



VeraSol



Kenya Consumer Experience Study: Insights on Solar Appliances

April 2022

Background

IN 2021, [VERASOL](#) LAUNCHED A LANDMARK STUDY IN COLLABORATION WITH [EED ADVISORY](#), WHICH SURVEYED A NATIONALLY REPRESENTATIVE SAMPLE OF 4,195 KENYAN HOUSEHOLDS TO LEARN ABOUT USAGE AND SATISFACTION CONCERNING SOLAR ENERGY KITS AND OFF-GRID APPLIANCES. THE FULL RESULTS FROM VERASOL'S STUDY ARE PUBLISHED IN THE [OFF-GRID SOLAR CONSUMER RESEARCH STUDY REPORT](#).

Kenya was selected because it is a pioneer and world market leader in the uptake off-grid solar products. In 2020 alone, GOGLA affiliates reported selling over 1,904,000 solar lighting products and over 269,000 off-grid appliance sales in Kenya, making it the largest market for sales of off-grid solar products by far.¹

Although the off-grid solar appliance market is growing rapidly, there is limited understanding of the penetration of these products and how consumers experience and interact with them. This information is essential to help manufacturers design products more effectively, for sector stakeholders to identify market gaps, and for programs and policymakers to scale quality assurance (QA) efforts. This report aims to answer these questions by exploring the appliance data collected during the 2021 study. It analyses the current state of off-grid appliances in Kenya, including consumers' perceptions of product quality, affordability, and short-term demand.

While the prevalence of solar-powered radios is very high in Kenya, as indicated in the initial report, this snapshot only analyses data for TVs, refrigerators and solar water pumps (SWPs) used in households and small home-based businesses. We exclude radios since they are comparatively less complex and more mature technology. It's also important to note that the number of households surveyed that owned a refrigerator (n=4) or SWP (n=7) was extremely limited compared to TVs (n=252). Due to the limited samples, any refrigerator and SWP data analysis should be taken anecdotally instead of as a representative of the Kenyan market.

Ownership and Projected Demand

Methodology

We referenced Kenya's 2019 census data and current growth rates to determine that there were 12.7 million households in 2021. To determine the current estimated penetration of off-grid appliances, we used the 5% rate of appliance ownership (households owning a TV, refrigerator or SWP) identified in the study to estimate that over 635,000 households in Kenya own at least one off-grid appliance. Given that most households surveyed own more than one off-grid appliance, the total number of off-grid appliances in Kenya is estimated at 1.13 million units.




To understand the growth potential of the off-grid appliance market in Kenya, we also estimated the projected short-term demand by asking all 4,195 households surveyed which appliances they are planning to purchase within the next six months and applied this number to the estimated 12.7 million households estimated in 2021. The demand estimate is based purely on the desire to own an off-grid solar appliance and not on the willingness or ability to pay.

1. GOGLA, Global Off-Grid Solar Market Report Semi-Annual Sales and Impact Data, [H1 2021](#) and [H2 2020](#).

Estimated penetration

Most appliance ownership comes from TVs, accounting for 96% of appliance ownership. This is consistent with GOGLA sales data in Kenya, in which TVs accounted for 97% of appliances sold in the region in 2020.² Table 1 summarises the estimated volume of solar TVs, refrigerators and SWPs being used in Kenya by household type (rural vs urban). While most off-grid TVs and SWPs were owned and used in rural households, solar refrigerators were more common in urban areas.

TABLE 1: TOTAL ESTIMATED OFF-GRID SOLAR APPLIANCES AT THE HOUSEHOLD LEVEL IN KENYA





NO.	APPLIANCE	URBAN	RURAL	NATIONAL
1	Solar TV 	178,900	898,800	1,077,800
2	Solar Pump 	14,700	20,800	35,500
3	Solar Fridge 	8,100	7,600	15,800
4	Total	201,700	927,200	1,129,100

Estimated demand

The survey data showed that consumer demand for TVs is high, with a projected demand of 863,400 units in the next six months- 65% of which is from rural households. Compared to TVs, the estimated demand for SWPs and refrigerators is moderate, with a projected demand of 209,200 and 148,300 units, respectively (Table 2). While none of the households surveyed owns a solar fan, a small percentage (.05%) of households stated that they plan to buy one within six months. The low demand for fans could be attributed to fans being a non-essential appliance since Kenya's climate is relatively mild.

