Counting the Impacts in the Solar Off Grid Sector

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Solar off grid entrepreneurs dream of doing their meaningful share towards ending global energy poverty by delivering clean, reliable, and sustainable electricity to the millions of people who live with no or only partial connection to the grid. At the same time, and in line with the pro-business rhetoric of philanthrocapitalist foundations, the selling of solar power to people living 'off' or 'under' the grid also represents an opportunity to pursue the untapped commercial value of new and expanding markets in Africa and Asia.[1] Initially, it was a sector defined by the mass production and marketing of simple solar lanterns that came to represent a 'minimal technology for living.'[2] The solar lanterns came to serve, as Cross[3] puts it, "as a benchmark of whether or not people have access to the most basic level of clean, efficient energy deemed necessary for human life." Today, the sector has grown to incorporate the sale of a wide array of other ingenious other solar-powered devices and systems, of different size and scale. In turn, lanterns, as the once iconic product, have largely come to be replaced by so-called solar home systems—sufficient, in the smaller formats, to power lights, mobile phone chargers, and in many cases a radio. The larger solar home systems provide enough energy to also power TVs, fans, and refrigerators. It is the latter kind of solar off grid products that this chapter will engage with. More specifically, my concern is here with the 'impact metrics' that are fashioned in

1 Eva Riedke, "A solar off-grid software: The making of infrastructures, markets and consumers 'beyond energy,'" in *Digitisation and Low-Carbon Energy Transition*, ed. Siddharth Sareen and Katja Müller (Basingstoke: Palgrave Macmillan, 2023): 31–52; Eva Riedke and Catherine Adelmann, "The good payers: Exploring notions of ownership in the sale of pay-as-you-go solar home systems," *Energy Research & Social Science* 92, no. 102773 (2022): 1–8; Jamie Cross, "The Solar Good: Energy Ethics in Poor Markets," *Journal of the Royal Anthropological Institute* 25, no. S1 (2019): 47–66; Jamie Cross, "Capturing Crisis: Solar Power and Humanitarian Energy Markets in Africa," *The Cambridge Journal of Anthropology* 38, no. 2 (2020): 105–124; Tom Neumark, "Leapfrogging the Grid: Off-grid Solar, Self-reliance and the Market in Tanzania," *Social Anthropology/Anthropologie sociale* 30, no. 2 (2022): 140–160.

2 Peter Redfield, "Bioexpectations: Life Technologies as Humanitarian Goods," *Public Culture* 24, no. 1 (2012): 157–184.

3 Jamie Cross, "Solar Basics," *Limn. Issue 9* (2018), https://limn.it/articles/solar-basics.

relation to these solar off grid products—metrics that are meant to give quantifiable insights into the results, effects and ultimately 'impacts' that solar companies are having in places that remain formally unelectrified.

By exploring metrics and what 'metrics do' in the solar off grid sector, the aim of this chapter is to draw attention to the relationality between what initially appears to be a series of heterogeneous and distinct infrastructures. The aim is namely to illustrate how impact metrics, being fashioned in response to the roll-out of solar off grid products, engender relations between solar off grid infrastructures and particular fiscal architectures. The chapter hereby engages with the sale of solar off grid products as representative of an 'infrastructure in the making' that readily aligns with our normative understanding of the term, i.e., as an infrastructure with a concrete material form. It also goes on to explore the wider constitutive relations which emerge therefrom. Solar off-grid infrastructures are made to produce certain metrics and these metrics, in turn, also come to serve as a tool to attract and incentivize investment, generating relations to wider economic infrastructures. Exploring the use of metrics in this manner, so my proposition, works to unsettle and extend our understanding of how material and immaterial infrastructures can hang together, overlap, and allows us to retheorize their mutual embeddedness.

