



## First Steps

How Early Adopters Climb the Solar Energy Ladder

WHITE PAPER

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## About FINCA International

FINCA International was founded in 1984 on a radical notion: giving small loans to the poor has the power to transform entire communities in a sustainable way. After impacting tens of millions of lives with responsible financial services, we are widening our focus to catalyze further economic growth and alleviate poverty in underserved markets around the world. We remain boldly committed to market-based solutions, and are supporting the rise of social enterprises delivering basic service and financial innovation to help low-income families and communities achieve a better standard of living. For more information, visit [www.FINCA.org](http://www.FINCA.org) or follow us on Twitter [@FINCA](https://twitter.com/FINCA).

## About BrightLife

BrightLife, a social enterprise by FINCA International in Uganda, provides last-mile distribution and end-user financing for basic service products, including solar home systems, improved cookstoves and productive use assets. These life-enhancing products—made affordable to low-income customers through pay-as-you-go financing—help create healthier and safer homes, increase productivity, reduce household expenses, and provide additional income-generating opportunities. Through BrightLife, FINCA International pairs access to finance with access to energy to create pathways to financial inclusion for the unbanked.

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[finca.org/insights/how-early-adopters-climb-the-solar-energy-ladder/](https://finca.org/insights/how-early-adopters-climb-the-solar-energy-ladder/)

## Summary

### Objective

Our research looks at how and why a specific segment of early adopters in Uganda used entry-level solar energy products—a 3 Wp solar portable lantern (SPL) and a 6 Wp mini solar home system (SHS)—to make their initial steps up the energy ladder.<sup>1</sup> These first steps are important because consumers must overcome significant barriers on the path to adoption, including cost, lack of familiarity and the pull of old habits. Positive initial experiences can build confidence and nurture the demand for future purchases, while broken equipment and unfulfilled expectations can just as easily prejudice them against an entire class of products.

Understanding the experiences and motivations of early adopters opens a window into this critical moment in the market's inception and can inform further efforts to build demand for solar as well as other emerging products that address basic needs for the world's poor. It is also central for understanding the social impact of these products, because turning *potential benefits* into *real-life improvements* depends on the customer behaviors that surround them. For example, a solar lantern could help improve a child's education through better studying, or not at all, depending on who is using the lantern and for what purpose. By framing our research in terms of the customer's experience, we can explore the related issues of adoption, usage and social impact, which all converge in the context of day-to-day life.

### Method

Our research method is consumer-centric, meaning that we start and end with the subjective perceptions of consumers themselves. Beginning with open-ended interviews, we mapped the principal adoption pathways as described in the customers' own words. Then, we surveyed 564 randomly-selected customers of [BrightLife](#), a social enterprise by [FINCA International](#) that distributes solar energy and other basic needs products in Uganda, to quantify the usage patterns and associated benefits among early adopters. The questionnaire was administered using [ValiData](#), a survey tool that uses machine learning and statistical algorithms to guard against bias and error in the end-user interview. Following an initial assessment of the quantitative data, we went back into the field for a final round of in-depth interviews to ground our analysis in the lived experience of customers.

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<sup>1</sup> Wp = watt-peak, i.e., the maximum electricity output of a solar panel under optimal conditions

## Main Findings

Among this group of early adopters, the nucleus of solar energy adoption is the household, driven by strong motivations to secure the family's safety and comfort, and to enrich domestic life through expanded activities for education and leisure. Across the different uses, customers are seeking more than just energy access: They want products that are reliable, affordable and safe, even if they are at the entry level of solar adoption.

Our conclusions can be summarized as follows:

- Client characteristics influence the initial selection of solar products, especially gender, marital status, family size and income. More women purchased a SPL, while more men purchased a mini SHS. Moreover, SHS were more commonly found in households with married parents and at least two people working. In the specific context of this study, there was little evidence of progression from one solar product to another. (*Section 3*)
- The first stage of solar energy adoption is shaped by pressing concerns for the family's health and safety, followed by small changes in domestic life that reflect a more active and engaged household. (*Section 4*)
- Within the domestic sphere, solar products play an important role in a family's self-provisioning, such as rearing chicks or harvesting grubs, the benefits of which are measured in food consumption rather than profits. There are also frequent spillovers into home-based business activities, like sorting and packing produce, scheduling deliveries, etc. (*Section 5*)
- Usage of solar lighting in the primary business is concentrated in trade and services, and it is enabled by a threshold level of energy access at home for basic needs. In a surprising number of cases, this enabling threshold is met through grid electricity. Customers who use their solar products in business report small but meaningful improvements in the volume of customers and increased profitability. (*Section 6*)
- Pico products (<10 Wp) are more than the bottom rungs on the energy ladder: They play an important role in securing energy access for *on-grid* families, with a variety of benefits that include better quality, reliability and affordability. The SPL, and even SHS, in combination with grid electricity, is what keeps them at a higher tier of access. (*Section 7*)

Specific recommendations arising from these findings are detailed at the end of this paper. (*Section 8*)

## 1. Context of the Study

### Adoption of Energy Products

Energy access is usually described as a progression, starting with traditional fuels like kerosene, which are gradually replaced with better alternatives such as battery-powered lights and solar portable lanterns (SPL). These lead up to larger solar home systems (SHS) and, eventually, grid connections.