2. GOGLA, Global Off-Grid Solar Market Report Semi-Annual Sales and Impact Data, [H1 2021](#) and [H2 2020](#).

TABLE 2: SHORT-TERM (6 MONTHS) PROJECTED DEMAND FOR OFF-GRID SOLAR APPLIANCES IN KENYA

NO.	APPLIANCE	URBAN	RURAL	NATIONAL
1	Solar TV 	304,400	558,400	863,400
2	Solar Pump 	79,500	130,400	209,200
3	Solar Fridge 	81,200	67,400	148,300
4	Fans 	13,400	50,400	63,800
5	Total	478,500	806,600	1,284,700

Consumer Perspectives

Quality is the top consideration for consumers when purchasing their appliances.

To understand how consumers make purchasing decisions, we asked households to identify their primary consideration when buying a TV, refrigerator or SWP. Quality was identified as the top consideration for purchase (Figure 1), highlighting the impact of QA efforts in the region. Programs such as [Lighting Africa](#), which has been working in Kenya since 2009, have been instrumental in promoting high-quality solar products and improving consumer awareness of the benefits of these products. Quality being ranked as the top consideration for purchase may also be tied to brand name, which is closely associated with quality.

Most households are satisfied with the price of their solar appliance.

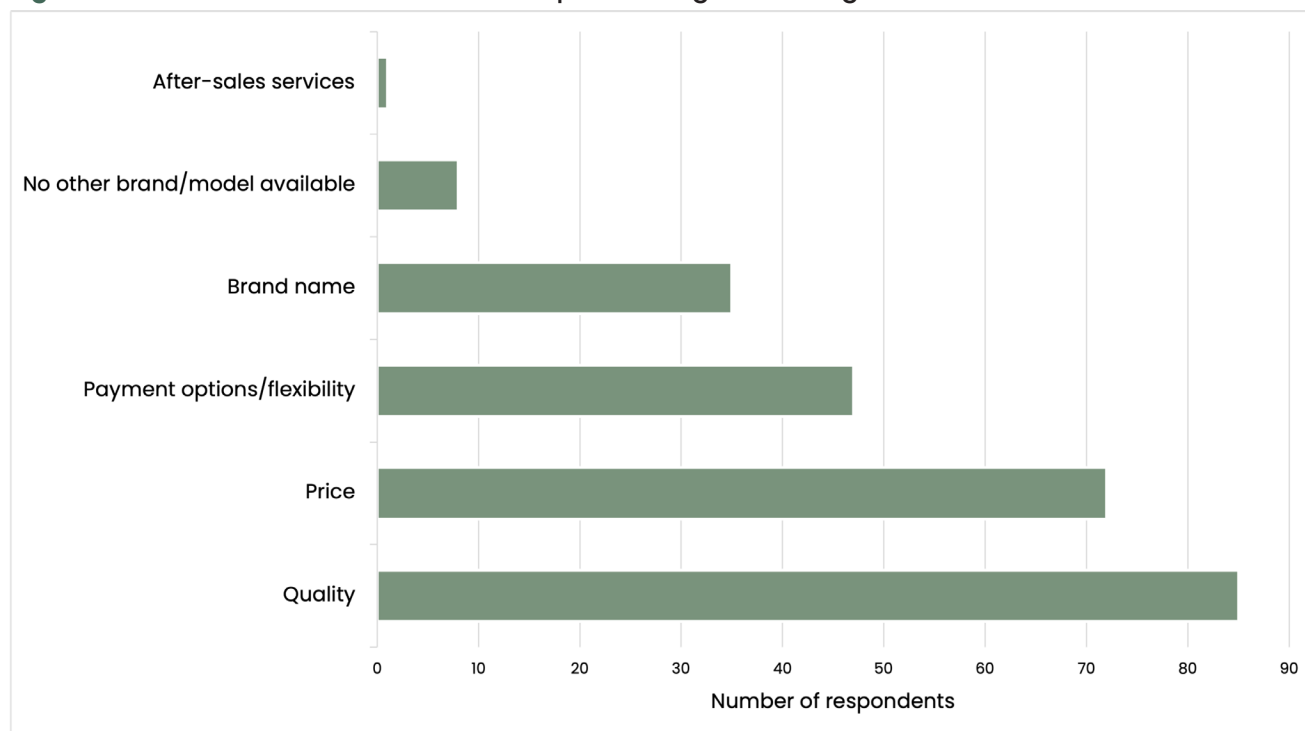
Consumer affordability is one of the most significant constraints for the growth of the off-grid appliance market. In Kenya, nearly half of consumers are still unable to afford an average priced off-grid TV and solar home system (SHS), even with standard consumer financing.³ As shown in Figure 1, our survey found that price and payment options were the second and third highest considerations to Kenyan consumers when making a purchase decision on appliances.

