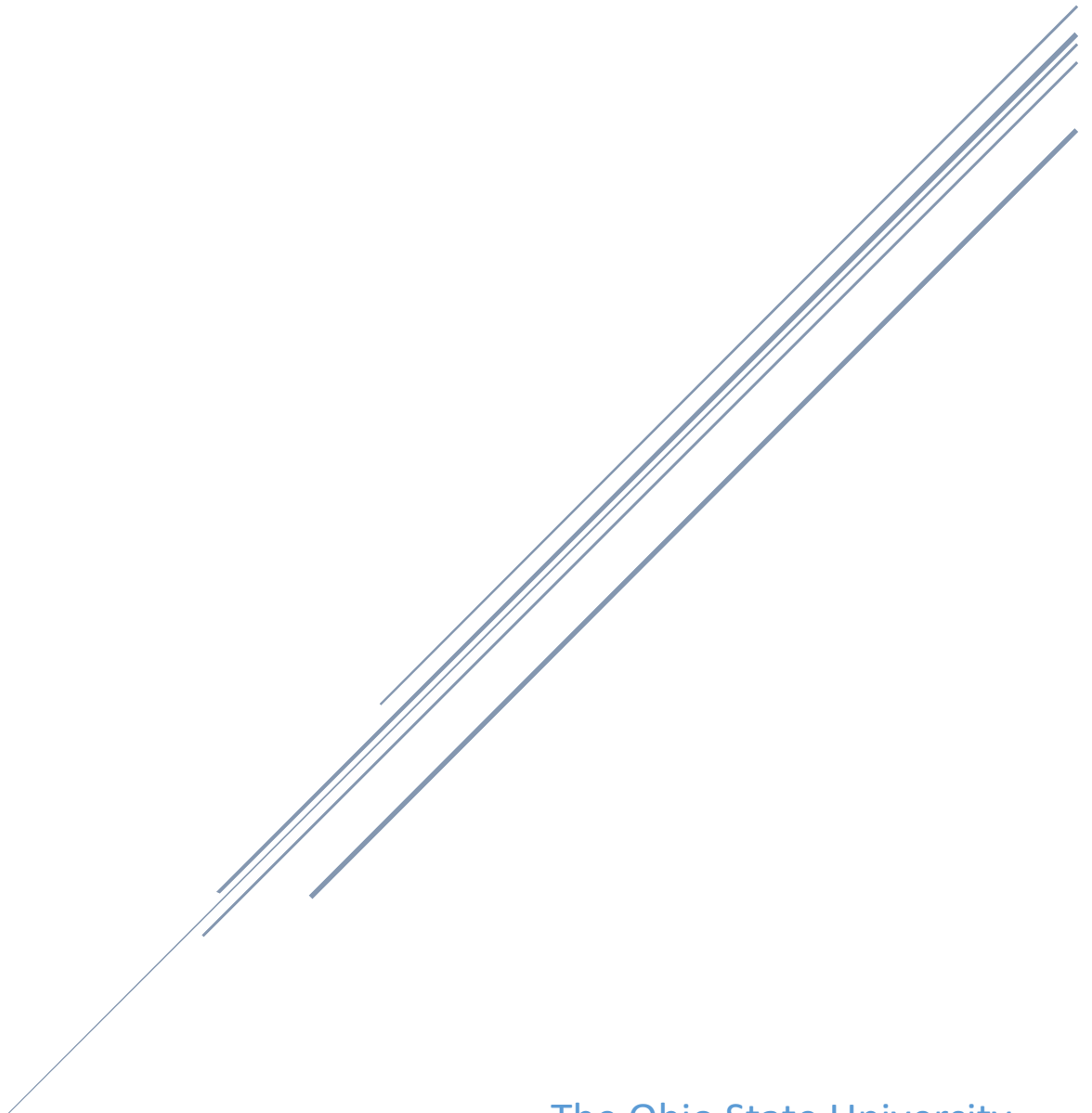


SMALL-SCALE SOLAR POWER SYSTEMS FOR RURAL TANZANIA: MARKET ANALYSIS AND OPPORTUNITIES



The Ohio State University
GAP 2017

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Energy Background

Tanzania has a significant energy problem. At 15.5%, the country has one of the lowest access percentages in the world, a minor increase from 5.3% in 1990¹. While 68% of the country's population resides in rural areas, it is estimated that only 2% of those citizens have access to energy of any form.² Biomass fuel sources, such as firewood and charcoal, are the dominant energy sources, with kerosene and diesel shortly behind. The national grid, maintained by the parastatal Tanzania Electric Supply Company (TANESCO) under the direction of the Ministry of Energy and Minerals, provides electricity to 10% of the Tanzanian population through the form of petroleum, hydropower, and coal.

Frequent blackouts and power rationing have forced TANESCO to look to new power generation activities to support its own grid system. Thus, TANESCO has undertaken privatization initiatives in hopes of sparking investment in energy infrastructure to support its fractured and unstable national grid. This resulted in the creation of Independent Power Producers (IPPs), private power companies that enter Power Purchase Agreements (PPAs) with TANESCO to supply the utility with the additional power needed to support its grid. Unfortunately, due to poorly written PPAs, TANESCO is left with a substantial financial burden, owing over half their monthly revenue to IPPs. Currently, TANESCO is in massive debt to the Tanzanian government and relies heavily on international donors and lenders for investments. Due to their current financial situation, there is a pessimistic outlook that TANESCO will expand as rapidly as desired into unserved, rural areas.³

With favorable regulations, renewable energy is positioned well to compete with conventional energy forms, but any effort would need to come in the form of private enterprise. Fortunately, the geography of Tanzania provides fruitful ground for renewable energy initiatives, with solar energy being a strong candidate with far-reaching geographic potential. With sunshine ranging between 2,800 and 3,500 hours per year and a radiation between 4 to 7 kWh per square meter per day, Tanzania is primed for a strong and prosperous solar industry.⁴

¹ World Bank Open Data 2014. <http://data.worldbank.org/indicator/EG.ELC.ACCS.ZS>

² United Nations Development Programme, http://www.undp.org/content/undp/en/home/ourwork/environmentandenergy/strategic_themes/climate_change/carbon_finance/CDM/tanzania.html

³ Christen, R., Gökgür, N., Nellis, J., Rühl, O. (2005). *United Republic of Tanzania – Privatization Impact Assessment*. World Bank. <http://documents.worldbank.org/curated/en/625791468172138286/pdf/688690ESW0Whit0privatization0Report.pdf>

⁴ Power Africa. *Investment Brief for the Electricity Sector in Tanzania*. [https://www.usaid.gov/sites/default/files/documents/1860/Tanzania%20 IG 2015 05 03.pdf](https://www.usaid.gov/sites/default/files/documents/1860/Tanzania%20IG%202015%2005%2003.pdf)

Project Background

The Global Water Institute's (GWI) Sustainable Village Water Systems Program is a multi-faceted initiative aimed at making measurable, far-reaching progress toward water and food security in Tanzania.⁵ To ensure the success and sustainability of such systems, regional economic activities must be cultivated to progress development and sustain income-generating activities among rural communities. As previously addressed, the lack of energy stifles rural economic growth and exacerbates poverty as the urban centers slowly progress in development.

GWI has enlisted the help of graduate students from The Ohio State University's Fisher College of Business to research the feasibility and optimal parameters to implement regional solar power solutions within rural Tanzania. This paper delivers an evaluation of current businesses operating such facilities in Tanzania and East Africa and an assessment of their associated business models. Each model is analyzed for development potential and risk mitigation, and a final recommendation is provided.

