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A Growing and Evolving Market for Off-grid Lighting

Market Presence of Off-Grid Lighting Products in the Kenyan Towns of Kericho, Kapkugerwet (Brooke), and Talek

Authors:
Meg Harper*, Peter Alstone#, and Arne Jacobson*
*Schatz Energy Research Center, Humboldt State University
Peter Alstone Clean Energy Consulting

January 2013

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Overview and Summary

This report is a snapshot of an African off-grid lighting market in transition. It builds on a baseline report completed three years prior in 2009 and shows market trends with respect to technology, sales volumes, and retail outlet characteristics. The continued monitoring of the retail and wholesale market offers insight on the progress of high-quality solar lighting products and the influence of programs like Lighting Africa that seek to combat market spoiling and improve consumer access to affordable, efficient off-grid lighting.

Market Presence Study Approach

Both fuel-based and electric off-grid lighting products are widely available in sub-Saharan Africa. This report focuses on characterizing the availability, price and market penetration of *electric* off-grid lighting products in Kenya based on a survey of retail vendors in three towns. We first designed and deployed a survey and field observation study in June 2009 in the Kenyan towns of Kericho, Kapkugerwet (also known as Brooke), and Talek.[1] In June 2012, we administered an updated survey in these same towns to compare to the baseline information from 2009. Only products that have electric light sources and do not require a continuous connection to grid electricity are included. These include dry cell incandescent torches (i.e., flashlights), grid-rechargeable products, solar lanterns and preconfigured mini solar home systems. We did not include component-based, customized solar home systems in the study. Data were collected about the diversity of products available, estimated prices, and weekly sales volumes of each product. Additionally, we compiled information about each retailer surveyed, including the use of credit in their business. We also track the emergence of high quality solar lighting products and their rapidly expanding market share.

The Pilot Study Sites

We studied the market in three towns in the Rift Valley region of Kenya. Kericho is a large town (~102,000 pop.) in the prosperous tea growing region in the highlands of southwest Kenya. Brooke is a small town (~14,000 pop.) that is close to Kericho (~5 km). Both Kericho and Brooke are electrified, but many residents and people who live in outlying areas do not have access to electricity. Talek is a small market center (~5,000 pop.) that is far from any large towns and is off the grid (all population estimates are from the Kenya Population and Housing Census 2009).

The off-grid lighting products sold in retail and wholesale shops in these towns are at the end (or an intermediate step in the case of wholesalers) of a complex, difficult to define supply chain. Many, but not all, of the products that are available "flow" through distributors in Nairobi. Once they leave Nairobi, the products are distributed along a cascading supply chain that follows the major highways in Kenya through large towns and medium-sized cities and eventually to the storefronts and street hawkers where they are available for retail purchase.

Our key findings from our studies of these three towns and their supply chains are summarized below.

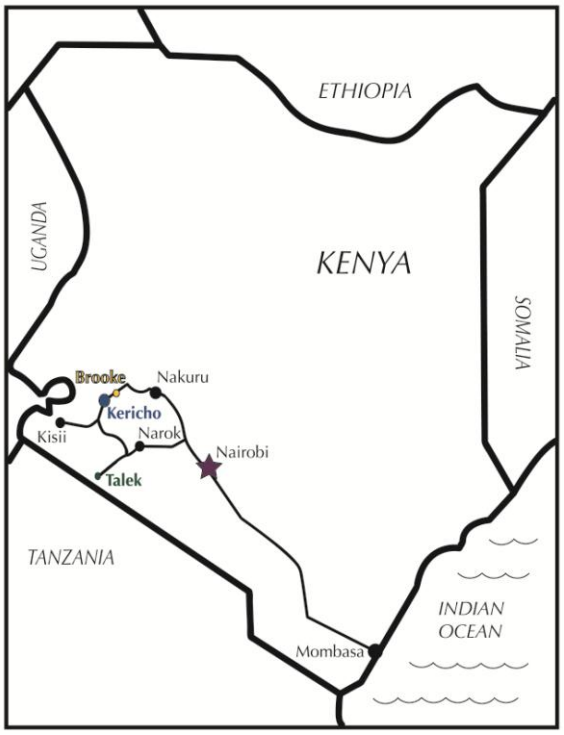

Figure 1 Map of Kenya showing the approximate location and relative size of the three towns included in the study. Cities and towns where retailers source their products are included as well.

[1] The report on the 2009 market presence survey is titled "Baseline Market Presence Study: Off-grid Lighting Products in three Kenyan Towns" and is available at http://lightingafrica.org/resources/technical-research.html

Key Findings

- **LEDs continue to dominate the market** and are found in products ranging from low-cost electric torches (also known as flashlights) to high quality mini-solar home systems. Just as in 2009, most of the products available in 2012 are low-cost torches with LED light sources; very few have incandescent bulbs. In all three towns, only 3% of distinct products were available with incandescent bulbs and these products made up less than 1% of estimated weekly sales, which represents a slight increase in the presence of LED products since 2009. Both the 2012 and 2009 studies confirm the dramatic shift in the market for torches away from the incumbent incandescent technology, which was dominant for decades.
- **The market for electric off-grid lighting products has grown**. In Kericho alone, sales of electric off-grid products have increased from approximately 37,000 units per year in 2009 to over 175,000 units per year in 2012 with growth expected to continue. The retail market also exhibits a degree of turnover with respect to the outlets offering lights. While the majority of shops have sold LED products for over three years, many shops have just started to offer lighting products in the last three months and others that offered products in 2009 no longer sell them.
- **Widespread quality problems are evident for low-cost rechargeable torches**. While many vendors state that customers prefer the convenience of rechargeable torches, others note that some customers are reverting to dry cell torches after repeated experiences with rechargeable torch product failures. Additionally, we observed that while the character of the products available in the market is very similar in 2012 compared to 2009, nearly all the brand names have shifted. These transitory brand names suggest that manufacturers may be reacting to market spoilage by attempting to prevent customers from recognizing products that have previously performed poorly.
- **Though many of the low-cost torches appear to be similar to previous models, a few new developments were observed.** Most notably, the design of many of the torches has been changed. Previously many torches had several small LEDs, but now many have a single large LED. Some vendors suggest that customers prefer this style of LED as it offers brighter light. This reflects broader trends in the LED market towards large packages (instead of arrays of 5 mm LEDs). The single LEDs used in the low-cost torches are not, however, surface mounted devices like those used in many good-quality LED lighting products that are currently available.
- **Solar-charged off-grid lighting products have widely increased in availability, both in Kericho and in the off-grid town of Talek**. We estimate that solar charged products now have a market share of approximately 30% in Kericho and 26% in Talek (in terms of the monetary value of sales). In the 2009 study, only 2 solar-charged products were found.
- **Quality-assured solar products are now prominently available on the market**. In Kericho and Talek, we observed 27 Lighting Global quality-assured solar-charged products in nine different shops.[2] This represents a substantial improvement in availability of quality-assured solar lighting from the previous survey in 2009; at that time no quality-assured products were available.
- **Though the increased availability of quality-assured solar products is promising, solar products with low or uncertain levels of quality are still available on the market**. We found an additional 16 solar-charged products that had either not been tested or had not passed Lighting Global tests. Just as the low-cost rechargeable torches pose a threat of market spoilage for LED lights in general, without continued monitoring and consumer education, lower-quality solar products may cause customers to lose faith in emerging solar-LED technology.
- **Vendors of quality-assured solar products identified several areas requiring market support for the emerging solar products.** These needs included advertising support; improved access to

[2] Some of these products were found in multiple shops; we observed 14 distinct quality-assured solar-charged products and 16 distinct non-quality assured solar-charged products. The Lighting Global quality assurance program is associated with the Lighting Africa and Lighting Asia programs. More information is available at www.lightingafrica.org/what-we-do/product-quality-assurance.html.

products, spare parts, and samples; and the provision of technical training for repair technicians and sales staff.

1 Introduction

In June 2012, Lighting Africa team members[3] undertook a market presence survey in the towns of Kericho, Kapkugerwet (also known as Brooke), and Talek. All three towns are located in Kenya's Rift Valley Province. The purpose of the survey was to determine the availability, price, and other characteristics of off-grid electric lighting products (hereafter known as "products") in each town for comparison to similar data from 2009. In this document we present background information about the towns and the method we used to collect data. Next, we present analyses of the data that we collected, including quantitative survey results as well as additional field observations. These data are compared to similar data from the 2009 baseline survey to better understand the transformation of the off-grid lighting market. Finally, we present our findings about the emergence of high quality solar lighting products and a discussion of the on-going needs of this industry, including marketing and after-sales support.

A well-used rechargeable LED torch

Town of Brooke

Solar lighting for sale

1.1 Geographic Background Information

Kericho (S 0.369 E 35.284)

Kericho is a large town in a tea growing region, with approximately 100,000 residents. Multinational corporations—notably Unilever Tea Kenya Limited and James Finlay Kenya Limited—and small holder farmers grow and process tea in the surrounding area. The town center is the commercial hub of the area. The center of Kericho town and the surrounding tea areas are shown in Figure 2. Our survey covered an area near the town center, where electronic goods stores are concentrated. The boundary of our study area is the same as that in 2009 and is noted in Figure 2. Information on product availability and pricing was also collected from two supermarkets and a petrol station outside of the boundary; this information is presented separately. Figure 3 shows a typical scene on the street in central Kericho.

[3] Peter Alstone, Maina Mumbi and Meg Harper with translation aid from Daniel Koech, James Mwangi and Julius Ndiangui

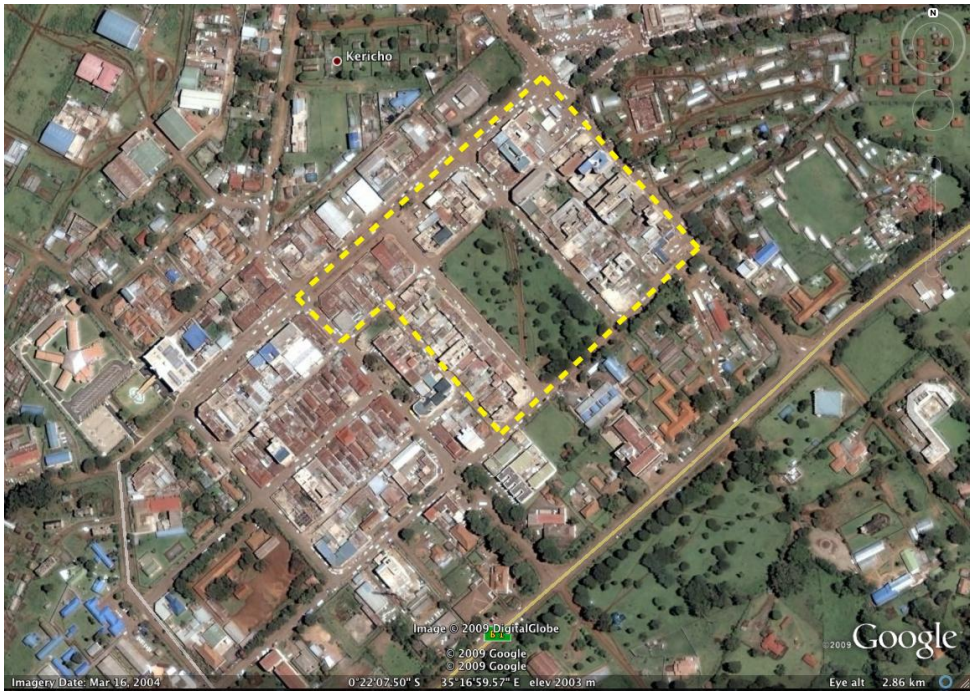

Figure 2: Aerial image of central Kericho (retrieved from Google Earth in 2009; imagery from 2004), with the boundary of the baseline market study indicated (yellow dashed line).

