers via a limited distribution network. Solar home systems in most cases comprise a rooftop mounted solar panel, an in-built battery, and one or more lamps. Depending on the size, the system can be used for lighting, charging mobile phones, as well as for powering radios and televisions. While the capacity range of solar home systems in the sector is subject to substantial variation, the companies we have engaged with for this paper sell solar home systems with an average capacity range between 11 and 100 Wp (Watt-peak) (see Table 1 for an overview).

Pay-as-you-go solar home systems feature a built-in mechanism to unlock the devices from afar and to re-lock them in the event of non-payment. Customers will in most cases pre-pay for electricity supply (in hours or days) through mobile money payments, at which point they receive a code that is sent to their cell phone via SMS, which in turn is entered into the keypad of the device to 'unlock' it. Once the supply period lapses, the system is automatically turned off by the service provider through a remotely managed control system. Other solar home systems feature a remote monitoring system with a SIM card – activated via a mobile network connection – that similarly allows solar companies to shut them down remotely if payments cease as well as enabling the companies to track their customers' energy usage in real time ([22], pp.7-8).

The dominant financing model for these devices has coalesced around the aforementioned pay-as-you-go contracts, in which customers may be offered the opportunity to purchase the system in a 'lease-to-

¹ As the same report makes clear: the sector is planning to serve 823 million users with off-grid solar products by 2030, requiring an investment of US\$ 1.7–2.2 billion within the next five years.

Table 1

The table includes different product categories of off-grid solar devices. Watt-peak (Wp) is the unit of measure used to express the capacity or power generated by the SHS. This is the maximum electrical capacity that a solar cell can yield under standard test conditions (Table adapted from ([20], p.7). See also [21] for an overview of sales in these different product categories).

Overall category	Solar module capacity, Watt-peak (Wp)	Services provided by the product
Portable Lanterns	0–1.49 Wp (indicative)	Single light only
	1.5–2.99 Wp (indicative)	Single light and mobile charging
Multi-light Solar Home Systems	3–10.99 Wp (indicative)	Multiple lights and mobile charging
	11–20.99 Wp	3–4 lights, phone charging, powering radio, fan, etc.
Mini Grids	21–49.99 Wp	As above plus power for TV, additional lights, appliances, and extended capacities
	50–100 Wp	As above but with extended capacities
	<10 MWp	Distribution system for a localized group of customers allowing for additional community-based services with higher power requirements, such as water pumping and grain milling.

own' model, whereby they make an initial down payment and then commit to regular monthly payments over a stipulated period, usually 18 to 36 months, after which they then 'own' the system. Alternatively, customers may be offered a 'usage-based payment' plan (alternatively also referred to as the 'energy-as-a-service' model), whereby the customer pre-pays for the electricity supply but never owns the system, only consuming the electricity generated (see [22] and [23,24] for a taxonomy of business models). Irrespective of the model adopted, customers' consumption is dependent on affordability, and off-grid solar providers collect payments in the form of mobile money billing. As the majority of companies in the sector today operate with lease-to-own models [24], for the purpose of this paper, the pay-as-you-go model is considered to be synonymous with the lease-to-own model.²

The rapid take up of pay-as-you-go models in the sector has been made possible through the widespread use of mobile banking. In Kenya, the dominant telecommunications operator, Safaricom, launched its mobile financial service, M-Pesa, in 2007. By 2021 it had >50 million active customers across the continent using the service for savings, for sending and receiving payments – much like conventional banking – as well as for direct purchases of goods and services [25]. A key factor in the success of the pay-as-you-go model has also been the ongoing technological innovations regarding the control systems installed in the solar devices themselves, particularly the ability of the providers to automatically turn devices off if customers default on payments, which has considerably reduced the risk for investments in this industry [15]. Most significant for solar entrepreneurs and solar customers alike is the fact that, through the form of payment tracking that telecommunication-finance platforms and smart meters have made possible, solar companies have been able to develop first-time credit histories for customers who until now had no access to financial services.