⁵ Global Water Institute. *The Franchise Model*. <http://globalwater.osu.edu/files/OSU-Tanzania-Project-Franchise-model-concept-paper-4.2-forweb-ENGLISH.pdf>

Overview of Solar Market Segmentation in Tanzania

Prior to arrival in Tanzania, our review of commonly available literature brought about the conclusion that the solar market in Tanzania had three segments: household solar, village solar (mini-grid), and industrial/commercial-scale solar. For clarity, we consider the “do-it-yourselfers” who purchase various solar components from the open market and create their own system to not be scalable for GWI, so they were intentionally left out of this market analysis. The table in Appendix 1 outlines the three segments of solar solution providers.

While in Tanzania, however, we learned that the market is more segmented than the table in Appendix 1 shows, primarily at the household level. We were very surprised to learn that M-Kopa, Zola, and Mobisol cooperate extensively to try to improve business conditions for pay-as-you-go solar companies. The market as presently segmented is presented in the table in Appendix 2.

All companies in the household segment use the pay-as-you-go model through mobile payment systems such as Airtel, Tigo-Pesa, or M-Pesa. Further, almost all household solar providers include the cost of complementary products (lights, radios, TVs, etc.) in their payment models, as they have adapted to sell capabilities rather than watts. For example, a salesperson will not sell a customer an 80-watt system, they sell five lights, a radio, and a TV, and then the solar system is merely how the equipment is powered.

Currently, the geography of the consumer base, the number of installed units, and financial backing are the primary differentiators, aside from system size for the household solar market. All players have significant financial backing, allowing them to pay for the marketing, capital expenditures, and customer service staffs needed to support the challenging Tanzanian market. For example, Zola’s parent company, Off-Grid Electric, claims to have raised over \$70M in calendar year 2015 alone.⁶ Finding good information about present installed user base has been challenging, as each company defines installed users differently and the information is likely to be dated differently. However, frame of reference thoughts are possible to measure scale and impact. Appendix 3 outlines a chart of the GAP team’s thoughts on the present installed user base and geographic focus for each company.

The market dynamics presently differ for the household solar companies and the village solar companies. The village solar companies are still in the pilot or “figuring it out” phase, as it seems that village politics and payment schemes vary from village to village and we did not talk to any company who could point us towards someone who has figured out village solar. Although the household market is still fragmented, market players are aggressively pursuing customer acquisition to solidify their place in the market. Ultimately, the handful of household companies with the best customer acquisition models will be the ones that survive when debt and investment financing runs out. This model includes the volume of customers, as well as the quality of customers. Customers using more complementary products are more profitable, and customers who pay on time and self-maintain systems require less support as the system is repaid. How soon until the household solar companies will start cannibalizing each other in

⁶ Off-Grid Electric Press Release, “OGE announces \$45M debt financing deal,” December 17, 2015

head-to-head competition is unclear. External dynamics including the availability of grant funding, ambiguity in TANESCO expansion plans, the Tanzanian Revenue Authority's inconsistency in VAT exception enforcement, intermittent confiscation by customs authorities of low-quality products, and rural economy variability all have yet to be determined.

Solar Home Systems

Although this market segment does not receive the headline attention that large, multi-kilowatt projects receive, the overwhelmingly dominant player in solar power in East Africa is the solar home system market. This segment is the elephant in the room that cannot be ignored. The industry is fragmented into two major disciplines, with one being retail vendors that sell individual solar products at storefronts to the “do it yourselfers”, and the other being companies that sell complete, closed-loop solar home systems (SHS).

For the retail vendors, this is also divided into registered companies selling solar energy components of different capacity and price, as well as street vendors selling low-quality/low-price solutions. The managers of both retail vendor companies and closed-loop SHS companies have both indicated that street vendors and their inferior products are the biggest pain point for the household solar industry. According to one business leader, when the “cheap Chinese imports break, which they always do, not only has the customer lost a substantial amount of personal investment, but we’ve lost that customer’s confidence in solar energy, and that is very difficult to gain back.” The retail vendors and the street vendors both tailor to the “do it yourselfer”, the individual customer that has the education and finances to customize their own personal SHS. Installation and warranty are subject to the retailer and vendor and may require an additional expense. The option to pay in installments is also subject to the retailer. A consumer in this segment generally possesses the knowledge to understand how solar energy works, the ability to identify their specific power needs, and the capability and knowledge to shop the market. As mentioned previously, this customer demographic does not reflect the population in the study for GWI, and as such, the vendors of solar components are not a viable solution for this initiative and will not be discussed further in this paper.

The interesting segment is that comprised of companies that produce closed-loop SHS. A quick online search of “solar home systems in Tanzania” will show that the market is flush with different consumer options. These companies provide everything that a consumer would need to secure basic off-grid electricity, including full installation, product warranty, mobile payment, and additional DC appliances to operate off of the battery storage. In our research, except for Devery, all SHS companies utilize the pay-as-you-go finance model towards hardware ownership. Each SHS requires an initial down payment, followed by monthly installments. After 36-months, the SHS is paid in full and the customer now owns the system outright and benefits from free electricity for the remainder of the SHS life.

A separate analysis on Devery is located at the end of this section, as their uniqueness in providing SHS power capabilities but operating as a mini-grid company differentiates them from the rest of the SHS market.

Capital Requirements

Household-level solar solutions have the lowest initial capital requirements for individuals in any of the industry segments we studied. For example, M-Kopa offers a system that for as little

as 49,000 TSH down + 30,000 TSH per month for 36 months, a consumer could have a full SHS complete with three LED light bulbs, a rechargeable LED lantern, a rechargeable radio, and a mobile phone charger. SHS companies assume some financial risk by providing a good prior to collecting the full retail price, but the financial effect of an account defaulting is minimal as that company grows in customer size. Outside of operating costs to the company, all retail capital requirements fall on the consumer.

On the surface, these solutions seem very cost-effective for a household that does not have access to the grid. Over time, a household's disposable income will increase as kerosene purchases are eliminated. The caveat is when TANESCO arrives at a village. TANESCO has the lowest energy tariff in Tanzania, so if there is a plan for TANESCO's arrival, new customers may be apprehensive to contract with SHS providers.

Project Risk

Household-level solar projects have relatively low risk, as the concept of starting small and growing organically allows a company to minimize risk. All project risk initially lies with the SHS companies, as they are responsible for upholding any warranty agreements. Our research has found that warranty standards range from 36 to 60 months in length. After that time, that risk shifts completely to the consumer. Any maintenance after 36 to 60 months is now a direct consumer expense and an aftermarket revenue for the industry players. The risk does not change in volatility or shift in ownership no matter the number of homes outfitted.

Scalability of Power Consumption

Household solar solutions can easily scale in customer size but are immediately capped in power consumption. The limit in potential customers is directly related to the production capability of an SHS provider. From what we have gathered, there does not appear to be any backlog in servicing new customers from any of the retailers. The scalability of power consumption is another story.

For SHS companies, the consumption capacity is immediately capped by the size of the system installed. As mentioned previously, there are three different segments within the SHS market: small, medium, and large SHS providers. The smallest system would simply be a 1W solar lantern. The largest system we found was a 200W package from Mobisol. For entry-level energy service in rural areas, or as a short-term backup to the unreliable national grid, household solar offers an adequate solution for initial energy needs for individual households. As development progresses, SHS solutions do not allow for scalability in consumption. The SHS is a closed-loop package and is not meant to be modular to incorporate hardware additions. The 200W package from Mobisol provides a lot of energy for a household or a small business but is not an adequate solution for industrial enterprises.