Figure 3: Street scene in Kericho - 2012

Kapkugerwet (Brooke) (S 0.336 E 35.323)

Kapkugerwet (colloquially, and throughout this paper, referred to as Brooke), is a small market center outside of Kericho town with a population of approximately 14,000. It is adjacent to the main offices of Unilever Tea Kenya Limited (previously the Brooke Bond Tea Company—the source of the Anglicized version of the town's name). There is electricity access for those who can afford a grid connection, though many in the surrounding villages do not have grid electricity. Our survey covered the commercial area, staying within the same boundaries as the 2009 survey, as noted in Figure 4. Figure 5 shows a typical street scene from Brooke in 2012.

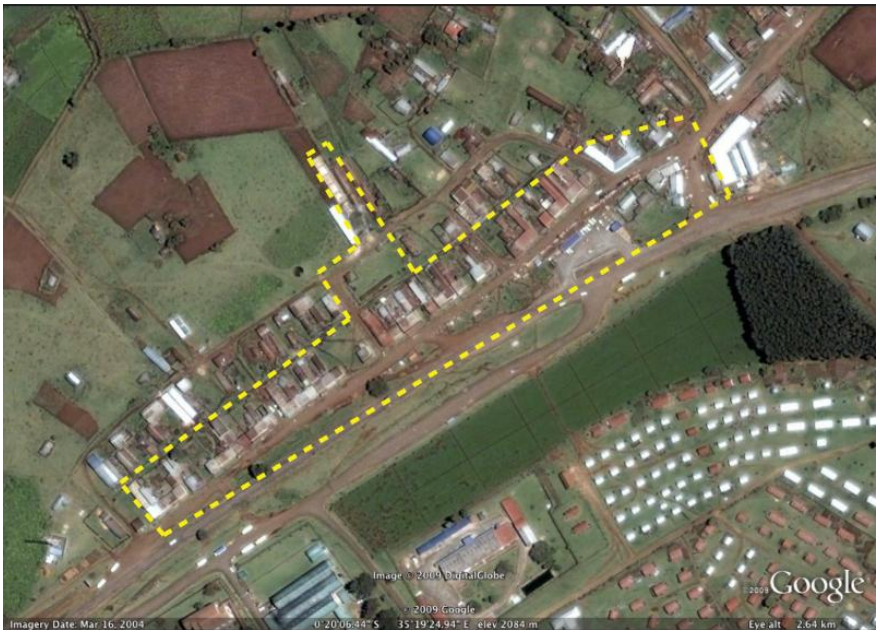

Figure 4: Aerial image of Brooke (retrieved from Google Earth in 2009; imagery from 2004) with the boundary of the baseline study indicated (yellow dashed line)

Figure 5: Street scene in Brooke (Kapkugerwet) - 2012

Talek (S 1.442 E 35.215)

Talek is a small town in southern Rift Valley Province, located near one of the entrances to Maasai Mara National Park. There are several lodges and hotels in the area for tourists who are visiting the park, and support of tourism is a large part of Talek's economic base. Additionally, people raise livestock and grow farm crops in the area. The electric grid does not extend to Talek, although mobile telecommunications are now available there. Our survey covered the commercial area. Talek grew substantially between the 2009 study and 2012; the commercial area had expanded greatly, and the number of shops carrying lighting products tripled. To capture the larger market, our survey area expanded as noted in Figure 6. Figure 7 shows a street scene in Talek in 2012.

Figure 6: Aerial image of Talek (Image retrieved from Bing Maps in 2012) with boundaries from 2009 (limited extent) and 2012 surveys demarcated. The extents noted on the map are for the survey boundaries, which roughly correspond to the main commercial area in both years. There was significant growth in Talek between 2009 and 2012.

Figure 7: Street scene in Talek from 2012

2 Methods

We used the same set of sampling, survey, and observation methods to achieve the data collection goals for this study as were used in the 2009 study. In this section, those methods are outlined.

With the goal of accurately capturing the presence of off-grid lighting products in the market, we used the following definition for "off-grid electric lighting products" in the context of the study:

- Has energy storage incorporated into the product (or uses dry cell batteries).
- Has an LED, fluorescent, incandescent, and/or other electric lighting source.

The definition was intentionally broad to ensure that we captured the full range of products, including "traditional" dry cell incandescent torches.

In Kericho and Brooke, we used the same geographic sampling area that was used in the 2009 study. These areas were determined in 2009 using the following methods:

- Select a study area that achieves the highest commercial density possible.
- Create a study boundary that is sensible (based on blocks and streets), and is a relatively normal polygon (we sought to avoid irregular shapes).
- Limit the size of the study area based on the available time for surveying.

In practice in 2009, surveys were started without a fixed boundary and the team established the boundary as they identified the extent of the main commercial areas and learned how quickly they could cover areas. In 2012, information was also collected at two supermarkets and a petrol station outside of the boundary; however, this information is presented separately to maintain a comparative sample in Kericho. These extra sites are referred to in figures as "Supermarkets." Full surveys were not conducted in the two supermarkets and the petrol station in Kericho; we only observed the diversity and price of lighting products in these shops.

In Talek, the team surveyed the entire commercial area of the town in 2009, which included only seven shops that sold lighting products. When we returned in 2012, the commercial area had more than doubled in size. Rather than limiting our survey to shops within the original geographic boundary, we decided to again survey the entire commercial area, which now included 21 shops with lighting products.

The general practice during a surveying day was to systematically administer the survey (Appendix 1) on a shop-by-shop basis, working street by street and block by block during business hours to identify and survey shops and other outlets where off-grid lighting products were available for purchase. Native speakers of Swahili who live and work in the region conducted most of the interviews with support and guidance from California-based researchers. There were a few exceptions where the interviews were conducted by the California-based researchers in cases where the interviewee was a very good English speaker. Figure 8 shows Daniel Koech, one of the research assistants, conducting an interview with a hawker in Kericho.

The survey included questions about the interviewee, the shop, the off-grid lighting products sold in the shop, and the shop's customers. Survey data collection focused on determining information about the diversity and price of lighting products. Data collected about lighting products included the form factor, light source, energy source, price and estimated weekly sales of each available product. Note that weekly sales data were only collected in 2012 (i.e. these data were not collected in 2009). We did not record the full inventory of each shop (i.e. how many of each product the shop had in stock). We also collected information about the shops, including the type of shop (ranging from market hawkers to solar specialty shops), number of employees, type of sales (retail or wholesale), length of time they have offered LED products, basic demographics of their customers and the use of credit in their business. The key additions to the 2012 survey are questions related to sales volumes for each individual product and questions about the use of mobile banking (i.e., "M-Pesa" and similar services in Kenya).

After completing the survey, we used a handheld GPS device to mark the location of the shop. Later, after completing the paper surveys, the data were entered into a database spreadsheet for each town.

Figure 8: Daniel Koech (holding clipboard) interviews a man selling lighting products on the street.

Following the market presence survey, we returned to shops that sold products associated with the Lighting Africa program (i.e., products that had been tested and passed the Lighting Global Minimum Quality Standards). In each of those shops we conducted a short structured interview to collect information about any additional support they would value from the Lighting Africa program to enable selling more good quality off-grid lighting products. When possible, these interviews were conducted with the manager or owner of the shop; however, in several cases sales staff provided responses.

3 Findings

In this section we present the study results from 2012 and compare them to the results from 2009. We begin by summarizing product availability and diversity in each town. This is followed by sections on product pricing, characteristics of retailers, the geographic distribution of shops in the towns and an estimate of the market size. Next is a section focused on retailers' use of and access to credit in their business operations. We also include a discussion about product quality, the indicators of market spoilage and the emergence of high quality solar products. We close with a discussion of the on-going needs for the successful integration of high quality lighting products, including marketing and after-sales support.

3.1 Availability and Diversity of Lighting Products

The markets for electric off-grid lighting products in Kericho, Brooke, and Talek continue to offer varying ranges of products in terms of function, quality and price. In 2012, we observed 155 distinct products for sale in Kericho, 27 in Brooke and 23 in Talek.[4] Figure 9 illustrates how, in comparison to 2009, these estimates represent a 35% increase in the number of distinct products available in Kericho, a 23% decrease in the products available in Brooke and a 44% increase in the products available in Talek. Additionally, in 2012, we recorded the available products at two supermarkets and a petrol station in Kericho which had not been included in the 2009 survey. To more accurately compare the 2009 and 2012 samples, the data from these three stores are not included in the Kericho sample and are reported separately with the label "Supermarkets". More distinct products (53 in total) were observed in these three stores than were observed in all of Brooke or Talek.[5]

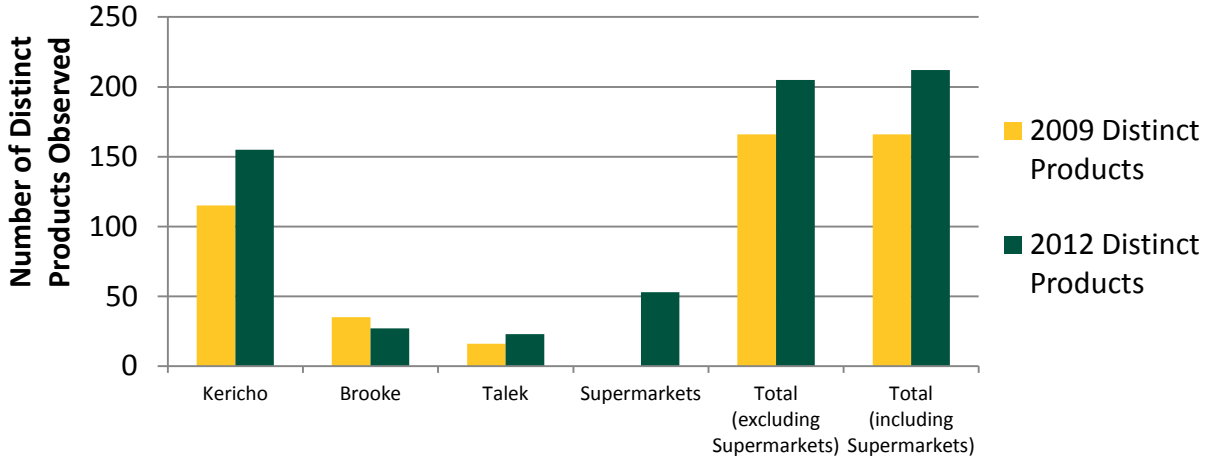

Figure 9. Comparison of the number of distinct products available in each town in 2009 and 2012. The "Supermarkets" category includes the two supermarkets and petrol station outside of the study boundary in Kericho.

