Disclaimer

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Energy poverty is a major driver of the overall poverty cycle in the developing world, contributing to poor health, environmental degradation and limited economic growth. However, companies have recently begun to distribute innovative, reliable and affordable energy options—such as solar lanterns and fuel efficient stoves—that are highly beneficial, cost-saving alternatives to traditional energy sources. While these products reduce the energy burden of those most in need—while also improving their quality of life and opportunity—they are failing to rapidly and broadly reach target markets.

This report details the results of a solar market assessment conducted across four districts in the Acholi sub-region of northern Uganda in April and May 2012. The assessment is part of a broader examination of the energy market within the sub-region, carried out by Mercy Corps Uganda, to inform its intervention strategy in the sector. It is also designed to inform energy actors of the potent market opportunity for cost-saving and energy-saving solar products within the Acholi sub-region. It highlights opportunities and offers recommendations for energy actors to innovate on current business and distribution models in order to more broadly reach this market. Lastly, the report offers transferable lessons for companies targeting similar rural, agricultural-based and transitional markets across Africa for distribution and sale of cost-saving, beneficial products.

Ultimately, the data indicate demand for affordable solar products across the Acholi sub-region, as well as opportunities for private sector actors to meet this demand with products available on the Ugandan market.

**Key findings include:**

**SUPPLY SIDE:**

- The number and range of solar lanterns available on the Ugandan market continues to grow. However, the quality of these products and the capacities of their suppliers vary significantly.

- Quality solar products offer tremendous monetary, health and safety value to consumers. However, most consumers are unaware of these benefits—or that such products even exist.

- Currently, there are no established, countrywide distribution or retail channels accessible to companies that sell affordable solar products. Instead, solar companies are attempting to build their own individualized retail channels—a slow, resource-intensive process.

- Transport services are unreliable, time-consuming and expensive. Transport challenges add significant costs to product supply and inhibit timely, cost-effective aftersales service.

- Inadequate access to affordable financing for solar businesses inhibits business channel growth and overall product availability, which slows sales. Similarly, minimal consumer credit hinders solar product uptake.
DEMAND SIDE:

- Of households surveyed, 91% indicate that they use two sources of light. The number of hours used, the costs of usage, and the distances traveled to acquire sources of light are similar for both primary and secondary sources of light.

- Consistent with low grid penetration throughout rural Uganda, the electrical grid extends to only a few towns in Acholi. However, most Acholi households in these towns fail to access electricity because the service is prohibitively expensive for most. Of those surveyed, only 0.4% of households reported electricity as their primary source of light. An overwhelming majority of households (79%) reported using paraffin as their primary source of light. The remaining households rely on torches or candles—9% and 3% respectively.

- Combined average annual household expenditure on lighting and phone charging amounts to UGX 212,524 (USD $85.70). About 42% of households surveyed own a mobile phone.

- Solar lighting and phone charging products are appropriate and timely for the Acholi sub-region. High household costs associated with securing energy (in the form of monetary expenditures, time spent traveling and lost economic opportunities) point to significant suppressed demand for such products.

- The payback period, or amount of time it takes a household to earn back the money invested in a product through savings accrued from lighting and charging costs not undertaken, ranges from 12 to 32 weeks depending on the unit. Accordingly, the average household could pay off the value of the most advanced solar unit in eight months or less.

Key observations and recommendations include:

- **The solar opportunity:** The assessment findings indicate that the Acholi sub-region is a potent market for innovative, cost-effective energy solutions. The findings also indicate that household solar products offer a tremendous opportunity to alleviate the Acholi household energy poverty burden more immediately.

- **Consolidated distribution:** Efficient distribution is a major bottleneck for solar companies and must be addressed. Most solar companies recruit and train individual retailers. This is an expensive and time-consuming way to build distribution channels, and it is untenable for companies relying on the sale of pro-poor products with minimal profit margins. New, creative business models that can piggyback on shared channels to maximize points of sale while minimizing investment are imperative.

- **Awareness:** Though affordable solar products have been available on the Ugandan market for several years, consumer product awareness remains low. Increased investment in building awareness is necessary to effectively sell more products, especially in new markets like Acholi.

- **Financing:** Households are unable to raise the necessary funds to adopt cost-cutting technology all at once by making a single, expensive solar unit purchase. Accordingly, consumer credit or other flexible financing schemes that enable consumers to pay off debt slowly are imperative for solar product purchase. Similarly, businesses that wish to invest in solar inventory are constrained by minimal working capital. Availing access to affordable financing for energy businesses is also imperative for product penetration.
• **Product selection:** Based on analysis of the strengths and appropriateness of products and companies for the targeted area, as well as the performance of products and companies in past projects, the Mercy Corps team has decided to actively work with d.light design, Barefoot Power and Sun King.

**Purpose of this Report**

This report provides a comprehensive outline of the existing Acholi solar energy market, including market inefficiencies, opportunities and key leverage points. Further, it aims to highlight opportunities to innovate on business and distribution models to crowd-in energy-saving products to reach the market at scale. The document is aimed at local private actors looking to take advantage of these market opportunities. It is also intended to inform the development of Mercy Corps’ programming over the coming years and to communicate our approach and thinking to interested external parties.
Introduction

Background on Acholi Sub-region
In 2006, the Ugandan government and Lord’s Resistance Army ended an armed conflict that spanned more than two decades, displaced millions of people and destroyed economic productivity within the Acholi sub-region of northern Uganda. During the conflict, the humanitarian aid community stepped in to provide material support where the market failed to function. Working in concentrated locations for a prolonged period, aid drove the provision of products and services to meet the needs of the people. Concurrently, businesses and financial institutions chose to invest in other more accessible regions, leaving Acholi underdeveloped and disconnected. In recognition of the changing post-conflict context, humanitarian agencies have steadily cycled out of Acholi while a small amount of outside investment has trickled in. However, what was once a humanitarian challenge has now become a long-term, complex development challenge. The protracted conflict handicapped growth—inhibiting agricultural productivity, hampering trade and impeding investment. As humanitarian agencies have scaled-down their involvement in the region, a gaping hole in product and service provision has remained.

The Acholi economic environment is a complex and systemic challenge that has resulted in costly, inefficient and fragmented markets that are failing to spur inclusive economic expansion and more widespread competition. As a result, more readily available, high-quality products and services that meet the needs of households and businesses alike are absent. And this absence is significant. At its most basic level, this means that the quality of life and the opportunities it holds for the Acholi are poor. In other words, day-to-day activities are difficult, time-consuming and expensive. This is particularly true for women as they are often solely responsible for the welfare of their families in addition to the economic productivity of their households.

Mercy Corps Uganda
Working in some of the world’s toughest places, Mercy Corps helps people turn the crises of natural disaster, poverty and conflict into opportunities for progress. Mercy Corps has worked in East Africa for more than 20 years. Mercy Corps is also a recognized global leader in the design and implementation of market development programming; our experts are skilled in improving core market relationships and transactions, as well as in supporting functions and rules of market systems to improve access, and the terms of that access, to the poor. When applying market-driven development, Mercy Corps is consistently facilitative, working behind local actors to improve performance sustainably. Mercy Corps employs five main principles throughout market-driven programming: systemic approach, evidence-based interventions, contextually driven, sustainability, and partnerships.

In 2006, Mercy Corps began work in Uganda, offering humanitarian assistance and peace-building support to internally displaced populations within the Acholi sub-region. Mercy Corps has expanded programming within Acholi and Karamoja, integrating targeted, short-term humanitarian assistance within a larger program of market-oriented development. By addressing a number of interrelated needs within a wide range of activities (livelihoods, peace building, agriculture, water
and sanitation, health and nutrition, financial access and economic development), Mercy Corps applies a broad but integrated approach to address challenges to product and service availability, access and utilization.

Mercy Corps Market Facilitation Programming in Uganda

Within the Acholi sub-region, Mercy Corps has worked to spearhead the transition first to post-conflict recovery and now to market-driven and facilitative development. Throughout 2011, Mercy Corps piloted a solar project with the goal to facilitate sustained access to affordable solar products for the inhabitants of Pader District. Using a systemic and facilitative approach, Mercy Corps chose to mitigate barriers that prevented Kampala-based company entry into the Pader market while also incentivizing local actors to sell solar. The project resulted in substantial, unsubsidized product sales that continue to grow exponentially and move over sustained distribution channels—more than a year after the project’s conclusion. Moreover, the pilot’s success illuminated a potentially robust market with high demand for products that are not currently available to consumers and are not likely to be available soon without outside intervention.

Building on the success of the solar pilot model and to best meet the needs arising from the changing Acholi development context, Mercy Corps developed a new Economic Development Team (EDT). The team’s goal is to speed the pace at which businesses adapt to meet the needs of the poor across the targeted geographic area of programming and areas of technical focus—partnering with private sector actors to build local capacity for the provision of vital goods and services. To do this, the EDT works to demonstrate that Acholi is a viable market, offers tools to extend reach, crowds-in tailored products and services, and then documents and shares learning so that more businesses can enter the market and innovate on earlier models to better meet the needs of the poor.