Making sense of these developments allows us to generally explore how the provision of basic forms of solar electrification—a sector in which philanthropic, altruistic claims and high notions of 'common good' are commonplace—is being tethered to market logics and the ongoing rise of neoliberalism.[4] More specifically, exploring the sutures made between these different infrastructures, enables us to begin exploring ethnographically what is often presented and experienced as the more benign side effects in a sector that is out to sell solar products to people living with or using off-grid solar energy—namely the significance of forecasting investment opportunities 'off the grid.' Focusing on the infrastructure sutures at hand, draws our attention to what Crane[5] has, in the context of global health humanitarianism, described as the 'valuable inequalities' that create opportunities for investment, yet that also demand the creation of data and stories to document and justify them.[6]

Let me begin with recounting a meeting I had with solar entrepreneurs in April 2021. It is over zoom that I sat together with three founders of a small solar energy start-up, who I will here refer to as Jua Power, that initially sought to produce and market solar home systems in rural Kenya but who then—after being a few years on the market—reoriented towards software development. They were now in the

4 Cross, "The Solar Good"; Neumark, "Leapfrogging the Grid."

5 Johanna Tayloe Crane, *Scrambling for Africa: AIDS, Expertise, and the Rise of American Global Health Science* (London: Cornell University Press, 2013).

6 Lilly Walkover, "When Good Works Count," in *Metrics: What Counts in Global Health*, ed. Vincanne Adams (London: Duke University Press, 2016): 163–178.

business of developing digital services for other solar companies, including digital platforms through which the latter could then manage sales operations, track payments as well as generate performance and impact metrics—i.e., numbers, enumerations, and quantifications to account for the money spent, to gauge sales impact, and to evaluate electrification outcomes. They sought my opinion on a series of impact metrics that they were hoping to integrate that would be equally meaningful for their clients (namely other solar firms) and the investors that stand behind these clients. We discussed the common indicators that solar off grid companies regularly reported on, to what degree the data for these were readily collectable, and the range of phenomena that they worked to push inside and outside of visibility. We concentrated our discussion on the example of a solar-powered street food cart in Nairobi—a solar 'product' for which they were currently programming a template in their software. What were legitimate impacts to measure and report on? They suggested indicators directly linked to the product, such as: 'Amount of CO2 saved,' 'Quantities of charcoal saved,' 'Amount of clean cooking hours enabled.' In addition, they also sought to highlight financial and social impacts, which included 'Income generated,' 'Jobs created,' 'Lives affected,' and 'Women empowered'—indicators for which, as they readily admitted, numbers were a bit more difficult to find.[7]

A few days later, I discussed these last three metrics with an investment advisor in Nairobi. I remarked: "How do companies realistically go about estimating the number of jobs created, lives affected, and women empowered when it comes to a solar powered street food cart? Or even the 'simpler' products like solar powered lanterns?" The answer she gave was straightforward: "The numbers are far-fetched, that is clear." She laughed. "Off grid populations are, by definition, more difficult to speak to and to count." "But this [these numbers/ metrics] is what social impact investing is about and what everyone in the sector needs to appeal to when selling to investors." She added: "Significant is that these [numbers/ metrics] are also less about evaluating the impact *made*. Attached to them are also stories about the future. So, the *future worth* of such food carts if one invests."[8] Herein, as Erikson[9] has similarly illustrated for the field global health, metrics that initially served to ensure accountability for money invested, are now undergoing a shift towards becoming 'value' metrics—defining a prospective future-centric value of a potential investment. Accountability metrics are tethered to market logics, Eriksen elaborates,

7 All indicators are linked to the global indicator framework established for the sustainable development goals (SDGs). Since 2015 the sector has, also in relation to the SDGs, established a series standardized impact metrics specifically for lighting products (see https://www.gogla.org/impact/gogla-impact-metrics).

8 Interview, 12 October 2022, emphasis added.

9 Susan L Erikson, "Metrics: What Counts in Global Health," in *Metrics*, ed. Vincanne Adams (London: Duke University Press, 2016): 225–230.

and in the process, these become suffused for investors with a sense of anticipatory forward-looking excitement, for they become suggestive of how much money is likely to be made.