In each town, many of the popular products were carried in multiple shops, leading to our observation of 311 total products in Kericho, 45 in Brooke, 51 in Talek and 63 in the supermarkets. These observations of total products available follow the same trend as for the distinct products, with a 30% increase in Kericho, a 17% decrease in Brooke and a 104% increase in Talek. As expected, the large town of Kericho offered the greatest number and widest variety of products, especially if the supermarkets are included in the sample. Interestingly, while the population of Talek is approximately 40% that of Brooke, the availability of both distinct and total products was similar between the two towns in 2012.

Figure 10 is a summary of physical design characteristics of all the observed products in each town 2012, while Figure 11 displays the previous results from 2009 for comparison. In each market, torches (flashlights) were still the dominant form factor, though in Kericho, the proportion of ambient lights increased substantially, while the availability of torches decreased proportionately. Figure 12 shows an example of a typical ambient light found in Kericho. In both Brooke and Talek, there were only two products that were not strictly torches. Surprisingly, the two supermarkets offered the greatest diversity of products in terms of form factor, with torches only comprising 51% of their available products. One of the supermarket shelves with a variety of products is displayed in Figure 13.

LEDs were the dominant light source for the products we observed. While some incandescent and fluorescent products were available in the Kericho shops and the supermarkets, 93% of the products available in the Kericho shops were LED, only one incandescent product was available in Brooke, and no

[4] In each town, we analyzed how many distinct products and total products were available. For example, if Acme Model X was sold in three shops in Kericho, it only represented one distinct product, but three total products. We did not collect total inventories of products, i.e., we did not distinguish between a shop which carried one Acme Model X and a shop that carried 20.
[5] Eight of these 53 distinct products found in the supermarkets and petrol station were also found in shops in the Kericho sample.

incandescent or fluorescent products were available in Talek. Again, the greatest variety of light sources were available at the supermarkets, where only 64% of their available products were LED and they offered several incandescent, fluorescent and LED / fluorescent combo products. One way to interpret the prevalence of incandescent products in supermarkets is that the supermarket chains may have long-standing "legacy" relationships and contracts with distributors who continue to offer the incumbent technology; other retail and wholesale operations may be more nimble and able to switch technology.

An important finding of this follow-up survey was the growing market presence of solar-charged lights. While most of the products in all the towns still used either dry cell batteries or rechargeable batteries with integrated grid charging systems, 13% of the products available in Kericho could be charged using solar power. This represents an increase from two solar-charged products in 2009 to 41 products in 2012, or 50 total products if the supermarket sample is included. Several of these products are shown in Figure 14 and Figure 15. Additionally, as shown in Figure 16, two solar products were found for retail sale in Talek, whereas no solar products were found in Talek in 2009. A more detailed discussion of these emerging solar lights is included later in this report.

As in 2009, the distribution of energy sources shows that the proportion of products with dry cell batteries increases in the more rural markets. Dry cell batteries constitute 40% of the available products in Kericho, 58% in Brooke, 78% in Talek, but only make up 27% of the available products at the supermarkets. Unsurprisingly, grid-charged products decrease as access to the grid becomes less common, and make up 47% of the available products in Kericho, 42% in Brooke, 18% in Talek and 59% in the supermarkets.

For people who lack free access to grid electricity, fee based battery charging services were available in each town we surveyed. The fee in grid-connected Kenyan towns (like Kericho and Brooke) is typically Ksh20/charge for products with small batteries (e.g., mobile phones, torches). Charging services were also available in Talek (an off-grid town) at shops with small solar electric systems. A detailed treatment of the economics of off-grid lighting is available in Radecsky et al. (2008).[6]

[6] Radecsky, K., P. Johnstone, A. Jacobson, and E. Mills "Solid-State Lighting on a Shoestring Budget: The Economics of Off-Grid Lighting for Small Businesses in Kenya," Lumina Project Technical Report #3, http://light.lbl.gov/pubs/tr/lumina-tr3.pdf

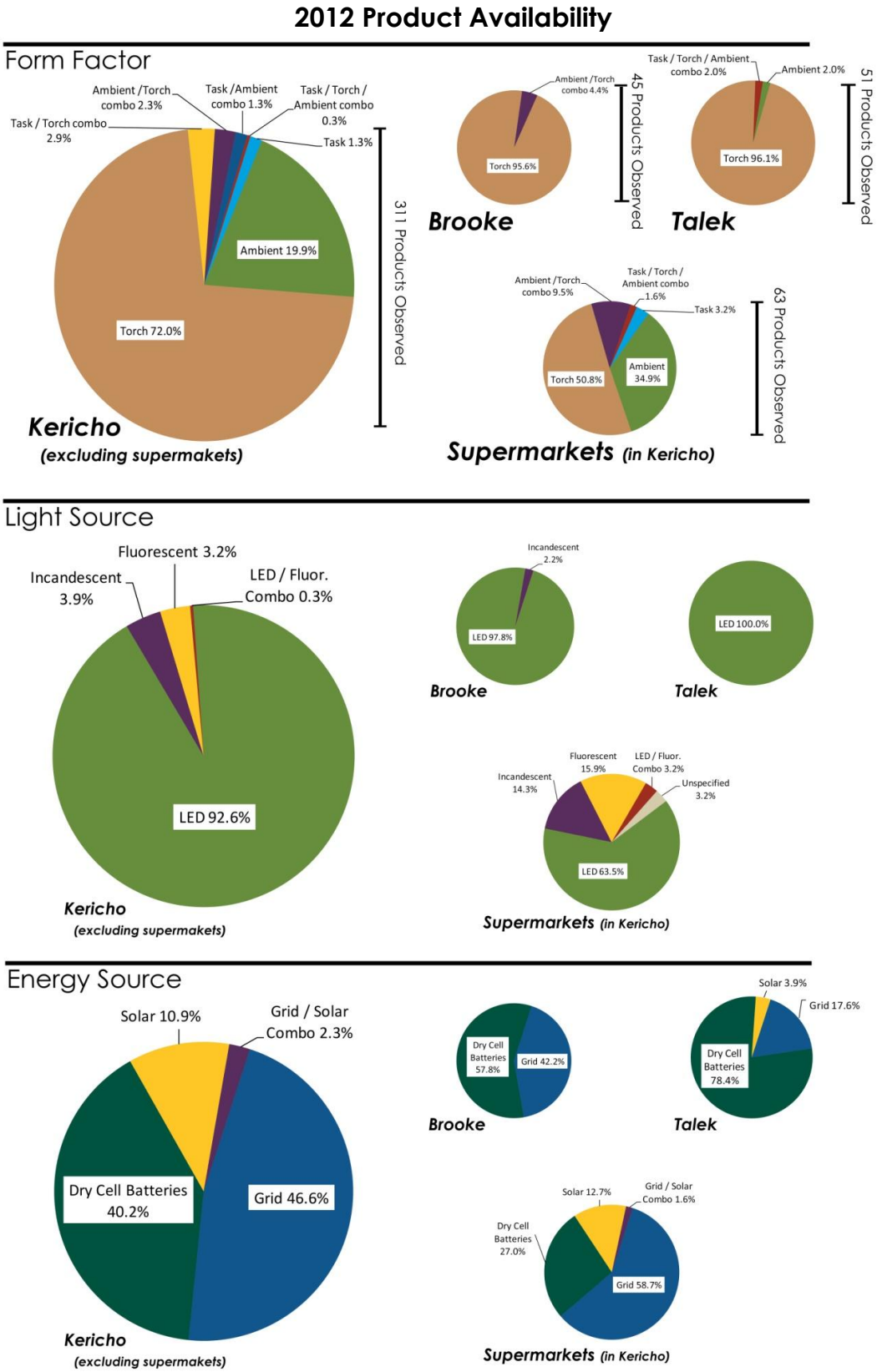

Figure 10: Characteristics of observed off-grid lighting products in 2012. All percentages represent portions of the total products available for sale in each given town.

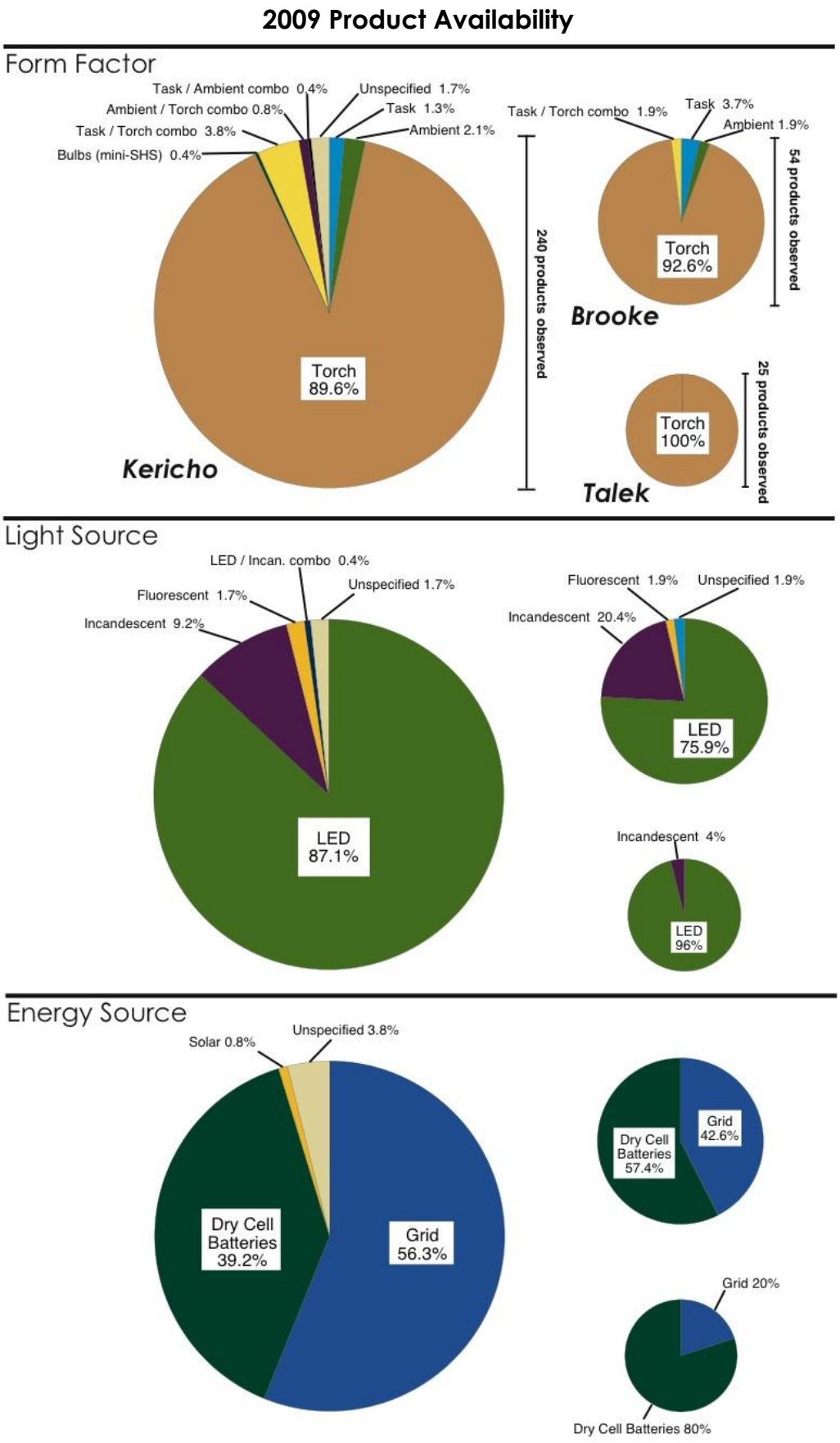

Figure 11: *Characteristics of observed off-grid lighting products in 2009. All percentages represent portions of the total products available for sale in each given town.*

Figure 12: An ambient / task light hybrid product. Large LED arrays such as these were common in Kericho and typically marketed as emergency lights.