For business and community services, customized solar systems would need to be installed for each business with the potential to install additional hardware to grow with the enterprises as electricity starts to become mainstream. There is currently not a business solution within SHS

retailers. The standardized product line is the only solution offered. At a max capacity of 200W, some small business enterprises could benefit, but nothing that is going to have a substantial economic impact for the community, such as the energy required for a milling business. Mobisol said that they performed a pilot project to outfit a school, but did not feel that the project was in line with their business model, and that they were most likely not going to pursue business customers.

Ease of Adoption

Although household solar solutions are segmented and do not incorporate an entire community investment, many retailers work with new customers to highlight the benefits and instruct on proper use. With policies ranging from 36-60 months, the warranty programs provide customers with peace of mind should the system falter. Mobisol has developed a proprietary analytics program using cellular GSM networks to monitor a customer's entire SHS and troubleshoot problems—even before a customer contacts the service hotline. SimuSolar provides an indicator that measures both the battery storage as well as the days remaining until mobile payment. Since every SHS company provides the same basic service, they use system size and customer service as their selling points.

A systemic concern with SHS retailers is that the solutions provided are DC systems, not AC systems, which is the nationally adopted electric current. Finding appliances that use DC power is difficult, and most require a customer to purchase appliances directly through their respective retailer. As development progresses and energy consumption increases, the DC systems will be a severely limiting factor.

Overall Analysis

Criteria	Capital Requirement	Project Risk	Scalability	Ease of Adoption
Grade	B	A	F	B

Devergy Analysis

Devergy is an interesting company to study. They provide the same capability as the other SHS companies but operate as a mini-grid company. Devergy is the only company we discovered in the SHS segment that utilizes a pay-as-you-go finance model towards energy consumption versus hardware ownership. Their reason for this is that they are a “DC mini-grid” company. They use their SHS product as a stepping stone towards the eventual installation of their DC mini-grid towers. After acquiring enough SHS customers in close proximity to each other, they remove the SHS systems and install scalable DC solar towers. In talking to their Chief Energizing Officer, he explained that customers pre-pay for energy consumption, but how that energy is delivered is transparent to them. Whether it is a standalone SHS or part of a growing DC mini-grid, the same amount of pre-paid electricity is provided to the customer. The reason Devergy uses a pre-pay model is that, since their customers have never had an electric utility before, the culture does not allow for an understanding of a consumption bill. So instead of charging per watt at the end of the month, they charge by capability. “Like mobile phone operators do when

they sell data plans paid for on a monthly basis, Devergy sells energy plans that can be used for a specific purpose like charging a phone or powering a refrigerator, within a previously agreed period of time”.⁷

Capital Requirements

As opposed to traditional SHS companies, Devergy utilizes a pre-pay model for energy. This means that at the end of 36-months, customers will still be paying Devergy for energy use as opposed to owning an SHS outright. Another difference between Devergy and traditional SHS companies is that since Devergy does not provide a complete package, customers must buy DC appliances independently. Devergy does provide this additional service, but it also comes with an additional cost to the consumer. Also, the state-run TANESCO provides the lowest price per watt, so when TANESCO eventually expands into an austere location, customers that do not own an SHS outright may be inclined to switch to the TANESCO grid. Devergy is relying on their customer service and fast maintenance response time as reasons that customers will stay with them, but for a population that is incredibly price-sensitive, TANESCO may come out on top in the end.

Criteria	Capital Requirement
Grade	C

Project Risk

Like other SHS companies, all project risk lies with Devergy but continues to do so beyond the 36-month mark. In a give-and-take approach, since customers do not own the Devergy system outright, they are not liable for maintenance and upkeep of the system. Other mini-grid companies are forced to rapidly install customers to their mini-grid as consumption must quickly cover the operating costs of the grid size. Since Devergy's model allows it to scale with the demand of power consumption, they are not in a forced position to rapidly install customers to their grid.

Criteria	Project Risk
Grade	A

Scalability of Power Consumption

Since Devergy acts as a mini-grid, their ability to scale with power consumption distinguishes them from other SHS companies. The caveat is that Devergy operates a DC network, so scalability is subject to the need for DC power. In talking with Devergy, the Chief Energizing Officer said that they can support just about every small business enterprise except for those that require large-capacity AC engines. He explained that Devergy will work with business owners to help acquire the systems needed to run their business. For example, a carpenter that historically used hand tools could now use high-efficiency, battery operated power tools.

Criteria	Scalability
Grade	C

⁷ Club Africa. “‘Devergy’: Selling pay-per-use energy services in Tanzania”. <http://www.your-bizbook.com/en/Club-Africa-News/devergy-energy-services-in-tanzania>

Ease of Adoption

There is no difference between Devergy and traditional SHS companies with regards to the ease of adoption of electricity. Devergy works with the client base to educate them on electricity consumption, and their finance model makes it easy for customers to understand exactly the energy service that they are receiving from Devergy. Also, as mentioned before, Devergy suffers from the same limitations that DC power imposes on other companies.

Criteria	Ease of Adoption
Grade	B

The Failure of Mini-Grids to Provide Electricity in Tanzania

Technologically, mini-grids offer the best potential for the delivery of power to rural communities in the developing world. However, implementation has proven that stand-alone energy systems have a better chance for success, while mini-grids have quickly become relics of the failure of donor aid. There are multiple reasons why mini-grids fail to deliver on their technological promise. Causes of failure that will be explored include:

- Mini-grid energy generation capacity is more than customer demand
- Pricing structure is confusing at best; frequently impossible
- Mini-grids insert the energy provider at the center of village politics
- TANESCO expansion threatens return on investment

Lastly, we will explore the experience of JUMEME and look at why, in 2016, Zola repositioned themselves from mini-grids to single home solar (SHS), with Devergy following in 2017.

The Battle between Supply and Demand

Every mini-grid project that we found had more installed capacity than possible customer demand, even if all target customers were connected to the grid. The cause of this is that, apart from Devergy, mini-grid electrical generation capacity cannot be easily scaled up as electrical demand within the village rises. Therefore, NGOs and companies must install a system based on forecasted demand within a certain amount of time, as opposed to the current demand for electricity in a community. The first challenge with this is that future forecasted demand is usually very optimistic. JUMEME, for example, installed a 16-kW system although actual customer demand was only 8 kW. This adds enormous cost and risk to the project both from initial capital expenditure and for ongoing maintenance and operating costs. Further, most estimates made during system design are formulated assuming many customers will connect to the grid, and in some cases, 100% connectivity was assumed. In the past, the assumption that many customers would connect to the mini-grid might not have been so irresponsible. Now, however, customers have the option of purchasing an SHS as a substitute to a mini-grid. When Zola was trying to sell mini-grids, they noticed that in most villages there were only a small number of early adopters. Because of this, the early adopters would get frustrated as Zola worked to build sufficient interest to justify expenditure on a mini-grid. As the construction of the mini-grid was delayed, the early adopters would gradually purchase SHS solutions, causing Zola to lose their best potential customers prior to installation of the mini-grid.