Through the detailed payment records of its customers, the off-grid solar sector has thus brought about a unique connection between two infrastructures, namely the physical apparatus for solar electricity generation and the technical financial apparatus for lending and borrowing ([15], p.907). As Jamie Cross and Tom Neumark (ibid.) illustratively

² All of the companies that we engaged with in the context of this study operate lease-to-own models. For off-grid solar home systems, this has become the dominant business model, with energy-as-a-service models (akin to conventional utility models) primarily being implemented for products with larger system capacity, such as the sale of micro or mini grids.

emphasize: 'off-grid solar systems have provided the energy infrastructure for mobile banking' – the solar home systems are what charge the mobile phones upon which mobile money platform depends. The sector has hereby established itself firmly within the larger 'financial inclusion assemblage' [26], with the aim of bringing a new generation of low-income customers into the orbit of the digital financial system (ibid. See also [15,26,27]). Pay-as-you-go, as Meyer and Overen highlight, in itself demonstrates that 'the core business of off-grid providers goes beyond promoting clean and sustainable rural electrification', from the outset encompassing the provision of affordable financial services ([23], p.4276).

2. Methods

In this article, we build on the first author's ongoing ethnographic research on the ethics of off-grid energy provision in rural Kenya, since early 2019, in the context of which data has been collected through interviews and participant observation in two German solar start-ups [28]. Further, the article draws on the second author's ongoing PhD research on off-grid electrification as well her autoethnographic reflections in her simultaneous role as founder and CEO of one of Germany's leading off-grid solar manufacturers.³ Autoethnography is an approach that sets out to describe and systematically analyse (*graphy*) one's personal lived experiences (*auto*) against wider cultural, political, and social meanings and understandings (*ethno*) [29,30]. It has increasingly been understood as having the potential to offer a 'corrective', 'critical' viewpoint as individuals 'describe themselves in ways that engage with representations others have made of them' ([31], p.65) (see also [32]).

Furthermore, the article draws on five months of mutual research (November 2021–March 2022) conducted by the two authors together and focusing explicitly on notions of ownership in relation to pay-as-you-go models in the sector. Twelve semi-structured qualitative interviews were conducted with off-grid solar customers in Zambia to explore experiences amongst three categories of customer: those who had recently acquired a solar home system (4), those who had defaulted on payment and whose system had been repossessed (4), and those who had successfully paid off a system (4). In addition, eight in-depth semi-structured interviews were carried out with current and former company executives, investment advisors, analysts, and consultants in the sector, all of whom can look back on multiple years of experience in designing, marketing, selling, or repossessing solar home systems, or in advising companies as analysts and consultants. All interviews were transcribed and (in the case of interviews with non-English speakers) translated into English. These were analysed together with pre-existing field notes that were categorized and coded as part of both a content and narrative analysis to identify significant themes and patterns [33,34]. In sum, what we present in the forthcoming sections is the result of a process of layering and triangulating interview data, autoethnographic insights, textual analysis, and participant observation.

3. Findings

3.1. Off-grid solar companies

An exploration of the pay-as-you-go model, the financial instrument through which solar home systems are sold and purchased, is central to an understanding of notions of ownership. In focusing on pay-as-you-go under the rubric of 'lease-to-own', the aim in the following section is to explore the values that solar firms ascribe to this instrument, and the

³ The ongoing PhD research by the second author is being carried out at the Lappeenranta-Lahti University of Technology (LUT) in Finland – exploring the implementation of renewable, off-grid household energy supply, with a particular focus on unelectrified regions in the Global South.

uses to which it is put. Ethnographically, we aim to render tangible through their accounts the fact that there is more to the solar home systems sold on a pay-as-you-go basis than initially meets the eye. Given that solar entrepreneurs continuously strive to balance for-profit interests with an ethic of care for distant others, we argue that their core business model of selling solar home systems, and also the financing scheme behind it, go beyond the mere provision of affordable access to basic solar energy technologies. Our objective in this section is thus to explore the implicit as well as explicit agencies behind pay-as-you-go as a particular financial instrument, agencies that in turn feature so centrally in making sense of wider notions of ownership. Subsequently, in Section 3.2, we turn our attention to the customers of these commodities, exploring shifts in meaning and value as the product travels, is bought by consumers, and becomes susceptible to further classifications and reclassifications. What are the stories told by solar entrepreneurs about the pay-as-you-go solar products that they design, and how do these change as objects shift and move, ending up on the rooftops of customers? On the part of consumers, our perspective similarly focuses on the 'uses' to which solar home systems and the associated pay-as-you-go financing scheme behind it are put ([10], p.11).