Figure 13. A section of shelves at one of the supermarkets in Kericho. While torches are still common, the supermarket offered a wide variety of form factors, light sources and energy sources.

Figure 14: Several solar-charged lighting products available for sale outside a shop in Kericho. The solar products all used LEDs, but ranged in form factor and size.

Figure 15: One of the larger electronics shops in Kericho offered a wide selection of solar-charged lights. Pictured is Maina Mumbi conducting a survey with one of the sales staff.

Figure 16: A retailer in Talek offered two solar-charged lights in his shop.

3.2 Prices of Available Off-Grid Lighting Products

Low-cost LED torches continue to be the most widely available lighting products in each town and constitute approximately one half of the available products at the supermarkets. A statistical summary of the prices we observed in each town is presented in Table 1.

In Kericho and Talek, the mean price of products increased substantially between 2009 and 2012 due to the increased presence of more expensive solar products in 2012. The median price of non-solar products in each town is still at or below Ksh150, approximately US$1.80. As suggested in the 2009 report, this median price is an order of magnitude smaller than many of the emerging solar-charged products; the median price of solar products was found to be greater than Ksh3000 (>US$35) in each market.

The distribution of prices (Figure 17) shows that the products available in the shops are still concentrated below Ksh300; however, now approximately 30% of products in Kericho are priced above that level. As indicated by the difference in median prices, solar products are typically more expensive than products that do not offer solar charging. In Figure 17, solar products are highlighted in gold to display the distribution of prices. As in 2009, there does not seem to be an increase in price in the smaller towns for either solar or non-solar products, though the supermarkets do appear to offer a variety of higher-priced non-solar products that often exceed the price of the solar products.

Table 1: Statistical summary of off-grid lighting product prices in Kericho, Brooke, Talek and the Supermarkets.

		Mean Price (Ksh)	**Median Price** (Ksh)	**Std. Deviation of Price** (Ksh)
Kericho	**All Products 2012** (n=311)	846	180	1675
	All Products 2009 (n=239) [7]	162	130	184
	Non-solar Products 2012 (n=270)	326	150	505
	Solar Products 2012 (n=41)	4334	4400	2451
Brooke	**All Products 2012** (n=45)[8]	137	140	87
	All Products 2009 (n=54)	121	110	87
Talek	**All Products 2012** (n=51)	282	170	568
	All Products 2009 (n=25)	153	150	66
	Non-solar Products 2012 (n=49)	171	150	71
	Solar Products 2012 (n=2)	3000	3000	707
Super	**All Products 2012 (**n=63)	1422	673	1370
	Non-solar Products 2012 (n=54)	1180	520	1185
	Solar Products 2012 (n=9)	2847	3000	1582

[7] An outlier in the Kericho dataset was disregarded for this statistical analysis: a Ksh15,000 mini-solar home system.
[8] As no solar products were observed in Brooke, prices are not further divided into solar and non-solar categories.

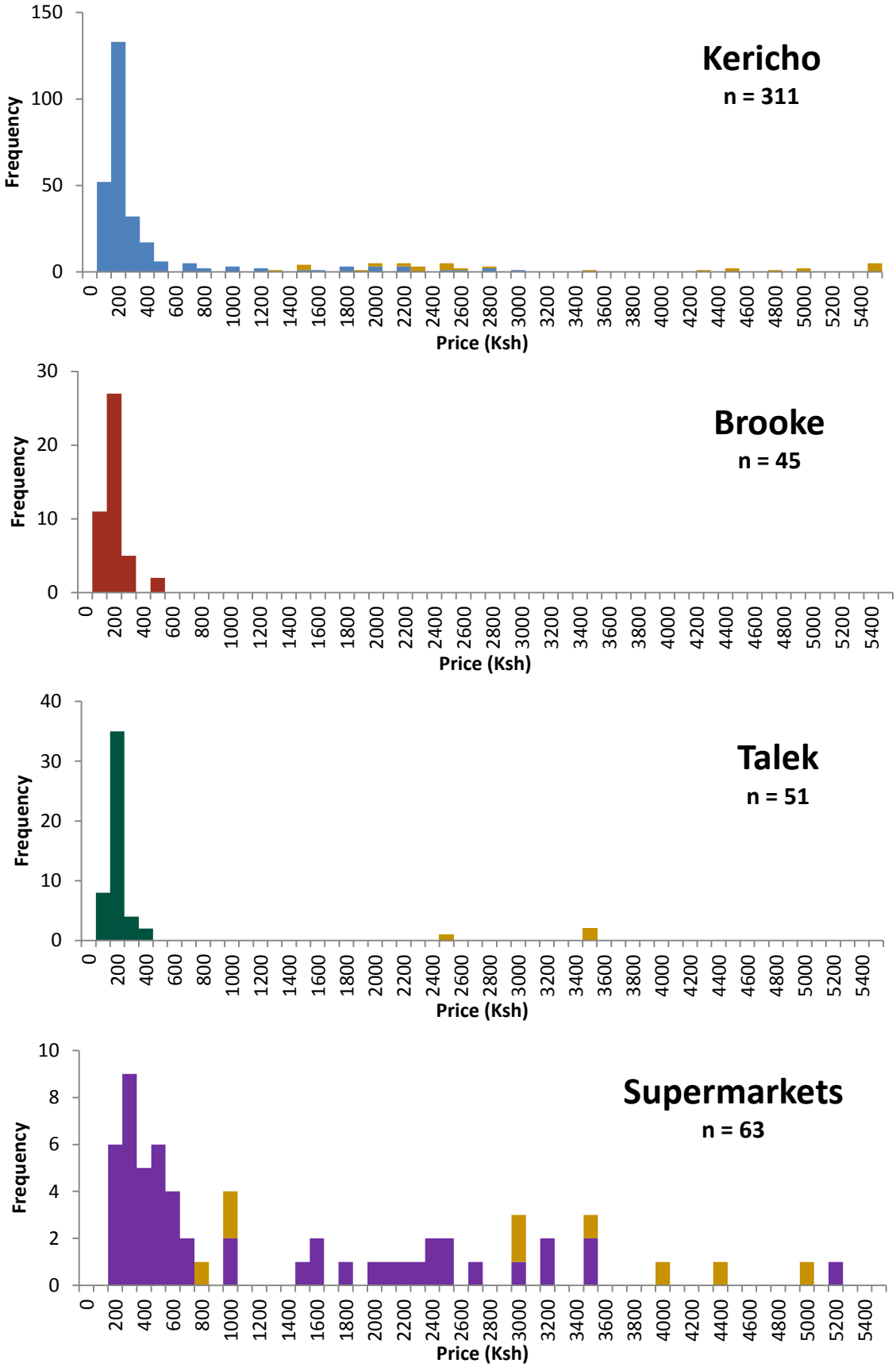

Figure 17: Histograms showing the distribution of product price in 2012. Solar products in Kericho, Talek and the supermarkets are highlighted in gold. Note the frequency is scaled differently for each market. In Kericho, outliers greater than Ksh 5,500 and having a maximum value of Ksh 11,500 are not shown here. These outliers comprise 10 solar products which constitute 25% of the available solar products observed in Kericho.

In 2009, the research team identified the six "most commonly available" products in Kericho which accounted for 29% of the available products in Kericho. In 2012, all of these products were still available in Kericho but were no longer as broadly popular; only the generic keychain LED torches were still commonly available. Vendors noted that a few of the products were no longer available from distributors, and the 2009 "most available" products now only make up 6% of the available products. Table 2 shows the availability and median price of each product in 2009 and 2012.

Many products on the market in 2012 are very similar to the previous "most available" products, but with a new brand and model number. This decline in sales and availability of individual brands and models and emergence of superficially different substitutes may serve as an indicator of market spoilage, suggesting that consumers do not have brand fidelity and that manufacturers may be "re-branding" their products to avoid customers recognizing poor performance products.[9]

The most commonly available products in Kericho in 2012 are presented in Table 3. As in 2009, all of the most common products are low-cost LED torches; some are grid-rechargeable and some require dry cell batteries. All of them have a median cost less than Ksh180. Small keychain LED torches were by far the most commonly available and most commonly sold products. Their high sales volume is due largely to their low cost (~Ksh30) and being sold in bulk, often in packs of 20 or 25 from wholesalers to general kiosks, where they are sold as disposable, fast moving goods. The next most commonly available product is a plastic torch with a single LED that requires 2 dry cell batteries: model FTJ991E1 (Figure 18). These products had pictures printed on the sides, sometimes of landscapes, but most often of the current US president, Barack Obama, and were referred to as "Obama torches". These, along with many of the common torches, were manufactured under several different brand names as listed in Table 3. As pictured in Figure 19, the LZ-7588 offers a small 3-LED task light on the handle of the grid-rechargeable torch. The LZ-7588 also illustrates a common change we observed in the low-cost torch market: some versions (with identical packaging and model numbers) use a single large LED instead of three to seven smaller LEDs. During the surveys, several vendors noted that customers prefer the new torches with the single LED because they are brighter. The AQIN AH3141 (Figure 20) is a grid-rechargeable torch with 5 small LEDs. The last three popular products, models 9772B (Figure 21), 9771B and FTJ2D1, are all LED torches that require dry cell batteries. Model 9772B and FTJ2D1 each require two D-cells, while model 9771B requires only one.

Table 2: Comparison of commonly available products in Kericho 2009 to 2012

Product	Incidence in Kericho (2009)	Incidence in Kericho (2012)	Incidence in All Towns (2012)	Kericho Median Price (Ksh) (2009)	Kericho Median Price (Ksh) (2012)	Total Sold in All Towns (2012)
Casibao CA199	19	1	2	130	120	5
Jinge JG6170	14	1	3	135	150	4
Keychain LED	12	13	25	20	30	1275
Lion Head LED	9	2	2	80	110	12
Diamond	8	3	3	110	150	16
Jinge JG6162	8	1	1	163	200	0

[9] The only brand of low-cost torch that was mentioned as being preferred by shopkeepers was the metal Tiger Head FT2DE2 torch (this is different from the plastic Tiger Head FTJ2DE1 which is cited as a common torch in 2012). Several shopkeepers in Talek suggested that Tiger Head torches were preferred because they were metal and could be dropped without breaking. The Tiger Head torch is a metal dry cell torch with LEDs. Though the metal Tiger Head was not in the top 6 most common in 2009 or 2012, it is one of the few torches that was commonly available in both years.