Complicated Pricing Structures

Another cause for mini-grid failure are the pricing structures—ranging from difficult to almost impossible—that must be implemented in the developing world. Energy companies that try to sell “watts” will struggle to sell anything in Tanzania. In the West, cell phone providers have struggled to sell individual data plans over the years, so they have been forced to adapt the way they market their data plans. For energy in Tanzania, very few customers know the capacity of,

say, 100 watts, so convincing them to purchase 100 watts of power is difficult. Therefore, the energy companies have adapted to selling solutions and capabilities. Rather than selling 100 watts, the company sells the capability to watch TV or the capability to run a barber shop. The electrical system is a part of the package but not the selling point. In the SHS industry, the pricing structure is easy to decipher, as the energy generation capability is self-contained. However, with mini-grids, it is very difficult, as most towns will have multiple barbershops and multiple customers using TVs. The catch is that one barbershop might be open for eight hours per day for five days per week, while the other barbershop is open ten hours per day for six days per week. The customers know they are consuming a different amount of electricity, but the energy company cannot set up their pricing structures for this difference, because they are forced to sell the ability to run a barbershop. Therefore, the barbershop that is open less frequently feels they are subsidizing the cost of energy to the barbershop that is open more frequently, and they become a customer that may not pay consistently or even at all. The unpredictability that this injects into the system interferes with the model that outlines how the energy company will recoup their investment. Items like TVs, water pumps, and carpentry shops are even more problematic than barbershops with regards to setting up fair pricing. When customers do not use the products they have purchased electricity for, they don't want to pay, but given the business model, there is no way to forecast shop closures, vacations, etc. This leads to further erosion of the paying customer base. SHS companies avoid the pricing problem because each customer is aware that they have been given the same capacity and they can use their TV or electric razors as much as they want. Therefore, usage variances are perceived to be owned by the customer, with the energy company not being involved in any friction or hard feelings regarding low usage. Unless, of course, the system is broken.

As stated previously in this paper, Devergy has made a slight adjustment to this pricing structure, in that they have added time as another calculating factor. Using a proprietary algorithm, Devergy charges customers by the activity and time. For example, if a customer says that they would like to pay for the use of a TV for one week, Devergy can calculate the amount of energy that would take and then charge the customer accordingly. The customer then has a certain amount of energy allotted to them, and how they choose to use that is up to them. If they choose to run their TV every day, their allotment will last a week. If they only power lights, their allotment may last a month, but if they chose to power a DC refrigerator, then their allotment may run out after just a few days. Devergy may have solved the problem of customer disparity, but at the cost of extensive customer service overhead.

Dynamics of Village Politics

The third reason mini-grids fail is that they have multiple customers, and the delivery of energy becomes a function that agitates village politics rather than avoiding them. As mentioned above, pricing is based on the ability to use an appliance or electrical device, not how much the electrical device is used. Customers are aware that appliance use correlates to higher electrical usage, and the energy company is blamed for this inequality. Further, the energy companies

will usually seek out the customers with the highest probable usage first and work their way down until they get whatever amount of potential sales that are needed to justify the investment. This means the rich get richer thanks to international aid money or unfair contracts, and the energy company becomes perceived as another example of inequality. Lastly, mini-grids don't leverage pride of ownership since no one owns their system or connection. Every issue with the grid or lines is someone else's fault, and simple maintenance like preventing mice from chewing on the lines is not the responsibility of the customer, but of the energy company. This causes maintenance costs to increase rapidly. With SHS products, customers get what they pay for, so the energy company is not viewed as directly responsible for expanding the perceived inequality that electricity only favors the affluent. Also, the ownership model draws pride out of owners. Devergy and Zola both mentioned that owners are much more likely to learn and be proactive with simple maintenance like wiping off the solar cell and ensuring mice don't eat power cords. This results in much lower customer service costs for SHS than for mini-grids. This advantage was something that Devergy talked to the GAP team about extensively.

Threat of TANESCO

Lastly, the villages that have the highest and fastest return on investment for mini-grid companies also are the villages that TANESCO is most likely to expand to. We heard countless stories about how, shortly after a mini-grid was installed in a village, TANESCO would expand the national grid to that village. This does not appear to be TANESCO's plan, but they seem to be under the strong influence of politicians, and if a politician feels a mini-grid threatens their support, they will put immense pressure on TANESCO to expand to that community. Given the large capital investment of mini-grid installations, any time this happens, it causes great financial loss to the energy company. SHS not only are smaller and fly under the radar of politicians, but they have a significantly lower financial risk, even if TANESCO extends the grid into a town. There are three reasons for this:

1. Capital investment is very small so one, two, or twelve customers failing to repay their systems can be absorbed by the energy company.
2. Installations are spread out so different customers are at different repayment points. Rather than all customers being 10% of the way to repaying their system connection, some might have repaid 75% of their system cost, some 50% and only a few at 10%.
3. TANESCO requires customers to pay a connection fee. Given the low cost of monthly payments and the 36-month payment period for SHS providers, their customers may choose not to connect to the grid if TANESCO expands into their village.

Given all the advantages of SHS solutions, it is no surprise that for-profit companies have repositioned themselves in the market to SHS products and away from mini-grids. Zola directly stated that they realized they weren't going to survive by selling mini-grids and needed to sell SHS in 2016, despite mini-grids being a superior technology from a development standpoint.

Devergy pivoted away from true mini-grids in February 2017 to a business model more like SHS providers. Given Devergy's technological solution, they are still technically a mini-grid provider, but they use SHS to measure demand, retain early adopters as customers, and analyze which customers are likely to make monthly repayments. Then they only provide the electrical output justified by demand.

The Ukara Island Project

JUMEME is the one company that appears to be continuing down the mini-grid path after more than three years of trying to get their pilot site to work. As mentioned earlier, JUMEME's pilot site is a 16-kW system, but only delivered 8 kW of electricity after the ribbon cutting. This was due to the common misperception that "if we build it, demand will come" which has always failed to occur. This still happened despite installing their system in a location that was known to be impossible for TANESCO to expand to, and prior to the widespread presence of SHS providers in the area. To JUMEME's credit, rather than quitting, they quickly found financial support for entrepreneurs to try to increase the electrical demand. Their experience shows that mini-grid developers need to be prepared to not only build the system but also build whatever demand is needed to justify the capital expenditure on the system. Despite JUMEME's best attempts, after three years and 16 million euros of investment, the most optimistic person the GAP team talked to said "the jury is still out" on whether JUMEME's pilot will be successful, although their site had more conditions for success than will be found in most Tanzanian locations. JUMEME is not a good candidate for GWI investment, as they have realized that they are very limited on potential locations for expansion, being a diesel-solar hybrid (Marty stated that GWI will not invest in diesel hybrids), and the massive overhead required to work with entrepreneurs and build electrical demand causes it not to be widely scalable.

Overall Analysis

The GAP team's experience and research in Tanzania show that mini-grids have not worked and are unlikely to work in the future due to the challenges associated with their implementation.

The GAP team's first meeting regarding solar was with Fredy Canizares from Micro-Energy International, a German energy consultancy, and the conversation went something like this:

Fredy stated that they have never seen a mini-grid work in the developing world, and only SHS have worked, with the widest adoption being in India and Bangladesh. The above-mentioned challenges are just too much for a for-profit company to overcome, and NGOs either lose interest or funding before they can scale a solution out to many people.