Technically, what does pay-as-you-go make possible? Why have solar entrepreneurs established pay-as-you-go as the dominant financing scheme for off-grid solar home systems? While there are undeniably certain overlaps, the views of solar designers, sales agents, CEOs, and consultants to the sector mutually crystallize around the following three points, namely that pay-as-you-go enables companies: a) to monitor usage and payment data, b) to establish credit histories for 'the unbanked' and 'the unelectrified', and c) to identify new consumers for new consumer markets that go a long way 'beyond energy' ([13], p.2).

As mentioned above, most solar home systems are sold on a pay-as-you-go basis with a remotely managed control system, enabling not only the establishment of a record of payments but also, in some cases, allowing the monitoring of the customer's energy usage data – making it possible to zoom in, at a distance, on both usage data and payment profiles in real time. 'We call it pay-as-you-go, but that really isn't the whole point. The point is that it is a smart technology that we can use,' John B., a senior consultant to the World Bank, emphasized in one of our conversations.⁴ Pay-as-you-go is on the one hand about being able to provide warranty and remote sensing, but also about remote monitoring and access to data that, in turn, has its own value. 'Pay-as-you-go is the packaging that we see, but it is not what is critical,' John B. adds,⁵ referring to the fact that companies are not only in the business to provide solar technology and credit, building a financial relationship with their customers, but are also anticipating the (future) value of listener, viewer, and user data collected from radios, televisions, and other electrical devices to come (see also [35], p.100). While the integration of Internet of Things (IOT) technology into solar home systems was introduced as an innovation to enable remote monitoring and, in the long run, to contribute to improving the performance and maintenance of such systems [36], it is acquiring new purposes as the number of objects equipped with IOT technology, as well as their technological complexity, continues to grow.⁶

One example of this phenomenon is described by Julius D., the CEO of a Berlin-based start-up: 'Already now, with the larger solar-powered

cooling devices that are being put on the market, we can already go online in the evenings and see how many times that fridge door was opened and closed on that day... That is data that is already available and has a value.'⁷ John B. has an interesting analogy: 'Pay-as-you-go is just a function, just like the head of the hydra. But what does the hydra look like? We don't see it, we just see one of those heads.'⁸ In sum, what both foresee is the manner in which one side of this financial instrument, namely data monitoring vis-à-vis payment monitoring, is acquiring a value of its own – value, in the sense that the innovations surrounding it and the technological idealisations with which they go hand in hand are becoming embodied in value forms that in turn foster further actions and new economic practices [37–39]. To what ends this will unfold, to what uses the data will be put, and to what gains or predicaments for consumers this will lead, is difficult to predict, as are the larger consequences of the financial system in which off-grid solar companies operate. What nevertheless becomes clear in the conversation is that data monitoring, having now been introduced through pay-as-you-go payment schemes, is beginning to 'normalize' a reality in which the day-to-day energy consumption of off-grid populations – the everyday 'watt traces' that their devices leave – are being financialized (see also [38]).

Let us move to the second dimension stressed in our interviews with solar entrepreneurs, investment analysts, and consultants working in the sector: the identification and production of 'creditworthy' consumers.

