PERSISTENT ENERGY PARTNERS

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Distribution: Addressing the Central Energy Access Challenge in Africa

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About

Persistent Energy Partners (PEP) invests venture capital, advises businesses and incubates companies in the energy access sector in sub-Saharan Africa. PEP also manages three funds with more than 40 investments in solar product, clean cook stove and LPG distribution businesses in 7 African countries. For more information, see www.persistentnrg.com.

The authors thank Pepukaye Bardouille, Senior Operations Officer with the International Finance Corporation, for her advice and assistance with this paper.

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Abstract

Distribution—reaching customers with products or services—is an underestimated challenge to providing access to energy to low income off grid people. For affordable solar products, the cost of distribution is too high to enable businesses to build sustainable, scalable businesses that can reach a significant population. Financing models and energy services models that have the advantages of consumer goods distributors are promising as approaches to build large-scale distribution businesses that can meaningfully address energy access in sub-Saharan Africa. Emphasis should be placed on focusing resources on these approaches with grant and investment capital, regulatory reform, and other removal of barriers to development.

Executive Summary

Providing access to basic modern energy services for the world's 1.3 billion energy poor requires overcoming many significant challenges. In sub-Saharan Africa, perhaps the challenge most often underestimated is the challenge of building sustainable distribution organizations that reach deeply into off grid populations. As technology develops and product costs fall, we believe that the absence of robust, large scale distribution organizations that reach the doorstep of every - or nearly every – off-grid home is the central challenge to achieving access to energy in sub-Saharan Africa.

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Cost drivers

There is a broad range of cost drivers that make building a sustainable distribution organization difficult. These cost drivers fall into four categories: physical infrastructure challenges, institutional barriers, human capital challenges, and customer adoption. Each presents a cost of doing business that squeezes margins or becomes such a high hurdle that small businesses cannot get to a level of commercially sustainable, scalable growth.

The cost/price dilemma strangles durable goods distributors

The array of solar products available to provide entry level energy access to rural off-grid Africa is broad, ranging from solar home systems costing several hundred dollars to inexpensive solar lanterns. While larger solar home systems are out of the price range of most off-grid consumers and suffer from customer acceptability issues at such high price points, small[1] high quality solar lanterns[2] cost between $5 and $10 each to manufacture. This is the amount it is estimated that most off-grid sub-Saharan households pay for kerosene or batteries for lighting in a month. Why then are solar lanterns not ubiquitous in sub-Sahara? The reason is the cost/price dilemma: the cost of distribution is too high relative to the price off-grid customers are willing to pay for lanterns. In this paper we present a financial model of a prototype lantern retailer, demonstrating that it can never generate enough profit to grow into a scalable business. [3]

We understand why lantern distributors are hamstrung. Why, then, aren't distributors that are selling larger solar home systems achieving commercial scale? We are aware of no durable goods distributor in rural sub-Saharan Africa – including distributors of solar home systems – that has achieved or has the prospect of creating a large-scale distribution business that reaches deep into untapped rural markets. The reason again is the cost/price dilemma: the price of the product is too high to build the necessary customer base for such a business.

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[1] 0.5 – 1.5W, 30 – 100 lumens, 4-5 hours reading light.

[2] For example: http://www.dlightdesign.com/productline/s2/

[3] We also include a link to this financial model for those readers who would like to see an illustration of a business selling larger systems. *http://persistentnrg.com/distribution-financial-model*.

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Solutions: financing and services models

Experience suggests that financing consumer acquisition can overcome the price side of the cost/price dilemma. The comprehensive financing and distribution program run in Bangladesh has allowed distributors of solar home systems to reach over 3 million customers with a current growth rate of approximately 30, 000 new customers added per month.[4] In spite of this success, a Bangladesh-type program has not yet been successfully implemented in any sub-Saharan African country.

The other approach to overcome the cost/price dilemma is to follow the consumer goods model. Distributors of consumer goods – be it kerosene or Coca-Cola – have succeeded in building large-scale businesses that have successfully penetrated rural Africa. The correlative strategy in energy access is the services model: the distributor retains ownership of the energy-generating assets and sells energy services – lighting, mobile phone charging, radio, TV, etc. – to consumers for a recurring fee. Microgrid operators such as Devergy Group and solar home system operators such as Off-Grid:Electric are pursuing this model.[5]

Working capital starvation

The most consistently cited barrier to providing access to energy is the lack of adequate working capital for distribution businesses to acquire inventory and finance operations. The cost/price dilemma demonstrates why this is the case: retail solar businesses cannot achieve the level of scale that makes them attractive borrowers of working capital.[6] Solving the price side of the cost/price

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[4] See "Scaling Up Access to Electricity: The Case of Bangladesh." Sadeque, Zubair; Rysankova, Dana; Elahi, Raihan; Soni, Ruchi. (2014) World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/18679. *See also generally*, "The nexus between the successful SHS program in Bangladesh and the emerging DESCO sector in sub-Saharan Africa and India" Chris Aidun & Dirk Muench (2014)

[5] In our recent white paper, "How a New Breed of Distributed Energy Services Company Can Reach 500 million Energy Poor Customers in a Decade" by Pepukaye Bardouille, Senior Energy Specialist, Energy Access Lead, International Finance Corporation, and Dirk Muench (2014), http://goo.gl/h6LBEF, we discuss these models, which we refer to together as "Distributed Energy Services Companies" or "DESCOs".