Recommendations

Do Nothing or, More Correctly, Nearly Nothing

- *Market leaders in the solar industry are too mature for meaningful investment by GWI or have business models that agitate village politics requiring the acceptance of substantial overhead costs to make the project successful.*
- *GWI could work with Tanzanian customs authorities and the Tanzanian Bureau of Standards to ensure solar products not meeting existing TBS standards are confiscated at the point of entry.*
- *GWI could work with the Tanzania Revenue Authority to eliminate the perceived irregularity with VAT tax exception being enforced for solar products.*

Mobisol, Zola, and M-KOPA are the undisputed market leaders in the household solar market, which is the only solar industry with a market in Tanzania. As described above, entrants into all other market segments have either failed or have spent years and millions of dollars trying to get pilots to work, only to learn that at sites two through 100 they are going to experience the exact same pain that they worked through at the pilot site. Given the massive amount of overhead expended at pilot sites, it is clear why Zola changed their strategic alignment to the household solar market in 2016 and why Devergy did the same in 2017. Everyone is grappling with the reality that they must be profitable by the time grant and investment funding runs out.

Although this analysis of the Tanzanian solar market may sound downbeat, it is an incredibly positive development, as it demonstrates that market forces are shaping the direction of the solar industry in Tanzania, as opposed to donor wishes. This showcases that, at least in the solar market, the mistakes of the last half-century of international grant money are not being made. Organizations with first-world backing are not coming into communities and telling people what they need and then providing for this 'need' free of charge. These organizations are asking people what they want. Then they go back to the whiteboards and figure out if there is a market that is likely profitable. If they determine that a profitable market likely exists, they develop products for that market and return to customers to figure out if the product developed matches the customer expectations for what they would likely pay for it. If the opportunity cost of capital for the product is higher than what the firm can get with other projects, they will launch a pilot project. If the pilot is determined to be successful, then the company will complete a standard product launch. Although this sounds like a gross generalization of a college lecture in new product launches during a Marketing 101 class, it is revolutionary in the world of international development.

Therefore, the question is: what can GWI do to support and encourage the adoption of solar technology in rural Tanzanian communities? The GAP team identified seven players in the Tanzanian household solar market, and it is likely that there are more, as the team's travels were limited. Furthermore, there are likely additional players in other African countries of varying size that are evaluating expansion outside of their first country. Given the number of

players in the East African market, it does not appear that a new start-up can enter the market successfully without a solid differentiation strategy. The GAP team asked many questions relating to why the major players appear so homogenous (provide DC powered radios, TVs and lights that are part of a kit). The basic response was that most companies tried to differentiate themselves somehow originally and discovered there was either no market or the pricing structure was going to be so enormously complex that they would not be able to recoup their investment. Thus, establishing “GWI-Solar” is not worth pursuing, given that there is no apparent way to differentiate, and the main players are aggressively capturing market share now.

The GAP team was asked to review the possibility of purchasing a solar company and matching the company’s technology with millions of dollars of GWI funding to aggressively accelerate the adoption of solar technology. All seven companies basically meet the following criteria presented by GWI:

1. Have five or more sites in place for more than one year.
2. M-KOPA, Zola, and Mobisol are the only companies that clearly have more than one site operable for longer than three years, but it is likely that all seven have the technology and customer service backbone to achieve this goal.
3. All self-contained solar kits cost less than \$1,000, so the initial capital requirement is manageable. Devergy’s model is not a kit as each system is custom designed, so initial capital requirements vary at each site. Specific repayment time varies per kit and company, but the initial investment in all kits is repaid within two years.

Therefore, the question comes down to the price of the acquisition and business plan. We were asked to look at a business plan targeting annual sales of \$1M and a profit of \$100k in three to five years. Frankly, annual sales of \$1M would result in delivering solar systems to less than 2,000 customers annually, which would result in GWI-Solar being an annoyance to the seven mentioned players who are striving to deliver solar kits to more than 10,000 customers annually between now and 2020. (Appendix 4)

All of the companies investigated are private companies, so we do not have a handy tool like share price and shares outstanding to estimate market value, but there is information available regarding what equity investors and debt markets have invested in many of the analyzed solar companies. The table in Appendix 4⁸ shows that solar companies founded in the US, Germany, Italy, and Kenya all have received substantial investment from their founding through February 2016 utilizing normal business fundraising organizations. Given that this report only runs through February 2016, it is likely that additional fundraising has occurred, both reported and

⁸ “Stimulating Pay-as-You-Go Energy Access in Kenya and Tanzania: The Role of Developmental Finance,” World Resources Institute, June 2016 Issue Brief, Retrieved on 25 May 2017 from https://www.wri.org/sites/default/files/Stimulating_Pay-As-You-Go_Energy_Access_in_Kenya_and_Tanzania_The_Role_of_Development_Finance.pdf

unreported. One example is Mobisol, which raised greater than \$14M in December 2016⁹ shortly after receiving an investment that was “well above \$20M.”¹⁰ In our opinion, the companies that are most likely to survive once market cannibalization occurs already have sufficient financial backing, so any GWI investment would be an investment and not an influencing activity. Further, if any of the companies not listed in the chart above develop a truly differentiated market advantage, the statistics have shown that solar start-ups have the capability to fundraise in the debt and equity markets, so GWI investment is not needed.

In all our discussions with Tanzanian solar energy companies, they stated that external entities could positively impact the Tanzanian solar market in the following three ways:

1. Do not give anyone anything for free. It undermines the market-based systems growing within the Tanzanian solar industry. Customers who have been given something for free take years to re-enter the market if their free system becomes inoperable.
2. Cheap solar products that are being installed by do-it-yourself handymen are undermining well-intentioned companies from growing. These products are usually less expensive and promise a three-to-five-year warranty, however, the customer has no way to redeem the warranty and the manufacturers know this. Therefore, they only make products that last for six to twelve months. They all asked for help getting customs authorities to enforce TBS standards on imported solar products.
3. The erratic nature of enforcement of the VAT exception for solar products causes needless variability in solar companies’ financial models and raises costs for customers. Work with the TRA to ensure the VAT exception is always applied to imports of solar products meeting TBS standards.

By allowing the free market to work, community members are positioned to receive the best return on their investment. Through increased farmer income brought on by GWI-backed farmer education programs, these rural communities will become target locations for the market players to enter, and subsequently will put the bargaining power in the hands of the consumers.

Create an Electric Utility

As opposed to allowing the free market to compete for customers, GWI is also positioned to create its own electric utility within a village or region and using the Sustainable Village Water System Program as an anchor business for revenue generation. Mini-grids offer exactly what SHS solutions have failed to deliver, and that is the ability to provide continuous power as a community develops. SHS provide the exact power that a customer needs at that point in time, and very few provide the ability to increase wattage over time. Mini-grids, on the other hand,

⁹ Mobisol Press Release, “IFC and FMO invest in Mobisol,” December 12, 2016, Retrieved on 26 May 2017 from <http://www.plugintheworld.com/mobisol/2016/12/12/ifc-and-fmo-invest-in-mobisol/>

¹⁰ “Investec Buys Stake in Berlin-Based Off Grid Solar Developer,” by Anna Hirtenstein, Bloomberg, Retrieved on 25 May 2017 from <https://www.bloomberg.com/news/articles/2016-10-04/investec-buys-stake-in-berlin-based-off-grid-solar-developer>

are built to meet the future potential energy needs of a community or region. The problem is that the future potential energy needs are rarely met within the timeline that the mini-grid provider needs to pay off its debts. As mentioned previously, there has yet to be a profitable and successful mini-grid in Tanzania. The jury is still out on the JUMEME project, but they have a lot of hurdles still to overcome to break even on the project. The underlying problem is that mini-grid companies use a bottom-up approach without empowering the bottom to develop. They believe that by simply having access to energy, the demand for consumption will follow. The problem is that a field of solar panels sitting with 20 kW of power is not going to change overnight the way a carpenter produces a bed frame. Education and awareness are crucial to generating demand for energy. This paper has been very critical of mini-grids, but it is merely a presentation of the data at hand. Mini-grids offer the best potential for sustainable development, but come with an incredible risk of failure if not properly implemented. With the right approach, GWI could build its own mini-grid and establish an electric utility for a village or region.