One Solar Lantern = One Kerosene Lamp

The significance of metrics to ensure accountability for money spent is not new. However, with the rise of private-sector non-profits, a new emphasis on metrics has taken shape, including a significant rise in requests that numbers produced also function to tell 'future values.' This includes using metrics as *anticipatory praxis*. A development, if we follow others,[10] that is ascribable to the unique character of many developers of humanitarian goods, like solar off grid startups, that, following the promise often sold by financial advisors of the Gates Foundation, seek to 'make money by doing good.' These philanthrocapitalist players do not envision their objects only as stop-gap solutions or 'band-aids' for entrenched systemic failures,[11] but rather "envisage their technologies as the building blocks for new kinds of universal infrastructures" and envision markets as the most effective mechanism for realizing scale.[12] There is a repeated commitment to the "market's vocabulary, as well as its values and assumptions of growth", as the only viable engine of infrastructure development and social change.[13] This, in turn, has an effect on the pressure to produce particular kinds of metrics and works to define notions of what the complex grafting together of numbers and stories is supposed to do—effects already reflected in the documents that start-up companies sign with investors.

The three solar entrepreneurs concerned with defining impact indicators for a solar powered food cart in Nairobi emphasized in our conversation that the commitment of investors is always newly dependent on the numbers produced. "Even if aspects like jobs created and women empowered is difficult to measure," Ruby B., one of the co-founders of the start-up explains, "solar companies stand in competition with one another and those who sell more impact attract more investment."[14] Despite describing new pressures that have arisen in the context 'selling of impact' in recent years (in particular, the emphasis on shorter time frames), Ruby emphasizes

10 Cross, "The Solar Good"; Peter Redfield, "Shacktopia: The Meantime Future of Humanitarian Design," *Social Anthropology/Anthropologie sociale* 30, no. 2 (2022): 16–33; Erikson, "Metrics: What Counts in Global Health."

11 Peter Redfield, "On Band-Aids and Magic Bullets," *Limn. Issue 9* (2017), https://limn.it/articles/on-band-aids-and-magic-bullets/.

12 Jamie Cross and Alice Street, "To Fail at Scale!: Minimalism and Maximalism in Humanitarian Entrepreneurship," *Social Anthropology/Anthropologie sociale* 30, no. 2 (2022): 101–109, 104.

13 Cross and Street, "To Fail at Scale!," 116.

14 Zoom meeting with the author, 23 April 2022.

that "the problem with the indicators has always been there, ever since the sector emerged and sold simple solar lanterns."

A good example for the problem being an 'old one' in the sector is the calculation of 'number of people electrified per solar lantern sold.' Instead of companies calculating the impact on the basis of the number of mobile lanterns sold and the number of people who may *actually* use each lantern (at the same time)—a calculation which takes into consideration that a 25 lumen lantern has less of an impact than a 300 lumen lantern—solar off grid companies progressively moved on to define the impact in terms of the number of people who could *potentially* use the lantern available in a household. Different producers of solar lanterns, in turn, went on to define 'households' in very different terms—with the average number of people per household ranging from 2.8 people to 6 people. As an (incomplete) overview by Schützeichel[15] suggests with reference to different producers of solar lanterns:

- 2.8 people/lantern: Lighting Africa
- 3.4 people/lantern: Little Sun
- 4.5 people/lantern: SolarAid / Sunny Money
- 5–6 people/lantern: D.light

The companies listed here have in common that they did not consider the brightness (in lumen) of the actual lanterns sold. As a senior industry consultant based in Johannesburg, Esther B. remarks with reference to this list: "Another funny thing is, that these metrics about the 'number of people electrified' are then also translated into 'the number of kerosene lamps replaced' and in turn 'the amount CO2 saved.'"[16] She adds, "[b]ut, when we look closely, we often find that the solar lantern is only really used for a very short period in the evenings, to find the kerosene lamps and to light them." As she explains, at the end of the day, most solar lanterns, if only one is bought, simply do not provide enough light for a household with multiple persons and therefore do not replace the kerosene lamp.