Various frameworks emphasize different aspects of this process, starting with the World Bank's [Multi-Tier Framework](#), which defines increasing levels of access based on the quantity and quality of energy supplied. Focusing more on the consumer journey and the incremental nature of this evolution, the Global Off-Grid Lighting Association (GOGLA) posits an [energy staircase](#), whereby households combine old and new sources as they pursue an upward trajectory. This is an appealing thesis because it offers an easy entry point for introducing new products, and a path to growth both for consumers and providers of products.

The transition from kerosene to very small (or pico) solar products is explored in a recent multi-country study by GOGLA in East Africa ([GOGLA, 2018](#)). But it is less clear whether customers then climb upward to higher tiers of *solar* energy access toward larger capacity SHS. GOGLA found that roughly 40 percent of larger SHS customers had previously used a solar energy product.<sup>2</sup> In contrast, UNCDF found that only [3 percent](#) of customers in Uganda had previously used a solar product, concluding that “the energy ladder hypothesis does not hold for this respondent base.” This contradiction is likely to reflect different local conditions, such as the supply of products and the overall maturity of the market, as well as differences in the groups that were sampled.

### Impact of Solar Energy Products

Another set of questions revolves around the *impact on clients*, asking whether and under what conditions the transformative potential of solar energy is producing measurable changes in the health and wellbeing of consumers, especially the poor. The evidence, unsurprisingly, is mixed. Client-level impact is strongly influenced by customer behaviors and social conditions that vary across locations, products and market segments. Generalizable findings will be hard to determine.

The same survey of lower-income consumers in Uganda that is the basis for the present paper found an array of perceived health benefits, especially improved vision and breathing, among low-income pico customers ([FINCA International, 2018](#)). By contrast, [Gunter et al](#), in an experimental study in Tanzania, show that SPL replaced kerosene, generating some cash savings and welfare benefits, but very little change in domestic routines, including studying. Similarly, [Aklin et al](#), found that mini solar grids increased

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<sup>2</sup> The larger systems ranged from 11 to 50+ Wp

access to electricity by around 30 percent in India, with accompanying reductions in kerosene expenditure, but no reductions in savings, spending, time spent working or studying, or other broader changes of socioeconomic development.

There is also a growing interest the business impact of solar energy products, but little evidence so far. GOGLA's recent study in East Africa found that a majority were able to expand their productive activities, resulting in higher incomes.

Our research adds to this discussion by detailing the various benefits of solar lighting, at home and in the business, as described by customers themselves. If GOGLA's research depicts the ways that customers combine energy products to meet higher needs over time, our data shows that there is a corresponding hierarchy of benefits that drive the adoption and usage of different products. The bottom rungs on this use-case ladder correspond to improvements in the health and comfort of the family, strengthening household consumption and productivity, and then moving up to income-generation through business activities.

### Focus of this Study

Our goal was to better understand the process of product selection, usage and perceived impacts at the entry stage of solar product adoption. We drew our sample from a relatively homogeneous population of individuals with a typical business earning on average \$106 per month.<sup>3</sup> These include smallholder farmers and micro-enterprises in trade and services who had purchased entry-level solar products with financing by [FINCA Uganda](#), a microfinance credit and deposit-accepting institution. The two products in question, a 3 Wp SPL and a 6 Wp mini-SHS, represent small incremental changes in energy access, although the 70 percent cost differential is substantial, and the use-cases are quite distinct. This focus limits the generalizability of our findings, but it also affords us a deep view into the lived experience of customers who are mostly at low levels of energy access, and whose motivations are rooted in basic quality-of-life concerns.

## **2. Methodology**

We started with deep qualitative research with solar customers to uncover the language and experiences that arise naturally in their domestic and business routines. This phase revealed key themes and variables, including access to electricity, sources and uses of lighting, household-level impacts, and the various use-cases for solar products. We then administered a quantitative survey, reflecting the common terms that were established in the qualitative stage, to measure the frequency and magnitude of these experiences among a representative sample of our target population, with minimal prompting by the surveyors.

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<sup>3</sup> \$ = United States Dollars (USD).

Both the SPL and the mini SHS are at the higher end of the pico range but on the lower end of the overall solar product spectrum. As shown in Table 1, the mini-SHS provides more lights (and luminosity) than the SPL, plus a 12-volt DC outlet.