Table 3: Summary of Commonly Available Products in Kericho in 2012

Product Brand(s)	Product Model	Incidence in Kericho	Incidence in All Towns	Kericho Median Price (Ksh)	Total Sold in Kericho
Keychain LED	**--**	13	25	30	1275
Liger Head, Horse Brand, Horse Yu	**FTJ991E1**	11	13	150	158
LZ	**LZ7588**	9	10	180	137
AQIN	**AH3141**	8	11	150	97
San Feng, Xian Feng, Xiang Feng, Eagle Head	**9772B**	7	8	150	66
San Feng, Xian Feng, Xiang Feng,Wen Bang	**9771B**	7	7	150	52
Eagle Head, MJM Power, Tiger Haida, Tiger Head, Two Tiger	**FTJ2DE1**	6	7	100	75

Figure 18. The most popular product, the "Obama" torch, FTJ991E1.

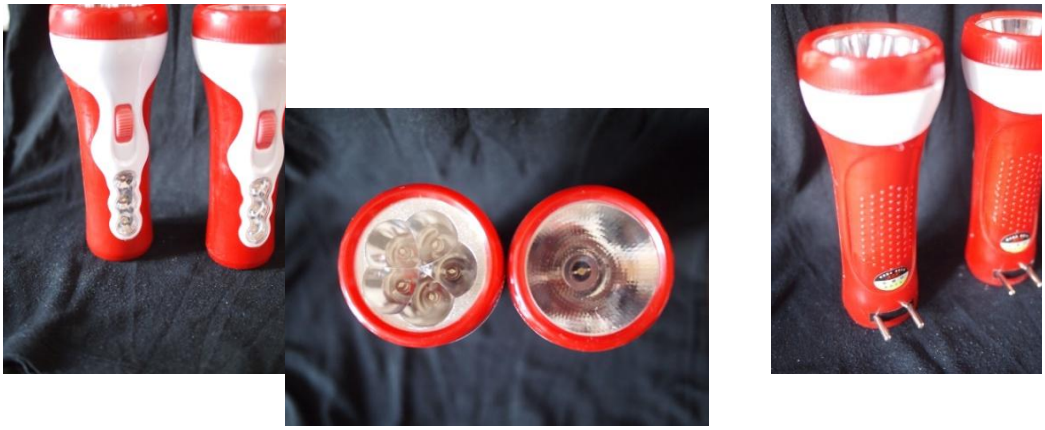

Figure 19: The LZ-7588 was found in two styles, one with five small LEDs and another with one large LED.

Figure 20: The AQIN AH3141, a common grid-rechargeable torch

Figure 21: A common dry cell LED torch, model 9772B, also came in a smaller version that required only one D-cell, model 9771B.

3.3 The Retailers

The general stores, street hawkers, supermarkets, electronics wholesalers, and other shops we surveyed are at the end of the supply chain for off-grid electric lighting products. We surveyed a total of 32 shops in Kericho, 14 in Brooke and 21 in Talek. In comparison to 2009, we found three fewer shops in Kericho, two fewer in Brooke and 14 new shops in Talek. As mentioned previously, we collected information about the diversity of products and pricing at two additional supermarkets and one petrol station in Kericho, but no surveys were conducted at these stores. As in 2009, the shops in Kericho generally carried a greater selection of products (9.7 products/shop average) compared to Brooke (3.2 products/shop) and Talek (2.4 products/shop). The two supermarkets offered some of the greatest selections of products, with 18 and 43 products/shop, while the Total petrol station carried only two products. Table 4 summarizes the key results of the short survey we administered to shopkeepers. Results from 2009 are included for reference in Table 5. The survey form is in Appendix 1. The highlights from Table 4 are:

- The proportion of male shopkeepers has increased since 2009 in all three towns. Talek is still the only town with a higher proportion of women than men working as shopkeepers.
- In Kericho there was a wide range of shop types that offer lighting products. Specialty electronics shops (34%) were the most common shop carrying off-grid lighting products, though there were more individual street hawkers selling lighting products than any other shop type.[10] Many general stores also carried products, while one shop that specialized in solar products carried an array of small off-grid solar lighting products. Many products were also available in Kericho at the two supermarkets and the petrol station, but since these were not officially surveyed (they were outside the bounds of the 2009 survey), results from these stores are not included here.
- In Brooke and Talek, general shops were the most common vendor of off-grid lighting products (79% and 81% respectively). Lighting products are not generally available in either town from hawkers or vendors with temporary displays, but each did have either a kiosk or market stall selling products.
- As in 2009, the shops that sell lighting products in each town are predominantly small operations, with a majority having 1-2 employees. Kericho also has several larger shops (i.e., > 3 employees). There is one larger shop in Brooke.
- Lighting products were available on a strictly retail basis in Talek, while there was a mix of retail and wholesale vendors in Kericho. There was one vendor in Brooke that did business on both a retail and wholesale basis. Only 59% of sellers in Kericho were strictly retail shops; the others did some or all of their business on a wholesale basis.
- In Kericho and Brooke, over 50% of the shops stated that they had offered LED and/or fluorescent off-grid lighting products for more than three years. In Talek, most shops had offered these products for over 1.5 years, reflecting the growing nature of the town with many new shops. In both Kericho and Talek, several shops had just started to sell products in the last three months, while in Brooke, all shops had sold these products for at least one year.
- In terms of the demographics of the customers of each shop, there were no clear trends in customer age, but very few shops stated that their main clientele were women; all but one shop stated that most of their customers were either men or an equal mix of men and women. Several retailers suggested that the most common uses for these products were for emergency purposes, studying, and taking animals out to graze, and the products were often purchased by visitors or tourists, night watchmen, nursing mothers, and school children.

[10] In Kericho we counted 16 total street hawkers in the study area, but were only able to survey ten. Many of these hawkers were part of larger collectives of hawkers who shared products.

Table 4: Shop Survey Summary Results 2012

Information	**Kericho** (n=32)	**Brooke** (n=14)	**Talek** (n=21)
Gender of Interviewee			
Male	88%	71%	43%
Female	13%	29%	57%
Shop Type			
Electrical and Electronics	34%	7%	0%
General Shop	28%	79%	81%
Super Market	0%	0%	0%
Hardware	0%	7%	5%
Solar Specialty Shop	3%	0%	0%
Kiosk	0%	0%	5%
Market Stall	0%	7%	0%
Blanket / Street Hawker[11]	34%	0%	0%
Other	0%	0%	10%
Number of Employees			
1-2	59%	86%	100%
3-5	28%	0%	0%
6-10	6%	7%	0%
11+	0%	0%	0%
Unspecified	6%	7%	0%
Sales Type			
Retail	59%	93%	100%
Wholesale	3%	0%	0%
Retail + Wholesale	38%	7%	0%
Length of time they have offered LED lighting products			
0-3 mo.	13%	0%	24%
3-6 mo.	3%	0%	14%
6 mo.-1 yr.	6%	36%	5%
1 - 1.5 yr.	0%	0%	0%
1.5 - 2 yr.	9%	0%	10%
2 - 3 yr.	16%	7%	10%
3 - 6 yr.	34%	36%	14%
6+ yr.	16%	21%	24%
Not yet[12]	3%	0%	0%
Demographics of Customers			
Mostly Men	25%	57%	52%
Mostly Women	3%	0%	0%
Men and Women Equally	59%	43%	48%
Mostly Under 40 yrs. old	22%	36%	5%
Mostly Over 40 yrs. old	19%	21%	5%
All Ages Equally	56%	43%	90%

[11] Ibid.
[12] Shop owner stated that they have products in stock, but have not yet made any sales.

Table 5: Shop survey summary results 2009

Information	**Kericho** (n=37)	**Brooke** (n=16)	**Talek** (n=7)
Gender of Interviewee			
Male	73%	63%	29%
Female	27%	31%	71%
Unspecified	*0%*	6%	*0%*
Shop Type			
Electrical and Electronics	41%	13%	14%
General Shop	27%	63%	86%
Super Market	3%	6%	*0%*
Hardware	3%	*0%*	*0%*
Solar Specialty Shop	*0%*	*0%*	*0%*
Kiosk	*0%*	*0%*	*0%*
Market Stall	*0%*	13%	*0%*
Blanket / Street Hawker	24%	*0%*	*0%*
Unspecified	3%	6%	*0%*
Number of Employees			
1-2	68%	88%	100%
3-5	22%	*0%*	*0%*
6-10	*0%*	6%	*0%*
11+	8%	*0%*	*0%*
Unspecified	3%	6%	*0%*
Sales Type			
Retail	58%	100%	86%
Wholesale	12%	*0%*	*0%*
Retail + Wholesale	27%	*0%*	*0%*
Unspecified	3%	*0%*	14%
Length of time they have offered LED or fluorescent lighting products			
3 mo.	14%	13%	14%
6 mo.	22%	*0%*	14%
1 yr.	22%	6%	29%
1.5 yr.	3%	6%	14%
2 yr.	22%	6%	14%
3 yr.	3%	6%	*0%*
3+ yr.	8%	*0%*	*0%*
Not yet	*0%*	6%	*0%*
Unspecified	6%	56%[13]	14%

[13] The reason so many Brooke shopkeepers did not answer this question in 2009 is unknown.

3.4 Physical Geography of Off-grid Lighting Shops

In the 2009 Baseline Report we found that basic geospatial analysis of the location of shops was helpful for understanding the market. The key findings from 2009, for reference, were:

- There were clusters of market activity in Kericho and Brooke that revolved around the main outlets. In Kericho, this was a wholesale mall; in Brooke it was the largest retail shop in town.
- The retail and wholesale vendors in Kericho and Talek tended to procure their products from outlets in Nairobi (with a small number procuring from other Kenyan cities or international locations). The majority of vendors in Brooke procured their products in Kericho, while others went to Nairobi or elsewhere.

The updated data from 2012 show how the market is changing (Figure 22). In Kericho and Brooke there are fewer outlets with less geographic dispersion, but they are collectively offering and selling a larger number of more diverse products than in 2009. Talek has far more outlets (21 vs. 7) in 2012 than in 2009, owing to the rapid growth in the town during that period.

In the maps in this section, each shop we surveyed is represented by a dot that is proportional in size (and color) to the number of products available at the shop. The maps were created with GPSVisualizer and Google Earth. In some cases, the precision of the GPS receiver (+/- $\geq$10m) combined with inaccuracy in satellite photos leads to dots being shifted away from the true shop location. However, they are approximately in the correct place relative to each other and the base maps.

