RE TRENDS EAST AFRICA

Tracking regional renewable energy developments

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Issue No. 9

Opening Thoughts

Welcome to Renewable Energy Trends! It's good to be back. This time we're taking a closer look at a sector that's of growing interest to politicians and businesses alike in East Africa: the household solar PV market.

There is no doubt that small-scale off-grid solar is having its day. Always an active sector in this region, we are now seeing a maturing market, growing in quality, reach, affordability and technological capacity. Consumers are responding, and governments are shifting from giveaways to the poor to light-handed support for commercial efforts.

ASD has had an up-close view of this market development in recent months, working on recommendations to shape the policy and enabling environment for household solar PV in Kenya and Ethiopia, and to gather baseline data on off-grid lighting markets in Somalia and Somaliland.

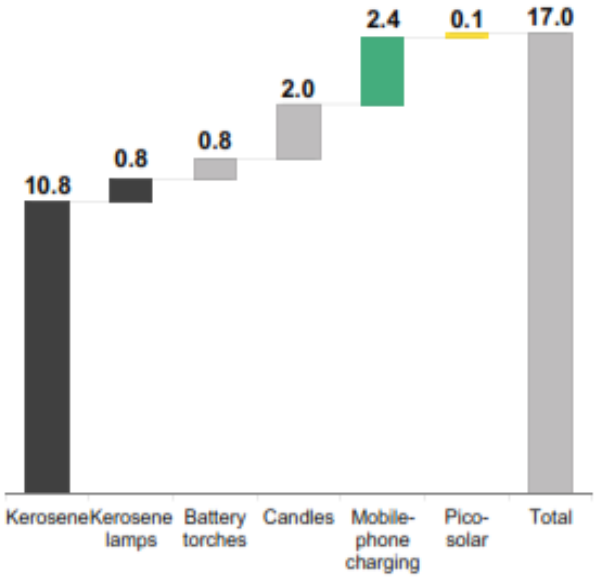
Enjoy this edition, and feel free to get in touch – we welcome your comments!

All the best, until next time—

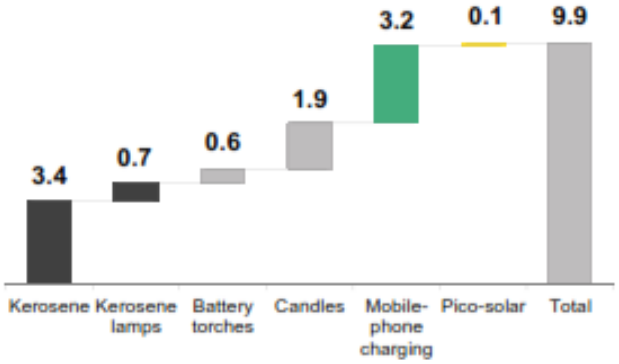
Mark Hankins

ASD team surveying the potential of Pico and SHS in Somaliland with the SECCCO team as part of the World Bank Solar Off-grid Project

Estimated annual spend on off grid lighting and phone charging in Africa (2014, US$ Billion)



Estimated annual spend on off grid lighting and phone charging in Asia (2014, US$ Billion)



Source: Lighting Global Off-Grid Solar Market Trends Report 2016

Financing for companies and consumers in revolutionizing East Africa off-grid market

Since the 1990s, off-grid solar PV has been seen as having potential to transform entry-level electricity access for millions in sub-Saharan Africa. In East Africa, rural off-grid demographics, extensive telecommunications network coverage and the prevalence of mobile money provide fertile ground for markets, and indeed, Kenya and Tanzania markets are the strongest in the region.

But industry is still young. The kerosene industry still has a lion's share of the lighting market – valued at nearly US$10.8 billion across sub-Saharan Africa (GOGLA, Lighting Africa, Bloomberg, 2016) – largely without competition from other lighting sectors. Until recently, high equipment costs, competition from low quality products and lack of financing solutions for both companies and their customers have limited market growth and – perhaps most crucial for scaling beyond small operations – made off-grid solar products unappealing as a commercial investment.