At the same time that off-grid solar companies provide low-income populations who live beyond or below the grid with clean, renewable energy sources, they also work to establish and extend a financial infrastructure for consumer credit and debt. As Cross and Neumark ([15], p.903) highlight, this combination of decentralized solar energy with a mobile money infrastructure for lending and borrowing 'was championed by energy companies, investors and international development organizations as an infrastructure of inclusion capable of lifting those living without electricity out of energy poverty'. The majority of off-grid solar customers have thus far had little or no access to formal financial institutions and are therefore considered to belong to the 'unbanked'. Mobile phone-based money transfer services, such as the Kenyan service M-Pesa, have essentially brought banking to people who in many cases continue to live miles from a physical bank branch. All payments made by a customer for a solar product through a mobile money platform are recorded and become accessible to the companies. As Bernd F., the CEO of a second 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 have never previously possessed – they can then access loans and other credit products.' He adds: 'There is a lot of energy going toward these issues of developing algorithms and data analysis that can also define a customer's ability to repay in the future.'⁹ On the one hand, the vision is to enable customers to climb the energy ladder and take out loans for larger systems and appliances. However, more generally, through the establishment of these first-time individual records, 'a new generation of low-income customers and their payment histories' are brought "into the orbit of a digital financial system that seeks to capitalize on hidden reserves of 'creditworthiness'", as Cross and Neumark have similarly noted ([15], p.907 (see also [27])).

In general, 'consumer credit scoring systems are designed to gauge people's ability to pay off their debts, their intent to pay them off, and the likelihood of their being sanctioned in case they default, for example by repossession' ([40], p.6). On the basis of pay-as-you-go payment records, solar entrepreneurs offer customers a first-time credit history that deems them creditworthy for future loans, ideally making it possible, in future, to 'discriminate more easily between worthier and

⁴ In order to protect the anonymity of our interlocutors, we have changed their names and also make no detailed mention of the organizations and companies for which they work.

⁵ Interview, senior industry expert and advisor, 26 January 2022.

⁶ In criticizing the manifold processes through which digital metadata in the sector is becoming a valued product in its own right, it is also important to note positive developments in this regard: GOGLA has established a first de facto industry standard for consumer protection (the 'GOGLA Consumer Protection Code') for off-grid solar companies, investors, and other stakeholders, to which off-grid solar providers are progressively committing themselves.

⁷ Interview, CEO, off-grid solar company Berlin, 10 October 2021.

⁸ Interview, senior industry expert and advisor, 26 January 2022.

⁹ Interview, CEO off-grid solar company, Berlin, 25. March 2021.

less worthy clients' ([41], p.75) (see also [42,43]). Put differently, the aim is to incentivize customers to score highly in order to gain access to additional loans for additional consumer products in the future. However, 'on the part of the customers', Almasi M., a senior sales manager working for an off-grid solar company in Nairobi, highlights: 'the issue of credit and credit assessments has not really taken root. Particularly amongst the unbanked. They are just not familiar with the concept. Most of them just do not get the concept, since some of them have never banked in their life.' She adds that, in consequence, when customers default on payments and sales agents warn them against receiving a negative credit score, which would make it much more difficult for them to receive a subsequent loan in the future, 'some of them just don't care. Simply because they are not familiar with the whole credit thing.' Because credit assessments and credit scores are carried out individually by each off-grid solar company, a customer can, upon defaulting on payments, simply purchase another product on a pay-as you go basis from another company. 'We sometimes come into homes and find that they have three of the same products from three different companies,' Almasi remarks.¹⁰ Her observations make explicit the manner in which credit scoring aims to introduce, as Hadas Weiss has put it, 'immediate advantages and disadvantages among people in their capacity as consumers' ([40], p.7). However in practice, the unregulated nature of the market contains a loophole that allows off-grid solar customers to simply switch providers, buy a new product, and take on another loan (and thereby often more debt) elsewhere.

Let us turn to the third aspect. What is it, exactly, that pay-as-you-go established credit histories are seen as valuable for on the part of solar off grid companies? What are creditworthy consumers deemed 'worthy' of? Solar entrepreneurs who design and market solar home systems for so-called 'off-grid populations' emphasize that solar is just the beginning, and that other modern energy appliances, including fans, TVs and fridges can soon follow. Solar home systems, in this vision, thus become the first consumer product in an imagined chain of many more. Already now, according to solar sales agent Kibeko M., who has been working on the outskirts of Nairobi for many years: 'You will have trouble finding a solar company that only sells solar home systems and no other package with a mobile phone or a TV or a fan. And frankly, everyone wants the TV and wants these other things to come. They have to start small to prove their credit worthiness but can't wait to upgrade to other products.'¹¹ Upon a credit assessment, customers with extremely low, irregular monthly income and/or insufficient assets are encouraged to 'begin' with a solar home system. "If they are 'a good payer' for the solar home system, then they can upgrade to a television," Almasi, the senior sales manager from the Nairobi based start-up, suggests. 'If we just left it to them, all of them would immediately want the other products. They don't really think about whether they are able to afford it, and then a lot of them end up defaulting.'¹²