**Table 1: Product Specifications**

	<b>SPL</b>	<b>SHS</b>
installation	portable	fixed
lights	1	3
lumens (normal)	81	67
runtime (normal) - hrs	13	27
lumens (turbo)	169	310
runtime (turbo) - hrs	5.9	5.6
phone charger	✓	✓
12-volt DC outlet		✓
watts - Wp	3.0	6.3
battery capacity - mAh	2,900	5,900
cost	\$37	\$63

*Source: Lighting Global*

These variations in price and performance might seem small, but they are significant considering that the cost of the mini SHS represents almost half of the median monthly income among this population. The incremental difference between the SPL to the mini SHS produces a very fine-grained view of product adoption, use-cases and perceived benefits at the lower end of the energy spectrum.

### **3. Customer Profiles and Product Selection**

#### Customer Characteristics

Our sample included 564 individuals who had purchased a SPL or mini SHS from BrightLife with credit provided by FINCA Uganda, usually in the form of a Village Bank loan. General profiling characteristics are included in Table 2, showing a higher concentration of women and rural customers. Forty-three percent of respondents had completed only primary school or less, 31 percent were secondary school graduates and 26 percent had some post-secondary education. Large families with three or more children were the norm.

**Table 2: Client Profile and Product Selection**

		SPL	SHS	TOTAL
<i>n</i> =		322	242	564
<b>Client's Gender</b>	Male	26%	58%	39%
	Female	74%	42%	61%
<b>Client's Education</b>	No schooling	5%	3%	4%
	Less than primary	7%	5%	6%
	Primary	34%	41%	37%
	Secondary	30%	31%	31%
	Post-Secondary	13%	9%	11%
	Collage or university	11%	12%	11%
<b>Household Size</b>	HH Size = 1-3	13%	11%	12%
	HH Size = 4-6	39%	31%	36%
	HH Size = 7 and above	48%	<b>58%</b>	52%
<b>Number of Children</b>	no children	9%	6%	8%
	1 or 2 children	36%	23%	30%
	3 and more children	55%	<b>72%</b>	62%
<b>Marital Status</b>	Married	72%	85%	75%
	Single	12%	5%	11%
	Divorced/ Separated	6%	4%	6%
	Widow(er)	10%	6%	8%
<b>Location</b>	Urban	48%	31%	41%
	Rural	52%	<b>69%</b>	59%

Certain customer characteristics had a statistically significant influence on product selection.<sup>4</sup> More women purchased SPL, while more men purchased a mini SHS. Additionally, SHS were more commonly found in households with married parents and at least two people working. A large family was also associated with the purchase of a SHS over a SPL.<sup>5</sup>

As shown in Table 3, 24 percent of respondents were not dependent on income from some form of self-employment. Among the rest, agriculture was the most common (36 percent of the total). Trade and services were also well represented, at 20 and 17 percent, respectively. Unfortunately, the number of customers in production is too small to be representative of the sector overall.

<sup>4</sup> The influence of client characteristics was assessed using simple contingency tests and Chi-squared test of association. Statistical significance was at  $p < 0.01$  for gender, marital status and number of income earners.

<sup>5</sup>  $p < 0.05$  for family size

**Table 3: Business Profiles and Product Selection**

	% of Sample	Business Profile		Product	
		Monthly Profit \$	Average # of Workers	SPL	SHS
Not Self Employed	24%	n/a	n/a	24%	25%
Agriculture	36%	\$77	2.7	31%	43%
Trade	20%	\$124	1.4	21%	17%
Service	17%	\$137	1.8	20%	12%
Production	3%	\$122	2.4	4%	2%
Total	100%	\$106	2.1	100%	100%

Farmers (“agriculture”) had the highest tendency to purchase SHS, even though their incomes were by far the lowest, at \$77 per month. The preference for SHS among the poorest, most rural households shows that adoption is shaped by the severity of unmet energy needs rather than economic factors alone, especially when financing is available for incrementally larger systems.

#### Previous Lighting Source

A key question for us is whether consumers can be moved along an energy continuum, starting with pico-sized lanterns and eventually graduating to larger systems. Our findings below are highly specific to the customer segment that we surveyed—low-income farmers and micro-entrepreneurs using entry-level solutions in an early-stage market. The products themselves present small but important gradations in power (from 3 Wp to 6 Wp) and functionality. As a result, any transition we observed from SPL to mini SHS is objectively incremental, although meaningful at the customer level.

Among our sample, the evidence of “climbing up” a solar energy ladder is modest but not altogether absent. As shown in Table 4, 14 percent of SHS customers already owned a solar lighting product at the time of their purchase, which is a bit higher than the 9 percent among SPL customers. As the market matures, these numbers are bound to increase because the number of people with some previous exposure to the products will have expanded.

**Table 4: Previous Lighting Source**

	<b>SPL</b>	<b>SHS</b>
other solar only	9%	14%
electrical grid*	43%	17%
none / biofuels / batteries	48%	69%
Total	100%	100%

\* with or without a solar product

It is interesting to observe that 69 percent of mini SHS customers were making their very first solar purchase. Despite the extra cost, the uptake of the SHS product was highest in rural areas (see Table 2) where households depend principally on farming, which generates the lowest profits (see Table 3). So, this leapfrogging over SPL in rural areas is not a function of income, but of unmet energy needs and customer preference.