[6] While it is true that some solar distributors are able to access concessionary working capital – and efforts in the global development community to make such funding available appears to be effective – these businesses remain small scale and marginal. As such they have little prospect of making a meaningful contribution to meeting the energy access challenge.

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dilemma with an effective financing or services model would give a business predictable recurring revenue stream and attractive profit margins at scale. This ability to scale will of course only succeed if such a business can attract adequate equity capital to grow to large and profitable organization.[7] In doing so that business will create an attractive lending opportunity for lenders, while at the same time leveraging the businesses assets and operations with debt for the benefit of its equity investors. We believe that this is the avenue to solving the working capital shortage problem.

Meeting the distribution challenge

Although there are no easy solutions to the distribution challenge, it is important to recognize the magnitude of the challenge. It is also important to recognize what will not work. We are convinced that cash sales of solar products will not make meaningful inroads to achieving energy access in Africa. On the other hand, consensus appears to be developing among leading solar product manufacturers, entrepreneurs, and investors financing models that energy services models can reach scale and lead energy access in sub-Saharan Africa. Global development and investment communities and national governments should focus on promoting these models and removing legal and regulatory barriers to their growth. Resources should be committed to helping these businesses establish a strong presence so that they can become sustainable.

Introduction

The challenge of providing clean, affordable energy to over 500 million people living off the grid in sub-Saharan Africa is a daunting one. Solar lanterns and systems, small hydro minigrids, hybrid solar/diesel minigrids, and other approaches are being employed to reach this goal. There are many projects but few successful businesses that can scale to meet the needs of off-grid communities.

Our work with many businesses trying to reach off-grid customers at scale has convinced us that distribution is an underestimated bottleneck to achieving

[7] This conclusion is supported by the recent report, "Investment and Finance Study of Off-Grid Lighting" by A.T. Kearney and GOGLA (2014). http://global-off-grid-lighting-association.org/wp-content/uploads/2013/09/A-T-Kearney-GOGLA.pdf.

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widespread access to energy. We believe that building and maintaining a commercially scalable distribution organization that can reach the doorstep of a substantial population of low-income rural off-grid households is the central challenge to providing access to energy.

This paper will analyze what it takes to build and operate a commercially sustainable distribution organization. It will show why even the seemingly most affordable energy access solution—purchasing solar lanterns—is actually too expensive for off-grid consumers because the cost of distribution is so high.[8]

What we learned

The team behind PEP assumed the management of E+Co's legacy assets in 2011. This portfolio included approximately 50 investments in distribution businesses (solar lanterns, solar home systems, clean cookstoves and LPG gas). The result of our simplified model for distribution businesses in this paper reflects our experience of working with these companies for the last 3 years. Successful businesses eventually abandoned retail sales for the reasons outlined in our model, i.e., they could not achieve meaningful profitability even though *in theory* it is possible. Instead, these successful businesses have refocused on the institutional market, installing larger more complex solar systems for governments and institutions.

Why the Cost/Price Dilemma Hampers Distribution in Off-Grid Sub-Saharan Africa

Getting products or services to customers in most sub-Saharan countries is an expensive and time-consuming process weighed down by many hurdles. Combining a market of rural low-income consumers with a challenging set of cost drivers contributes to the cost/price dilemma.

[8] A similar conclusion is reached in a recent study by Hystra for the Bill & Melinda Gates Foundation, The Children's Investment Fund Foundation and the Shell Foundation entitled "Marketing Innovative Devices for the Base of the Pyramid" (March 2013) http://hystra.com/marketing-devices/ (the Hystra Report). Although the report describes the challenge as marketing problem concluding that, "In short, engineers have done their job but marketers have not," Hystra's broad definition of "marketing" centers around sales organization, distribution, and after sales activities (page 1).

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Cost drivers

The challenges in sub-Saharan Africa and similar parts of the world where rural low-income families live can roughly be grouped into four categories: physical infrastructure, institutional barriers, human capital, and customer adoption.