To assess the affordability of solar appliances, respondents were asked to indicate: the cost of purchasing the product, the payment method used to acquire their off-grid solar product and their perception of its price.

3. Efficiency for Access Coalition, [State of the Off-Grid Appliance Market](#), 2019.

Overall, 79% of respondents reported that they were satisfied or very satisfied with the price of their off-grid TV, refrigerator or SWP. On average, households paid around US\$300 for their solar TVs.⁴ Half of the households paid for their TV with cash, while the rest paid via a payment plan (i.e., pay-as-you-go (PAYG)). 70% of those using PAYG were still paying off their TV, with an average of US\$70 left to pay. Because of the low ownership of refrigerators and SWPs, there is not sufficient data to analyze the average price that households paid for these products.

Figure 1: Consumer considerations when purchasing a TV, refrigerator or SWP



While households agree that it’s easy to find dealers of solar appliances, they may need to travel far to purchase a product.

Accessibility was assessed by asking respondents: the distance they would need to travel to purchase their off-grid solar appliance if they purchased it today and how easy it was to find dealers of the product.

While 79% of households surveyed agreed or strongly agreed that it was easy to find dealers of their solar appliances, the distance that consumers would need to travel to purchase a product can be a barrier to the uptake of the solar appliances. On average, respondents indicated they would need to travel 14 km to purchase a TV and 4 km to purchase a refrigerator.

SWPs were the least accessible, as respondents said they would need to travel approximately 60 km, on average, to make a purchase. This is likely because households that had a SWP were in remote areas far from Nairobi or other major cities where these products are more likely to be sold. For example, one SWP owner located in Mahoo reported they would have to travel 150 km to purchase their SWP. Mahoo is an extremely remote village over 250 km from a major city. This suggests that even in a solar market as mature as Kenya, accessing SWPs may still be challenging for rural consumers.

4. For PAYG products, the cost was calculated using the total repayment cost.



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Most respondents reported that their product's level of service has not changed since they purchased it.

Only 8% of TV owners and none of the households with refrigerators reported a change in the level of service from their product since they first purchased it. One SWP owner reported that the level of service has changed since purchase due to the rainy season. The minimal change in the level of services may partially be due to the appliances being relatively new, with 90% having been purchased within the last four years. This could also be an indicator of product quality – high-quality appliances shouldn't see a significant shift in performance over a short period of time.

Respondents are happy with their appliance's durability.

Durability can be broadly described as the ability of a product to withstand wear, pressure, or damage over a long time. Durable products have a longer lifespan with lower maintenance costs. Overall, respondents were happy with their appliance's durability. As with the level of service, this may be because most of these products were purchased recently.

87% of TV owners stated that they were very satisfied or satisfied with their product's durability. Product durability was rated even better for refrigerators and SWPs, with none of the respondents indicating that they were unsatisfied or very unsatisfied. However, it's important to caveat that the sample size for refrigerators and SWPs is small, and so may not be representative of the market in this case. For example, Efficiency for Access found that market actors identified durability as one of the key challenges for SWPs. Some of these challenges include designing systems that can operate with dirty water⁵, and that can be used in areas with highly variable, site-specific conditions.⁶ A field study by Efficiency for Access⁷ also found that product malfunction and breakdown was one of the top challenges for SWP users.⁷

Most products come with a warranty, and SWPs had the longest warranty period by far.

The majority (79%) of households had a warranty with their product. When looking by appliance type, all SWPs and almost 80% of TVs had a warranty (Figure 2). The average warranty duration for surveyed TVs was 15 months. SWPs had the longest warranty period on average at almost four years (Figure 3), with one of the surveyed households stating that their SWP had a 10-year warranty from an unknown brand. Although the sample size of refrigerators is small, only half of the surveyed households had a warranty with their product, with the average warranty covering seven months.

For households that had their TV break down, over a third did not have their warranty honoured by the distributor or manufacturer.