This narrative is changing now, for three main reasons:

- First, lower cost and higher quality products have become available. Efficient LEDs, low cost PV modules, lithium ion batteries and integrated circuit controls have redefined the product. That most pico-solar products offer mobile phone charging capacity makes products that much more appealing for end users.
- Secondly, awareness of solar has dramatically changed consumer perceptions and increased their willingness to pay for the products.
- Thirdly, innovative business models that incorporate mobile money and cellular data are changing the way people pay for and use solar. These updated micro-credit options provide consumers with modular approaches to pay for power or system components as and when they can afford.

Though the first two reasons are important, the fact that investors are buzzing has less to do with marketing and product sales and everything to do with data. The key to unlocking low-income consumer markets has come with the data-driven ability to accept small incremental payments without (or with less reliance on) an expensive distribution and collection network; to disable unpaid systems remotely as a means of credit control; and to gather data on consumer energy demand and use. Consider the following emerging success stories:

- M-Kopa Solar first recognized that mobile cash could lead to mobile credit for rural consumers. They chose pico-solar as the test product. As of early 2016, they had installed 300,000 systems in Ugandan, Kenyan and Rwandan households. Their pay-as-you-go model is fully integrated with M-Pesa's mobile money platform ("kopa" is Swahili for "loan").
- Off-Grid: Electric distributes their M-Power products in Tanzania and Rwanda. They guarantee service for the lifetime of the product and operate a 24/7 call center to respond to customer needs. Their leasing model is adding 10,000 customers a month – with a view to nearly 80 percent of the Tanzanian population as potential customers.
- In Uganda, Azuri Technologies and Fenix International are competing with M-Kopa for a share of the off-grid market. By December 2015, 100,000 households in Uganda and Tanzania were using Fenix solar products and batteries. Azuri Technologies, meanwhile, allows customers to pay their daily, weekly or monthly fees using pre-paid mobile money scratch cards. Other Ugandan companies such as Solar Now have dedicated micro-finance departments that help customers cover up-front costs before installing solar home systems.

By addressing critical obstacles around micro-credit access and high cost of product sales in remote rural areas, these companies – and others like them – are leading a groundswell that has attracted both public funds (from governments interested in the potential to dramatically increase basic energy access) as well as a surge of private investment (from

Off-grid Market at a Glance

Developing world population that has at least one solar lighting product in their homes	**89 million**
Brand quality solar lights (solar lanterns and home systems smaller than 10W) that had been sold by July 2015 worldwide	**44 million**
Off grid Sub-Saharan Africa population's expenditure on lighting in 2015	**$14 billion**
Africa has the lion share of pico-solar and solar home system sales	**Kenya & Tanzania as leader**
Average consumer saving per every dollar spent on pico PV in Africa	**$3.15**
Per cent of 2014 & 2015 direct investment into off-grid solar companies that has gone to pay-as-you-go companies in Africa	**87%**
Annual investment into the sector in 2015	**$276 Million**
According to Lighting Africa baseline forecast, number of off-grid households globally that will use solar PV by 2020:	**1 in 3**
Off-grid TV's likely to be solar powered by 2020.	**15 Million**

Source: Lighting Global Off-grid Market Report 2016

commercial actors who see off-grid solar PV as increasingly profitable). A snapshot of financing announced in 2015 alone for off-grid solar PV companies on the continent follows – with initial research by the ASD team showing over $170M of recent grants and investment for innovative off-grid small-scale solar companies.

Funds attracted in 2014 and 2015 by various off-grid solar companies in the region