1. *Physical Infrastructure*

Anyone who has worked in Africa understands the deficiencies in its transportation infrastructure. Cities are clogged with traffic. Rural areas are poorly served with roads and those roads must serve as passenger routes and shipping routes in lieu of first world rail shipping infrastructure.[9] Operating a business dedicated to energy access for rural communities requires managing the challenges of deficient infrastructure. For example:

- Devergy installs and operates solar microgrids outside of Morogoro, Tanzania. Morogoro is approximately 200 kilometers from Dar es Salaam, the major city and port of Tanzania. According to Google maps, the drive from Dar to Morogoro is 2 hour and 30 minutes; however, that trip routinely takes between 5 hours and 11 hours to complete. Devergy sends personnel and materials between Dar and Morogoro region every week as part of its business.
- Persistent Energy Ghana has three pilot microgrids in the Afram Plains district of the Eastern Region of Ghana. Minimum travel time is approximately 5 hours and includes a ferry across Lake Volta. Relatively close to Accra (approximately 200 kilometers), the Afram Plains is a remote off-grid region.

Both Tanzania and Ghana have large populations without access to clean energy – approximately 25 million in Tanzania and approximately 5 million in Ghana. Because of the physical barriers of poor infrastructure (and the associated added costs of doing business), both Devergy and Persistent Energy Ghana are

[9] According to the World Bank, Africa has 204 km of roads per thousand square km of land area. 75% of these roads are unpaved. North American has over 3,000 km roads per thousand square km of land area. Less than 40% of all rural Africans live within 2 km of an all-season road.
http://www4.worldbank.org/afr/ssatp/Resources/WorldBank-TechnicalPapers/TP141.pdf
http://infrastructureafrica.org/system/files/BP14_Roads_maintxtnew.pdf

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working in *off-grid areas* of their respective countries. This lack of infrastructure makes reaching communities around Kigoma, Tanzania, or Bolgatanga, Ghana - each on the other side of the country from its largest city and port - daunting.

2. *Institutional Barriers*

Institutional barriers include (1) legal and regulatory impediments that make it more expensive or simply uneconomical to do business, (2) inefficient and disinterested governments, (3) corruption that saps funds and delays operations and (4) currency instability.

- **Legal and Regulatory Impediments.** Certain energy access businesses, such as retail sales of solar lanterns and systems, are lightly regulated in most sub-Saharan countries, making for relative ease of entry.[10] More sophisticated delivery systems, such as minigrids (whether solar, hydro or hybrid) are generally considered generators or transmitters of electricity under national utility regulatory statutes. As a result, installers and operators of minigrids must either be licensed or have received an exemption under local utility laws to build and operate their systems. They may even be subject to tariff setting procedures, requiring them to obtain approval of the rates they charge customers from national public utility regulatory commissions.[11] For small-scale minigrids not connected to national grids, complying with the administrative burden of tariff rate setting procedures and other compliance matters can be extremely burdensome. Minigrid developers that have sought approval for minigrid projects in one West African country have reported that the expected time period for approval of each *single* project is approximately two years.

[10] In Ghana, for example, such a business must be licensed as a renewable energy business under Ghana's Renewable Energy Act of 2011 (Act 832), a relatively simple clerical process.

[11] Ghanaian law could be interpreted to place minigrids that are not connected to the national grid under such licensing and regulation. Public Utilities Regulatory Act, 1997 (Act 538). Tanzania, in contrast, recently adopted regulations that would exempt "Very Small Power Producers" (under 100kW installed capacity) and would regulate "Small Power Producers" (under 10 MW transmission limit) in a manner more conducive to promoting their development. *See generally*, EWURA RULES APPROVED AND GAZETTED_GN.111_11_04_14. http://www.ewura.go.tz/newsite/index.php/sppmenu/165-small-power-projects-2014. *See also generally*, Tenenbaum, Greacen, Siyambalapitiya and Knuckles, From the Bottom Up; How Small Power Producers and Mini-Grids Can Deliver Electrification and Renewable Energy in Africa. (World Bank 2014)

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- **Inefficient and disinterested governments**. Levels of bureaucratic inefficiency, dysfunction, lack of political will, and simple disinterest of many governments inhibit a business from establishing itself and bringing its goods or services to rural markets.
    - *Customs Delays*. In many sub-Saharan countries clearing customs can be an arbitrary process, even when one is represented by an experienced customs agent. Solar related equipment imported from overseas may be exempt from VAT and customs duties but will not necessarily get the benefit of the exemption in the hands of every customs officer. Delays at customs cost businesses money, since equipment sitting in port must be financed with precious working capital and employees often must wait for goods to clear before they can get back to work. In most countries there is a faster route, involving paying bribes. In some countries this may be a virtual necessity to maintain a reasonable import schedule.
    - *Disinterest*. Even the most routine licensing and registration processes in many sub-Saharan countries can take an excruciatingly long time. Whereas a business corporation can be formed in a day in Delaware, a similar ministerial act languishes for weeks in many sub-Saharan countries for opaque reasons.[12] With more substantive matters, often it seems that government officials do not have the political will to move energy access initiatives forward, even when benefits abound. Indeed, the most common sign visible in many rural areas of Ghana, "no light, no vote!" seems largely ignored.
- **Corruption**. Almost any businessperson who has had contact with a sub-Saharan government will agree that the backdrop to most institutional deficiencies is corruption. Corruption touches businesses directly in sub-Saharan African countries and it also impacts businesses indirectly. For example, the increased cost of infrastructure projects as a result of corruption is one reason why some sub-Saharan countries have inferior road networks: it is extremely expensive to build roads because of the "black hole budget". Donor governments are reluctant to finance such

[12] In one instance, this ministerial act was not completed until the Minister of Justice interceded on the new company's behalf.