Amongst EDT initiatives is a focus to improve Acholi’s energy market performance—adapting and growing the solar pilot model, incorporating additional solar products, fuel efficient stoves and other products and services that reduce energy poverty. Energy poverty is a major driver of the overall poverty cycle in the developing world, contributing to poor health, environmental degradation and limited economic growth. Moreover, energy poverty negatively impacts women and girls disproportionately to their male counterparts. Females are almost exclusively responsible for cooking meals, doing in-home chores, collecting wood and making almost-daily incremental fuel purchases. As a result, females are also disproportionately impacted by respiratory illness and eye diseases that result from indoor air pollution, injury from open fires and kerosene lanterns, and loss of economic opportunities that result from time spent gathering energy sources rather than on productive livelihoods.

In recent years, companies have begun to distribute innovative, consistent and affordable energy options—such as solar lanterns and fuel efficient stoves—that offer highly beneficial, cost-saving alternatives to traditional energy sources. Though these products improve the quality of life and opportunity for the most marginalized members of the global community, they are also failing to rapidly and broadly reach their target markets.

This assessment outlines the Acholi solar energy market and opportunities to innovate on business and distribution models to crowd-in new, innovative, energy-saving products to reach the market at scale.
Context

The Macro-picture

In Uganda, only 11% of households have access to grid electricity, and almost all of these are located in a few major towns and cities. Among rural households, 97% have no access to grid electricity. Instead, the majority relies exclusively on traditional sources of light that are inefficient, unhealthy and expensive. The Ugandan government, in conjunction with multilateral agencies, does invest in increased energy production and grid expansion within the country. However, with population growth rates among the highest in Africa (estimated at 3.5% for 2012) and minimal available infrastructure, the level of investment is not substantial enough to meet need.

Recent advances in off-grid solar technologies have generated an increasing number of low-cost, clean and safe lighting alternatives for rural communities. Though these advances do not constitute full energy access, they do offer more immediate power solutions that reduce household fuel expenditures and increase hours of available light. Solar-powered lighting and household electricity systems are the most common of these new technologies. Small solar lamps, including flashlights and lanterns, and small home systems are now commonly available in many low-income countries for between USD $10–200. These solar-powered systems not only provide lighting but also an increasing range of cursory services designed for the developing world market, such as radio and cell phone charging.

Small-scale photo-voltaic products are being produced by an ever-expanding group of global firms that target developing and emerging markets. Concurrently, an increasing number of business actors within these markets are recognizing the sales opportunity for small-scale solar. In Uganda, a large number of Ugandan businesses are now offering imported solar products for sale; most focus their sales within Kampala, the regions surrounding the city and the west. Markets in more distant and rural parts of the country are not yet a sales focus largely due to limited resources and little current market information on consumer preferences and willingness to pay for products in these areas. In addition, not all small-scale solar products are of the same quality. The absence of regulations to monitor product quality combined with the inability of consumers to distinguish between products of varying quality has eroded consumer trust in the new technology.

Increasingly, organizations and multilateral institutions recognize the potential of small-scale solar technologies to more immediately meet energy needs. To counter challenges of product quality and the associated market spoilage, some institutions are establishing testing centers and quality control systems while building more expansive and accurate market information systems. One of the most visible efforts is led by Lighting Africa (LA), a joint World Bank and IFC initiative that tests and rates the performance of solar models imported into Africa. Moreover, institutions are also building more comprehensive pictures of the rural market opportunity. A 2011 GIZ study of market dynamics in the West Nile region of northern Uganda concluded that willingness to pay among rural households was high. It was noted, though, that most products did not live up to expected durability and, as a result, households were not able to fully replace their traditional lighting means.

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2 GIZ Solar Lamps Field Test Uganda, 2011.
Pader Pilot Project: Results and Lessons Learned

Throughout 2011, Mercy Corps implemented a pilot solar project with the goal to facilitate sustained access to affordable solar products for the residents of Pader District in northern Uganda. At the start of the pilot, only extremely limited access to solar power products, and indeed all products, was available. Most widely, small shops located in trading centers (TC) utilized solar panels to charge mobile phone batteries as a business. Neither small solar lamps nor large solar units, however, could be found for sale. Moreover, unskilled and unequipped businesses had not enticed crucial solar company investment. As a result, successful distribution channels for a new era of affordable solar power were absent in Pader; innovative and more competitively priced solar items were neither circulated nor known. Residents were unaware of the existence, much less the affordability and benefits, of innovative solar solutions.

To realize the pilot project goal through a systemic and facilitative approach, Mercy Corps chose to mitigate barriers that prevented Kampala-based company entry into the Pader market, while also incentivizing local actors to sell solar in the district. Mercy Corps invested in the following key project components:

- A household assessment and feasibility study was conducted in Pader District to measure solar market viability.
- Key study data was disseminated to solar market players, including Kampala-based solar companies that distribute reputable, affordable solar products; Pader-based entrepreneurs; and communities based in Pader and the wider Acholi sub-region. Solar market players were invited to participate in the pilot project.
- Partnerships were established between respected Kampala-based solar companies, Pader-based entrepreneurs and local financial institutions.
- Marketing and sales acumen was advanced among local solar entrepreneur partners.
- A marketing campaign was conducted to boost consumer demand through expanded knowledge of the health, savings and livelihood benefits of solar power products, as well as awareness of new Pader-based solar availability.

Mercy Corps partnered with two respected solar companies, Barefoot Power and d.light design (UltraTec (U) Ltd.), to support the sale of their products throughout Pader District. Barefoot connected with eight Pader-based businesses; seven of these businesses chose to invest in becoming Barefoot Power micro-franchisees. d.light design connected with a large, regional savings and credit cooperative, Agaru SACCO Ltd., with four branch locations. Following three months of availability, 750 solar units were sold. After six months of availability, 1,250 solar units were sold. Mercy Corps did not subsidize product costs nor offer start-up grants to local entrepreneurs.

In September 2011, following three months of solar product availability, Mercy Corps conducted a project evaluation. The evaluation team collected and analyzed data using a knowledge, attitudes and practices survey of 87 randomly-selected solar product purchasers, as well as key informant interviews conducted with both Pader solar business owners and Kampala-based solar company
Managers. The goal of the evaluation was to learn from pilot project successes and failures and to generate recommendations for comparable future market facilitation programming. Mercy Corps’ future solar market projects are both derived from this pilot and its evaluation as well as the larger solar market analysis herein. Key findings from the pilot project evaluation follow.

Demographic Trends
Solar product purchasers came from middle to middle-high income households—this is when compared to peers in Pader and should be considered relative. Nearly 40% of purchasers work for an organization, government or are otherwise employed. Only 32% of purchasers rely on farming as their main source of income. In line with these figures, average monthly income is estimated at UGX 281,819 (USD $112.73) and household assets are relatively high. Similarly, 86% of households have savings (36% and 51% keep their savings in a bank or savings and credit cooperative, respectively). Prior to the solar purchase, 64% of purchasing households received a loan in the past.

Notably, 86% of purchasers lived in a trading center (TC); while 13% travel to a TC at least once a week. Mobile phone usage among solar product purchasers is extremely high. Of purchasing households, 97% own one mobile phone and 80% of purchasing households have another mobile phone within the household. Of those surveyed, 100% use a phone even if neither they nor another member of their household owns a phone.

Purchase Trends
Mercy Corps partnered with two solar companies in the Pader pilot. Each solar company adopted a different strategy and set of partners to avail access to their products in the district. d.light design partnered with an area savings and credit cooperative that was able to offer loans for products across their four branch locations. Barefoot partnered with individual entrepreneurs, almost all of whom chose to invest to become micro-franchisees. Barefoot entrepreneurs adopted their own mechanisms for moving products, including flexible financing that was tailored to individual customers.

Prior to purchase, most households had some experience or perception of solar. Of those that purchased, 44% had a neighbor or office that used solar. Further, 80% of purchasers had not experienced any problem with solar in the past.

About 86% of purchasers heard about the availability and benefits of solar adoption on the radio. Further, 36% of purchasers heard about the local availability of solar in Pader and the benefits of adoption from their family, friends or acquaintances.

All purchasers used some cash to pay for their solar product purchase. However, most also accessed some sort of flexible financing mechanism to make their solar purchase. Of the
total, 31% of purchases were made using installments that lasted, on average, four months. Only about half of those who paid for their solar product using installments were required to complete payment before they were able to take the solar unit home. Notably, 52% of households that purchased a solar unit did so with a loan.

Change in Light and Mobile Usage and Expenditures

Solar product adoption changed household light and mobile usage and costs significantly. Purchasers identified UGX 214,032 (USD $85.61) reduction in annual lighting and mobile recharging expenditures. This amounts to a 59% total reduction in lighting and mobile recharging costs at the household level as a result of solar product adoption. Moreover, 32% of those households that purchased a solar unit also began to take payment to recharge other people’s mobile phone, using their newly purchased solar product. Generally, those who took payment for mobile recharging asked for UGX 500 (USD $0.20) per charge, resulting in an average of UGX 4,695 (USD $1.88) in revenue from their mobile recharging business each week for a total of UGX 244,140 (USD $97.66) in revenue from their mobile recharging business annually.