Investee	Investors and donors	US $ (million)	Type	Country
Off-Grid Electric	David and Lucile Packard Foundation, Ceniarth, Calvert Foundation, Solarcity, Vulcan Capital, Zouk, Omidyar	70	Debt + equity	Tanzania, Rwanda
M-KOPA solar	Generation Investment management LLP, LGT venture Philanthropy and Gray Ghost Ventures DOEN Social Ventures Coöperatief, Commercial Bank of Africa, DfID, Shell Foundation, Gates Foundation	19	Debt + grant	Kenya, Tanzania and Uganda
BBOXX	DOEN Foundation, Synergy Energy, Bamboo Finance, Ceniarth, Khosla Impact Fund and new backers ENGIE Rassembleurs d'Energies and MacKinnon, Bennett & Co.	15	Debt + equity	Rwanda, Kenya, Uganda
Fenix International	GDF Suez, Schneider Electric, Orange France Telecom, clean tech entrepreneurs Tom Dinwoodie and Warner Philips	12.6	Debt + equity	Uganda, Tanzania
D-light	DFJ, Omidyar Network, Nexus Capital, Gray Ghost Ventures, Acumen Fund, Garage Technology Ventures	11	Equity	Kenya,
Mobisol	European Union	7.6 grant	Grant	Tanzania
LittleSun	Bloomberg Philanthropy	5	Debt	Sub Saharan Africa, Asia
Greenlight Planet	OPIC	5	Debt	Sub Saharan Africa, Asia
SunFunder	Includes 3.8m from Koshla Impact, Better Ventures, Schneider Electric and 13m from a consortium including Iberdrola, Deutsche Bank, Ceniarth, the Packard Foundation, and Calvert Foundation	17	Equity	Tanzania
Orb Energy	USAID	2.5	Loan guarantee	Kenya
SolarNow	Novastar Ventures and Acumen	2	Equity	Uganda
Azuri Technologies	Barclays Bank	1.56	Debt	Ethiopia, Uganda Kenya
WakaWaka	FMO	0.75	Convertible grant	Rwanda
STM Ethiopia	Niwa and SunTransfer	0.13	Equity	Ethiopia

Source: GOGLA and various companies' website.

While there is no quarrel that 600 million people in Africa do not have adequate "electricity access", there is lively discussion on what is meant by "100% electricity access" and which tools should be used to go about achieving 100% access. Off-grid approaches are advocated by solar advocates. Grid extension is supported by traditionalists. They are both right.

Grids are expanding and connecting people.

Governments focus on achieving 100% access through grid-based rural extension (and researchers such as Catherine Wolfram agree). Certainly, in East Africa, there is a lot of grid extension going on, especially in Kenya (see Figure 1). In the last five years, millions of new customers have been connected to the grid. Most on-going electrification is reaching urban and peri-urban customers. In rural areas, schools, clinics, police posts, businesses and farms are being electrified --- with tremendous positive impact. It is one thing, though, to electrify a commercial center and another to electrify the thousands of scattered homesteads in its vicinity.

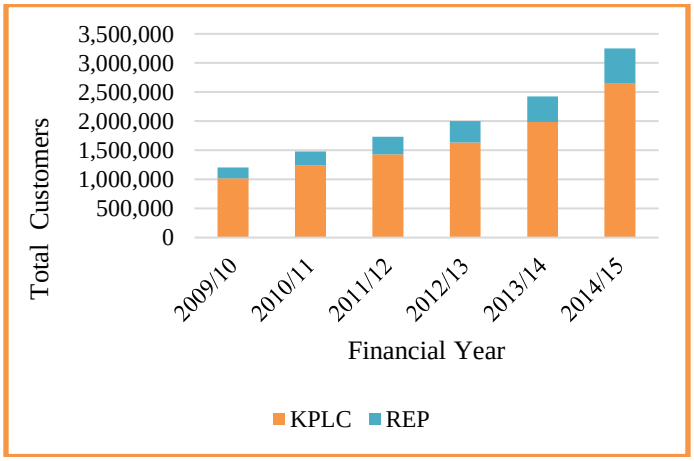


Figure 1: Grid Connectivity in Kenya
Source: Kenya Power

So, despite optimistic targets, reaching 100% of the population with grid connections isn't an easy task. While great for growing cities, grid extensions are less effective for highly dispersed rural populations. Grid extension is costly and it gets more expensive per connection in areas where customers are dispersed and poor. Once a line is extended into a community, it often costs between $500 and 1000 to connect each household. The IFC estimates that it would require $7.5 billion per year to wire up 70% of Africa's unserved population by 2040.

Who will pay for this? Rural people do not have the finance to wire their houses and connect to transformers. Neither do, cash-strapped power companies and rural energy agencies. Governments and donors are hard pressed to fund distribution networks, especially in economically-challenged remote and rural areas.