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projects - even though they would be an engine for growth - because of this black hole.

- **Currency instability**. International products – solar lanterns, panels, batteries and other system components - used by African distributors must be purchased with Dollars or Euros. Much financing offered to African distributors of solar products or services to the energy poor is also denominated in those currencies, particularly if provided by impact investors or development finance institutions; yet distributors' revenues are generated in local currencies. Many African countries have weak monetary policies that have led to significant devaluations over relatively short periods.[13] This currency instability creates an arbitrary and sometimes devastating mismatch.

Institutional barriers like delays, disinterest, corruption and inability to rely on a stable local currency increase the cost of doing business.

3. *Human Capital*

The challenge of building and retaining capable staff in energy access distribution businesses is also substantial.

- **Building capable staff**. Workforce knowledge and experience in sub-Saharan Africas is not comparable to Western countries. Sub-Saharan countries are in earlier stages of developing a middle market business community that is educated, sophisticated and that recruits, trains and expands its own numbers. In many countries, such as Ghana and Kenya, the workforce is ambitious and entrepreneurial. However, intensive training and, ultimately, a generation or more of entrepreneurship is needed to create a labor pool that would enable new and growing businesses to recruit staff and execute distribution-based business at the pace of Western countries.

[13] For example, the Ghana Cedi has declined from 1.905 to the US dollar on January 1, 2013 to 2.353 to the US dollar on January 1, 2014. http://en.wikipedia.org/wiki/Ghana_cedi#Exchange_rate_history. From January 1, 2014 to July 31, 2014, the Cedi has declined an additional 1.1 Cedis to the US Dollar. Oanda.com

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- **Retaining Capable Staff**. Maintaining a capable team - whether it be employees, commission-based agents or both - will depend on adequate training, capable management, career building opportunities, and as discussed below, a sustainable business that can compensate staff handsomely enough to promote hard work, loyalty, and a desire for advancement.

4. *Customer Adoption*

Businesses and NGOs that have worked for over a decade attempting to distribute solar lanterns and systems to low-income rural households will attest that customer adoption can be a major challenge.[14] People are careful with relatively large cash outlays for consumer goods. In some instances shoddy product or lack of understanding of how products should be used and cared for have led to product failures that can poison entire rural communities' opinions about solar as an energy access solution. One way of analyzing customer adoption is through a price analysis. Viewed in this way, solar home systems, which are more expensive than solar lanterns, are too expensive even for consumers with sufficient income to purchase them, i.e., the price is too high given the customer's lack of trust in the product and the financial commitment required for a potential customer to even experiment with adoption of the product.[15]

Cost drivers are total barriers for many

The cost drivers we discuss above are hard to quantify. They make progress and growth for any business harder and thereby more expensive and riskier. These cost drivers not only increase the cost of distribution in rural Africa relative to other markets, *they also increase the failure rate of entrepreneurs*. In other words, these cost drivers prove to be insurmountable barriers to all but the most talented and stalwart entrepreneurs.

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[14] This is aptly discussed by Ardun Gore, President and CEO of Gray Ghost Ventures, Inc. http://video.mit.edu/watch/arun-gore-gray-ghost-social-ventures-fund-speaks-at-the-legatum-center-5170/.

[15] The Hystra Report zeros in on several aspects of this issue, concluding that "BoP customers want risk free solutions, not cheap products," (page 6) and that peer customer recommendations is the most effective marketing of new products (page 11).

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Reports from the Front Lines

Our conclusion, that building successful distribution businesses is the key challenge to meaningful increase of energy access in sub-Saharan Africa, is shared by others who have experienced the challenge first hand:

Jesse Moore, a Managing Director and Founder of M-Kopa, a sales finance DESCO that sells solar home systems to Kenyans on an installment basis, recently told GIGAOM:

"Technology is just step one of ten. The other nine steps are about getting the product to market, having stock and availability, and having customer care.... It's not sexy stuff that makes it happen, it's rolling up your sleeves and hiring people."[16]

Securing over 75,000 customers in three years, M-Kopa has successfully climbed the learning curve to do this.

James Sawabini, co-founder of solar product distributor ZamSolar in Zambia, had this to say upon shutting down ZamSolar after 22 months in operation:

"When we started Zamsolar, our mandate from investors was to build a business around delivering cost-saving solar products to average rural households. We quickly concluded that our primary impediment was not technology, but a lack of distribution channels. Existing channels lacked the capacity to conduct customer education, marketing, and after-sales service. They also lacked capital and an appetite for risk. Building a new distribution network that could achieve these functions at a low cost and in a difficult environment was our business's greatest challenge."