None of the 11 solar refrigerator or water pump owners reported that their product had broken since purchase. This may be because SWPs and refrigerators in particular were purchased very recently. All but three of the SWPs and all but one of the refrigerators were purchased in the last two years. It is noteworthy, however, that two of the SWPs were purchased over 9 years ago, in 2006 and 2012, and the users reported that there was no break-down since the product was purchased.

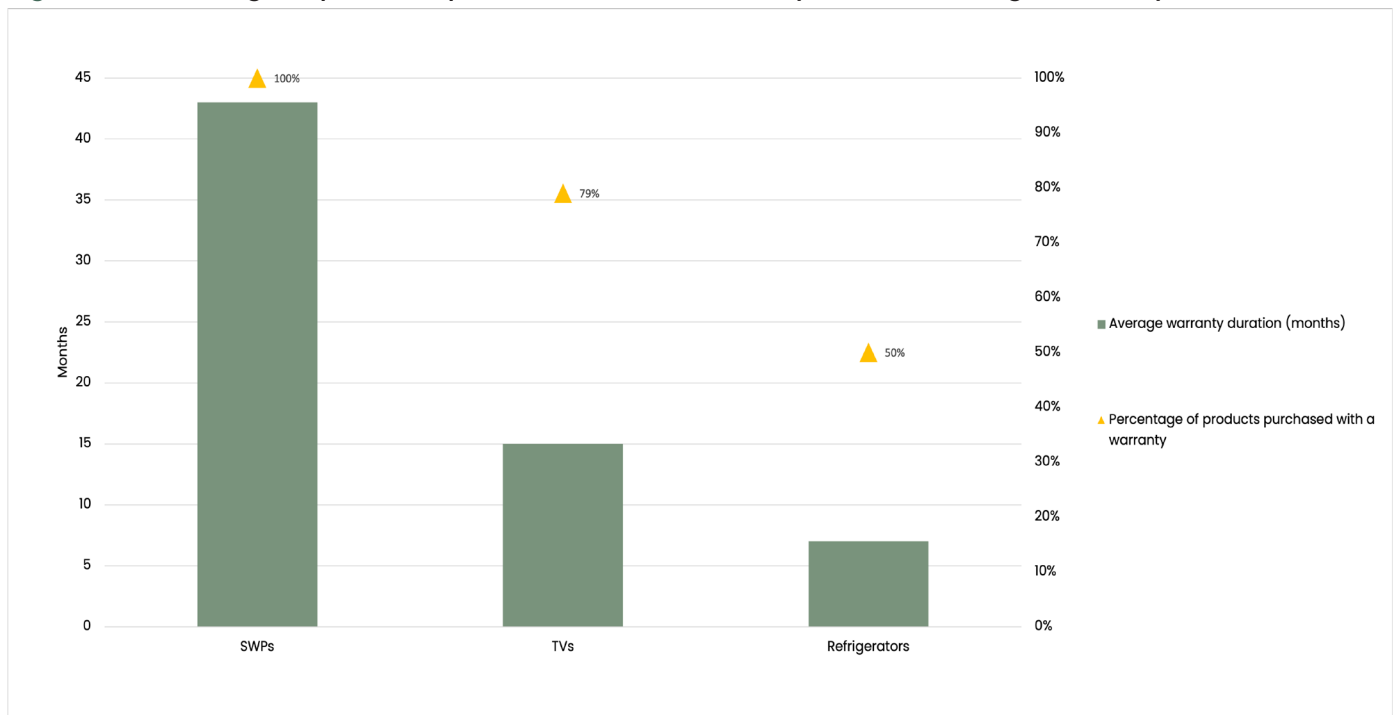
Of the 252 households that owned a TV, 10% said that their product had broken down, on average, after one year. Of the households who reported a broken TV, 72% had purchased a product covered by a warranty, meaning most should have had their product repaired or replaced if it was within the warranty claim period. However, of those claiming a warranty within their claim period (11 respondents), 36% did not have their warranty honoured, meaning they could not get their products fixed. While the reasons that caused the equipment breakdown are unknown, more work can be done to ensure that sellers and distributors of solar TVs in Kenya are honouring warranties.

5. Dirty water can contain 1) sand, which can cause abrasion and wear 2) clay, which can cause blockages and clogging, and/or 3) have high salinity, which can cause corrosion.

6. Efficiency for Access Coalition, [Solar Water Pump Durability Research Memo](#), 2020.

7. Efficiency for Access Coalition, [Use and Benefits of Solar Water Pumps](#), 2019.

Figure 2: Percentage of products purchased with a warranty and the average warranty duration



Appliance Use

Almost all households still use their solar appliance.