In the last few years, as mentioned, the sector has rapidly diversified from solar lanterns to also include in their portfolios the marketing and sale of other products, such as TVs, fans and refrigerators (amongst others), that are then powered through so-called solar home systems. The latter are frequently technically designed in a manner that allows for the monitoring of the customer's energy usage data in real time—making it possible to zoom in, at a distance, and analyse individual cus-

15 "How to measure social impact of a solar lantern?," *Sun Connect: Sub-Saharan Africa News*, 2014, accessed 19 January 2022, https://sun-connect.org/how-to-measure-social-impact-of-a-solar-lantern/.

16 Interview, 26 January 2022.

tomer's energy consumption patterns.[17] "We can already go online in the evenings and see how many times that fridge door was opened and closed on that day [...]," I am told by Julius D., the CEO of a Berlin-based start-up.[18] He goes on to explain that on the basis of this data, similar predictions can be made about 'CO2 saved,' for the solar unit providing power for the fridge is likely to have replaced a diesel-powered generator. "For companies dependent on capital from private investors, this data will also need to be translated into a series of other indicators such as 'Jobs created' or 'Income generated'. There are no capacities to do surveys with off-grid customers to determine whether in fact, a kiosk was established or whether income was factually generated, he goes on to explain.

Sutured Infrastructures

Metrics as the "translation of (assumed) realities into numbers" have for decades been the standard means of evaluating processes and phenomena as a form of creating and ensuring accountability and transparency.[19] Modern governments succeed or fail, as James Scott illustrated compellingly in his book, on the basis of their ability to measure or evaluate complex social phenomena through numbers and thereby render these comparable and countable.[20] "Yet there is little doubt" as Beer suggests, "that these systems of measurement have escalated and intensified over recent years," particularly through the cultivation of forms of neoliberalism. In addition, the growth of IoT technologies and products in the sector have intensified and incentivized the reliance on metrics further.[21]

In the solar off grid sector, as in other fields, the production of metrics today is as troubled by imperfection as were the efforts in previous times.[22] This does not however, as Adams underlines, "get in the way of efforts to produce them, nor does it impede efforts to rely on their empirical products as if they were indelibly factual."[23]

17 Riedke and Adelmann, "The good payers."

18 Interview, 10 October 2021.

19 Richard Rottenburg et al., *The World of Indicators: The Making of Governmental Knowledge Through Quantification* (Cambridge: Cambridge University Press, 2015), 2.

20 James C Scott, *Seeing Like a State* (New Haven: Yale University Press, 1999); see also: Vincanne Adams, *Metrics: What Counts in Global Health* (London: Duke University Press, 2016), 7.

21 David Beer, *Metric Power* (London: Palgrave Macmillan, 2016), 4.

22 Adams, *Metrics: What Counts in Global Health*, 8.

23 Adams, *Metrics: What Counts in Global Health*, 8.

Metrics acquire an authority that makes it difficult to imagine other forms of creating transparency and accountability.[24]

Convincing investors to invest in solar off grid electrification as a 'thing,' as an 'asset class,' means using metrics to elaborate on (future) value. Few numbers are available and yet these need to serve as the basis for more elaborate stories about on the ground, complex social phenomena and need to sell 'solar' as an investment from which to expect attractive annual returns. As one scans through the evaluations in 2022 that concern the potential of the solar off grid sector, commentators highlight that market leaders are increasingly 'gaining investors' trust' as they are going 'beyond energy' and diversifying into energy-adjacent products such as mobile phones and digital finance.[25] "This shows that the infrastructure built by off-grid solar companies has a great potential to be maximized to respond to new consumer needs."[26] The aim of the sector has been, so the point also in this evaluation, to deliver clean energy access to the so-called 'unelectrified poor,' but beyond that has also been to catalyse and expand markets for goods and services that go beyond energy and establish new consumer subjects for these very markets.[27] In order for the market to grow, Koen Peters, the head of the global association for the off-grid solar energy industry (GOGLA) underscores in a guest commentary on the *NextBillion* website, "[t]he sector needs to find a way to tell its story compellingly, highlighting the fact that there will be profits in the long term, along with other positive human and climate impacts, and those future profits and impact should play a more important role in the narrative."[28]