[16] https://gigaom.com/2014/04/10/how-m-kopa-unlocked-pay-as-you-go-solar-in-rural-kenya/

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The cost/price dilemma: How cost of distribution limits scalability of a solar lantern business

Many of the cost drivers described above, together with ordinary operating costs, can be budgeted by a distribution business. Below we illustrate the cost of distribution using the example of a hypothetical business selling solar lanterns or small solar systems.[17] While the cost of distribution is not a function of the price of the product itself, the illustration demonstrates the cost/price dilemma any seller of small solar products faces.

The underlying excel model for the illustration below can be downloaded at *http://persistentnrg.com/distribution-financial-model*. With the model, readers can insert other inputs of product price, costs and sales to analyze the impact of each input.

Suppose a group of entrepreneurs wants to establish Solarette, a solar sales business in sub-Saharan country X. As they prepare their business plan, they make the following assumptions about distribution:

- Solarette will sell a high quality lantern or small (level 1) system[18] for an average price of $30 per unit. The average cost FOB is $15, the average landed cost is $20.
    - The landed cost in this example includes the shipping, customs, and overland transport cost of the product.
- Given the personal nature of the sale and the frequent need for customer education to close a sale, one agent can typically sell 1-2 lanterns per day on average.
- The agent expects to earn a salary in line with other available employment: $2-3 per day / $100 per month / $1,200 per year.
    - If a lantern is sold for $30, this is equivalent to a commission of 10%.
- Each agent has a reach of 200 customers, consisting of residents in his own village and 1-2 neighboring villages.

[17] This illustration would also apply to analyzing any other durable good sold to rural, low-income households.

[18] For example: http://www.dlightdesign.com/productline/s2/

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    - Accordingly, an agent saturates his market within seven months (200 sales / 1.5 sales per day), at which point she will drop out and pursue another income generating activity.
- An agent supervisor can visit one agent per day and needs to visit an agent once every month to provide the agent with product and collect sales revenue.
    - Each supervisor can handle 10 agents.[19]
- To find and train an agent costs $50 on average.
    - This is a recurring expense since, after every 100 sales, an agent drops off and, to maintain the same level of sales, Solarette must train and launch a new agent in another geographic area.
- Agent supervisors are paid roughly twice as much as agents, or about $4,800 per year. This is above the average income for country X but far below the typical salary of a Western-connected business or NGO. Our experience is that capable managers often demand much more than this when involved in a Western supported business.
- Solarette also has to finance its inventory for 6 months on average at an interest rate of 10% per annum.
- The minimum SG&A cost to run a local operation is $100,000 per year. This SG&A is sufficient to manage up to 15 supervisors and therefore about 150 agents. Thereafter SG&A increases as a function of scale.

Graphically the distribution organization of Solarette looks very simple and has three levels: Senior management (the major cost factor for SG&A), Agent Supervisors, and the sales agents themselves,

[19] SELCO for example reportedly operates with 8 agents per manager, See Hystra.

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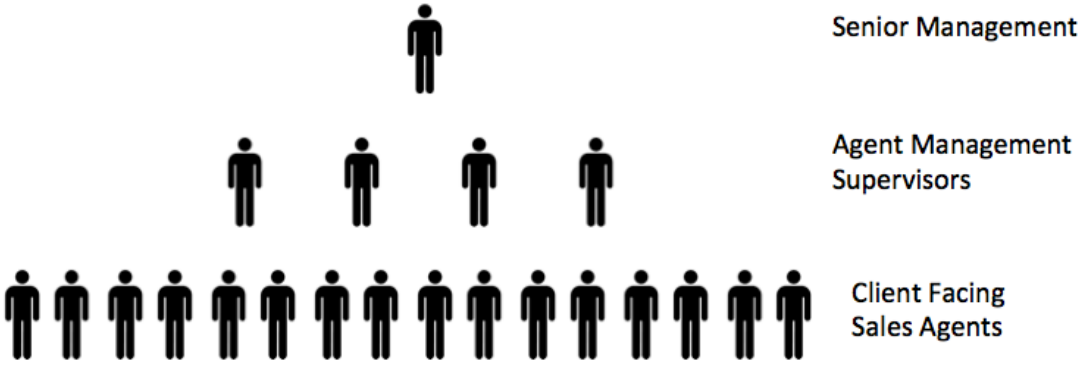
Figure 1: Solarette pyramid structure of sales organization



Market Saturation and Agent Churn

A solar lantern (or solar home system) sales business is essentially a single product durable goods retailer. The retailer requires a sales force; ideally a low cost local sales force that can make an attractive commission on each sale of a lantern (or system). Most single product solar sales businesses engaged in active distribution use local agents who work on commission (in contrast to shopkeepers stocking a few lanterns and systems with other products). An ambitious and talented agent should generate an attractive income until he or she has saturated his or her local market with sales. Then he or she will need a bicycle[20] to travel to other communities to sell products—unless his or her distributor already has agents in those markets. There will be some ongoing replacement business and perhaps upgrades to larger solar systems, but a good agent will, in a matter of months or less, saturate his or her accessible market and seek other income generating activities. With nothing to sell, the distributor will lose the agent. The agent will have had no more than temporary employment. Moreover, there will be no after sales support network for the community he or she served.