In these accounts, what is rendered tangible is how, on the part of solar entrepreneurs, the provision of affordable, renewable solar energy and, at a minimum, their quest to provide households better household lighting, is suffused with ideals about the establishment of new markets 'beyond energy' and the production of 'proper market actors' [44]. Interviewees stressed that the ethical commitment to bring affordable access to electricity services to the so-called 'unelectrified' was not one that was progressively being abandoned as the sector continues to grow. At the same time, the fashioning of 'creditworthy consumers' and the inclusion of the 'unelectrified' in new consumer markets is becoming an increasingly central aspect of their business model. 'The impact aspect is still very strong,' Louis A., the COO of a solar start-up in Nairobi

underlines. 'But I don't feel that we are all in it just for the impact, right? We need to be able to be profitable [...] and we need to be able to innovate, grow, and offer more stuff.' He adds that one 'cannot only be in it' to provide basic access to electricity (emphasis added).¹³ In the same vein, Almasi makes a similar point, illustrating how much greater the ambitions of Kenyan off-grid solar companies have become in the past year: 'We have most of the solar companies already offering mobile phones, and some are now talking of motorbikes.' She explains how some companies are planning to offer the purchase of motorbikes on a pay-as-you-go basis following positive credit scores through assets or previous (solar product) purchases. "So, we really don't know what is next and the scope of products is really growing and expanding. Which is a good thing for the rural people because access to credit in Kenya is not an easy thing. A lot of people have been 'locked out' of getting such products. We are in it to offer them a *payment option*'"¹⁴ (emphasis added). Louis and Almasi both stress the collective efforts of the sector to 'cultivate the (financial) relationships' established with the first (solar) products, and thereby also the initial establishment of creditworthiness.

Thus, rather than establishing solar home systems as commodities that simply 'are', and which are produced solely as material things to enable affordable access to a basic form of electricity with which particular notions of ownership naturally align, the views of solar entrepreneurs discussed here crystallize around core issues and bring to the fore the manner in which these products are at the same time made into things intended to provide 'more' than basic and affordable access to lighting. These assumptions and idealizations around the ways that pay-as-you-go solar products *are being, could be, or should be* put to use are, we argue, central to arriving at a more in-depth understanding of notions of ownership as they relate to off-grid solar products. In Section 3.2, in line with Kopytoff's [7] notion of an 'object biography', we will turn to how these very same solar home systems are taken up by customers – exploring the various registers of meaning and value with which the systems become invested.¹⁵

3.2. Off-grid solar customers

For off-grid customers, the solar panel installed on the roof – 'in most cases on the side of the house where it has a certain visibility for neighbours and passersby' – is a 'prestigious commodity', 'the sign of a life no longer in the dark', we are told in one interview with Esther B., an off-grid development advisor based in Johannesburg.¹⁶ 'It is even more so [a symbol of prestige], when they own the TV to go with it,' Almasi, the senior sales manager from the Nairobi-based start-up, emphasizes.¹⁷ 'The panel on the roof is a symbol of my wealth'; 'It is a thing through which I can also be someone who helps others, like my neighbours who then also use it' – David K. and Vincent C., two of the off-grid solar customers interviewed, explain.¹⁸ The reason it becomes a symbol of 'prestige' or 'wealth' or even 'a dignified life', continues Almasi, is that through the availability of purchasing on loan, on a pay-as-you-go basis, commodities that were otherwise unaffordable to this population have been placed within reach. "Before the solar home systems took off,

¹⁰ Interview, senior manager, off-grid solar company, Nairobi, 11 February 2022.

¹¹ Interview, solar sales agent, Nairobi, 2 February 2020.

¹² Interview, senior manager, off-grid solar company, Nairobi, 11 February 2022.

¹³ Interview, chief operating officer, off-grid solar company, Nairobi, 21 January 2022.