Operating Model. GWI already has a history of creating and maintaining a public utility. The procurement, installation, and maintenance of the SVWSP can be transferable to an electric utility as well. For a mini-grid to be successful, it needs to generate enough demand to cover its operating costs and needs to do so expeditiously, or the budget will run dry. That is where an Anchor-Business-Community model could be effectively administered. The anchor-business-community (ABC) model supplies power primarily to an anchor partner, such as a telecommunication tower, with the remaining power prioritized to local businesses and households in that order. Using an “anchor” will not cover enough costs to break even, but will hopefully give the utility enough of a head-start in revenue to allow for development to catch up organically. For GWI, that “anchor” is the SVWSP.

Reliable water can spark a multitude of small agro-business enterprises. With proper education and consultation, small-farm water programs should develop rapidly once the water capability is there. Like a domino effect, with capability and education come increased production capacity and demand. Since the SVWSP is already being used as an “anchor” for productive farming practices, it can easily be extended as an “anchor” for a mini-grid.

To determine the size of the mini-grid project, GWI must conduct a feasibility study on the development potential of the village or region. Too small of a mini-grid and development is stifled, but too large of a mini-grid and GWI cannot recoup operating costs. This includes value chain analyses in both agriculture potential, as well as manufacturing potential. After identifying the potential for power demand in a village or region, GWI can accurately determine the size of mini-grid to construct.

After construction, GWI would then find itself facing the same problem that has ruined mini-grids in the past, and that is generating enough demand to cover operating costs. By using the SVWSP as an anchor business for the mini-grid, they should be able to bring enough revenue to

give them a head-start, but GWI will still be required to rapidly accelerate power demand in the project's vicinity. This means that GWI cannot rely on organic development, but instead needs to facilitate productive uses of energy through the development of agriculture and manufacturing.

Management Model. The management construct of an electric utility is not something we researched, and therefore we cannot make a recommendation on how to execute mini-grid operations. GWI uses a franchise model to operate, maintain, and manage the SVWSP. Determining if and how a franchise model could be tailored to an electric utility could be a future GAP project.

One management dynamic that we did uncover in our research is the inconsistency in end-user energy consumption. In our meeting with Sisty Basil, the National Coordinator for the Energy Change Lab, he highlighted that consistency in household energy consumption is a problem that plagues mini-grid projects. The issue is that electricity is not viewed in rural communities as a necessity. Households have gone the entirety of their lives without it, so convincing someone to pay additional money for electricity is difficult to do, especially if kerosene prices are cheaper. Water, on the other hand, is a necessity and people know they cannot afford to go without it. Linking water and electricity together as "energy" could give the mini-grid the legitimacy it needs to maintain consistent consumption from households. Further research needs to be conducted on the feasibility of combining water and electric utilities, particularly in complement with GWI's franchise model for the SVWSP, and how that would affect the dynamics of village politics.

Overall Analysis. With the right approach and a patient donor base, mini-grids stand to be incredibly successful. On paper, mini-grids are a better tool for economic development than SHS because they are built to potential demand as opposed to current demand. The problem is that there has yet to be a mini-grid that could generate enough revenue to cover its operating costs, and eventually the money goes away and the project fails. GWI can buck this trend by using the SVWSP as an anchor business to its own mini-grid electric utility. GWI would still need to be heavily involved in enterprise development, as the SVWSP alone would not generate enough revenue for the mini-grid. GWI will be forced to push development and drive energy demands, but do so in a manner that the price per watt would be lower than that of kerosene. Continuing development of the SVWSP, constructing a mini-grid, and driving enterprise expansion may be too much for GWI to handle on its own, and as such, GWI should consider strategic partnerships with companies that specialize in mini-grid operations or enterprise development before establishing an electric utility.

Appendix

1 Solar Segments

Segment	Size	Companies Operating in that Space
Household Solar	<1kW	Zola, Mobisol, M-Kopa, Devergy
Village Solar (mini-grid)	1kW to 100kW	JUMEME, Rafiki
Industrial/Commercial Scale Solar	>100kW	Hecate

2 Market Segmentation

Segment	Size	Leading Companies in the Space	Trailing Companies in the Space
Small Household Solar	<10W	M-Kopa	
Medium Household Solar	12W to 80W	Zola	SimuSolar, SolarGrid Tanzania
Large Household or Small Business Solar	80W to 200W	Mobisol	SimuSolar, Sikubora, Devergy
Village Solar (mini-grid)	1kW to 100kW	Rafiki	JUMEME
Industrial/Commercial Scale Solar	>100kW	Hecate	

3 Present Installed User Base

Company Name	# of Systems Installed	Geographic Focus Area(s)	Comments
M-Kopa	>7,000,000	TBD, country headquarters in Dar Es Salaam.	Most installations are in Kenya, expanded to Tanzania in late-2016.
Zola	>50,000	Northern Tanzania, but aggressively expanding to other regions.	Likely first mover in Tanzania, expanded into Uganda in 2016 or 2017. Set-up a JV with EDF to expand into the Ivory Coast.
SimuSolar	>5,000	Lakes Region, other NGOs have brought their system elsewhere.	Partnered with We Care Solar NGO
Sikubora	Unknown	Likely Arusha, but unknown	Found them online, limited awareness among competitors when asked.
SolarGrid Tanzania	>5,000	Morogoro & Dar Es Salaam	
Mobisol	>84,000	Northern Tanzania, but aggressively expanding to other regions.	Started in Rwanda, but expanded to Tanzania. 50,000+ units sold in Tanzania.
Devergy	~20	Morogoro & Mbeya	Executed a strategic market shift in February 2017 to reposition themselves hoping for growth acceleration.
Rafiki	8	Iringa and Arusha	No information available regarding how many grids are still operable, although based on our findings it is likely at least some are now inoperable.
JUMEME	1	Next phase will stay around Lake Victoria	