[20] Profits are not high enough for the agent or the distributor to afford a truck, car or motor scooter.

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The business plan for Solarette can be modeled as shown in the financial model summarized below. Note the following results illustrated by the model:

- The model for Solarette has 13 independent input parameters. This reflects the difficulty optimizing the distribution chain. There are scenarios (combinations of values for these input parameters) where such a distribution organization can be modestly profitable, but given the number of parameters and the sensitivity of the model to each parameter, it should become evident just how unlikely it is that Solarette will be able to maintain profitability over several years.
- Using the above parameter values as a starting point to understand the sensitivity of the economics of a distribution chain, we find that:
    - **The cost of distribution is greater than $9 per product.** Note that we do not separately model ground transportation in the market. Given the potential high cost of ground transportation in some markets, the model may understate total cost.
    - **The cost of distribution is not a function of the product cost.** For example, even if the product is available for $1, the distribution would still cost $9.
    - **The cost of distribution is not a function of scale.** *In other words, there are no economies of scale in the distribution business under these assumptions.*
    - **The EBITDA margin of a business with the above parameters is at most 2.6%.**
        - This EBITDA margin is achieved at a scale of about 30,000 products sold per year. This would generate revenue of approximately $900,000 a year. Based on our experience, this would be an outstanding sales level. We are aware of few examples of a retailer who has achieved and is able to sustain this.

The cost of distribution is independent of the price of the product and this cost - $9 using the assumption above - may already be too high relative to the willingness of customers to pay for a lantern.

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Table 1: Summary of Solarette simplified model for a product distribution business targeting customers in a rural setting

Parameters of distribution				**Sensitivity** Dist. cost per unit	Notes
Margin	Cost of Product FoB	$	15	0%	
	Landed Cost	$	20	0%	1
	Sale Price	$	30	0%	2
Sales Agents	Sales per day and agent	#	1.5	-2.3%	
	Salary target per agent	$/mth	100	2.4%	
	Customers reached per agent	#	200	-6.0%	3
	impl. time to saturation	mth	6.67		
	Acquisition & training cost	$/agent	50	0.2%	
Agentmanager	Agents per manager	#	10	-5.7%	
	Cost per manager	$/mth	400	2.6%	
Management	SG&A to control **[x]** managers	$/year	100,000	3.6%	
	[x]	#	15	-3.3%	
Capital	Turn-over	mth	6	1.0%	
	Interest rate on WC	%	10%	1.0%	

Analysis				
Revenue	Annual Sales	#	30,000	4
	Revenue	$	900,000	
Cost	Cost of Products Sold	$	600,000	
	Total # agents per year	#	150	
	Total # managers per year	#	15	
	Salary of Agents	$	66,667	
	Cost of recruiting	$	7,500	
	Cost of managers	$	72,000	
Gross Profit		**$**	**153,833**	
	Working Capital Required	$	300,000	5
	Cost of Capital	$/year	30,000	
	SGA	$	100,000	
EBITDA	Subtotal		23,833	
	EBITDA Margin		2.65%	

Cost of distribution	**$ per unit**	**9.21**

Notes on the model: Input parameters are yellow. (1) Landed cost is defined as the cost of the product to the business at the point of sale to the customer. It includes shipping, import duties, taxes, storage and overland transportation to the customer. (2) This example implies what many

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would consider a healthy margin of 50% even though Solarette is only modestly profitable. (3) Total number of customers reached by any given agent on average before she has saturated her market. (4) Annual sales is also an input in this analysis. (5) The amount of working capital required depends on the product turnover and the available interest rate for such working capital – 6 months and 10% is probably optimistic.

- The sensitivities[21] of the model are set forth below, ordered by absolute size:
    - Customers reached per agent before saturation and loss of agent (-6.0%). This means that for every 10% increase in a single agent's reach in terms of customers, the cost of distribution would fall by 6%. This however is a function of the cost to recruit and train new agents. If this cost were 0, this saturation effect would have no impact on the cost of distribution.
    - Agents per agent supervisor (-5.7%). If the number of agents a supervisor can handle increases by 10%, the cost of distribution declines by 5.7%. In cases of high agent churn (i.e., faster loss of agents as they saturate their markets) a supervisor could certainly not handle more agents, as she has to constantly recruit, train and manage new agents.
    - SG&A required to operate the business (+ 3.6%). This sensitivity depends significantly on the scale of the business and the assumptions about how SG&A expenses would grow with such a business. This sensitivity correlates well with our own experience that general management expenses are often a critical factor for distribution businesses and in many cases are too large to be sustained given the scale of the distribution business itself.