The following charts outline change in household lighting and mobile cost and use patterns, delineating these prior to solar product adoption and after solar product adoption.
Solar Product Satisfaction

Most households purchased a solar unit because they believed it was a brighter, safer and cheaper lighting alternative that also saved money on mobile recharging costs. The vast majority of households interviewed indicated overwhelming satisfaction with their solar product.

- 92% believe the solar product was priced fairly.
- 98% satisfied or very satisfied with paraffin savings.
- 96% satisfied with the brightness of the solar unit.
- 100% satisfied or very satisfied with the length of time that a solar battery lasts.
- 95% satisfied or very satisfied with mobile recharging component.
- 98% plan to purchase additional solar lighting and mobile recharging products.

Solar Retail Business Success

The adoption of solar products resulted in clear monetary gain for consumers. Further, solar product sales also resulted in tremendous monetary gain for those Pader-based businesses that invested in selling the products. All Barefoot businesses saw an increase in income as a result of solar sales. Interestingly, all Barefoot businesses also saw a cursory increase in their overall business; they built loyalty among solar consumers, which translated into higher sales of other products. d.light design’s partner, Agaru SACCO, also built its clientele and overall revenue. The SACCO sold most products through a solar loan that it also offered to purchasers. In order to access the loan, customers were required to join as SACCO members, building overall membership and associated duties for the SACCO. Moreover, the SACCO also received revenue for interest accrued from solar product loans.

All Barefoot entrepreneurs were limited by cash constraints. Each used their own savings to invest in the business, choosing to invest in solar inventory as opposed to other product inventory. Cash constraints did inhibit business investment in solar inventory and the businesses’ capacity to grow sales more rapidly. All Barefoot retailers stated that it was difficult for them to raise the capital to make follow-on investments to grow their solar inventory, citing limited flexibility and availability and competing responsibilities as the main challenges.

Pilot Project: Success and Failure

Visible savings and health benefits derived from solar usage among early adopters generated high interest in solar among other Pader residents. Though early solar product purchasers came from middle to middle-high income households, it is expected that a greater number of lower income households will purchase solar over time. However, the depth to which solar products can penetrate the base of the pyramid remains an important and unanswered question. Similarly, the types of consumer financing and sales mechanisms that must be in place in order to reach lower income households are not yet established.

The early success of Pader entrepreneurs who chose to sell solar, as well as the increased consumer interest in solar products, also increased business interest in selling solar, not just within Pader but across additional districts. Interestingly, however, the success of the pilot project did not
entice solar companies to invest further and to grow retail channels in the sub-region. Instead, solar company partners requested further collaboration with Mercy Corps in order to reach like markets in additional districts. There are additional challenges that inhibit solar company capacity and opportunity to invest to grow retail networks in Acholi, Uganda and globally. These challenges are explored in greater depth in the analysis that follows.

Methodology

This assessment was conducted during April and May 2012 across four districts within the Acholi sub-region: Kitgum, Lamwo, Pader and Agago. The assessment is divided into two sections: The first explores demand for solar according to consumer segment, while the second section maps and analyzes solar supply-side market dynamics.

The consumer market research was conducted by an experienced group of Mercy Corps EDT members based in Kitgum. Households from each of the four districts in Acholi were targeted in order to develop as broad an understanding of the region as possible. Reaching a sufficient number of remote, rural communities was a challenge and therefore two survey methods were employed:

1) In-person interviews were conducted in the local language in towns, TCs and villages throughout the four districts. Interviews were divided evenly among tiers based on distance from an urban center to ensure wide and representative coverage. Interviewees were selected with the help of local government officials to ensure that only participants from nearby households were selected. In as much as possible, officials also helped to identify participants across income and gender strata.

2) Mobile-based surveys were carried out with support from 99 Community Knowledge Workers (CKWs), who are village-level agricultural extension agents charged with disseminating agricultural information to nearby farmers utilizing mobile technology. The CKWs—backed by the Grameen Foundation AppLab—conducted the survey across Kitgum, Pader and Agago Districts (currently, there are no CKWs in Lamwo District). They interviewed fellow farmers throughout their geographic areas; the survey included questions to support consumer segmentation across geography. Most CKWs live in small and medium towns or in rural locations, not in urban settings. CKWs have operated for nearly one year under Mercy Corps’ programming and have received considerable training and support from the AppLab team in order to carry out regular data collection accurately. Mercy Corps utilizes this channel for data collection purposes often.

In total, 252 in-person interviews and 237 CKWs interviews were conducted, for a total sample of 489 respondents. Both questionnaires contained mostly forced-choice questions and mirrored each other as much as possible. Results from the in-person interviews were examined for accuracy and error at the end of each day, and were then recorded into a pre-designed Excel document for ease of analysis. Data entry was also monitored for

<table>
<thead>
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<th>Distance to TC</th>
<th>Segment</th>
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<tbody>
<tr>
<td>0km</td>
<td>Urban</td>
</tr>
<tr>
<td>1 – 2km</td>
<td>Peri-urban</td>
</tr>
<tr>
<td>3 – 5km</td>
<td>Rural 1</td>
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<tr>
<td>5 – 10km</td>
<td>Rural 2</td>
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accuracy and error. CKWs survey results were collected via mobile and uploaded to a central database in real time. Results were also monitored and cleaned for accuracy.

Based partly on the results of a small-scale energy assessment in the Pader District, as well as from ongoing desk research, the Mercy Corps team hypothesized that geographic proximity to TCs, accounting for the variation in size of the TC, would be a key determinant for behavior around energy use. Typically, household location in urban or rural settings is an important determinant of fuel type, and fuel type determines which stove a household will use. With this in mind, consumers were divided into four market segments based on geographic proximity to the nearest TC. Survey respondents were asked to self-identify household distance from the nearest TC and these responses were used to segment the market as shown in the table. Rural households were divided into two segments depending on distance to a TC (Rural 1 households live 3 to 5 km from a TC, while Rural 2 households live 5 to 10 km from a TC). The terms are relative; it should be noted that “urban” in the context of Acholi simply means within a trading center; “peri-urban” means within 2 kilometers of a trading center. In reality, both would be considered rural in the context of the country as a whole.

The chart illustrates the percentage of respondents living in each geographical locale, as well as the survey technique used to reach them. As expected, face-to-face interviews captured more people from the urban segment, whereas the CKWs were able to reach more from the peri-urban and rural segments. In the end, the combination of consumer profile interviews and CKWs surveys resulted in a solid spread across segments. The “other” category represents a combination of no response, unsure of distance and other unclassified responses. These segments are used in the consumer data analysis section to test the hypothesis that proximity to a TC impacts cooking behavior.

A total of 33 focus group discussions (FGD) were also conducted in TCs. Participants were selected according to the same methodology as in-person interviews. Local officials helped identify participants and, in as much as possible, careful attention was made to ensure gender balance and appropriate representation of varying income segments among each group. Mercy Corps Economic Development Officers led each FGD according to a predetermined set of questions designed to add depth to survey results.

Concurrently, information was collected on the supply side of the solar market. The Mercy Corps team mapped solar retailers and distributors as well as product availability across the region. A similar exercise was conducted at the national level. The purpose was to outline the current solar supply chain, from importers and companies to retailers, identifying actors who are either already active in the Acholi market or who have the capacity to become active in the coming year.

Once the mapping exercise was completed, structured interviews were conducted with each actor. These interviews were designed to gather as much information as possible about the products themselves; the functions of the existing supply and value chains; and major trends in supply and demand. Product testing was not included in this assessment; however product evaluations and certification by the LA program was used to verify the quality of all products involved.
Challenges

The Mercy Corps team faced a number of challenges while conducting this assessment. First, while the CKWs were an efficient and inexpensive way to reach many rural households, it was not possible to replicate exactly the questions contained in the consumer profile questionnaire. The CKWs survey questions were deliberately limited in number as CKWs are only contracted to complete a certain number of survey questions monthly. Shorter questionnaires typically result in more accurate responses; and AppLab limits surveys accordingly. As a result, analysis of the full sample was not always possible.

Second, gathering accurate information on some key data points was a challenge—particularly for household income. Income is a key measurement in this energy assessment because it allows for the calculation of proportional expenditure on fuel. However, most respondents are reliant on income derived from agriculture, which is both seasonal and varied and lends itself to recording income over time. Consequently, households were often unaware of income levels, and their responses were likely estimates. Respondents also self-reported distance traveled and time spent on fuel collection and these are thus subjective estimates.

A combination of data from recent and reliable sources, including the United Nations (UN) and Uganda Bureau of Statistics, were used for market projections in this assessment. While population data in Kitgum, Lamwo, Pader and Agago Districts is difficult to obtain, these sources provide reasonable estimates from which to base projections.

A combination of data from a UN water study of the region and a government household survey in 2010 was used to develop an estimated population figure of 870,000 people and 144,800 households across the four districts. These estimates are not official government figures; however, the last full census was conducted 10 years ago. As the region has undergone significant change in recent years, the water study figures provide a more accurate projection.