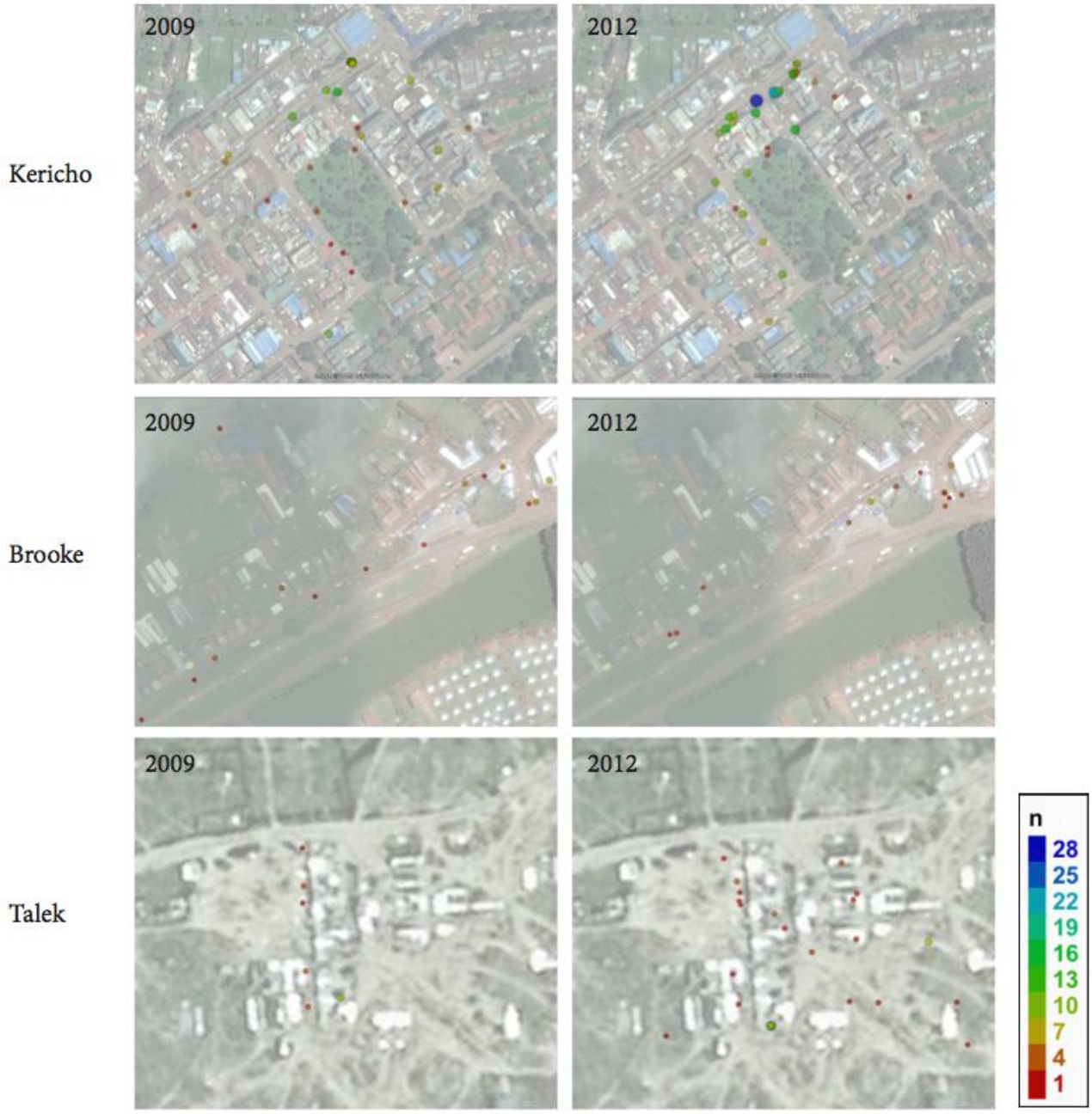

Figure 22: Maps of lighting product availability by shop in each town, in both 2009 and 2012. The size of the dots is proportional to the number of lighting products available in each shop (also indicated by the color scale). The aerial images for each town are all the most recently available images on Google Earth as of January 2013 i.e., historical aerial images were not used for 2009 maps.

3.5 Product Procurement

Each shop keeper provided us with information as to where they procured their products, giving insight into the "step above" them in the supply chain. Most products go through Nairobi, but overall retailers listed seven different towns as sources for their products. Each of these towns, with the exception of Dubai, UAE, is included on the map displayed in Figure 1.

Thirty-one of 32 shopkeepers in Kericho shared information about where they procure their stock (Figure 23). As in 2009, most of the shops (69%) get stock from Nairobi at least some of the time. Only one shop stated that they go directly to Dubai to procure the latest products, skipping links in the typical supply chain.

Many of the street hawkers and one shopkeeper procure their stock locally in Kericho from the local wholesalers. Two other shopkeepers purchased from dealers in other cities (Nakuru and Mombasa). In Kericho, 53% of vendors go to purchase their stock themselves. An additional 31% have a regular delivery, while 16% use both mechanisms.

All but two of the shopkeepers in Brooke procure their products in nearby Kericho (Figure 23). One business stated that they procured their products from Nakuru, while another did not provide a response. Eleven of the fourteen vendors who told us how they procure their products go to their source to pick them up, while three have their products delivered from either Kericho or Nakuru.

The shopkeepers in Talek procure their stock mainly from markets in Nairobi and Narok, the closest large town (Figure 23). One shopkeeper reported procuring stock from Kisii, and several reported uncertainty about the source of their goods as they buy from traveling hawkers. Most of the shopkeepers (57%) go to buy their products from the distributors, while 33% of shopkeepers have products delivered and 10% report using both strategies.

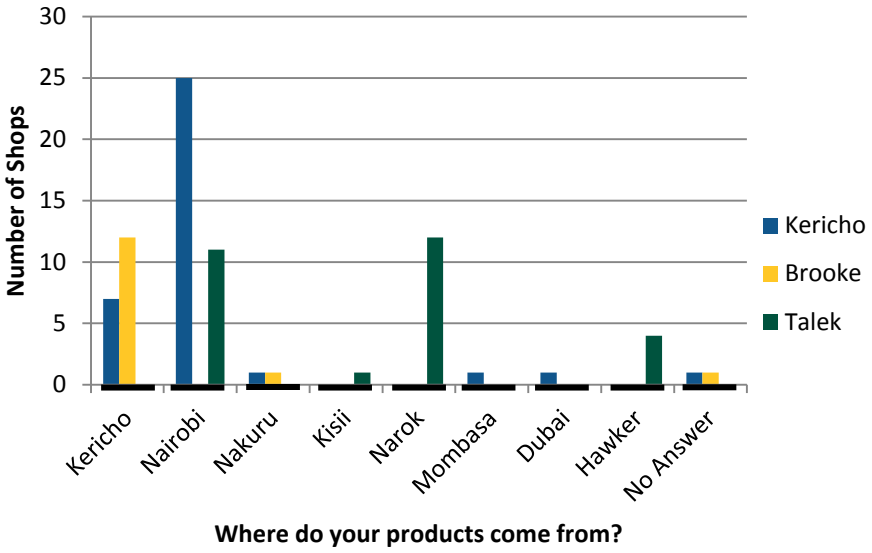

Figure 23: The distribution of retail suppliers for shops in Kericho, Brooke and Talek.

3.6 Market Size

Based on the weekly sales figures provided by each shop for each product, we were able to estimate the market volume of lighting products in each town (Table 6). The estimates are surprisingly high—about one or two products per person annually.

Based on our estimates, the yearly sales volume in Kericho has grown from approximately 40,000 units to 175,000 units between 2009 and 2012 (note that two different methods were used to estimate in 2009 and 2012, which leads to uncertainty in the comparison).[14] Given the population estimate of 102,000 people in Kericho, the estimated sales volume in 2012 corresponds to approximately 1.7 units per person per year. While many of the products that are purchased in Kericho likely leave the city, it also is notable that the low quality (and cost) of many products we observed leads them to be disposable commodities rather than

[14] This comparison is difficult to make as the data in 2009 and 2012 were collected in different manners. In 2009, shopkeepers were asked to estimate their total monthly sales volume and at times reported the monthly sales volume for their best selling product, while at other times reported the monthly sales volume for all products. Additionally, differences may arise from being asked to estimate on a weekly basis, rather than a monthly basis. Despite these discrepancies, the difference between the two sales volumes is large enough to suggest that the market has grown.

durable goods. Some residents, such as night watchmen, may purchase new products every month.[15] The sales volumes in Brooke and Talek also appeared to grow substantially between 2009 and 2012.

If one extrapolates to the wider off-grid lighting market in Sub-Saharan Africa, assuming sales on the order of 0.2 to 1.0 products sold per year per person without access to electricity (approximately 600 million people), the annual sales of electric off-grid lighting appears to be on the order of 100 to 600 million units, most of which are low-cost LED torches. At a typical retail cost of US$ 2, this represents approximately a 0.2 – 1 billion dollar annual market – up to 10% of the value of the market for kerosene[16] before one even considers the additional costs for disposable batteries and recharging services. While we do not have enough evidence to make an estimate with any degree of certainty, anecdotal evidence indicates that low-cost LED torches are widely available on the continent. Even the low-end estimate of $US 100 million annual sales is striking.[17]

Table 6: Estimated monthly sales volume of off-grid electric lighting products in the towns we surveyed. Note that the estimation methods in 2009 and 2012 are different.

	Estimation method	**Kericho**	**Brooke**	**Talek**
Monthly Sales 2012 (units)	Product by product sales estimates	14,600	1,050	1,178
Monthly Sales 2009 (units)	Total sales estimates	3,100	210	90
Monthly Sales 2012 (Ksh, US$)[18]	Product level pricing and sales	Ksh 2,313,000 US$ 27,500	Ksh 120,000 US$ 1,500	Ksh 252,700 US$ 3,000
Monthly Sales 2009 (Ksh, US$)[19]	Median price and total sales estimates	Ksh 403,000 US$ 5,400	Ksh 23,200 US$ 310	Ksh 13,500 US$ 180

Our method for making the estimates was to ask shopkeepers to estimate how many of each product they had sold in the past week, but we did not requested to look at their books for accurate numbers. Therefore, these values should be taken as estimates with some degree of uncertainty. As we hoped to extrapolate the weekly sales estimate to monthly or yearly sales, we asked each shopkeeper whether the week had been a low, normal or high week for sales. The majority of shops in all three towns reported that it had been a low week for sales and only two shops in Kericho and one shop in Brooke reported that it had been a high week. This suggests that the weekly estimates are potentially lower than average.