Our most striking finding is that a surprisingly high percentage of customers (43 percent for SPL and 17 percent for SHS) were *already on the electrical grid* when they purchased their solar product from BrightLife. For these adopters, solar lighting is an important *addition* to their grid-connected household. Dealing with power-outages was a common motivation, but it was far from the only one. These “grid + solar” customers cited a wide range of use-cases for their solar products, which are discussed in Section 7 of this paper. This result expands our concept of SPL and mini SHS as more than the bottom rungs on an energy ladder—they also play an important role in improving energy usage at higher levels of access.

#### Usage Starts at Home

The central focus of energy needs, and consequently the nucleus of solar adoption, is the *household*. As shown in Table 5, 85 percent of survey respondents were using their solar products *only* at home, even though most of them were self-employed. Only about 12 percent were using their solar product in their main business activity.<sup>6</sup>

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<sup>6</sup> The framing of this question excludes *residual* income-earning activities, such as rearing chicks for consumption and selling a bit of surplus. These are discussed in Section 5.

**Table 5: Primary Usage**

	SPL	SHS	Total
Household Only	81%	91%	85%
Business and Household	11%	4%	8%
Business only	5%	3%	4%
Broken/Sold/Stolen	3%	2%	3%
	100%	100%	100%

Usage in the primary business, which is not widespread, is more common when the family has crossed a threshold of energy supply, as shown in Table 6. Fifty-four percent of the people using solar lighting in their principal business are already connected to the grid.

**Table 6: Business Usage by Previous Lighting Source**

	Household Only	Business*	Overall
Other solar only	12%	9%	12%
Grid**	19%	54%	22%
No other source	69%	36%	66%
Total	100%	100%	100%

\*Includes some home usage.

\*\*includes grid+solar

One practical implication is that the *introduction* of solar energy to entry-level market segments should start with compelling use-cases for the household. As we will discuss in the next section, these use-cases should emphasize the health and quality-of-life benefits that solar solutions can offer.

At the same time, small-scale domestic solar products are a weak starting point for promoting commercial usage, at least among this segment. Individuals with previous solar lighting had an even *lower* rate of business usage (9 percent) than people with nothing at all (36 percent).

## 4. Promoting a Healthy, Active Household

### Health and Safety

As described in our [earlier publication](#), solar clients are more likely to notice the ways in which their products contribute to a safer, healthier household by replacing kerosene lamps and candles than other types of benefits, including savings on energy expenditure, which was rarely mentioned.<sup>7</sup> Approximately 90 percent of respondents reported specific improvements in health-related areas, including better eye health and breathing, and less exposure to fires and burns.

Households with no other source of electric lighting are more likely to describe these benefits, along with better safety at night. Children can play outside when a light is hung near animal pens or open-air businesses. Family members can safely use lanterns without fear of animals. Pests are deterred from entering the house. Freed of these worries, SHS customers, in particular, were more prone to mention *sleeping better at night* as one of the top three benefits of their product.<sup>8</sup>

*“At night we leave the solar on because we have rats in the house, so they used to disturb us very much. But now they no longer move in the house because of the light.”*

*“We have an abasezi. He disturbed us a lot in the darkness. He came and threw stones and kicked the door, but not anymore. He is afraid of the bright light of my solar lamp.”*

### A Longer, More Active Day

Roughly 30 to 40 percent of solar customers credit their product with giving them more time to be active, roughly four additional hours on average. Solar lanterns generate this benefit with greater frequency, but the magnitude of time gained is slightly higher for SHS users. Clients described a more animated household in the evenings, with improved eating habits and later bedtimes. The extra time is mainly used for housework and recreation, with about one-third of the freed-up time going toward business activities.

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<sup>7</sup> This survey did include household energy expenditures and savings, which will be presented in a subsequent paper.

<sup>8</sup> An *abasezi*, or night runner, is a traditional figure in Ugandan culture who roams the countryside and causes mischief under cover of darkness.

**Table 7: Time Gained**

	<b>SPL</b>	<b>SHS</b>
n =	322	242
% who report time gained	42%	32%
hours gained per day by duration of ownership		
0-12 months	3.7	3.8
13-24 months	3.9	4.0
25+ months	2.7	3.6
<b>Total Average</b>	<b>3.6</b>	<b>3.9</b>

*“Before we used to go to bed early; now we sleep at 11 pm. We eat supper and chat longer under the light and the kids read and I can clean the plates and then sleep.”*

*“I was cooking only one meal and I would keep some of the food to be used as supper but when I got the solar lamp, I was able to cook supper.”*

*“In fact, we used to only eat early in the day and forego supper and go sleep early.”*

*“Now we can do different activities at the same time. While others are cooking, some are reading.”*