Using the realistic input parameters of the model above, Solarette projects an EBITDA margin of 2.65% and a ROC of less than 7.5% (EBITDA [$23,833] / working capital [$300,000] + other capital) depending on the amount of equity required. A business with such a return potential will always struggle to attract

[21] Sensitivity is defined as the % change in the distribution price for a 10% increase in any given input parameter.

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capital. **The lack of capital is not a cause of lack of growth of solar distribution businesses, it is a consequence of the inherent potential of the model.**

Moreover, agent churn means that Solarette is not building a permanent distribution channel—that is, it is not creating a valuable intangible asset that would increase Solarette's equity value and help it raise equity capital to grow. Rather, Solarette's agent network is a wasting asset that must constantly be replenished.

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Anecdotal Evidence

To further illustrate the analysis, consider two of the largest distributors of solar lanterns in East Africa, SunnyMoney and Total.

SunnyMoney has distributed over 1 million solar lanterns – mostly a small study light – primarily in Tanzania but also in several other sub-Saharan countries. It has done so by utilizing grants to support its own operations.[22] But more important, SunnyMoney ingeniously used existing organizational structures to distribute lanterns. In Tanzania, they distributed lanterns through schools using teachers as sales agents. Teachers were not paid for their efforts – the teachers volunteer because they believed in the positive impact solar lighting would have on their students. The teachers also didn't have any costs – real or opportunity costs - as the students were coming to classes everyday. We applaud the success of SunnyMoney and are impressed with their innovative approach. Yet even SunnyMoney acknowledges that the model is not commercial and rests ultimately on the participation of teachers.[23]

We do not have data on how many solar lanterns and systems Total has distributed to date, but from anecdotal evidence we believe they are one of the largest distributors in sub-Saharan Africa. They use their existing distribution network – which ironically is built around a consumer good, i.e. petrol and kerosene sold at Total petrol stations – to distribute solar lanterns. The marginal distribution costs for them are accordingly small. Total's solar product sales are part of its Corporate Social Responsibility (CSR) program. We would therefore include the Total solar distribution business in the category of subsidized distribution efforts.[24, 25]

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[22] According to Steve Andrews, CEO of SunnyMoney and affiliated non-profit Solar Aid, SunnyMoney country teams are getting close to covering operating costs, but not yet contributing to cover overhead. http://www.sun-connect-news.org/articles/business/?tx_news_pi1[news]=317&tx_news_pi1[controller]=News&tx_news_pi1[action]=detail&cHash=ec4972068a5a2bde6651696199da1cbf (May 8, 2014 comment to blog post).

[23] For more detail see: www.ashden.org/files/SolarAidwinner.pdf

[24] See also: http://total.com/en/media/news/press-releases/20121112-total-introduces-awango-by-total-solar-solutions-improve-access-energy.

[25] Where are aware of at least one market where a local solar lantern distribution business was forced to liquidate because Total entered the market and sold products at such a low price that the business could no

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The cost/price dilemma of distributing larger systems: price becomes a hurdle

The cost of distribution is very high and independent of the cost of the product. If costumers are not willing to pay the price the distributor needs to charge to cover the low cost for a small solar lantern plus the relatively high distribution cost of such product, there is no business opportunity to build scalable businesses around this product line. However, why are there so few businesses selling higher priced solar home systems to these customers at or approaching a scalable level?

As the manufactured price of a product increases, the proportion represented by cost of distribution shrinks. Therefore even in markets with high distribution costs such as those in rural Africa, the cost of distribution is a diminishing proportion of the price of the product sold as price increases. This would suggest that all would-be solar lantern distributors should simply sell larger solar home systems to develop dynamic expansive businesses.

We are not aware of a distributor that has successfully built and is maintaining a business selling solar home systems to rural low-income families in sub-Saharan without providing financing to customers.[26] There may be some, but we would suspect that they are few and not profitable enough to grow into scalable businesses. The anecdotal evidence from the portfolio of investments we have managed is that, after attempting to build solar home system retail distribution businesses, the most talented entrepreneurs migrated towards large institutional sales and installations of solar. In other words, they were unable to maintain and grow their businesses with a retail sales focus.

The absence of successful, scalable distributors selling solar home systems in sub-Saharan Africa suggests that the price point of such businesses exceeds the target customers' perceived value of those products, or exceeds customers' financial capabilities to purchase such product—or both. In short, these would-

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longer cover its operating costs. While this business had other growth challenges we discuss in this article, it never reached the threshold of those other issues because Total's price left it with no sales margin.