¹⁴ Interview, senior manager, off-grid solar company, Nairobi, 11 February 2022.

¹⁵ Due to the pandemic and severe travel restrictions, we were only able to conduct in-depth interviews with off-grid customers remotely, over the phone. In the following section, the inherent limitations of such a virtual ethnography become particularly apparent as the views and accounts of solar customers remain comparatively shorter than those of the solar entrepreneurs.

¹⁶ Interview, senior industry consultant, Johannesburg, 26 January 2022.

¹⁷ Interview, senior manager, off-grid solar company, Nairobi, 11 February 2022.

¹⁸ Interviews, off-grid solar customers, Chongwe and Mumbwa, 18 January 2022.

owning something like these solar devices or a TV was mostly for people who lived 'on the grid'. And for a lot of rural customers, that was a product beyond their means. So, the 'coming of solar' has given them the opportunity to own a product that was otherwise seen to be a product exclusively for the rich, those on the grid'. In this sense, the off-grid solar system, from its very first instalment, becomes a sign of social mobility, a sign of 'doing well'. As anthropologists have argued, consumption practices herein become intricately related to the 'making up of persons', and, more precisely, become 'visible markers of social status and achievement' ([45], p.9) (see also [46,47]).

But are these registers and meanings of value that customers attach to the products dependent on having successfully paid off the system and thereby 'fully owning it outright', as is often the formulation in the sector? What, in turn, is the effect upon this of the lockout mechanism, through which the device can be remotely turned off, or the threat of repossession?

'When I pay that first amount for the deposit, the system is mine',¹⁹ we are told in one of the conversations with a customer, Akeno B. In a similar vein, solar designers, sales agents, and CEOs interviewed stress that in their experience and engagements with off-grid customers, the latter feel that the product is 'theirs', 'as soon as the panel sits on their roof'.²⁰ The physical presence of the product overshadows their current stage of (re)payment.

The lockout mechanism is an experiential scenario that lingers in the background and only becomes acute when customers default on multiple payments. The mechanism does little in terms of the sense of 'owning' the device. Rather, the mechanism allows customers to pursue established practices of everyday estimation and calculation that already marked the consumption and use of kerosene, firewood, and other household fuels prior to installation of the solar device. Put differently, customers are seen to pursue the same 'daily calculative logics' with which they otherwise also work to make 'multiple ends meet'. Julia H., recounting her own research with off-grid customers, suggests: "We have done interviews with customers and users who were defaulting on payments and who, when asked 'could you tell us a bit about what happened last month (when payments were not made)?', would say: 'Oh well, I was visiting my grandmother in the village. I wasn't using the device, so I didn't pay'".²¹ The lived tension between buying on loan and yet facing the same economic instability and the same amount of disposable household income as prior to the purchase of the solar system makes it difficult to keep up with any form of regular payments. In contrast to the interpretation that the concepts of 'credit' and 'loans' 'have not yet taken root' amongst solar customers, a second dimension also becomes significant. This is namely the fact that customers must search for convenient options 'to stretch', as Idalana Baptista ([48], p.1016) puts it, 'a daily (yet uncertain) income to cover as many goods and services as possible' – including basic necessities such as health insurance, education fees, and food – and see in the solar device's lockout mechanism a means of exercising a limited form of 'autonomy' or 'control' over spending and consumption ([48], p.1014). In fact, users in some cases deliberately choose to let the device shut off, spending some days in the dark when money is needed for other things ([49], p.19).

In the following, we want to discuss, in brief, two additional observations regarding the 'biography' of the device (as Kopytoff [7] puts it) or its 'itinerary' (as Hahn and Weiss [10] put it) that interviewees frequently drew attention to, and that in turn illustrate particular registers and meanings of values with which solar home systems become invested: a) when the system has successfully been paid off by customers, and b) when the system stops working (here the latter can also

precede the former).