Off-Grid Solar is here to stay

Advocates of off-grid approaches (this writer included) make the case that solar is right for millions of families who can't manage a grid connection. Indeed, solar is widely used today in rural areas. In 2015, 2.7 million Kenyans used a solar product and 947,000 pico solar systems were sold. Over the past 2 decades, rural people have been actively buying solar systems over-the-counter from shops and solar sales agents; there is on the order of 100MW of installed off-grid solar PV in East Africa.

Solar found this large niche because rural customers want lights, TV, music and cell phones today. Even if they would prefer to get a grid connection, they are not willing to wait for it.

Stage of Market Development	Key Events
Stage 1: Pioneer stage (1985-95)	Early efforts to design off-grid PV systems were stimulated by wealthy customer demand for television and lighting. Pioneer entrepreneurs quickly understood the technology and wider potential for off-grid solar home systems, especially in cash crop areas.
Stage 2: Development of Demand and Distribution Chains (1995-2005)	Market-based distribution systems evolved as competing importers built supply chains and sourced products. The private sector drove sales of PV systems for private consumers and institutions. Consumer awareness (and hence demand) increased rapidly.
Stage 3: Focused Product and Market Development (2005-2010)	Development of lower cost pico-systems was made possible by inexpensive solar modules, lithium ion batteries and high-efficiency LED lights --- and a better understanding of the market. IFC's Lighting Africa created a platform for pico-solar companies to grow their markets.
Stage 4: Introduction of Data-Driven Business Models (2010-present)	Mobile money and cell phone technology enabled companies to introduce financed PAYGo systems. This opened up a large market segment and simultaneously attracted social entrepreneurs and significant investment into the off-grid sector.

Solar PV systems provide a superior solution to kerosene, dry cell batteries and they ease the hassle and cost of carrying a cell phone to a center to get it charged. But, they deliver quite small packages of electricity: A fifty dollar two watt pico system can power a light and a cell phone, a 100 W PV system ($500 investment) can power four lights, a couple of cell phones and a TV for a few hours.

African households have long known about the limitations of solar. In 1990's South Africa, Nelson Mandela once refused to support an internationally-sponsored solar home system project. Aware of the technology's limitations, he sided with constituents that preferred ESKOM connections to solar. Rural Africans desire refrigerators, irons, kettles and even washing machines. Even if they don't own the appliances, they want to be able to power them when they get them. They certainly don't want a power system that places a ceiling on their aspirations.

Given the choice rural consumers still usually prefer grid power

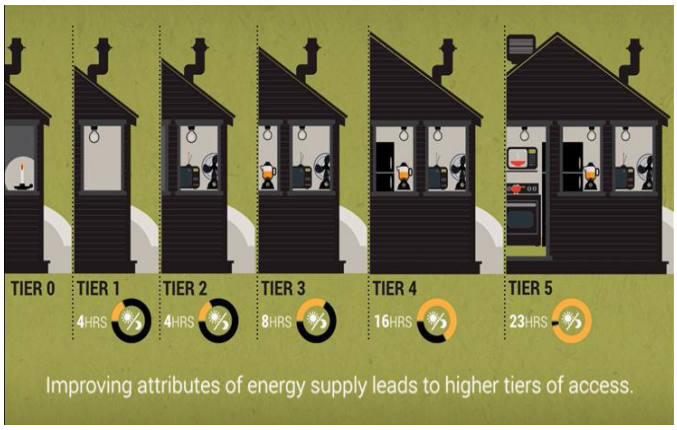
Mandela was right. When customers have money and the grid is near, grid electricity is almost always more economical than off-grid solar.

So under Mandela, South Africa (which then had an excess of power) made huge progress in connecting rural consumers to grid electricity. Today, leaders throughout the continent see off-grid solar as a political hot potato and prefer to promise grid connections even if they know they aren't possible! No one wants to tell a community they won't get the grid.

Energy Tiers: Access is a process, not a destination.

Unlike South Africa in the post-apartheid era, most of sub-Sahara Africa today does not have the funds to achieve 100% grid connection immediately. In the short term, it is technically and financially impossible.