As shown in Table 7, the time gains peak in the second year of product ownership but then falls in the third year, especially for SPL. Customers explained the decreasing utility of their product due to reduced battery life, dimmer lighting, shorter duration of lighting, broken pins and cables, etc. The SPL sold by BrightLife at the time of the study fulfilled the Lighting Global standards for durability, but three years under harsh conditions takes a toll on product performance.<sup>9</sup>

<sup>9</sup>See [https://www.lightingglobal.org/wp-content/uploads/2017/09/Pico\\_MQS\\_v8\\_0.pdf](https://www.lightingglobal.org/wp-content/uploads/2017/09/Pico_MQS_v8_0.pdf)

The declining useful life of these products should be considered when calculating the total energy savings over time through the substitution of kerosene. This feedback also highlights the importance of long-term follow-up with clients for repairs and replacement sales, as products approach the end of their useful life.

Over time, habits and perceptions do change. So, another possible explanation is that some long-term users may simply have grown accustomed to having more light and are less inclined to notice the difference.

### Reading at Night

The potential of solar lighting to improve the study habits of schoolchildren has generated a lot of interest. Unfortunately, recent studies (including RCTs in [Kenya](#) and [Zambia](#)) have found no evidence of this impact at the household level. While we do not question the validity of these findings, we can only report that the respondents in our survey did, in fact, report that solar lighting at least made it possible for children to read at night. This does not mean that the time was *fully spent* reading, but rather that the light was available for this purpose, and that this usage is something that *clients notice and value*.

Some of the perceived benefit could represent a shift in activities from afternoon to the evening, but the average amount of increased time available for reading was significant. Families with more children were more likely to report this benefit and to attribute longer periods available for reading, especially for the SHS.

**Table 8: Children Can Read More**

# of Children in HH	Frequency		Avg. Avail. Hours per Day *	
	SPL	SHS	SPL	SHS
1	54%	55%	1.4	1.8
2	60%	61%	1.9	2.1
3	68%	70%	2.0	2.2
4+	73%	83%	2.3	2.7
Total Average	60%	70%	2.0	2.5

*\*Excludes zero values*

While it is natural to focus on children's study, it is easy to overlook the importance of enabling adults to read, since their days are packed with housework, farming and running their businesses. The extra reading time is reported less frequently and for shorter durations for adults, who are busy cooking and cleaning-up after dinner, but it could be even more valued for that very reason. As with children, this benefit is more pronounced for SHS than for SPL, both in the frequency and number of minutes available.

**Table 9: Adults Can Read More**

Schooling Level	Frequency		Avg. Avail. Hours per Day *	
	SPL	SHS	SPL	SHS
less than primary	11%	22%	0.8	0.7
primary or secondary	19%	15%	1.1	1.1
above secondary	35%	46%	1.8	1.7
Total Average	22%	22%	1.4	1.3

*\*Excludes zero values*

*“I use my solar lamp very early in the morning to read through my business records and balance my books before starting my business day.”*

*“I now read my bible every night before going to bed.”*

### Phone Usage

Phone charging is a common and highly desired feature of SPL and SHS products. The alternative—charging your phone at a shop or kiosk—is not only expensive over time, but also it renders the phone unusable, either because the battery is depleted or because the phone is with a vendor. Some customers also have security concerns with leaving their devices unattended for extended periods of time, and even accuse vendors of swapping out new batteries for old ones.

Besides saving money and reduced risk of battery-swapping, we were interested to know whether customers noticed any improvements in the availability of their phone for making calls and sending texts throughout the day. Of these, making more phone calls is more common than texting, especially among SHS customers. On average, solar charging allows six additional hours per day of phone availability.

**Table 10: Increased Calls, Texts and Social Media**

<b>Phone Calls</b>	<b>SPL</b>	<b>SHS</b>
% of respondents	62%	76%
time gained (average hours per day)	6.4	6.2
<b>SMS</b>		
% of respondents	44%	36%
time gained (average hours per day)	6.1	5.0
<b>Social Media</b>		
% of respondents	26%	12%
time gained (average hours per day)	3.0	2.5

Location, age and education strongly influence how people use their phones. Rural households are much more likely to notice that they have more time available for phone calls (see Table 11). Meanwhile, younger and better-educated customers are most likely to notice improvements in their ability to send and receive text messages (see Table 12). In the in-depth interviews, older clients said that they prefer to call than send texts, due to poor eyesight, lower literacy levels and discomfort texting. This aversion to texting is an important fact for customer engagement, for example, in following-up on delinquent pay-as-you-go (PAYGo) payments or other communications.

**Table 11: Phone Availability by Location**

<b>Location</b>	<b>SPL</b>	<b>SHS</b>
Urban	53%	46%
Rural	72%	89%
Total average	62%	76%
Hours available per day	6.4	6.2

**Table 12: Texting by Age and Educational Level**

	<b>Age</b>	
	<b>18-40</b>	<b>41+</b>
> secondary	42%	28%
secondary+	53%	47%
Total	48%	38%

The benefits of a charged phone are not limited to family usage. As discussed in Section 6 below, solar customers describe a variety of ways in which they use their phones to conduct business from home, such as taking orders and arranging deliveries.