In the process of paying for a solar home system in instalments, and in particular once the final payment has been made, customers ask for different forms of 'certification'. In some cases, this is a page from the (pay-as-you-go purchasing) contract with the solar company that is framed and put on the wall or, in other cases, customers ask for an explicit certificate that is issued by the company to testify that the solar home system has been successfully paid off. "I have seen in a number of houses that the contract has been put on the wall, as a kind of certificate that 'this is mine'," Lisa S., an investment advisor, recounts from field visits.²² In other cases, solar entrepreneurs have provided t-shirts and hats for 'good, successful payers'.²³ While all customers should receive mobile text messages to confirm when a regular payment has gone through and are more generally given the opportunity to monitor debt repayments digitally, their hope is nevertheless to receive a form of material certificate that they are "now a person successfully deemed a good payer and 'creditworthy'".²⁴ Conflated herein are both the wish to receive material 'mementos of creditworthiness' that testify to the customer's having 'passed' an initial household credit risk assessment and been deemed 'worthy' to receive a solar home system as well as, at a later stage, the value of a symbolic certificate, t-shirt, or hat that confirms the customer's success in paying off all debt and having thereby been deemed creditworthy as a 'good payer' to be eligible for the purchase of additional consumer products.

The second observation – accounts of the many practices that occur around broken products – is related to this. When solar home systems break down, they are seldom put at a representational distance and even less frequently discarded. Esther B., an off-grid director based in Johannesburg, emphasizes that this has become apparent to off-grid solar companies, as many are struggling to purchase back old solar home systems whose lifetime has now, after three to five years, expired and which are no longer working. There is growing pressure in the sector, she goes on to explain, that under the banner of a 'circular economy', companies should readily offer take-back / buy-back models for broken products as a form of 'end-of-life management'. Despite this pressure, as Jamie Cross and Declan Murray [50] also highlight in their elaborate contribution on the afterlives of solar things, recycling is being problematized by customers as the ideal end scenario for solar waste. 'You will find on the one hand that households have three or four panels on the roof, yet only one is actually working,' Esther explains. They are kept in sight, she adds, "and again this is 'pride'". On the other hand, 'from one such system, you in most cases still have parts that are salvageable'.²⁵ Thus, 'when customers own multiple [solar home systems], there is the opportunity to take one component from here, the light bulb from another, the battery from a third, and so on'.²⁶ In Kenya, 65 % of solar products are said to be kept or left in the home when they stop working [50,51]. Our interlocutors emphasized that this number is likely to be far higher, as so few companies succeed with take-back/buy-back programmes. Customers see significant value in the spare parts thereby available for repairs of other systems and there is also a limited opportunity to earn money selling old products to ambulant scrap buyers. A third factor is that the old systems become 'mementos of creditworthiness' and are for this reason kept 'in sight' [50,52].

4. Conclusions

In this paper, we have focused on notions of ownership as they become attached to pay-as-you-go solar home systems. To do so, we

²² Interview, finance and impact advisor, 20 January 2022.

²³ Interview, senior sales manager, off-grid solar company Nairobi, 11 February 2022.

²⁴ Interview, off-grid solar company employee, Nairobi, 10 September 2019.

²⁵ Interview, senior industry consultant, Johannesburg, 26 January 2022.

²⁶ Interview, senior industry consultant, Johannesburg, 26 January 2022.

¹⁹ Interview, off-grid solar customer, Chilanga, Zambia, 17 January 2022.

²⁰ Interview, off-grid solar customer, Kabangwe, Zambia, 17 January 2022.

²¹ Interview, senior researcher, impact measurement company, 10 February 2022.

have foregrounded an understanding of ownership that exceeds the factual situation of an objective, formal relationship between a person (the owner) and the thing owned. In turn, we took up the proposition that alongside legal ownership there is also ownership of a moral and emotional order. This approach echoes efforts to differentiate more neatly between 'ownership' and 'possession' and the practices through which people attach different registers of meaning and value to the things they 'own'. As Carrier [8] underlines, possession captures the relationship of identity between a person and an object and goes beyond the legal link between the two. The practices that bring about this different form of relationship, in turn, have been termed by Carrier [8] as the work of 'appropriation' – the practices through which people transform an anonymous commodity in a meaningful, prized possession.