What an engagement with metrics in the solar off grid sector allows us to explore are the new linkages being sutured between policy and finance, between philanthropic aims to provide basic access to electricity and international investment portfolios, between ambitious utopian quests and opportunities for profiteering. Metrics in this case work to connect the roll out of electrical infrastructure that we

24 Beer, *Metric Power*, 5; Wendy Nelson Espeland and Michael Sauder, "Rankings and Reactivity: How Public Measures Recreate Social Worlds," *American Journal of Sociology* 113, no. 1 (2007): 5.

25 GET.invest, "New Investment Data: Global Off-Grid Solar Investments at a Record Sum in 2021," *GET.invest* (16 June 2022), https://www.get-invest.eu/new-investment-data-global-off-grid-solar-investments-at-a-record-sum-in-2021/.

26 GET.invest, "New Investment Data."

27 Cross, "Capturing Crisis"; Riedke and Adelmann, "The good payers"; Riedke, "A Solar Off-Grid Software."

28 Koen Peters, "The Growing Urgency of Funding Off-Grid Solar: Exploring the Multi-Billion Dollar Investment Opportunity in Achieving Climate and Energy Access Goals," *NextBillio*n, 2 Feburary 2022, accessed 18 April 2022, https://nextbillion.net/off-grid-solar-investment-opportunity-funding-climate-energy-access/.

readily think of in big material terms with the less tangible financial investment infrastructures. These are hybrid and the sutures are prone to escape our 'infrastructural gaze' for while we are positioned to readily adopt definitions of infrastructure as socio-technical, so Lemanski and Massey have also argued, "our critical exploration of the ways in which infrastructure networks are also socio-technical is more limited."[29] As hybrid and heterogeneous infrastructure configurations are sutured together, the larger whole that comes fully into view runs the risk of losing something of its infrastructural force and thereby evading the 'infrastructural lens.'

The study of a sutured configuration of hybrid, heterogenous infrastructures, in the context of the solar off grid allows us to trace old and new paths of capture and extraction,[30] and to ethnographically illuminate what people, through the purchase of these solar products, become enmeshed in—including, not least, the rapidly emerging digital data 'grids.' Further, it allows us to shed light on the emergence of infrastructure as a global asset and the new forms of speculation that are increasingly coming to characterize experiments in infrastructure finance.[31] Put differently, taking metrics as one of many vantage points to explore the relationality between these different infrastructures, in turn, works to draw our attention further to the kinds of accumulation that infrastructure has become associated with, the postcolonial practices of valuation, as well as the "apparently 'anomalous,' 'peripheral,' or 'frontier' sites" so central to global capitalism.[32]

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29 Charlotte Lemanski and Ruth Massey, "Is the Grid People or Product? Relational Infrastructure Networks in Cape Town's Energy-Housing Nexus," *Urban Geography* (2022): 1–25, 2. Lemanski and Massey speak of the physical-material and the human-relational as a heuristic binary that, when acknowledging their overlaps, effectively allows us to explore what makes "infrastructure." They refer throughout their text to the notion of 'infrastructural networks', highlighting that the lexicon of 'networks,' still "represents a primary discourse and practice through which infrastructures are imagined, planned, and delivered" (4).

30 Michael Degani, Brenda Chalfin, and Jamie Cross, "Introduction: Fuelling Capture: Africa's Energy Frontiers," *The Cambridge Journal of Anthropology* 38, no. 2 (2020): 1–18, 2.

31 Laura Bear, "Speculations on Infrastructure: From Colonial Public Works to a Post-Colonial Global Asset Class on the Indian Railways 1840–2017," *Economy and Society* 49, no. 1 (2020): 1–26.

32 Bear, "Speculations on Infrastructure," 19.