[26] The successful businesses using financing fall within our DESCO model. See http://goo.gl/h6LBEF

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be distributors are on the other end of the cost/price dilemma: if the product is expensive enough to support a sustainable distribution business, it is outside of the price range of rural customers.

Working Capital Starvation

The most consistently cited barrier to providing access to energy is the lack of adequate working capital for distribution businesses to acquire inventory and finance operations. The cost/price dilemma demonstrates why this is the case: retail solar businesses cannot achieve the level of scale that makes them attractive borrowers of working capital.[27]

Addressing the Challenge of Distribution

How do we address this central challenge to providing access to energy in sub-Saharan Africa?

Business models that can scale

The cost/price dilemma is not unique to the problem of providing energy access to low-income rural sub-Saharan Africa. We suspect that every durable goods distributor faces the same challenges as illustrated above. We are aware of no sub-Saharan Africa durable goods distributor that has achieved a scale that would give it access to commercial debt and equity financing.

Yet experience suggests that financing can overcome the price side of the cost/price dilemma. Financing programs run in Bangladesh have allowed distributors of solar home systems to reach over 3 million customers with the current growth rate approximately 50,000 more per month.[28] These programs have not yet succeeded in sub-Saharan Africa on the same scale as the Bangladesh program.

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[27] This conclusion is supported by the recent report, "Investment and Finance Study of Off-Grid Lighting" by A.T. Kearney and GOGLA (2014). http://global-off-grid-lighting-association.org/wp-content/uploads/2013/09/A-T-Kearney-GOGLA.pdf.

[28] See "Scaling Up Access to Electricity : The Case of Bangladesh." Sadeque, Zubair; Rysankova, Dana; Elahi, Raihan; Soni, Ruchi. (2014) World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/18679. See also generally, "The nexus between the successful SHS program in Bangladesh and the emerging DESCO sector in sub-Saharan Africa and India" Chris Aidun & Dirk Muench (2014).

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Another approach to overcome the cost/price dilemma is to follow the consumer goods model. Distributors of consumer goods – be it kerosene or Coca-Cola – have succeeded in building large-scale businesses that have successfully penetrated rural Africa. The correlative strategy in energy access is the services model: the distributor owns the assets and sells energy services – lighting, mobile phone charging, radio, TV, etc. – to consumers for a recurring fee. Microgrid operators and solar home system operators such as Off-Grid:Electric are pursuing this model.[29]

Why do financing and services models work? They do not reduce the cost of sale, nor do they lower the price of the product. They do:

- Spread the cost of more expensive products over time, making the benefits of such products affordable to low income consumers. Financing models do this in what remains a sale transaction; services models do this by retaining ownership of energy producing assets – and often appliances – and selling the use or services to the customer. Of course the total cost to the consumer over time is greater than the retail price of the equivalent product purchased for cash.
- Create a steady revenue stream for the distributor. This continuous consumer relationship and recurring revenue stream enable the distributor to predict revenue, maintain an agent network and continue to innovate (since innovation will lower the distributor's cost or give the consumer a superior product they might pay more for). The distributor's ongoing customer relationships creates opportunities to upsell and cross sell other products or services to consumers.
- The distributor's distribution system becomes a valuable asset with a growing yet stable cash flow. This is attractive to equity investors who will fund future growth to bring the distributor to a large enough scale to be profitable. Profitability – or even a clear climb toward profitability – creates an attractive opportunity for debt investors.

[29] In our recent white paper, "How a New Breed of Distributed Energy Services Company Can Reach 500 million Energy Poor Customers in a Decade" by Pepukaye Bardouille, Senior Energy Specialist, Energy Access Lead, International Finance Corporation, and Dirk Muench (2014), http://goo.gl/h6LBEF, we discuss these models, which we refer to together as "Distributed Energy Services Companies" or "DESCOs".

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Tackling costs

The factors that drive up the cost of distribution - poor infrastructure, institutional roadblocks and the shortage of human capital - will only be resolved over time. Market forces and enlightened leadership can speed that process.

There is at least one example where coordinated efforts of a nation's leaders, the international community and the private and NGO sectors came together in a commercial endeavor the electrify a large swath of an off-grid nation. That is the Bangladesh program. Whether any sub-Saharan country would have the political will and determination to launch a program like Bangladesh's remains to be seen.

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The efforts to reach rural off-grid households and businesses through sales organizations distributing solar lanterns and solar home systems have been laudable. Tremendous commitment of time and treasure have gone into these efforts. This paper draws on what we have learned from those committed entrepreneurs, donors, and investors with deep respect.

In this paper we demonstrate that we need to accept the learning from these models and advance to more sophisticated distribution systems using financing or energy services approaches. Even with these models, there is much work to be done in building distribution organizations. If successful, however, these organizations can be enduring distribution channels for energy access solutions – beyond lights and phone charging is the potential to bring modern first world appliances and energy services to rural off-grid sub-Sahara. A focused commitment to this effort holds great promise to achieve the goal of energy access.

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