The proportion of households living in urban (within trading centers) and peri-urban (1–2 km from trading centers) settings was also based on the 2010 UN water survey. The survey included population density maps for each district; these maps were used to estimate the number of people in each urban area. This method does not provide a truly accurate figure, however it does provide a usable picture of the market size and distribution.

Third, the approach to FGDs yielded limited findings. It was difficult for the team to set up FGDs according to distinct consumer segments. Namely, focus groups for women only could have resulted in more data regarding this particular segment. However, though not isolated, all FGDs included a range of participants across consumer segments. Further, focus group data was poorly recorded. Though the discussions were fruitful and lengthy, enumerators did a poor job of recording data.

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Supplier Overview

Solar lanterns are an increasingly common sight in shops and markets around Uganda, particularly within Kampala. However, the quality of these products along with the capacity of their suppliers varies significantly. Both of these considerations are important for Mercy Corps and any organization that invests in the solar market. Mercy Corps’ Pader pilot project chose solar company partners based on product reviews found in LA, recommendations from local research institutes and organizations managing solar projects, and interviews with local solar companies and distributors. Mercy Corps will continue to weigh and to choose partners and products similarly.

The following table outlines each supplier and their relative strengths and weaknesses in the Ugandan context based on the experience of the Pader pilot project plus meetings with the local representatives of each.

<table>
<thead>
<tr>
<th>Supplier</th>
<th>Background and Regional Presence</th>
<th>Product Line</th>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>d.light design</td>
<td>US-based company with global distribution. Imports products from China into East Africa. Distributed in Uganda by Ultra Tec (U) Ltd., a solar energy distributor and retailer based in Kampala.</td>
<td>One product line that includes three solar lanterns, one of which integrates phone charging. New product line expected this year.</td>
<td>Widely tested products; the premium model certified as meeting performance standards by LA and other models expected to be certified as well. Performed well in the Pader pilot project.</td>
<td>Cost for lighting and mobile charging unit relative to competitors’ products is high. Presence and investment within Uganda remains small.</td>
</tr>
<tr>
<td>Barefoot Power</td>
<td>Australian company with global distribution. Imports products from China into East Africa. Has a wholly-owned subsidiary in Uganda.</td>
<td>A breadth of available products includes solar lanterns with phone charging component as well as larger household products with multiple light and phone charging facilities.</td>
<td>Widely tested products, good battery life, and all models meet LA performance targets. Performed well in the Pader pilot project. Local subsidiary provides excellent support and training to distribution chain. Operates its own repair stations (two) with presence in the north and Kampala.</td>
<td>Distribution focus relies on recruiting and training microfranchisees and, to a lesser extent, dealers; this is an expensive process that limits scalability. Only about a third of microfranchisees sell enough products to be considered “very active.”</td>
</tr>
<tr>
<td><strong>Green Planet ('Sun King' brand)</strong></td>
<td>Indian-based company with a presence in the US. Imports products from China into East Africa with two distributors for Uganda. One distributor, Small Solutions Technology Consultants Ltd., is new to the solar lantern market. The other distributor targets large organizational purchases.</td>
<td>One line that includes two solar lanterns, Sun King and Sun King Pro, which includes an integrated phone charger.</td>
<td>Currently the best battery technology on the market and both products meet LA performance standards. Local distributor experimenting with financing options and distribution strategies.</td>
<td>Limited options in product line. Product costs are higher than competitors. New to the Ugandan market with minimal country-wide presence.</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Tough Stuff</strong></td>
<td>British company with global distribution, regional offices around the world and a local subsidiary in Uganda. Imports products into East Africa.</td>
<td>Product comprised of components with buy-as-you-go add-ons like radio batteries, additional batteries and phone charging pieces. Flexible, “unbreakable” panel.</td>
<td>Light meets LA performance standards. Modular product line allows for consumer flexibility.</td>
<td>Proved unpopular compared with d.light design and Barefoot in the Pader pilot project. Some questions about product quality also arose during pilot.</td>
</tr>
</tbody>
</table>
Based on analysis of the strengths and appropriateness of products and companies for the target Acholi sub-region area, as well as the performance of products and companies in the Pader pilot project, the Mercy Corps team decided to actively work with d.light design, Barefoot Power and Sun King. The following section looks at the specific products and distribution channels for each of these.

**Selected Supplier and Product Analysis**

<table>
<thead>
<tr>
<th>Model</th>
<th>Specs</th>
<th>Distribution Strategy</th>
</tr>
</thead>
</table>
| S1    | Cost: UGX 38,000 (USD $15).  
Light time (highest mode): four hours.  
Use: Study/specific tasks.  
Meets LA minimum standards. | d.light design has a sales presence in over 40 countries throughout the world, partnering with country-specific distributors in each country. Currently, d.light design distributes products in Uganda through Ultratec (U) Ltd. Ultratec is a well-respected and long-standing distributor of larger solar systems and associated products within Uganda. These products are the company’s core business. Ultratec has built a brand around quality merchandise and a guaranteed, long-term presence in Uganda. |
| S10   | Cost: UGX 44,000 (USD $18).  
Light time: four hours.  
Use: Ambient light.  
Meets LA minimum standards. | Ultratec has been the sole distributor of d.light design products within Uganda for several years. The company, however, has not invested to build a substantive distribution network, and does not recruit nor train individual distributors or retailers. Instead, Ultratec relies on other, larger shared channels to push d.light design products, namely those of other larger businesses such as tea estates or non-profit organizations. |
| S250  | Cost: UGX 115,000 (USD $45).  
Light time: four hours.  
Use: Any needs, phone charger.  
Meets LA performance standards. |
## Barefoot Power

<table>
<thead>
<tr>
<th>Model</th>
<th>Specs</th>
<th>Distribution Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firefly 5</td>
<td>Cost: UGX 35,000 (USD $1.4) Light time: six hours Use: Study/specific tasks Meets LA performance standards</td>
<td>Barefoot Power Uganda is a Ugandan-based enterprise and subsidiary of Barefoot Power Ltd. Barefoot Power Uganda has been operating in-country longer than its competitors and has an established countrywide presence. Barefoot Power focuses recruitment at the individual retail level, enrolling dealers or micro-franchisees. Barefoot micro-franchisees buy into a Barefoot system and are required to attend a subsidized training that builds basic entrepreneurial skills and product-specific knowledge. Micro-franchisees receive special product prices and are able to invest smaller amounts in inventory. In order to retain the micro-franchisee status, retailers agree to sell Barefoot products exclusively. Barefoot dealers, on the other hand, are not bound by exclusivity but are required to invest in larger amounts of product at less advantageous prices. Dealers are not required to attend training. Barefoot Power Uganda also sells large amounts of product to organizations and companies that receive special bulk-purchase deals. Barefoot Power’s early market entry enabled the company to grow a countrywide presence and to build brand awareness; this is a substantial competitive advantage. However, as more and more products have entered the Ugandan market in recent years, Barefoot has faced stiffer competition that has resulted in a drop in sales. The company is getting smarter and more targeted with its recruitment and sales campaigns but may need to adapt its distribution model. Individual retailer recruitment and training is an expensive undertaking that does increase sales but that is neither cost-effective nor scalable in its present form. Only about a third of Barefoot dealers and micro-franchisees are high-selling retailers, whereas a third sells products occasionally and a third fail to sell at all. This return on investment is not conducive to scale. Incorporating opportunities to pass on some costs associated with recruitment and sale may enable the company to invest differently to grow more widely.</td>
</tr>
<tr>
<td>Firefly Mobile</td>
<td>Cost: UGX 76,000 (USD $30) Light time: four hours Use: Ambient light, phone charger Meets LA performance standards</td>
<td></td>
</tr>
<tr>
<td>Firefly Mobile Ultra Torch</td>
<td>Cost: UGX 125,000 (USD $50) Light time: eight hours Use: All uses, phone charger Five-year battery Meets LA performance standards</td>
<td></td>
</tr>
<tr>
<td>5W Power Pack Home Lighting System</td>
<td>Cost: UGX 341,000 (USD $136) Light time: 10 hours, all four lamps Use: Household system with four lamps and a phone charger powered by a single large battery</td>
<td></td>
</tr>
</tbody>
</table>
### Sun King

<table>
<thead>
<tr>
<th>Model</th>
<th>Specs</th>
<th>Distribution Strategy</th>
</tr>
</thead>
</table>
| **Sun King** | Cost: UGX 60,000 (USD $24)  
Five-year battery life  
Meets LA performance standards   | Green Planet has a distribution agreement with Small Solutions Technology Consultants Ltd (SSTC). SSTC currently provides products directly to retailers in and around Kampala and in the southwestern part of Uganda and take responsibility for all transport costs. An ad hoc distribution channel is employed including public buses. No sub-distributors or retail chains are currently involved, and no credit is given.  
SSTC is experimenting with different models and strategies to move products and to build a wider presence in Uganda. SSTC currently experiments with providing consumer financing through a partnership with the micro-finance group FINCA, in which Sun King products are bundled into other loan products, typically for businesses. However, SSTC company presence is nascent and products sales reflect this. |
| **Sun King Pro** | Cost: UGX 130,000 (USD $52)  
Five-year battery life  
Meets LA performance standards   |                                                                                          |
Key Bottlenecks and Challenges

Each solar company highlighted within this report imports items into Kampala overland from the major regional port of Mombasa, Kenya. From Kampala, products are distributed to retail points and large-scale buyers throughout the country. Solar companies face the same broad sourcing and distribution challenges and bottlenecks as a result of their comparable strategies; these challenges are outlined below.