## Mobile Money

The linkage between solar energy and digital financial inclusion is of considerable interest, not least because PAYGo financing for solar energy is generating a sizeable influx of transactions for mobile money operators. GSMA notes that PAYGo solar providers are becoming some of the largest mobile bill-pay recipients and finds “early signs of increased financial inclusion with new customers signing up...to access PAYGo solar services ([GSMA, 2017](#)).” Here, the driver of digital inclusion is the requirement that a PAYGo customer open-up a specific mobile money account to make his or her purchase, assuming this is his or her first mobile money transaction.

[UNCDF found little evidence](#) of this kind of additionality in Uganda: Most customers already had a mobile money account prior to purchasing their solar product. They did, however, find growing levels of mobile banking activity among customers with larger SHS (50+ watts), but not the same increase in mobile banking activity for customers with solar products with smaller capacities.

We did not explore this issue in the quantitative survey because it was not mentioned by any customers in the initial qualitative stage. However, customers did discuss this during the follow-up interviews. Having a charged cell phone is obviously a prerequisite for mobile banking, including mobile PAYGo payments themselves. At the very least, increased phone usage is an enabling condition that will allow for greater engagement in mobile services of all kinds.

*“I use mobile money a lot now that the phone is charged.”*

*“I receive my mobile money from the people who call me, and I send the seedlings to.”*

*“My phone is charged now, and I can do mobile transfers and send money to my saving account whenever I want.”*

### Other Uses

As many as 18 percent of customers, both for lanterns and SHS, mentioned that they are using their phones to listen to the radio. The solar lighting affords them an average additional two and a half hours of radio usage, which relieves the drudgery of housework at any time of day. Besides entertainment, the radio is an important source of information for news, weather, education and local events.

While customers will occasionally rent out their lights or charge mobile phones for a small fee, it is much more common for neighbors to provide these services for free. Similarly, people expressed great pride in providing the lantern for community events or for night classes.

*“We charge other people’s phones, but none can charge for a fee. It is forbidden to do so in our community.”*

*“My neighbors come and charge their phones for free whenever they need. The sun is free, and they can benefit from it too.”*

*“Everybody wants to be near me to get the solar in case they need. I help them, and it gives me pride and respect.”*

*“I share my lamp during evening classes. I am proud of my solar lamp because it makes me stand out from other people.”*

*“We collect the lamps in the community and use them in our local school for night classes.”*

## 5. Shoring-Up Family Consumption

The intermingling of home life and business is well-known to microfinance providers and can pose a challenge for credit analysis and loan performance. It can be difficult to make a loan when working capital for a business is intertwined with family finances, or when business activities are easily interrupted by contingencies such as funerals and school fees. Even figuring out what to count as a business requires a nuanced approach, especially for home-based activities like raising chicks or selling excess produce.

This ambiguity is reflected in our data. On one hand, the percentage of people who are explicitly using their solar product in business is surprisingly low (roughly 10 percent, especially considering that most of them are self-employed micro-credit borrowers). However, the follow-up interviews made it clear that there are some use-cases that are much more widespread, where solar energy is being used to enhance family consumption while occasionally generating small amounts of residual income.

For example, raising chicks and other small animals in a shed or *kraal* adjacent to the home is common in both rural and urban areas of Uganda. This activity plays an important role in the household's food strategy, as a source of fresh meat, eggs and dairy. While it may generate some additional income, it is typically not regarded as a primary *business*. BrightLife customers place solar lights in the shed so their chicks can feed safely (and quietly) at night. This enables the chicks to grow faster and allows for a peaceful night's rest for the family. Solar lighting is also a big improvement over smoky kerosene lanterns, which can poison the birds and start fires.

*“The solar lamp makes feeding the birds a constant activity. The birds need to eat well at night if they are to give you a good outcome. If they don't feed well through the night, their weight and productivity fall.”*

In rural areas, farming households also use solar lighting to sort and pack their produce, allowing them to dedicate the daylight hours to cultivation and harvest. These activities are also directly linked to the family's food supply, with a bit of residual income. The same goes for catching white ants, which are eaten as a seasonal treat or sold in the neighborhood. The gains in productivity are not measured in profits, but in better sustenance.

*“During the ant season, we put the solar lamp on the shade outside, then get a mat or a basket and put it near the lamp and then switch on the lamp. The light from the lamp attracts the white ants onto the mat or basket and that is our trap. The ants are always*

*“The ants are mostly for the home. Sometimes we catch a lot of them. That is when we sell some and then send some to our neighbors and friends. The children take them around the village to sell when we catch a lot and we use that money to buy some food at*

## 6. Use in the Primary Business

### Sectoral Profile, Product Selection and Product Usage

The use of solar products in business is strongly conditioned by the sector of activity. The differences between sectors are more evident when we focus only on those respondents whose principal source of income is self-employment. In our sample, these individuals make up 76 percent of the total, or 426 responses, as shown in Table 13.