4 Key Funds Raised by Pay-As-You-Go Companies

Company	Details of funds raised
Azuri Technologies	<ul style="list-style-type: none"> ■ US\$1.7 million: Barclays Social Innovation facility (2013)^a ■ US\$0.75 million: AECF REACT Round 2 (2012)^a ■ Amount undisclosed: IP Group Plc, a VC fund (2012)
BBOX Capital	<ul style="list-style-type: none"> ■ US\$15 million: previous backers and ENGIE and Ceniath, Oikocredit (2015)^a ■ US\$3 million: DOEN and Bamboo Finance (2015)^a ■ US\$1.9 million: Synergy Growth and Khosla Impact (2013)^a ■ US\$0.30 million: AECF REACT Round 2 (2013)^a
Mobisol	<ul style="list-style-type: none"> ■ €10.7 million: DEG (2015)^f ■ £288,000: GSMA grant (2013) ■ US\$1.1 million: AECF REACT Round 2 (2013)^a ■ Amount undisclosed: DEG (2012)^a ■ €200,000: EEP (2012)^f
M-KOPA	<ul style="list-style-type: none"> ■ US\$19 million: led by Generation Investment Management (2015)ⁱ ■ US\$12.45 million: led by LGTVP (2015)^a ■ US\$20 million: syndicated by Commercial Bank of Africa (2014)^a ■ £350,000: GSMA grant (2013) ■ US\$-1.9 million: led by LGTVP (2011)^a
Off-Grid Electric	<ul style="list-style-type: none"> ■ US\$45 million: Packard Foundation, Ceniath, Calvert Foundation (2015) ■ US\$25 million: led by DBL Partners (2015)^a ■ US\$7 million: IFC, Cordiant Capital (2015)^a ■ US\$16 million: led by SolarCity, Zouk Capital, and Vulcan Capital (2014)^a ■ US\$7 million: Vulcan Capital, SolarCity, Omidyar Network (2014)^a
Devergy (a mini grid company in Tanzania)	<ul style="list-style-type: none"> ■ £350,000: GSMA grant (2015) ■ US\$809,000: led by Acumen (2015)^f ■ €115,000: DOEN project subsidy (2012)^a
Powerhive (a mini grid company based in Kenya)	<ul style="list-style-type: none"> ■ US\$20 million: led by Prelude Ventures LLC (2016)^a ■ US\$12 million: Enel Green Power (2015)^a

5 Meeting Notes

Zola Solar in Arusha

Point of Contact: Joseph Sengelela

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Email: josephladslaus33@gmail.com

The GAP team went to Zola's flagship store in Arusha on 8 May to learn more about Zola. We met with Joseph after he completed dispatching his installation staff.

At a high-level Zola appears to want to offer the cheapest electricity available. It is likely that they are only able to do this through their significant international funding (USAID has provided over \$60M), although this would have to be confirmed with Off-Grid as Joseph was not aware of COGS compared to Revenue.

Here are our notes:

Customer Plans

- Zola has four plans that customers can sign up for. Each plan has free installation, which is completed in one day, with a five-year warranty. The repayment period lasts for three years after which power is free. Each system comes with a 12V lithium battery that can be charged, so electricity can be used later.

Plan	Wattage	Peripherals	Initial Payment (tsh)	Monthly Installment (tsh)
Small	12 watts	<ul style="list-style-type: none">• Two light bulbs	17,000	17,000
Medium (Zola Home)	24 watts	<ul style="list-style-type: none">• Four light bulbs• Radio• Exterior light• USB charger	50,000	20,000
Large (Zola TV)	50 watts	<ul style="list-style-type: none">• 24" TV• Three internal lights• Exterior Light• Radio• USB charger• Strip Light	140,000	40,000
Extra Large	75 watts	<ul style="list-style-type: none">• 30" TV• Three internal lights• Exterior Light• Radio• USB charger• Strip Light	170,000	50,000

- Zola accepts three types of mobile payment m-pesa, tigo-pesa, and Airtel Money.

- Zola will sell kits to rural and urban customers however most customers are located in the rural areas. Presently in some regions power provided by Zola is cheaper than that provided by the national grid.

Customer Service

- Zola's customer service strategy is supported by three types of 'agents:'
 - Sales
 - Installation
 - Service
- Service Strategy
 - Zola has a 24/7 Customer Service line customers call with service issues (255 800 75 2222)
 - Customers with hardware issues call the hotline and attempt to troubleshoot a solution. If troubleshooting does not work, Zola will then put in a work order with a service agent. Service agents are spread throughout the 17 regions Zola sells in. Many service agents are members of the village they are assigned to support, so there is already a rapport between the service agent and the local community. Service agents then assess the issue and make a request for parts through Zola's aftermarket logistics network. Agents do carry small parts kit, but any major repairs require a second work order to be submitted for advanced servicing from Zola's aftermarket logistics network.
 - After the five-year warranty expires, customers still have access to Zola's Customer Support program, but is now assessed a fee for service and repair (pricing unknown).

Late Payment Policy

- If a customer is late on payments Zola has an escalation latter that is used to recoup payment:
 - 1 – 30 days: mobile contact made between Zola agents and the customer
 - 30+ days: an agent will be assigned to go talk to the customer and determine the repayment plan. The agent has full authority to allow the customer to keep the hardware or repossess the hardware. Joseph mentioned if the customer can catch-up on payments within two months, generally, the customer will be allowed to maintain their system.

Zola – Corporate Office

Name: Bethany Kanten

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Market Analysis

- Zola started out trying to provide village level power systems, however, village politics were too complicated and customers who had a strong desire for solar solutions could not afford 1kw+ systems. Therefore, in early 2016, Zola pivoted out of larger systems and into household sized systems which have been highly successful.
- We presented Bethany with our view of how the solar market is segmented as the following:

Size System	Companies in the Space
100kw+	Hecatate
1kw – 100kw	Jumeme, Rafiki
<1kw	M-kopa, Zola, Mobisol, Devergy

- Bethany was quick to point out that market is segmented below the 1kw solution size and that m-kopa, Zola, and Mobisol don't feel like competitors. She was familiar that Devergy existed but unfamiliar with their offering. Here is how Bethany submitted the market is segmented:

Size System	Company	Target Customers
<10w	M-kopa	Absolute base of the pyramid
10w to 80w	Zola	Households, very small businesses (barber shops, mobile phone charging, etc.)
80w to 200w	Mobisol	Restaurants, other businesses

- Further, there is geographic segmentation as m-kopa is very large in Kenya but smaller in Tanzania. Mobisol is very large in Tanzania but smaller in Rwanda. Lastly, Zola is large in Tanzania and expanding to Uganda.
- Bethany stated that all three companies intend to walk their customers through 'energy ladder.' This means that as customers gain affluence and desire more power their current provider will have solutions ready for them, rather than a m-kopa customer eventually becoming a Zola company.
 - Zola feels they have ability to influence what businesses their higher end customers participate in, so their product development teams are working on new 'business in a box' concepts for higher end offerings.
- Eventually m-kopa, Zola and Mobisol will likely be head to head competitors, but all three believe that market is so immature that cooperation is best strategy now. Zola doesn't see market competition heating up for 3+ years.

- Door-to-door sales is primary method of customer acquisition. Door-to-door salesman is trained to talk in terms of what appliances do customers want to use and not in terms of wattage requirements.

Operations

- Contractors do sales, installations, and service. One FTE manages 4 to 6 contract employees. Seems similar to U-Verse and Time Warner Cable's model in the US.
- A lot of Tanzanian's know a little bit about electrical work, so service employees can be quickly trained to an acceptable level
- All installations are completed in one day, so technician shows up in morning and will demonstrate functionality prior to sunset.
- Zola uses DC electricity rather than AC electricity in order to ensure customer gets highest amount of wattage system can provide. The downside is that not every desired appliance works with DC power. Irons, fans, and refrigerators currently are not available to use with Zola kits.

Talent Management

- Sales, installation, and service employees are easy to find and source.
- All FTEs are required to have a college degree, so finding Tanzanians who can work as supervisors/managers is very tough.

Pain Points

- As identified above Zola would like a better pipeline of college graduates for FTE roles within company. This limitation is hindering growth to some degree.
- However, the biggest pain point is government inconsistency.
 - Fake products were a major issue 2+ years ago, however now government does a good job catching them. Further, population has a better ability to identify fake products from real products.
 - Products not meeting TSB minimum standards are a major issue. Many products say they have a 3 or 5-year warranty, but manufacturers know customers can't return defective products so they don't try to manufacture products to last as long as warranty. Price sensitivity drives customers to these solutions, however when they break it limits willingness to buy solar products again.
 - Moshi and Mwanza Zola sales staff spend a lot of time educating rather than selling products.
 - TANESCO does not announce their 3 to 5-year expansion plan, so solar companies often are selling products in an area that is soon to be electrified. This is bad for customers and for solar companies as financing repayments are affected and bad word of mouth is generated.
- Biggest thing GWI can do to help Tanzania solar companies is trying to get TSB to enforce minimum standards for solar hardware and reject any hardware not meeting minimum standards.