Distribution and Sales Models

Distribution is the biggest hurdle to widespread solar product availability. Currently, only a handful of highly efficient and extensive distribution channels exist in Uganda. These channels were established by multinational companies that distribute fast-moving consumable products like soda, beer, cooking oil and washing detergent. These companies, including Coca-Cola and Mukwano, have invested heavily to build customized channels to meet demand for their products among even the most rural and dispersed populations. Fast-moving consumable distribution channels are not necessarily conducive channels for solar product sales. Solar products are notably more expensive and slower moving than consumables. To date, no multinational, consumable companies in Uganda have been open to pushing solar products through their channels.

In absence of access to an established distribution channel, solar companies must build their own. This is an expensive, time-consuming endeavor. Almost all companies recruit individual retailers or, at best, larger dealers that are willing to sell solar. These businesses generally lack the skill, experience and capital required to sell products in large volumes. Often, solar companies must invest to build basic retail skills such as accounting, marketing and planning. Small profit margins gleaned from the sale of pro-poor solar products are not enough to make the required investment to recruit and to train large numbers of retailers required to build sales channels that would scale presence and sales rapidly. Instead, recruitment and sales are haphazard and limited, slowing growth. Moreover, the heavy investment required for channel growth means that finite resources are not invested in product development nor placed in reducing product cost, further inhibiting solar product proliferation.

Though accessing established and expansive retail networks would be ideal for solar companies, this is not currently possible in East Africa. There may be opportunities for solar companies to rethink distribution schemes and channel development such that the high costs of recruitment and training are both minimized and dispersed more broadly throughout the supply chain.

Transportation

In a country without reliable postal service or widespread delivery service, most small- and medium-sized companies rely on private bus, minivan or truck transport service providers to move products. However, dilapidated roads with limited coverage, incompetent mechanics with deficient spare parts, aging vehicles and fluctuating fuel costs all result in unreliable, time-consuming and expensive transport. These challenges add significant costs to product supply, as well as to supporting a system of returns required to live up to warranty agreements. Transport companies pass their costs onto solar companies; solar companies, in turn, pass the high cost of transport onto retailers; and, ultimately, these costs are passed onto consumers. Higher product prices for consumers combined with lower profit margins for both companies and retailers inhibit retail channel growth and overall sales—limiting both availability of and access to affordable solar products.
The unreliable nature of importing into East Africa adds a further dimension to the transportation challenge. According to suppliers in Kampala, delays and sudden changes in import duties at the port are a common occurrence, adding costs and instability to the supply chain and ultimately limiting growth potential.

**Financing and Credit Options**

Access to affordable finance is a major challenge in Uganda. The Ugandan financial services market is characterized by staggering inflation and associated high lending rates, as well as general risk aversion among formal financial institutions. Accessing the capital required to invest in inventory and to grow a business is difficult, particularly for businesses selling lesser known, slower selling products like solar units. In the absence of a willing financial sector, some solar companies have moved to extend their own lines of credit. However, poor payback rates and minimal internal capacity to act as a bank have led companies to rescind these lines. Currently, the lack of affordable financing for solar businesses inhibits business channel growth and overall product availability, slowing sales.

Access to affordable financing not only constrains product supply, but also hinders product uptake. Solar products are generally beyond the cash price level of the vast majority of the Acholi market. Rapid payback rates may make the purchase of solar products feasible for many households; however, consumer credit is rarely available. Suppliers have experimented with partnerships with SACCOs and microfinance firms in order to fill this gap. Widespread consumer credit schemes are not currently available.

**Consumer Awareness**

Quality solar products offer a tremendous monetary, health and safety value to consumers. However, most consumers are unaware of these benefits or that such products even exist. For small-scale solar suppliers to reach their target markets more broadly, they must build consumer awareness. Low consumer awareness for a new, push product necessitates considerable investment to build demand, particularly in more rural and dispersed areas where product availability is nascent. Slim profit margins on household solar products mean the availability of resources to invest to build retail channels and to build demand is limited. Solar companies must target higher returns on their investment; the costs associated with rural market entry are usually too high to entice significant investment.

Compounding the awareness challenge is the range of low quality products that cost less but perform poorly. This type of competition hampers the reputation of all solar products, particularly in new markets that do not appreciate the difference between brands and product lines. Certification schemes led by the LA project are attempting to address this issue, but communicating this effectively to end consumers continues to be a challenge.
Consumer Profile Analysis

The following section outlines lighting and mobile phone charging energy use among households living in Kitgum, Lamwo, Pader and Agago Districts.

Household Wealth

Farming dominates as the main source of household income across the four districts. Combined results from both surveys show that 87% of respondents derived most of their income from farming. Commercial activity played a larger role as a main income source for those living in larger trading centers. The proportion of shop owners and casual laborers increased in urban areas. There was also a significant increase in the "other" category, with the majority of responses here indicating service industry income derived from restaurants, carpentry and motorcycle taxis. However, even in TCs, farming remained the dominant source of income, with three quarters of the population directly reliant on seasonal crop sales. This, in turn, impacts traders and all other small businesses in the region, which rely on increased purchasing around agricultural income influxes as well.

Because seasonal farming was the dominant source of income, monthly income was a difficult concept for people to measure. The average reported income is UGX 67,000 (USD $27.35); average income was around 20% higher among the Urban segment when compared to the Peri-urban or Rural 2 group. The number of Rural 1 responders to the income question was very small,

![Main Sources of Income](image)

### Average Income (UGX)

<table>
<thead>
<tr>
<th></th>
<th>Per Month</th>
<th>Per Year</th>
<th>Per Year (seasonally adjusted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>67,449</td>
<td>809,388</td>
<td>337,245</td>
</tr>
<tr>
<td>Urban</td>
<td>72,991</td>
<td>875,890</td>
<td>364,955</td>
</tr>
<tr>
<td>Peri-urban</td>
<td>60,000</td>
<td>720,000</td>
<td>300,000</td>
</tr>
<tr>
<td>Rural 1</td>
<td>88,300</td>
<td>1,059,600</td>
<td>441,500</td>
</tr>
<tr>
<td>Rural 2</td>
<td>60,684</td>
<td>728,213</td>
<td>303,420</td>
</tr>
<tr>
<td>Bureau of Stats</td>
<td>136,850</td>
<td>1,642,200</td>
<td>-</td>
</tr>
</tbody>
</table>

5 Median is more commonly used when looking at income figures, however the large number of households reporting zero or very little income at this point of the year made the median figure very low (UGX 30,000). Because of this the mean is considered to be a better reflection of likely household income in this case.
and the result was skewed by a single large outlier. The income figure found by this survey is very low compared to other studies of rural regions of similar make-up, which may be in part due to timing of the survey. The survey was conducted in April, which is the planting season and therefore a period of little income for farmers.

According to the Ugandan Bureau of Statistics' household study in 2010, the average monthly expenditure for rural households in the northern regions is UGX 136,850 (USD $55.86), around twice the income reported in this survey. A recent examination of seasonal variations in cash influx for rural households by Grameen Foundation AppLab concluded that households typically brought in income five months of the year, which makes annual income much lower once adjusted for seasons as shown in the table. Since true income measures were not possible through this survey, this combination of estimates provides a useful frame of reference.

**Lighting Habits**

Respondents were asked to identify their primary and secondary sources of light as well as characteristics of use for both. Of households surveyed, 91% indicated that they use both a primary and secondary source of light. Time used, costs of and distances traveled to acquire both primary and secondary sources of light are similar. However, both the main uses of light and geographic patterns of light usage can be distinguished between primary and secondary light choice.

Results indicate that the primary light source is much more widely used for key activities such as cooking and school work. This suggests “primary” was interpreted as the main light for use within the house, as compared to other more mobile light options identified below. Respondents reported using both sources of light interchangeably for business or income-generating activities and for lighting the way at night (a common torch use).

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8 Grameen Foundation AppLab: Annual Presentation to Partners, presented to Mercy Corps in May 2012.
Consistent with low grid penetration throughout rural Uganda, the electrical grid extends to only a few towns in Acholi. However, most Acholi households living in these towns fail to access electricity. The service is prohibitively expensive for most and, for those that might invest, generally too unreliable to justify the cost.

Only 0.4% of surveyed households reported electricity as their primary source of light. An overwhelming majority of households (79%) reported using paraffin as their primary source of light. The remaining households rely on torches or candles, with 9% and 3% respectively. Of those surveyed, 3.5% identified solar power as their main source of light, indicating some market penetration.