It is possible, however, to make a huge difference in most off-grid people's lives today by moving them off kerosene and dry cells. The "tiered approach" (see this report) allows planners to divide populations into groups based on their energy requirements. It recognizes that most off-grid families at the base of the pyramid have quite modest electricity needs: cell phones, lights, radios. Many have realized that, with off-grid solar, it is possible to reach everyone with a Tier 2 energy supply today even as power companies continue to extend the grid.



Source: World Bank report, Beyond Connection

If policy makers focus on getting all households to Tier 1 and 2, they will have made an important first step in solving a fundamental rural-urban divide. Consumers with entry level off-grid power systems will often benefit so quickly that they will seek to move to the next tier --- and, yes, --- some will seek to get a grid connection. Others may prefer to build their solar system based in evolving technology that is making the grid less relevant for rural households --- they will add appliances that fit within the systems' capacity. If information is available, they will certainly make informed solutions based on the choices available.

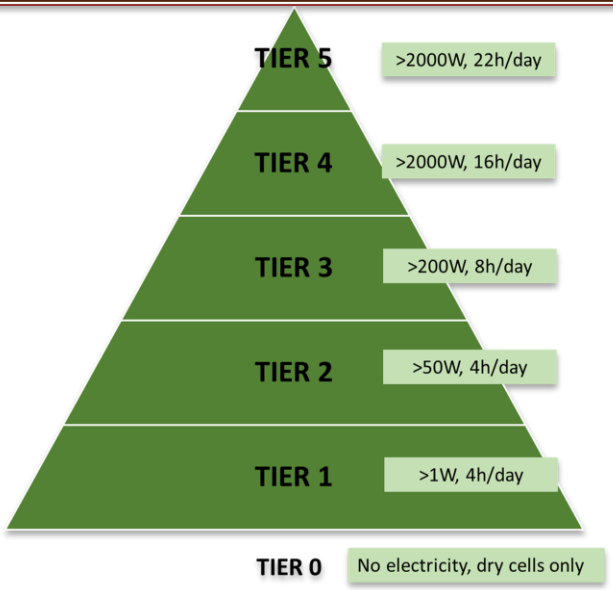
For those interested in energy access, these are truly exciting times. Today, governments, policymakers and donors are contemplating both on and off-grid approaches to energy access. Technology to deliver and store power is readily available. Business models are disrupting the way electrification is carried out and consumers have multiple options. Globally, finance is being mobilized for household electrification. As Xavier Helgesen of Off-Grid Electric Tanzania says, "The world is very different today than when Edison created the light bulb." It is now possible to "reimagine" the grid --- or not to connect to it at all.

The so-called "Base of the Pyramid" energy consumer – an estimated 600 million un- and under-electrified in Africa alone – is eminently reachable. We're watching the transformation now.

Infographics: 100% Access Now

Grid Extension
- Building productivity
- Urban & peri-urban focus
- Last mile focus
- Expansion of networks

Off Grid Access
- 100% Availability
- Commercially-driven
- Multiple technology
  - ✓ Mini-grids
  - ✓ Pico & SHS



ASD Team conducting a Feasibility study at Kreative Roses as part of Powering Agriculture project funded by USAID

ASD Top Tweets- Follow us @solarkenya

1. This year, U.S. solar installations are expected double, reaching a record 14.5 GW.
2. Mobisol Grows East African Off-Grid Electricity Markets
3. Metair acquires 25% of East African battery and solar power group ABM
4. How can we amplify electricity access?
5. A pay-as-you-go solar solution could kickstart renewable energy adoption in Nigeria
6. World's First 24/7 Solar Power Plant Powers 75,000 Homes
7. Pay-As-You-Go Solar Companies Spread Light Across Africa
8. Morocco turns on what will become the world's largest solar power plant
9. Germany's Tesvolt to supply 2.68 MWh storage system in Rwanda
10. Kenya Plans Debut Green Bond to Fund Renewable Energy Projects

About this Newsletter

RE TRENDS EAST AFRICA is a quarterly newsletter produced by ASD in a deliberate move to share its knowledge and expertise of the East African region that spans over 25 years. We cover emerging innovations and technologies and showcase energy trends in the region to paint a picture of the sector and the direction it is taking. At ASD we provide a range of technical, consultancy and capacity building assistance in the renewable energy sector with a focus on commercial and rural energy solutions.

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