Three other sources of uncertainty affect these estimates of market volume. One is the fact that we only interviewed 10 of the approximately 16 street hawkers in Kericho, thereby potentially underestimating the total market size. If it were assumed that the hawkers that were not surveyed had similar sales volumes to those who were, the total monthly sales in Kericho would increase by approximately 3000 products or Ksh 489,000 (US$5,800). The second source arises from the fact that many of the hawkers in Kericho and many of the shops in Brooke reported purchasing their products in Kericho, presumably at the local wholesalers. Because we interviewed the local wholesalers as well as these retailers, we may be double-counting sales of a single product. If all shops which sourced their products from Kericho are excluded from this analysis, the total monthly sales would decrease by approximately 4000 products or Ksh 619,000

[15] See Tracy, J., A. Jacobson, and E. Mills (2009), "Quality and Performance of LED Flashlights in Kenya: Common End User Preferences and Complaints." Lumina Project Research Note #4, http://light.lbl.gov/pubs/rn/lumina-rn4-torches.pdf

[16] The estimate for total kerosene spending is $10 billion and is based on Dalberg (2010), "Solar Lighting for the Base of the Pyramid" Lighting Africa Program Report.

17 The lower estimate for sales may be more appropriate than the upper estimate given that Kericho is a relatively wealthy region of Kenya, a relatively wealthy nation in the context of Sub-Saharan Africa).

[18] Based on the price and weekly sales volume of each product, the assumption of 4.3 weeks/month and an exchange rate of Ksh84/US$

[19] Based on the median price of products in each market, as reported in Table 1, and an exchange rate of Ksh 75/US$

(US$7,300). The third factor is that no sales figures were provided by the supermarkets, which may represent a considerable portion of sales in Kericho. As each of these sources of uncertainty affects the aggregate estimate in contradictory ways (i.e. the first and third would suggest that we have underestimated total sales, while the second suggests that we overestimated), the total sales estimate is left unadjusted, but with an acknowledgement of the uncertainty.

3.7 Use of Credit and Mobile Banking in the Retail Sector

The 2012 survey found that retailers are using new approaches and technology to make transactions with their distributors and customers. The use of mobile banking services and an increased level of credit access are notable trends that should continue to be monitored, since both hold promise for enabling the market for good-quality off-grid lighting.

In 2009 we found very low levels of credit access for customers in the shops we surveyed; in fact only one shop out of the 60 that were surveyed that year offered any type of credit to their customers. The results in 2012 indicated increased use of consumer credit. We found that 12 out of 67 shops offer credit to their customers. In many cases, shopkeepers explained they only offered credit to "good customers." The implication is that personal relationships and trust are the basis for credit, and not formal credit assessment bureaus, collateral, or other means of establishing credit worthiness. Credit was more widely offered in Kericho (25% of shops) and Brooke (21% of shops) than in Talek.

In addition, we asked shopkeepers in 2012 about whether they accessed credit themselves to purchase goods and found relatively high rates of access in Kericho (about 40%, mostly through banks), but low access in Brooke and Talek (less than 10%, mostly through SACCOs and individual loans). There was no apparent correlation between shops that accessed credit themselves and those that offered credit to their customers.

"M-Pesa"—a mobile banking and cash transfer service offered by Safaricom[20]—and other services like it have changed the way many in Kenya do business, including the shopkeepers we surveyed. About half the shopkeepers use M-Pesa, or another mobile banking system, either to sell products (48%) or to buy products from their distributors (55%). There was strong correlation between users; shopkeepers who use mobile banking for one or the other tend to use it for both selling and buying products (40% of all shops use the service for both—a significant fraction of those who use it for one or another). In other words, shopkeepers tended to either adopt it fully or not at all into their business transactions.

While mobile banking/money was adopted relatively widely in Kericho (66%) and Talek (52%), only 29% of shopkeepers in Brooke use the technology. It is not clear, based on our survey, what the reason for this disparity is. However, it may be that the shopkeepers and their customers in Brooke are less well off, or because most of the shops in Brooke source their products from Kericho rather than farther away there is less need for the service on the procurement side of their business.

There is anecdotal evidence that M-Pesa and other similar services can facilitate informal access to short-term credit. One shopkeeper explained that on his trips to Nairobi to purchase products, he sometimes would run out of cash. Instead of going home with fewer products to sell, the distributors (with whom he has a relationship built on trust and repeat business) would allow him to take extra product with the promise that he would repay them via M-Pesa once he is back in Kericho. By eliminating the need for in-person transactions, mobile payments help reduce barriers to trade. Instead of needing to wait for the vendor's return trip to Nairobi for payment, distributors are able to trust that there is a fast, secure way to be repaid for goods that are taken on short term loan.

Looking forward, the rapid increase in the use of mobile banking and mobile cash could provide new opportunities for "pico-finance," which should further enable markets for off-grid lighting.

[20] There are multiple, competing services offered by other mobile phone providers as well. We lump all of those in this analysis and did not distinguish between the services.

3.8 Product Quality Issues

A repeated set of questions from the 2009 survey asked vendors what the "main problems" were that they observed with the products. Though these questions were not limited to concerns about "non-solar products", most of the vendors that reported problems referred to issues that they had experienced with the low-cost torches that dominate the market and are either grid-rechargeable or powered with dry cell batteries. Of the 67 shops we surveyed, 57 (85%) of them reported problems with product quality. LED failure and durability in general were cited as a problem 27 times each (40% each). Some vendors stated that LEDs could fail as quickly as after one month of use. Failures related to the rechargeable batteries were cited 21 times (31%). Vendors also mentioned that the charging system on rechargeable products and switches on all types of products commonly fail. Vendors state that many products are fragile, as both the external casing and internal wiring often break when dropped. Vendors in Talek, where dry cell products were particularly common, suggested that metal torches, such as the Tiger Head brand, were preferred because the battery cap did not fail as quickly as the caps on the plastic torches and the torch did not break as easily when dropped. A final failure mode that many vendors noted was the plugs on rechargeable torches either breaking or corroding (Figure 24). However, just as in 2009, the perception of low quality was not universal. Twelve vendors did not report any problems with their products; some thought they were of good quality while others simply said they had not yet had any customer complaints.

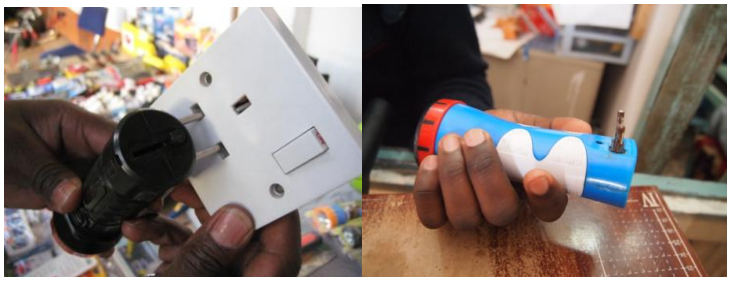

Figure 24: Failure modes for plugs on rechargeable torches. Vendors suggested that plugs often break, at times due to weak connections or rust/corrosion, but also due to user error, as users will often try to fit the round plugs into the rectangular sockets that are common throughout Kenya.

We also asked vendors what they thought their customers' priorities were when purchasing products. This question elicited a variety of responses, many of which alluded to product quality. In particular, vendors suggested that customers cared about price, brightness, portability, how long the battery lasts (run time), and durability. Several vendors indicated that customers consider the operating costs in their purchasing decisions. One vendor said that, "Rechargeable LED lights are favorable because the rechargeable torch costs the same as a D-cell torch plus the initial batteries. The ongoing costs are lower as you don't have to replace the batteries. Also, the lids on the D-cell torches fail after a short time." Another vendor suggested that even consumers purchasing dry cell torches consider the operating costs and often prefer to purchase models that only require one D-cell instead of two. Though many vendors stated that rechargeable torches were preferable due to their low on-going costs, several vendors stated that their customers requested dry cell torches because they "complain about the high failure rate with rechargeable torches".

This final statement supports the idea that many consumers perceive quality problems in the market, especially in relation to low-cost rechargeable LED torches. This finding suggests that substantial and continued efforts are needed to distinguish the emerging higher quality LED products from these low-cost torches to encourage consumers to risk the relatively high initial cost of solar-charged LED products.

3.9 The Emergence of Solar Lighting Products

When describing consumers' purchasing priorities, several vendors noted the value of solar lighting products, stating that:

"Products can be used when electricity isn't available"

"People without grid power like solar lights"

"These quality solar lights cost the same as buying a lamp and batteries over time, but last longer and can be charged outside."

A vendor of multiple high-quality solar products noted that the solar lights have additional benefits that people seek out, such as charging phones, powering radios, and providing multiple light points. He suggested that a large driver for consumers of solar products was economics: "in comparison to kerosene, which is at a higher cost than ever, purchasing these lamps makes economic sense".

In Kericho, seven of the 32 shops surveyed sold solar-charged products that had passed or are currently undergoing testing through Lighting Africa.[21] No similar products were available in Brooke, but two shops in Talek carried products associated with Lighting Africa. In total, 14 different quality-assured solar products were available in the three towns. In addition to the Lighting Africa quality-assured products, 16 distinct solar-charged products that are not yet associated with Lighting Africa were available in shops in Kericho and Talek. This represents a substantial improvement in availability of quality assured solar lighting from the previous survey in 2009; at that time no quality-assured products were available and only two solar-charged products were found.

Not only are solar products more readily available in these markets, but vendors also report that consumers are requesting and purchasing these products. In Kericho, 41 total solar-charged products were observed in shops and vendors reported selling 45 products in the past week. Though this sales rate may appear low, because of their higher price, solar sales make up a significant portion of the market (Figure 25). Based on the vendors' sales estimates and quoted prices, weekly sales of solar products account for Ksh 165,200 (US$1970) of sales in Kericho, which is almost half of the weekly sales of non-solar products totaling Ksh 372,800 (US$4440). A similar situation was seen in Talek, where the sale of six solar products in one week accounted for Ksh 15,000 (US$180), as compared to the 268 non-solar products sold in the past week, which totaled Ksh 43,800 (US$521). Despite these gains in the markets of Kericho and Talek, no solar products were available in Brooke, suggesting that consumers are likely traveling to larger neighboring towns when buying a higher cost product.

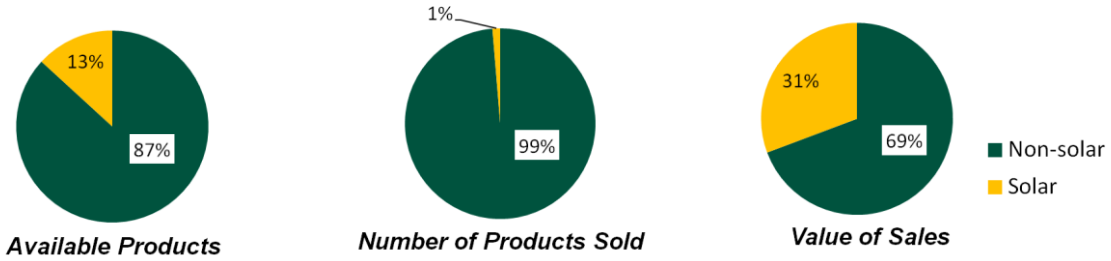

Figure 25. Presence of solar products in the Kericho market. Each graph presents the percentage of solar products in terms of total available products (n=311 products observed), estimated number of products sold (n=3440 products sold in 1 week) and the value of these sales (n=Ksh538,000).