Paraffin is the primary light source across all geographic segments; however, proximity to a TC does influence choice. The proportion of the Urban segment relying on paraffin is below average at 75%, with solar, electricity and “other” sources—generally battery-powered lamps—making up the remainder. Paraffin use is higher in the Rural 1 segment; here, nearly 94% of households rely on paraffin as a primary light source. The proportion of households using paraffin drops again in the Rural 2 segment where “other” sources make up almost 12% of primary lighting and paraffin accounts for just 79%. In the Rural 2 segment, “other” sources specified include dry grass or firewood, both inefficient fuel sources but that are without monetary cost.

On average, households use their primary source of light for 3.75 hours a day. However, households using solar as their primary source of light used seven hours of light a day. Increased light use among households with solar is likely the result of a confluence of many different factors, including higher income. However, it does indicate a desire to use more light if freely available.
The majority of surveyed households indicated the use of a secondary source of light. Secondary sources of light are more diverse than primary sources and battery-powered torches are the most frequent secondary source, used by a third of households. Of those surveyed, 16% use candles and a combined 12% burn either firewood or dry grass as secondary sources of light. Paraffin is used as a secondary source by 17% of those surveyed. This is roughly equal to the same proportion of households that do not use paraffin as a primary light source, indicating that nearly all households utilize paraffin for light.

There are recognizable differences in secondary light use between market segments. Of those surveyed, 9% of households reported that they do not have a secondary light source; the majority of these households live within the Rural 1 and Rural 2 segments. Conversely, candles are typically used as a secondary source among urban dwellers. Torches are used as a secondary light source across all market segments. The survey results did not segment the “other” category; it is expected, however, that dry grass and firewood use are more widely used by rural segments whereas battery lamps are generally used by urban segments—consistent with other findings.

<table>
<thead>
<tr>
<th>Secondary Source of Light</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Average hours used per day: 3.00 hours.</td>
</tr>
<tr>
<td>- Average household expenditure per week: UGX 1,230 (USD $0.50).</td>
</tr>
<tr>
<td>- Average distance travelled to purchase fuel: 4.38 km.</td>
</tr>
</tbody>
</table>

The heavy use of a second light source leads to high additional expenses; households spend an average of UGX 1,230 (USD $0.50) every week and travel an average of 4.4 km to access secondary light sources. Distance traveled varies significantly between market segments. In line with expectations, urban households travel much less to access sources of paraffin or other lighting. Accordingly, the opportunity cost for accessing lighting fuel is much lower for urban users as compared to rural households. Those households in the Rural 2 segment travel nearly 7 kilometers on average to access fuel for lighting. The size of the travel burden has an understandable impact on the selection of lighting sources.

The reliance on wood or dried grass for lighting—inefficient and ineffective options—is far greater among communities with the farthest travel required to access other forms of fuel. Although ineffective, wood and grass are deemed the best option at a certain cost point of the alternatives. Travel considerations are very important for low income households. Low income households are generally unable to purchase fuel in large increments due to income limitations. Further, the opportunity cost of traveling 7 km a day to purchase incremental fuel amounts is too high.
Aggregate Lighting Figures

The following table highlights average household fuel use and costs across both primary and secondary lighting sources for the four districts.

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Hours Used/Day</th>
<th>Distance Traveled/ Week (km)</th>
<th>Cost/Week UGX</th>
<th>USD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paraffin</td>
<td>3.67</td>
<td>3.47</td>
<td>1,969</td>
<td>0.79</td>
</tr>
<tr>
<td>Battery/Torch</td>
<td>3.51</td>
<td>3.47</td>
<td>1,240</td>
<td>0.50</td>
</tr>
<tr>
<td>Candle</td>
<td>2.38</td>
<td>2.38</td>
<td>1,625</td>
<td>0.65</td>
</tr>
<tr>
<td>Average HH Total</td>
<td>4.86</td>
<td>4.69</td>
<td>2,397</td>
<td>0.96</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FUEL USE BY FUEL TYPE AT HOUSEHOLD LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
</tr>
<tr>
<td>Paraffin Users</td>
</tr>
<tr>
<td># of Households</td>
</tr>
<tr>
<td>% Total</td>
</tr>
<tr>
<td>% of Paraffin Users</td>
</tr>
<tr>
<td>Battery Torch Users</td>
</tr>
<tr>
<td># of Households</td>
</tr>
<tr>
<td>% Total</td>
</tr>
<tr>
<td>% of Torch Users</td>
</tr>
<tr>
<td>Candle Users</td>
</tr>
<tr>
<td># of Households</td>
</tr>
<tr>
<td>% Total</td>
</tr>
<tr>
<td>% of Candle Users</td>
</tr>
</tbody>
</table>

Paraffin is the dominant light source for households across the survey area. Paraffin is used by 79% of surveyed households for an average of 3.6 hours a day and at a cost of UGX 1,969 (USD $0.79) per week. An estimated 114,500 households burn paraffin. This amounts to a total weekly cost of UGX 225 million (USD $90,000) across the districts.

Figures for battery-powered torches are remarkably similar to those for paraffin. One significant difference, however, is the lower average cost per week (UGX 1,505, USD $0.60) of torch use to paraffin use. Despite this lower cost, torches are less popular than paraffin as a primary light
source because they are less effective in providing ambient light—but safer and easier to use for lighting the way at night and other mobile activities. Aggregate market-wide figures indicate that torches are a significant light source for over 60,000 households.

Candles are the third most common source of light. The analysis suggests that although more accessible, they are a less cost effective option—exemplified by the higher cost-to-hours-use ratio. Still, candles are used by 19% of households—over 27,000 in total across the four districts.

Figures for these three main light sources combine to provide an estimate of the value of the lighting market in the Acholi sub-region. Market-wide, 710,000 hours of lighting from these main sources is currently consumed on a daily basis at an average of five hours per household. In order to access this lighting, UGX 350 million (USD $140,000) is spent each week at an average of UGX 2,397 (USD $0.96) per household. Annually, the lighting market for the sub-region is currently valued at USD $7.2 million.

### TOTAL HOUSEHOLD FUEL EXPENDITURE ACROSS FOUR DISTRICTS

<table>
<thead>
<tr>
<th></th>
<th>Total HH: 144,800</th>
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<tbody>
<tr>
<td></td>
<td>Weekly</td>
</tr>
<tr>
<td>UGX</td>
<td>USD</td>
</tr>
<tr>
<td>347,115,036</td>
<td>138,846 USD</td>
</tr>
<tr>
<td>7,219,993 USD</td>
<td></td>
</tr>
</tbody>
</table>

**Mobile Phones**

In recent years, access to and adoption of mobile phone technology has grown exponentially across East Africa. Even in the most impoverished regions of Uganda, phones are fairly common and play an increasingly important role in daily life and the economy. This is also true of the Acholi sub-region where 42% of those surveyed own their own mobile phone. An additional 26% of those surveyed claim to regularly contribute to the costs of charging a mobile phone, indicating that though they may not own a phone personally, they do use others’ phones regularly. In total, slightly under a third of households (32%) do not have regular access to a mobile phone.
Mobile phone access is more prevalent among urban households and declines steadily as household location becomes more rural. On average, urban households are twice as likely to own a mobile phone as rural households. However, the proportion of people regularly using phones is only marginally higher in urban areas. The most rural households, those living in the second rural segment, own and use more mobile phones than those living in the Rural 1 segment. Mobile phones are a cheaper alternative for communication, reducing transportation and transaction costs. For remote users, costs associated with time and distance are significantly more than for their more urban counterparts. The relative geographic cost-benefit of mobile phone adoption may be reflected in use patterns highlighted in the survey.

The revolution in mobile technology adoption across East Africa in recent years has created a new subset of entrepreneurs rising up to meet demand for mobile-related services. Today, one of the most common sites in TCs across the Acholi sub-region is mobile phone recharge shops, which are often the sole source of electricity for a community. Among those respondents regularly using mobile phones, 56% use a recharge shop (RS), the majority of which are solar powered. The next most common source of phone recharging in the Acholi community are the CKWs, who each have a solar-powered battery with an integrated phone charger (many have created a mobile enterprise for phone charging). However, as CKWs participated in data gathering for this assessment, the number of respondents indicating CKWs as their main source of phone charging may be skewed. When combining CKWs with the solar recharge shops, at least 60% of phones are currently charged using solar power, a good demonstration of its feasibility for the region.

Of the 71% of respondents who regularly pay to charge a phone, the average cost is UGX 506 per charge. The average household recharges 1.8 times a week, resulting in average mobile recharging expenditures of UGX 895 (USD $0.37) weekly and UGX 46,540 (USD $18.62) annually. Average distance traveled to recharge is 1.6 km per trip, amounting to a total of 150.8 km traveled annually.
The average distance traveled to recharge a mobile phone is 1.6 km round trip, resulting in an average of 2.9 km traveled weekly and 150.8 km traveled annually. Thus, the costs of mobile recharging are also those associated with time and monetary costs of travel and associated lost economic opportunity.

Delineating by market segment shows that the time and energy invested in charging phones increases significantly with distance from urban areas. The average distance traveled to recharge mobile phones among Rural 2 households was estimated at 4.15 km per week, which multiplies out to 215 km per year. While it is unknown how much of this travel might take place for other reasons, significant rural household time and energy investment in recharging phones is evident.