All the households with refrigerators and SWPs actively used their appliance, while 92% of TV owners were still using their products. Of the 8% of households who were no longer using their TV, most respondents indicated that this was because of non-payment on PAYG (so, the service was cut off by the energy service provider). The fact that almost all households were still using their TV, refrigerator, or SWP showed that the products continue to work and deliver value to consumers.

TV owners reported using their product over 6 hours a day, nearly every day of the week.

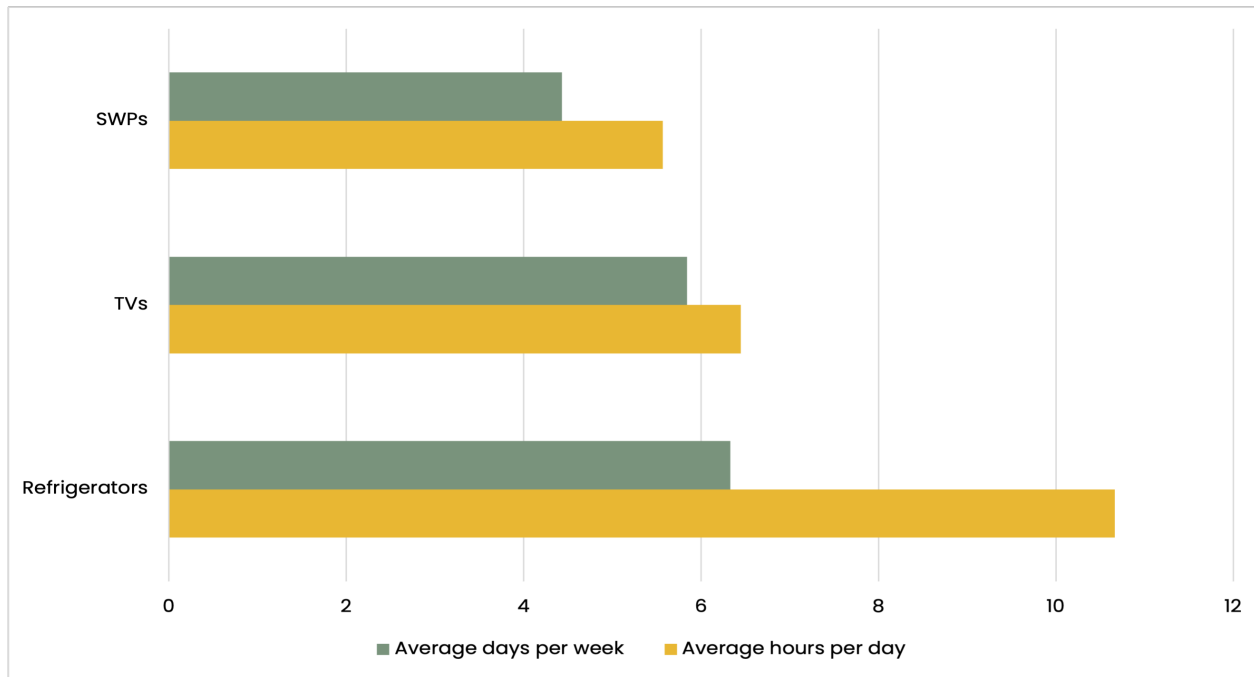
Figure 3 shows the average number of hours per day and days per week households reported using their appliance. Typically, in grid-connected households, refrigerators are always powered on. So, they are used 24 hours a day, 7 days a week. It's therefore unsurprising that the survey results found that households used refrigerators for the greatest number of hours per day and days per week compared to TVs and SWPs.

It's noteworthy, however, that respondents reported keeping their refrigerator powered for only 10.66 hours on average. This is consistent with observations from Efficiency for Access's refrigerator field testing project in Uganda. The field-testing data showed that some users were powering their refrigerator during the day and unplugging it at night to save energy.⁸

Households with TVs reported a relatively high usage, with an average of 6.5 hours of usage daily, almost every day of the week. SWP users reported the lowest usage. Like refrigerators, this is consistent with Efficiency for Access field testing observations which showed that most pump customers don't run their pump every day.

8. This field-testing data was unpublished due to a relatively small sample size.

Figure 3: Average daily and weekly usage by appliance type



TVs are primarily used for entertainment in household settings, with only a small percentage used for home-based businesses.