**Table 13: Use in Primary Business**

	SPL		SHS	
	% of Sample	use in business	% of Sample	use in business
Agriculture	41%	7%	58%	1%
Trade	28%	42%	23%	14%
Service	26%	23%	16%	27%
Production	5%	8%	3%	20%
Total / Average	100%	21%	100%	9%

*n = 426*

Business usage of solar is nearly zero in agriculture, which comprises a very large portion (41 percent) of our sample. By contrast, BrightLife customers in trade and services are making robust business use of their solar products, albeit in different ways. Business usage of SPL reaches 42 percent in the trading sector, dropping to 14 percent for SHS. By comparison, SHS is used more commonly in services (27 percent), though SPL is not too far behind (23 percent).

### Customer Flow and Profits

Traders, who are often located near a crossroad, use solar lighting to attract more customers during the peak traffic hours. The light also makes it easier to count money and identify counterfeit bills. The portability of the solar lantern is a key value-driver in this sector because the business is subject to frequent relocation.

*“Passerby’s come and buy from me because they see the light is still on in the business.”*

*“Farmers passing by on their way home from the fields after 8 pm are my main customers.”*

*“My customers come at night. This is the time they are back from work. This is when I earn the most.”*

*“During the two extra hours I stay because of the lamp I earn a lot. It is almost more than my income from the rest of the day.”*

Slightly more service sector customers purchased the mini-SHS over the SPL. Some in the service sector have their activities based at home, so they take advantage of the multiple lights to serve customers in one room while family activities are underway in another. Larger businesses, like restaurants, require more dispersed lighting to serve several customers simultaneously. Also, the extra wattage of the larger system allows service-oriented businesses to offer mobile phone-charging while their customers are eating or getting their hair cut, for example.

Additionally, a small portion of farmers are using solar lanterns to sort and process their crops at night, so they can focus on cultivation or harvesting in the day-time.

These uses result in increased customer flow and profits, shown in Table 14. Between 56 and 83 percent

of business users reported that they were able to serve roughly five more customers in a day, which adds up to additional income of \$12 to \$17 per month. Again, we see more business impact from lanterns over fixed systems, both in the frequency and the magnitude of benefits.

**Table 14: Business Benefits**

	<b>SPL</b>	<b>SHS</b>
Self-Employed, Using in Business	21%	9%
of which		
% with increased activity	83%	56%
Average gain in monthly profits (\$)	\$17	\$12
# of additional customers per day	6	4

*n = 426*

These benefits are more pronounced among SPL customers than SHS because SPL are more frequently used in trade. The customer flow of a trading business is more responsive to changes in the operating hours than a service, because it normally involves a shorter customer interaction.

Communication with Customers and Suppliers

We have already noted that solar charging makes phones available for about six additional hours per day. One of the examples of the business-related spillovers that emerged in the follow-up interviews was the ability to stay in more regular contact with customers, for a solar lighting product that was primarily categorized as “for home use”.

Most respondents were keenly aware of the importance of simply being in regular contact with their customers, whether for taking orders, arranging deliveries or simply informing them that goods are available for purchase. Service-sector businesses can make and change appointments, which reduces time waiting on all sides. Food traders are reducing spoilage by coordinating between their buyers and sellers, while other businesses benefit from improved inventory management. Other customers mentioned using their phones to calculate the change owed to customers. Having a charged phone also enhances their use of mobile money and other forms of mobile commerce.

*“I now have phone clients. They call me, and I deliver the product they want.”*

*“When I finish the clients’ work, I just use my phone to call them and they come and pick their clothes. Before I would use my children as a messenger.”*

*“Now I use my phone to schedule the appointments. It reduces the waiting time for my clients a lot. When they are happy I am happy.”*

## 7. Energy Stacking at Higher Tiers

Continual improvements in the efficiency, capacity and overall performance of solar products are making these goods increasingly attractive and expanding the use-cases for customers. The advent of more and better solar-powered appliances, such as fans and televisions, will only accelerate this trend. In the meantime, however, entry-level solar products are largely limited to lighting and small electronics, which provide limited levels of energy access.<sup>10</sup>

Overall energy output, though, is not the only value-driver for pico-level products, even in the entry-level market. Variations in portability and lighting create very different use-cases for customers, as we saw in the preceding section. Moreover, factors such as health and safety improvements, along with affordability and quality of light, have a strong influence on the perceived benefits.<sup>11</sup>

Our research also shows that pico products, far from being the bottom rung of energy access, can play an important role at higher tiers. As we saw in Table 4 (reproduced below), *energy stacking* (or back-filling) occurs in households that are connected to the grid and are using BrightLife solar products to compensate for its shortcomings.<sup>12</sup>

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<sup>10</sup> As standalone solutions, SPL and SHS would be classified at Tier 1 of the Multi-Tier Framework, which covers products with peak capacity up to 50 watts for basic lighting and phone charging.