Total Investment

The following section examines the survey data from an aggregated perspective. These calculations are significant, offering a broader examination of energy poverty in Acholi as well as potential aggregated demand for modern energy-saving alternatives.

Combined average annual household expenditure on lighting and phone charging: UGX 212,524 (USD $85.70).

Overall, average weekly household expenditures on lighting amount to UGX 3,192 (USD $1.30). Throughout the course of the year, average total household lighting expenditures add to UGX 165,984 (USD $66.93). Average weekly household expenditures on mobile recharging amount to UGX 895 (USD $0.37), amounting to UGX 46,540 (USD $18.77) annually. When combined, total average lighting and phone charging expenditures amount to UGX 4,087 (USD $1.67) weekly and UGX 212,524 (USD $85.70) annually, per household.

Based on the market-wide figures previously calculated in this section, the estimated market-wide aggregate expenditure on lighting and phone charging adds to USD $182,000 weekly and an annual total market expenditure of over USD $9 million.
Urban households consistently face a smaller energy burden than their more rural peers. Though the difference is small, it is also significant. The Annual Expenditure chart delineates the average combined annual household expenditure on lighting and phone charging and shows that costs steadily increase as the population moves further away from a TC. Transportation costs are likely responsible for this variation in lighting and mobile recharging costs, with traders covering the cost of product transport to rural areas by adding to product and service costs. The burden of the 11% increase between costs for those living in a TC and those living 5 to 10 km away is magnified by lower overall income and greater reliance on seasonal income among rural households. Moreover, those living in more rural settings must also invest greater time and expenditure on travel to source their energy needs. This additional cost, or the shadow cost, further exacerbates urban versus rural energy burden.

Observations and Recommendations

This section highlights overall solar market potential for the Acholi sub-region and offers recommendations for actors looking to penetrate the market. The section also provides suggestions to Mercy Corps for facilitating solar market development.

Market Potential

The assessment findings demonstrate that solar lighting and phone charging products are appropriate and timely for the Acholi sub-region. High household costs associated with monetary expenditures, time traveling and lost economic opportunities point to significant suppressed demand for such products, a point highlighted by the estimated USD $9 million spent each year on lighting and mobile phone charging.

A key metric for calculating the ability to sell products to this market is the payback period. This period is the amount of time it takes a household to earn back the money invested in a product through savings accrued from paraffin and charging costs that are not undertaken. The Payback Periods table shows the payback periods in number of weeks according to different market segments based on the data gathered on average household expenditure. Payback periods are presented for three price points—approximations for different levels of product currently available. The calculations for UGX 40,000 (USD $16.33) and UGX 60,000 (USD $24.49) were made using household expenditure on paraffin only as units offered at these prices are ambient lights. The calculation for UGX 76,000 ($USD $30) and UGX 120,000 (USD $48.98) are based on models that include phone chargers; the payback period includes the expenditure on phone charging.

The payback periods range from 12 to 32 weeks, meaning that the average household could pay off the value of the most advanced unit in eight months or less. With battery lifespans for solar products increasing from two to five years and overall unit lifespans of about 10 years, this represents a short space of time and means the units can provide genuine cost savings for households in short returns on initial investment. In addition, solar units also provide higher quality, safer and longer lasting light to support more productive evening activities.
An alternative way to look at the market potential is to calculate likely household savings over time from purchasing solar lights and phone chargers. The graph below compares household spending over a four year period using existing lighting and phone charging methods compared to costs associated with purchasing certain solar products. Since the baseline household expenditure data encompasses primary and secondary lighting, plus phone charging, the comparison is based on potential "solar packages" that include two lights, one of which contains phone charging capacity. The two packages vary by product specification:

- **Basic**: d.light design S1 reading light (UGX 36,000/USD $15), Barefoot Power Firefly Mobile (UGX 76,000/USD $30).
- **Advanced**: Sun King lamp (UGX 60,000/USD $24), d.light design S250 (UGX 115,000/USD $45).

### Payback Periods

<table>
<thead>
<tr>
<th>Segment</th>
<th>Unit Price Points (UGX)</th>
<th>40,000 (sm. light)</th>
<th>60,000 (light)</th>
<th>76,000 (w/charger)</th>
<th>120,000 (w/charger)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td></td>
<td>15.0</td>
<td>22.5</td>
<td>20.0</td>
<td>31.9</td>
</tr>
<tr>
<td>Peri-Urban</td>
<td></td>
<td>13.2</td>
<td>19.9</td>
<td>19.2</td>
<td>30.8</td>
</tr>
<tr>
<td>Rural 1</td>
<td></td>
<td>10.7</td>
<td>16.1</td>
<td>15.5</td>
<td>24.8</td>
</tr>
<tr>
<td>Rural 2</td>
<td></td>
<td>11.8</td>
<td>17.7</td>
<td>17.7</td>
<td>28.3</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>12.5</td>
<td>18.8</td>
<td>18.4</td>
<td>29.4</td>
</tr>
</tbody>
</table>

Household Expenses Over Time

[Graph showing household expenses over time]
This analysis assumes that products would need to be replaced after two years; this is a very conservative outlook as all suppliers included in this assessment currently have or are rolling-out products with new battery life of four to five years; in addition replacement batteries are available for purchase. Even working from this conservative assumption, savings over a four-year period is clearly visible. The table shows estimated figures for these monetary savings for the two main consumer groups and packages used in this model. Accurate comparisons to income level are not possible given the uncertainty around income figures. However, these four-year savings figures are very high compared with the income estimates presented in Section 5.1, and could represent anywhere from 25 to 50% of household annual income.

The payback period and potential savings figures combine to make a strong case for high market potential across the region as a whole. When looking at the potential success of a market, it is important for suppliers and private actors to understand the actual total size of a market and based on the results of this assessment an estimate of aggregate market size is feasible. The data show that almost 100% of households regularly pay for their primary lighting source, 80% pay for a secondary light source, and 70% pay for mobile phone charging. The following table presents a rough calculation of total market demand based on these figures. A general assumption that those households that pay for mobile phone charging are also likely to be the same as those that purchase a secondary light source was employed for simplicity.

<table>
<thead>
<tr>
<th>Existing Fuel Expenses</th>
<th>% HH</th>
<th># HH</th>
<th>Products Mix to Maximize Savings</th>
<th># Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Light only</td>
<td>20%</td>
<td>28,800</td>
<td>Single lamp</td>
<td>28,800</td>
</tr>
<tr>
<td>Primary and Secondary Light</td>
<td>10%</td>
<td>14,400</td>
<td>Two lamps</td>
<td>28,800</td>
</tr>
<tr>
<td>Primary, Secondary Light and Mobile Phone</td>
<td>70%</td>
<td>100,800</td>
<td>Two lamps, one w/ phone charger</td>
<td>201,600</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>259,200</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

These figures represent total potential demand based on the cost savings figures presented—making a strong case for resource efficiency for every household to acquire at least a single lamp since almost every household purchases lighting fuel. These figures do not represent the actual current demand, but rather potential demand if market actors can find ways to address the major barriers of awareness, distribution and financing as identified in Section 4.3.
Market Segmentation

The table below summarizes the consumer profiles for each of the market segments identified at the beginning of the analysis.

<table>
<thead>
<tr>
<th>MARKET SEGMENT COMPARISON</th>
<th>Urban</th>
<th>Peri-Urban</th>
<th>Rural 1</th>
<th>Rural 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income (month)</td>
<td>72,991</td>
<td>60,000</td>
<td>-</td>
<td>60,684</td>
</tr>
<tr>
<td>% Farmers</td>
<td>78%</td>
<td>90%</td>
<td>94%</td>
<td>94%</td>
</tr>
<tr>
<td>HH Purchasing paraffin</td>
<td>92%</td>
<td>93%</td>
<td>99%</td>
<td>84%</td>
</tr>
<tr>
<td>Distance traveled to purchase/week (km)</td>
<td>1.5</td>
<td>3.8</td>
<td>3.8</td>
<td>6.7</td>
</tr>
<tr>
<td>Weekly expenditure on lighting (UGX)</td>
<td>2,666</td>
<td>3,022</td>
<td>3,725</td>
<td>3,485</td>
</tr>
<tr>
<td>HH that regularly use a mobile phone</td>
<td>77%</td>
<td>55%</td>
<td>44%</td>
<td>54%</td>
</tr>
<tr>
<td>Distance traveled to recharge/week (km)</td>
<td>0.3</td>
<td>1.5</td>
<td>3.75</td>
<td>4.15</td>
</tr>
<tr>
<td>Weekly expenditure on recharging (UGX)</td>
<td>1,093</td>
<td>879</td>
<td>1,112</td>
<td>846</td>
</tr>
<tr>
<td><strong>Total combined energy expenditure (light/phone)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Per week</td>
<td>3,759</td>
<td>3,901</td>
<td>4,837</td>
<td>4,243</td>
</tr>
<tr>
<td>-Per year</td>
<td>195,468</td>
<td>202,852</td>
<td>251,524</td>
<td>220,636</td>
</tr>
<tr>
<td>Payback period for light and charger (weeks)</td>
<td>32</td>
<td>31</td>
<td>25</td>
<td>28</td>
</tr>
</tbody>
</table>

This comparison demonstrates that, despite some differences between geographic segments, behavior around lighting and mobile phone use are largely consistent among the estimated 145,000 households in the sub-region. The ubiquitous nature and generally consistent price of paraffin means that high household expenditure on lighting is common, with rural areas paying slightly more due to distance from market. Secondary sources of light vary between battery-powered devices in urban areas to biomass in rural areas, but both add an extra burden on household members and provide low quality light. Investment in mobile phone charging varies a little more, with a larger proportion of urban households having access to mobile phones. However, mobile phone access remains around 50% in rural segments.