We also asked respondents what they use their appliances for. Households with TVs indicated that they primarily used them domestically for entertainment. Beyond entertainment, households also reported that they used their TV for education. TVs are vital in delivering national, regional and global information, especially for women and children living in rural areas. This is increasingly important during the COVID-19 pandemic to obtain important messages on public health and provide entertainment when social interactions are more limited.⁹ A small percentage, 3% of households with a TV, used their product for a home-based business.

Of the four households that owned a solar refrigerator, half indicated that they used their appliance for a home-based business, while the other half used it for domestic purposes. For SWPs, one household used their pump for a home-based business, and the remaining five households used their product for domestic use.¹⁰

Most households shared that this was their first time using a solar TV, refrigerator or SWP.

All SWP users and all but one solar refrigerator user had not used these products before, while 96% of households surveyed had not used a solar TV before. Since many of these customers are first-time users, providing comprehensive user instructions ensures that consumers install and operate their products correctly to prevent misuse. Overall, 80% of respondents indicated that they were satisfied or very satisfied with the user instructions for their solar TV, refrigerator and/or SWP. This satisfaction can also indicate the product quality of household appliances in the Kenyan market.

9. Efficiency for Access Coalition, [Appliance Data Trends Report](#), 2021.

10. The remaining household with a SWP used it for an 'other' unspecified purpose.



HOUSEHOLDS WITH TVS REPORTED A RELATIVELY HIGH USAGE, WITH AN AVERAGE OF 6.5 HOURS OF USAGE DAILY, ALMOST EVERY DAY OF THE WEEK.

Key Takeaways



Quality is a crucial consideration for Kenyan consumers when purchasing a solar appliance.

Respondents indicated that the top consideration when buying their solar appliance was quality, followed by price. The prioritisation of quality from consumers exemplifies the need and demand for quality assurance frameworks for off-grid appliances to ensure that products are working as expected and that consumers are informed on product performance and protected from poor quality products.



Ensuring that sellers honour warranties will be essential to improved consumer protection.

Most households indicated that they were satisfied with the durability of their solar appliance. Of the households surveyed with a TV, 10% reported that their product had broken down since purchasing it. Although this number is promising and suggests that most of these TVs are durable, 36% of those that claimed a warranty after the product had broken down did not have their warranty honoured by the manufacturer or distributor. The study found that most appliances rely on third-party distributors to provide after-sale services, but the distributors who may not have the incentive or capacity to follow up with consumers after purchases are made. This highlights a need to ensure distributors are aligned with the manufacturer's warranty, especially when users are in rural, hard-to-reach areas where spare parts or repair shops may not be accessible. In addition, building local capacity to provide high-quality maintenance, installation, and repair services is critical to improving product durability.



Appliance sales are driven mainly by rural customers, but there is a potentially untapped market for off-grid refrigerators in urban areas.

Overall, we estimate that 82% of households that currently own an off-grid appliance live in rural areas and 62% of the appliances estimated to be purchased over the next six months are demanded by rural households. On the other hand, the majority of surveyed households with a refrigerator are located in urban areas and refrigerators are most demanded by urban households. Although the estimated penetration of refrigerators in urban areas is relatively small (8,100 units), the estimated short-term demand is over 10 times that, at 81,200 units. This represents a significant potential market for off-grid refrigerators in urban Kenya. In order to convert this demand into sales, more work is needed to improve affordability, efficiency, and after-sales care, among other items.

The research generated through this survey and outlined in this report is designed to help market stakeholders and programs like VeraSol understand consumers' expectations related to off-grid appliances and help inform program design. If you are interested in learning more consumer insights on the quality of appliances and solar energy kits in Kenya, please read the full [Off-Grid Solar Consumer Research Study Report](#). If you have any additional insights or questions about this report, please contact info@verasol.org.

About VeraSol

An evolution of Lighting Global Quality Assurance, VeraSol supports high-performing, durable off-grid products that expand access to modern energy services. VeraSol builds upon the strong foundation for quality assurance laid by the World Bank Group and expands its services to encompass off-grid appliances, productive use equipment, and component-based solar home systems. VeraSol is managed by [CLASP](#) in collaboration with the [Schatz Energy Research Center at Cal Poly Humboldt](#). Foundational support is provided by the World Bank Group's Lighting Global program, UK aid, IKEA Foundation, and others. Please visit [VeraSol.org](#) for more information.



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