<sup>11</sup> This viewpoint contrasts with the World Bank’s Multi-Tier Framework, in which factors such as quality, safety and affordability only come into consideration at higher tiers, when energy output exceeds 200 watts per day.

<sup>12</sup> Energy stacking among *solar* products is less common. At most, 14 percent of SHS customers were building on some previously-acquired solar product—even less for SPL. This does not mean that solar energy stacking does not happen, only that it was not common among this customer segment at the time of our survey.

**Table 15: Previous Lighting Source**

	<b>SPL</b>	<b>SHS</b>
other solar only	9%	14%
electrical grid*	43%	17%
none / biofuels / batteries	48%	69%
Total	100%	100%

\* with or without a solar product

Blackouts and power surges were a common and unsurprising motivation to purchase solar products, but hardly the only reason. If anything, respondents observed that power cuts in Uganda were less frequent than in previous years. Nevertheless, such incidents were deemed disruptive and damaging to sensitive electronics. The owners of more expensive smartphones (who are often the children of the solar customer) preferred to power their devices with solar energy because it offered a smooth charge, free from harmful power surges.

Other benefits of solar energy for grid-connected households are summarized below:

- **Reliability**: Solar is available when PAYGo credits for electricity have expired. Lighting and energy are available during power cuts.
- **Coverage**: Lighting and energy can be extended to rooms, home additions, animal coops and sheds without additional wiring. Portable lanterns can be used beyond the family compound.
- **Quality**: The solar lantern can provide better illumination for near-range tasks such as reading and sewing. Phone charging with solar avoids damage to devices because of power surges.
- **Cost**: Solar lighting can be combined with grid electricity to lower utility bills.

From our in-depth interviews, we also would sound a note of caution for how the PAYGo model of solar financing is positioned with customers. Respondents often mentioned the constant availability and freedom from regular payments as key advantages for solar products. To the extent that service is cut-off when payments are not made, the PAYGo model of financing mimics a utility, which runs counter to this customer motivation. Marketing and communications should characterize the PAYGo payment method as a pathway to ownership, and to convey the option to pay-off the loan in advance. Messaging that emphasizes freedom from utility providers will resonate strongly with customers who are eager to reduce their reliance on grid electricity.<sup>13</sup>

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<sup>13</sup> [UNCDF](#) found similar results.

## 8. Recommendations

Our recommendations pertain specifically to the introduction of solar products in an early-stage market. Choosing between two closely-related yet distinctive pico solutions, our customers revealed key factors that drove the selection and usage of their solar products, and they described their initial experiences as they climbed onto and up the energy ladder. From this feedback, we can draw conclusions about the priorities and perceived benefits that drive consumer behavior, especially among first adopters.

- When entering an early-stage market, key aspects of the marketing mix, such as products and promotion, should clearly target domestic needs, starting with the health and safety of the family. The first stage of adoption is strongly influenced by the desire for improved eye and respiratory health, and for a household that is clean, safe and free of pests.
- Once health and safety concerns are addressed, other use-cases that emphasize home-based provisioning—such as rearing chicks, processing farm outputs and harvesting termites—will find a receptive audience both in urban and rural households (at least in Uganda). The benefits of these activities are measured in better family consumption, not in profits.
- There are many other benefits that convey the image of an engaged, active household—such as phone usage, socializing and leisure—that will resonate with early adopters. These benefits include pride of ownership and enhanced social status from offering services to neighbors and contributing solar light to community events.
- A high percentage of both SPL and SHS customers observed that their phone is more available because of their solar products, with interesting distinctions between urban and rural markets. While the direct impact on mobile money usage seems weak at the early stage, the potential linkage should be of interest to mobile network operators (MNOs) and financial service providers.
- Among self-employed people, the boundary between home and business is very fluid. Use-cases that demonstrate how solar energy allows for people to conduct their business activities from home—taking orders, arranging deliveries, etc.—will have broad appeal.
- Solar-to-solar adoption (i.e., purchasing one solar product and then another) was not yet evident among the customer group surveyed. This represents an important transition for consumers and for the market overall, and it should be studied in a more developed market.

- For most customers, the extension of solar lighting into a formal business context (through usage in the primary enterprise) is conditioned on a basic level of energy access at home. Pico solar products did not cross this threshold, at least among this customer group, but grid electricity did. Making sure household energy needs are met is the first step in promoting real productive use of solar energy. Adoption in this arena is likely to be very low in any sector except trade and services.
- Solar product retailers and distributors should not overlook a very important market segment comprised of on-grid households who need a more reliable, cost-effective source of energy that will not harm their sensitive electronics, and which can easily be extended throughout the home and compound. Focusing exclusively on off-grid customers risks missing a valuable opportunity to grow their business.

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