On average, Lighting Africa quality-assured products were priced slightly higher than products that were not associated with Lighting Africa. The average price of quality-assured products was Ksh 4600 (US$55), while the average price of other solar products was Ksh 3700 (US$44). Despite these higher prices, more quality-assured products than non-quality assured solar products were observed, and sales rates of quality-assured products were nearly identical to the other solar products. We observed 27 quality-assured products in Kericho and Talek, and vendors quoted sales of 32 units in the prior week. We also observed 16 other (non-quality assured) solar products, and vendors quoted sales of 19 units of these products in the past week. Based on these estimates, quality-assured products accounted for sales of Ksh 101,400 (US$1,200), while the non-quality assured solar products accounted for Ksh 78,800 (US$938).

Vendors of these solar products acknowledged differences in quality between many of the quality-assured products and other solar products. A retailer that was very familiar with the Lighting Africa program stated

[21] In addition to these seven retail shops, Lighting Africa associated products were found at the supermarkets and the petrol station in Kericho. These stores were not surveyed because they were not included in the 2009 study.

that the quality-assured products were generally better than others and that their shop would routinely check the Lighting Africa website before stocking a new product. One vendor stated that previously their shop sold two non-quality-assured solar products, both of which failed, and the company would not honor their guarantee. Another vendor noted that the only non-quality-assured solar product they sell has a very short battery life and fails quickly. Though retailers expressed that the quality-assured products were of better quality and customers registered few complaints, the retailers did note problems with a few of these products, such as failed fuses and batteries, but suggested that most of these issues were addressed with the release of newer models.

3.10 A Call for Marketing and After-Sales Support

After the initial market presence follow-up survey, the Lighting Africa team returned to all of the shops that offered Lighting Africa associated products to collect information about any additional support they would need to sell more of these products. The areas of support most commonly requested by retailers were:

- Help with advertising,
- Access to products, spares and samples, and
- Assistance through technical trainings

Retailers suggested that, along with other advertising support, additional road shows would increase interest. One retailer remembered the original *Songa Mbele na Solar* road show in Kericho (sponsored and organized by Lighting Africa) and said it initiated customer interest in products; another retailer in Talek suggested that road shows in small towns on a market day would boost business.

A pressing need expressed by many of the retailers was for manufacturers to provide spare parts for products. Many customers are concerned about the availability of spare parts, and some retailers would like to be able to offer repair services for products that are outside of the manufacturer's warranty. One retailer mentioned that customers often prefer products that have easily available spares, such as common fuses and batteries that are found on the Kenyan market. Further, one retailer expressed that the manufacturer's repair service took over one month, which led to customer service complaints; one solution to this would be for these products to be serviced locally by trained technicians with readily available spare parts. This desire for faster, local service led many retailers to be interested in technical training for their repair technicians. Retailers also expressed interest in training for their sales staff to enable the people at the end of the supply chain to better market the products and provide more informed service to the customers. The Lighting Africa program has recognized this need for after-sales support of the solar lighting industry. The Lighting Africa team has started to conduct technical trainings for technicians throughout Africa and plan to focus on other mechanisms for after-sales support in the coming year.

4 Conclusions

In June 2012 a Lighting Africa team conducted a follow-up market presence study for off-grid electric lighting products in the towns of Kericho, Brooke, and Talek for comparison to the baseline study of these same towns in 2009. Our research team administered a survey to 68 shopkeepers located inside a distinct geographic boundary in each town and collected information on available products at two supermarkets and a petrol station outside of the study boundary in Kericho.

In Kericho we identified 32 shops, offering 155 distinct products. The median price for all products was Ksh 180, while the median price of non-solar products was Ksh 150. The diversity of products in terms of form factor and energy source has increased since 2009 in Kericho; in the 2012 survey, only 72% of products were torches (compared to 90% in 2009). More options were available for room lighting and solar charging in 2012; 23% were ambient lights (compared with 3% in 2009) and 11% of products included solar charging (compared to 0.8% in 2009). LEDs were even more dominant, and were the primary light source in 93% of products (compared to 87% in 2009).

In Brooke, we identified 14 shops offering 45 total products with a median price of Ksh 140. In Talek, we identified 21 shops, offering 51 total products with a median price of Ksh 170 and a median price of non-solar products of Ksh 150. The products in Brooke and Talek were less diverse than those in Kericho, offering only two non-torch products in each town and only two solar products in Talek. Nearly all products used LEDs; for example, only one product in Brooke used an incandescent bulb. In the off-grid town of Talek the majority (78%) of available products used dry cell batteries, but we witnessed a growing interest in solar products.

Our key findings about these markets are:

- **LEDs continue to dominate the market** and are found in products ranging from low-cost electric torches (also known as flashlights) to high quality mini-solar home systems. Just as in 2009, most of the products available in 2012 are low-cost torches with LED light sources; very few have incandescent bulbs. In all three towns, only 3% of distinct products were available with incandescent bulbs and these products made up less than 1% of estimated weekly sales, which represents a slight increase in the presence of LED products since 2009. Both the 2012 and 2009 studies confirm the dramatic shift in the market for torches away from the incumbent incandescent technology, which was dominant for decades.
- **The market for electric off-grid lighting products has grown**. In Kericho alone, sales of electric off-grid products have increased from approximately 37,000 units per year in 2009 to over 175,000 units per year in 2012 with growth expected to continue. The retail market also exhibits a degree of turnover with respect to the outlets offering lights. While the majority of shops have sold LED products for over three years, many shops have just started to offer lighting products in the last three months and others that offered products in 2009 no longer sell them.
- **Widespread quality problems are evident for low-cost rechargeable torches**. While many vendors state that customers prefer the convenience of rechargeable torches, others note that some customers are reverting to dry cell torches after repeated experiences with rechargeable torch product failures. Additionally, we observed that while the character of the products available in the market is very similar in 2012 compared to 2009, nearly all the brand names have shifted. These transitory brand names suggest that manufacturers may be reacting to market spoilage by attempting to prevent customers from recognizing products that have previously performed poorly.
- **Though many of the low-cost torches appear to be similar to previous models, a few new developments were observed.** Most notably, the design of many of the torches has been changed. Previously many torches had several small LEDs, but now many have a single large LED. Some vendors suggest that customers prefer this style of LED as it offers brighter light. This reflects broader trends in the LED market towards large packages (instead of arrays of 5 mm LEDs). The single LEDs used in the low-cost torches are not, however, surface mounted devices like those used in many good-quality LED lighting products that are currently available.
- **Solar-charged off-grid lighting products have widely increased in availability, both in Kericho and in the off-grid town of Talek**. We estimate that solar charged products now have a market share of approximately 30% in Kericho and 26% in Talek (in terms of the monetary value of sales). In the 2009 study, only 2 solar-charged products were found.
- **Quality-assured solar products are now prominently available on the market**. In Kericho and Talek, we observed 27 Lighting Global quality-assured solar-charged products in nine different shops. This represents a substantial improvement in availability of quality-assured solar lighting from the previous survey in 2009; at that time no quality-assured products were available.
- **Though the increased availability of quality-assured solar products is promising, solar products with low or uncertain levels of quality are still available on the market**. We found an additional 16 solar-charged products that had either not been tested or had not passed Lighting Global tests. Just as the low-cost rechargeable torches pose a threat of market spoilage for LED lights in general, without continued monitoring and consumer education, lower-quality solar products may cause customers to lose faith in emerging solar-LED technology.
- **Vendors of quality-assured solar products identified several areas requiring market support for the emerging solar products.** These needs included advertising support; improved access to products, spare parts, and samples; and the provision of technical training for repair technicians and sales staff.

Appendix 1: Market Presence Survey UPDATE Survey Questionnaire

Lighting Africa 2012 Market Presence Survey UPDATE

Surveyor Names_____

Date		**Town**	
Shop Name			
Location			
GPS Point #		**Box #**	
Phone #			
Shop Type	Electrical/ Electronics [1] GenShop [2] Supermarket [3] Hardware [4] Solar [5]		
	Kiosk [6] MarketStall [7] Table [8] Hawker [9] OTHER [10]		
# Employees	**1-2** [1] **3-5** [2] **6-10** [3] **11+** [4]		

Interviewee

Name	
Gen	***M*** [1] ***F*** [2]
Position	***Owner*** [1] ***Worker*** [2] ***Other*** [3]

*Notes*_____

_____

_____

_____

1.1 When did the shop **first** start selling LED or fluorescent off-grid lighting products?

☐ 3 months ago [1] ☐ 6 months ago [2] ☐ 1 year ago [3]

☐ 1.5 years ago [4] ☐ 2 years ago [5] ☐ 3 years ago [6]

☐ 3- 6 years ago [7] ☐ 6+ years ago[8] ☐ Do not sell yet [9]

1.2 Is this a normal week for sales?

☐ Low [1] ☐ Normal [2] ☐ High [3]

1.3 Why do you think people buy some products over others? What are their priorities?

1.4 What are the **main problems** that you or your customers have experienced with the lighting products that you sell? (Mark all that apply)

☐ LEDs fail ☐ Battery failure ☐ Breakage from dropping

Other Problems experienced:_____

1.5 Do you mainly sell products on a **retail** basis or a **wholesale** basis?

☐ Retail [1] ☐ Wholesale [2] ☐ Both [3]

1.6 Who are the **customers** that buy the off-grid lighting products?

a) ☐ Mostly Men [1] ☐ Mostly Women [2] ☐ Both Equally [3]

b) ☐ Under 40 years [1] ☐ Over 40 years [2] ☐ All ages evenly [3]

1.7 Where is the main source of **your products**? _____

1.7.1 **How** do you get them?

☐ Go to buy [1] ☐ Products are delivered [2] ☐ Both [3]

1.8 Does your shop offer any **credit** to customers or **guarantees** on products?

☐Credit Offered [1] ☐Guarantee Offered [2] ☐Both Offered [3] ☐None Offered [4]

1.9 Do you access **credit** to run your business? ☐ Yes [1] ☐ No [0]

1.9.1 **If so**, **where** does it come from? (Mark all that apply) ☐ NA

☐ Bank ☐ Distributor ☐ SACCO ☐ Chama
☐ Other_____

1.10 Do you or your customers use **MPesa** (or other mobile cash services) to buy lighting products? (Mark all that apply)

☐ Customers can buy products
☐ Pay a distributor / buy wholesale products
☐ My business doesn't use it
☐ Other _____

Lighting Africa 2012 Market Presence Survey Datasheet UPDATE Shop Name_____ Surveyor Initials_____

*For **KeyChain LED**: If being sold, check for KEBS, indicate price or make an **X** for unknown price. Record how many sold in past 7 days.*
*For **Other Lighting Products**: Fill each line completely.*

	# of Dry Cells	Form Factor				Source			Energy				KEBS	Price	About how many did you sell in the past 7 days?						
Code for data entry→															[1]	[2]	[3]	[4]	[5]	[6]	[7]
Product Brand / Model (and features)	# of Dry Cells	Task	Ambient	Torch	Other	LED	Incan	Fluor	Grid	Dry Cell	Solar	Dynamo	KEBS?	Price (Ksh)	0	1-5	6-10	11-20	21-30	31-40	40+
Keychain LED																					

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