Power Providers

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Overview:

- Power Providers (PP) was founded in 2007 to address the problem of reliable power in remote areas. PP initially was focused more on safari lodges and camps but as others saw the success of the systems installed by PP they too asked for similar systems.
- PP installs solar power, solar water, and battery backup systems usually ranging between 1kw to 100kw in size.
- PP only does installation-for-hire work, so there is either a large electrical user funding the installation or a 3rd party, such as Rafiki Power, using PP as their service provider while the 3rd party handles reimbursement with end users. PP uses a five step process:
 - 1) Detailed Site Survey
 - 2) System Design
 - 3) Procurement of Goods
 - 4) Installation
 - 5) Service and Maintenance Support - Optional
- PP requires an 80% down payment to begin Step 3 in most cases.
- PP believes that they are differentiated from their competitors through having a very good data collection process to ensure the site survey and the design are very accurate and surprises are reduced during installation.
- PP will install anywhere in Tanzania, but their customer base is in North, West, and Central Tanzania. Upon request, PP will provide a detailed listing of installations completed in regions of interest.

Sales and Marketing

- PP started selling mostly to safari lodges but as others saw the success the lodges were having their market expanded into hospitals and schools. Today, PP sells to five primary markets:
 - 1) Solar Water Pumping Systems - ~50% of sales
 - 2) Solar Water Heating Systems - ~10% of sales
 - 3) Solar Power Systems - ~10% of sales
 - 4) Generators & Back-Up Systems - ~20% of sales
 - 5) Renewable Energy Consulting - ~10% of sales
- PP had no marketing strategy, to include pamphlets or a website, until 2016. To this day referrals are the primary source of new customer generation, but an excellent website and paper advertising have generated sales as well.

- PP completed a market analysis regarding where they benchmark among the ~10 companies they compete with in Tanzania. They believe they are located at the mid-point of the price range for customers. Some competitors are 10-15% below their price, but they believe those competitors sacrifice on quality to achieve their cost advantage. Some competitors are 40%+ higher and PP does not believe their products or services are significantly different than the higher priced competitors.
- PP believes that the market for systems ranging from 1km to 100km is still a very immature market.
- It is very common for customers to return to PP after 12 to 24 months asking for expanded service. Small expansions are usually easy (we believe this is defined as 10% more power or less), however medium to large-sized expansions usually require the entire system to be re-evaluated and reinstalled.
- Every installation discussed gave the appearance of an anchor user at each site – primary user who would bear the costs of the system, while extra electricity went to others as an act of generosity.

Suppliers/Supplies

- PP gets most of its product directly from the manufacturers. Occasionally distributors will be used, but their distributors also happen to be competitors so they do not like to do this.
- Procurement of parts not on hand generally takes 3 to 4 weeks but this will depend on specific system requirements for each site.
- A full listing of supplies commonly used, vendor datasheets, and pricing information can be found on their website in the webstore, <http://www.powerproviders-store.co.tz/>.
- Lithium ion batteries are a new entry into solar systems this size. PP plans to experiment/pilot their first site using lithium ion batteries this year (detailed information on batteries currently used can be found on the webstore).

Operations

- All 20-30 employees are based in Arusha. The staff is roughly split 50/50 between field employees and office employees.
- PP is reviewing the possibility of opening up a branch office outside of Arusha. There are two factors they are carefully considering prior to pulling the trigger:
 - Quality Assurance – Gijs said it takes years for most installers to be able to master installation of their solar solutions since each one is customized to the site to some degree. Right now they have six master installers and four apprentices, however, they don't expect any of the apprentices to graduate to a master installer within the next 12 months. Also, PP is considering the cultural dynamic of a one office team to a multi-location team.
 - Customer Demand – A second site will need to have sufficient customer demand to justify the overhead associated with it. Presently, solar awareness is higher in the north and in the coastal areas than inland and south. So, for example, if an office was opened in Iringa PP would have to ensure there is sufficient demand to justify that investment.

Pain Points

- Regulatory Environment
 - A mess, period.
 - The VAT exception for solar and power products is very sporadically enforced causing inconsistency in input pricing.
 - Customs frequently want to test batteries at the point of entry and they frequently damage or destroy the batteries being tested. The cost of replacement is with the firm who has ownership during testing, usually PP.
 - Tanzania Revenue Authority – New rules are constantly invented.
 - Difficulty hiring foreign workers to add critical skills.
 - Shipping delays caused by confusing customs procedures, not capacity constraints at the ports.
 - PP was not overly worried about sweeping regulatory changes in the next 12 months. They thought that any changes we've heard about would affect mini-grids or companies not established.
- Saturation of Fake or Low-Quality Products
 - Fake products are still a problem affecting customer confidence in solar systems, but not as big of a concern as they were 3+ years ago.
 - Products not meeting Tanzanian Bureau of Standards (TBS) requirements are a larger problem now than fake products. Usually, either poor hardware or a poor installation job causes the system to work temporarily, but not as long as expected. Therefore, the customer loses confidence in the longevity of solar systems.

Mobisol

Contact: Manon Vermeulen, Sales and Partnership Development Lead

The GAP team went to Mobisol's Northern Zone headquarters located in Arusha to talk with Manon Vermeulen, a Dutch citizen, who has been working for Mobisol as their sales and development lead in the northern zone for the past 8 months. According to Manon, Mobisol offers a point of competitive advantage and differentiation through their German quality, flexible payment options, 3-year warranty, and high service level.

Customer Scope

- Mobisol currently has 58,000 customers in Tanzania and a total of 80,000 in East Africa
- Roughly 80-85% of Tanzanians do not have access to the national power grid
- Sold in all but two regions of Tanzania
- 50 Mobishops (local sales shops) scattered throughout rural Tanzania
- Currently scaling up sales in Rwanda and Kenya
- 100% mobile customer payment

Competitive Landscape

- According to Mobisol, kerosene and generators are unhealthy and ineffective
- Mini grid solar systems offer a compelling option but are complex, develop slowly, and offer no chance of personal ownership
- On-grid electricity has a high cost and is unreliable

Product Scope

- Components: solar panel, battery, solar controller with SIM card (accessed via mobisol software platform), and LED bulbs
- Systems offered at 80, 120, and 200w levels, which is more than power level demanded
- Used at the individual household level or small businesses
- 35% of customers use Mobisol product for business
- Simple packages offered that include television and stereo, with plans of packaging with home appliances in the future

Service

- Customers must pick up their system at a *Mobishop* to ensure trained employee describes how to work the system and make payments
- Free installation, maintenance through contracted techs
- Flexible payment (30-day grace period per year of loan)
- 3-year warranty
- Maintenance resolved within 48hours of service call
- Only 2-3% of products are repossessed due to non-payment

Threats/Pain Points

- According to Manon, the Tanzanian government is not supportive of solar through their lack of investment and difficulty for foreign companies to conduct business
- 18% Value Added Tax (VAT) has substantial effect on individual affordability
- Managing a diverse and scattered sales and operations staff