These results suggest that potential demand for solar products is not markedly higher for one segment over another. And while rural households generally have lower incomes—which translates into relatively higher prices for solar—they also absorb a greater burden for current energy access through higher prices and greater travel. Substantial monetary and time costs in rural areas therefore shorten the estimated payback period and strengthen the case for investment at the household level.

Despite the relative consistency across market segments, they do differ in a number of ways that together justify targeted marketing. The distance that households travel to access energy is a major difference to be considered by private actors. This is important for marketing messaging, but
also a consideration for distribution chains and awareness-raising. Is it sufficient to rely on families to travel to market centers in order to educate them on the benefits of new technology, or would it be more effective to bring the product to them?

Access to capital is another marked difference. Rural segments have less disposable income and are more reliant on seasonal cash flows; suppliers and distributors will need to find ways to accommodate this pattern. The payback period analysis suggest that these areas are where suppressed demand is highest, which means profit opportunities exist for those able to overcome these barriers. The lower mobile phone use in rural segments also suggests an opportunity to concentrate sales on lowest-cost products. Around half of all households do not have a phone and would therefore benefit as much from a simple light. The opposite is true among urban segments where phones are prevalent, and thus marketing messages should target charging benefits as much as possible.

Recommendations for Solar Actors

The assessment findings indicate that the Acholi sub-region is a potent market for innovative, cost-effective energy solutions. The findings also indicate that household solar products offer a tremendous opportunity to alleviate the Acholi household energy poverty burden more immediately. Penetrating this market, however, is not straightforward. Three key challenges, though not new insights, must be overcome to reach the Acholi market to scale: distribution strategy, consumer awareness and financing.

Distribution Strategy

Efficient distribution is a major bottleneck for solar companies and must be addressed. Most solar companies recruit and train individual retailers. This is an expensive and time-consuming way to build distribution channels that is untenable for companies relying on the sale of pro-poor products with minimal profit margins. This is particularly true for companies attempting to reach the Acholi market or similar rural and dispersed populations where, in the absence of revolutionary technology, the higher the number of points of sale, the higher the overall sales.

New, creative business models that can piggyback on shared channels to maximize points of sale while minimizing investment are imperative. Large consumer goods distributors like Mukwano and Bidco offer one channel option. So too do mobile traders; a large proportion of respondents regularly charge phones with their local CKW, demonstrating that this network of mobile agent traders is a potent channel. As agent banking and other mobile agents develop, opportunities may arise to leverage technology and shared channels to access larger markets more cheaply and to scale.

Consumer Awareness

Though affordable solar products have been available on the Ugandan market for several years, consumer product awareness remains low. Small operating budgets impinge on solar company marketing investment. However, more investment must be made in order to effectively sell more products and especially in new markets like Acholi. Opportunities to leverage household energy expenditure data and payback periods are potent marketing points.
Financing

As demonstrated by the payback period calculations, solar units can generate significant household savings. Even the more expensive solar units can be paid off in six-eight months using money that was previously allocated for lighting and phone charging. If informed of the savings opportunity appropriately, this will make solar purchase more appealing for the 160,000 households in the sub-region. However, information is not enough. Households purchase fuel for light in small amounts and pay to recharge their phone periodically. Incremental payments, though more expensive in the long-term, are also manageable. Households budget a small percentage of their weekly earnings or savings to purchase fuel for lighting and to pay for mobile recharging. Paraffin, batteries and candles all meet consumer lighting needs by enabling consumers to spend according to their current means. While households are willing to adopt new technology if it cuts their expenses, they are also unable to raise the necessary funds to adopt cost-cutting technology and make a single, expensive solar unit purchase. Accordingly, consumer credit or other flexible financing schemes that enable consumers to pay off debt slowly as they earn are imperative for solar product purchase. This is a vital component to any solar business plan as few households have sufficient savings to cover the cost outright and, even they do, a willingness to invest it in solar over other vital consumer needs.

Low retailer and trader capacity and liquidity means that widespread consumer credit at point of sale is unlikely. Therefore, suppliers must continue to evolve relationships with SACCOs and other microfinance institutions to develop suitable loan products and financing models for bundling products with loans and other services. Mercy Corps’ Pader pilot project demonstrated the value of SACCOs. Some have high membership levels among rural farmers, direct access to the market, and mechanisms in place to provide smaller loans and to ensure repayment. The capacity of SACCOs varies and the ability of each to manage loan supply must be assessed accordingly.

Facilitation Role for Mercy Corps

Following this assessment, Mercy Corps believes that there is tremendous merit in solar adoption as well as a potent solar market opportunity within Acholi. Across the sub-region, Mercy Corps can play a valuable role in helping to accelerate access by reducing barriers to product availability and catalyzing consumer demand.

Mercy Corps is dedicated to a market-based approach to facilitate access to energy. Rather than serving as a direct actor, Mercy Corps works to target key leverage points. We place our resources where the market is failing to function effectively on its own and, at the same time, where the resources will result in the greatest possible and lasting impact. This assessment illuminates four central ways in which Mercy Corps can intervene to help the solar market to operate more efficaciously.

Improve Distribution Strategy

The current distribution models employed by the major small-scale solar product suppliers are inefficient and costly, limiting opportunities for solar market penetration. In Acholi, poor infrastructure adds significant costs to transportation and coordination, while limited product availability and awareness necessitates creating demand—which is also costly. A higher number of points of sale
as well as lower costs of establishing these dedicated sales points are more important in a rural, dispersed market with little awareness than in other places.

Mercy Corps could work with suppliers to develop alternative distribution models, identifying efficiency improvements based on Mercy Corps’ intimate knowledge of the sub-region. Opportunities may exist to bring together suppliers and distributors of different products to identify points of cooperation that may reduce costs and improve efficiency. Additionally, Mercy Corps could partner with the companies to help them to identify viable and active distribution partners; entering markets through active distributors with large networks of sub-venders—rather than entering markets through dispersed and individual retailers—will likely reduce costs and improve efficiency.

Moreover, Mercy Corps could play an effective role in helping to design new models that integrate training for retailers within distribution channels in order to reduce retailer onboarding costs. Mercy Corps could also partner with other organizations that already provide effective training services to retailers to transfer this training.

**Facilitate Access to Finance**

Limited financial resources inhibit access to solar for all actors within the value chain. Though credit does exist within the value chain itself, it is only available for a small minority. Solar companies are unable to access the capital they need to grow their businesses to scale. Distributors and retailers are unable to access the capital required to build inventory and expand their consumer base. Consumers are unable to pay for products in a single transaction. This limited access to finance creates significant inefficiencies that severely inhibit market growth and product access.

Mercy Corps may be able to facilitate access to finance along the value chain by leveraging existing relationships with banks and SACCOs to generate flexible financial products for businesses. Mercy Corps could also work to design and facilitate alternative business financing schemes, such as micro-consignment models or offer a guarantee to test new, riskier loan products.

With respect to consumer finance, Mercy Corps could help to design loan products in partnership with financial institutions for solar themselves. Learning from the Pader pilot project, successful partnerships with SACCOs or other financial institutions may provide a channel through which solar products can be passed from suppliers to consumers with associated and embedded consumer credit. Mercy Corps can build on partnerships with existing SACCOs and identify others in the adjacent districts that can play a similar distribution role, either offering product loans specifically for solar products or bundling them with other products such as fuel efficient stoves or even loans that are folded into other offerings. Mercy Corps primary role would be to identify micro-lenders with the capacity to take on a distributor role; support loan product development; connect them with product suppliers and help to promote the product among members.

**Build Awareness Through Social Marketing**

Acholi consumers not only lack access to solar products, but also are unaware of their many benefits; thus, solar suppliers and distributors should implement direct marketing to these potential consumers. However, slim profit margins generated by products aimed at this market mean that actors rarely have the resources or capacity for such an endeavor. Mercy Corps could
play a valuable role in producing and disseminating general social messaging. To maximize impact, Mercy Corps could also facilitate coordinated action among private sector solar and energy actors to pool their resources available for marketing.

**Strengthen Business Acumen**

Developing retailer, distributor and supplier capacity to design innovative models and manage successful businesses will improve access to and adoption of solar products. Rather than working with each group directly, Mercy Corps would be more effective by working with business support services in the region. Several private sector entities already exist that provide business planning and management consulting services. By working to strengthen these groups and the quality of their product, Mercy Corps can have a wide and longer-lasting impact on business skills within the region.