Making sense of the different registers of meaning and value that customers ascribe to solar home systems, requires, as we argue, a more fine-grained account of not only the explicit, but also the implicit agencies of off-grid solar companies that design, market, and sell these devices; the values that solar firms ascribe to pay-as-you-go as a particular financial instrument; and the uses to which the latter is put. Our engagements with product designers, manufacturers, and investors further up the supply chain, as well as with customers of off-grid solar products, have revealed how the purchase of solar home systems is motivated, at a minimum, by the quest to provide and receive a basic form of electricity – enough to power one or two lights, to charge a mobile phone, and to power a radio. Yet at the same time, the yearning for electricity has become closely related with the establishment of 'creditworthiness' for producers and consumers alike.

For those who have thus far had little to no access to formal financial institutions and are therefore considered to belong the 'unbanked', the establishment of a first-time credit history that deems them credit-worthy for future loans – in this case, through the purchase and payment of a pay-as-you-go solar home system – has become virtually synonymous with access to additional consumerist practices, as a prerequisite to realizing upwardly social aspirations. Having access to consumer credit is valued as a way of being able to invest in new consumption practices and consumer goods – from TVs to motorbikes – that would otherwise be difficult to finance. These commodities, in turn, play a role in consolidating particular consumer-based identities within neoliberal regimes – described by our interlocutors also as a particular notion of 'a more dignified life', akin to 'the life of those who already live on the grid'. Notions of ownership attached to solar home systems foreground that these products simultaneously provide a basic form of electricity and serve as material 'mementos of creditworthiness' and thereby as visible markers of social achievement.

5. The way forward

The ability to buy on credit – and the idea that a wide range of new consumer behaviour is made attainable through pay-as-you-go financing schemes – also introduces a life that harbours new precarities. As Clara Han's work [53] has astutely illustrated, credit is a mixed bag for the poor. 'Access to it gives them chances at a (modern, consumerist) life that gets associated with the aspirational normativity they've been so excluded from' ([54], p.223). At the same time, buying on credit makes this life increasingly uncertain and tentative. Significant parallels exist between the implementation of pay-as-you-go models in the off-grid solar market and what Han [53] describes as the emergence of a 'loaned life' in the context of neoliberal Chile.

The websites, policy reports, and investment guidelines in the off-grid solar sector commonly pay tribute to an ideal of creditworthiness and financial inclusion throughout the sector as neutral, inevitable, mutually beneficial, and empowering (see also [55]). A new challenge is to describe and render ethnographically tangible the new lines of exclusion that emerge as a life tethered to an expanded credit system manifests itself. This includes the more mundane transformations brought about by the extension of credit through the sector and the

classifications of those who come to use it [40].

During the last two decades, a wide range of anthropological studies has grappled with the social nature of debt and credit under contemporary capitalism and in particular the increasing commodification of different kinds of debt [56]. Building on the questions that have been asked here should prompt researchers and practitioners alike to pursue a critical engagement with questions of 'indebtedness' and 'overindebtedness' amongst off-grid users, as these have implications not only for business models, policies, and electrification practices, but are also likely to provide new glimpses into how the sector's financial inclusion agenda is experienced by customers – thereby attending to 'what finance presupposes, encourages and proscribes in specific settings' ([37], p.100).

Exploring 'overindebtedness' and foregrounding its subjective dimension entails asking: what is the line between 'debt' and 'overindebtedness'? When is debt experienced as a burden? When is debt seen as unpayable or perceived as illegitimate? How do early manifestations of opposition to a 'debt economy' manifest themselves? How do users come to negotiate the boundaries of public and private provisioning? When is the growing desire for not only social mobility but also the most basic functions of a household economy perceived by off-grid solar customers to be attainable only through indebtedness [37,57]? (For a study on debt perceptions in the Kenyan context see also [58].) In our engagements with the off-grid solar economy in Sub-Saharan Africa, we are reminded to engage with the 'wants and needs, desires and aspirations – that shape how and why people acquire or adopt solar technologies' ([50], p.108), but increasingly, it appears vital to also turn to the registers and meanings of values attached to the sector's efforts to propel the identification and production of 'creditworthy' consumers. These questions are vital if we are to make sense of some of the financialization processes that transcend the off-grid solar sector but also remain significant in its midst.

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Data availability

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