



TELEVISIONS

Solar Appliance Technology Brief

MAY 2021

EFFICIENCY FOR ACCESS COALITION

This television (TV) technology brief is one in a series of insight briefs developed to synthesise the latest market intelligence and chart the pathway to commercialisation for some of the off-and weak-grid appropriate technologies most relevant to catalysing energy access and achieving the Sustainable Development Goals.

The first iteration of the [LEIA Technology Summaries](#) was published in 2017 to help the newly established Efficiency for Access Coalition navigate a nascent market. At the time there was limited data and reliable research available on market trends and performance of appliances suitable for resource-constrained settings. This brief updates and expands on these summaries, bringing together the latest insights on market and technology trends, consumer impacts and pathways to scale for TVs. You can access briefs on all technologies that are a part of this series [here](#).

This brief was developed by CLASP and Energy Saving Trust as part of the Low Energy Inclusive Appliances programme, a flagship programme of the Efficiency for Access Coalition. It is a catalyst for change, accelerating the growth of off-grid appliance markets to boost incomes, reduce carbon emissions, improve quality of life and support sustainable development.

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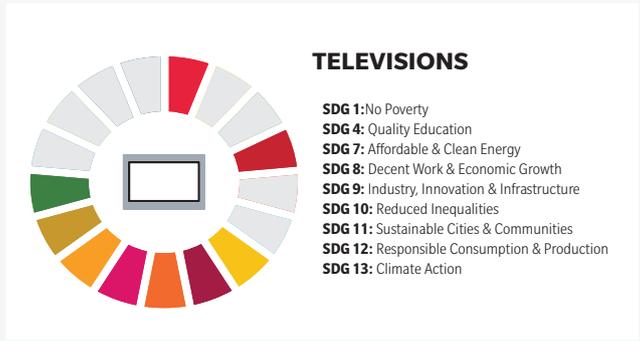


Introduction

Off-grid televisions (TVs)¹ consistently rank as one of the most popular off-grid appliances coveted by consumers in resource-constrained settings. While TVs are often associated with entertainment, they have the potential to drive significant social and economic benefits as a critical conduit for national, regional, and global information as well as a source of income for bars, restaurants and viewing halls.

Off-grid TVs, while similar in design to most on-grid models, must often operate in energy-constrained settings and under more extreme conditions. As a result, high quality TVs in the off-grid market are quite efficient and have resistance to dust, humidity, and voltage fluctuations. Some companies have also begun integrating internet connectivity into their TVs for greater customer convenience, as shown in Table 1. Many off-grid TV manufacturers also ensure that their products are accessible to first-time users with limited formal education. Their TVs include features like a user-friendly interface, remote control design and comprehensive remote call center support to ensure TVs are more accessible.

Some consumers prefer brighter screens, making TV luminance a key performance metric of off-grid TVs. Higher luminance, however, usually results in higher power consumption. Off-grid TVs are intentionally designed to work at lower luminance and often have ambient light sensors to dim brightness in response to their environment. In recent years, manufacturers have invested heavily in optimising LED backlit panels to increase television lighting efficiency. TVs that are more efficient require smaller PV panels and batteries to power them, making solar home system kits more affordable for consumers.



Televisions and access to cable are associated with and positive changes in school enrollment, literacy, family planning, financial decisions, and health. TVs are a vital conduit for national, regional, and global information, especially for women and children who often have less access to formal education. During the COVID-19 pandemic, TVs have provided essential public health information and offered entertainment.

State of Play

The commercial ecosystem for off-grid TVs has evolved quickly in recent years as the for high-quality, efficient off-grid TVs has expanded. Increased availability of TV brands and models is driving competition and economies of scale, resulting in substantial cost reductions. TV price index (price relative to size) has improved by 44% since 2016.³

Compared to other off-grid appliances, TVs are highly developed (see Figure 1 on page 4). Today’s TVs are more efficient than those available on the market at the time of the

Table 1. Key Off-Grid TV Characteristics²

Typical Product Size	Common Display Technologies	Average Retail Price	Rate Power Consumption	Performance Metrics	Technology Innovations
Small: 15” – 24”	Plasma display panel	Small: \$56 - \$195 (average \$115)	Small: 15 W - 39 W	Luminance (cd/m ²) Small: 51 – 387 cd/m ² Large: 133 – 230 cd/m ²	<ul style="list-style-type: none"> Resilient to voltage fluctuations Efficient optical films
Large: 24” – 32”	Light-emitting diode (LED) back-light liquid crystal display	Large: \$110 - \$257 (average \$181)	Large: 40 W - 30 W	Average EEI (sq. in/W) Small: 10.01 sq. in/W Large: 11.39 sq. in/W	<ul style="list-style-type: none"> Compatibility with relevant signal type, such as satellite, cable, or USB Integrated internet connectivity or battery Laminated glass screens

1. This brief focuses on TVs specifically designed for off-grid and weak-grid use, and does not consider models designed for use in on-grid settings.

2. Efficiency for Access, 2021 Appliance Data Trends. (2021), <https://efficiencyforaccess.org/publications/2021-appliance-data-trends>.

3. Id.

first [LEIA TV technology summary](#) in 2017. Average off-grid TV efficiency improved by 48% from 2016 to 2021.⁴ Many off-grid TVs available on the market today far exceed the efficiency of best-in-class TVs sold in off-grid retail markets in 2017.⁵ Due to the need to perform in energy-constrained environments, the best available TVs sold in off-grid markets are more efficient than conventional products sold in Europe. Despite these promising trends, efficiency still varies widely between models due to a lack of standards in the sector. Testing of over 150 off-grid TVs reveals the most efficient product is a 32-inch model that consumes only 8 Watts (W)—significantly less than most small- and medium-sized TVs.^{6,7} Many similar-sized TVs sampled from African markets consume 20-40 W, 2.5-5 times more power than the most efficient models.⁸

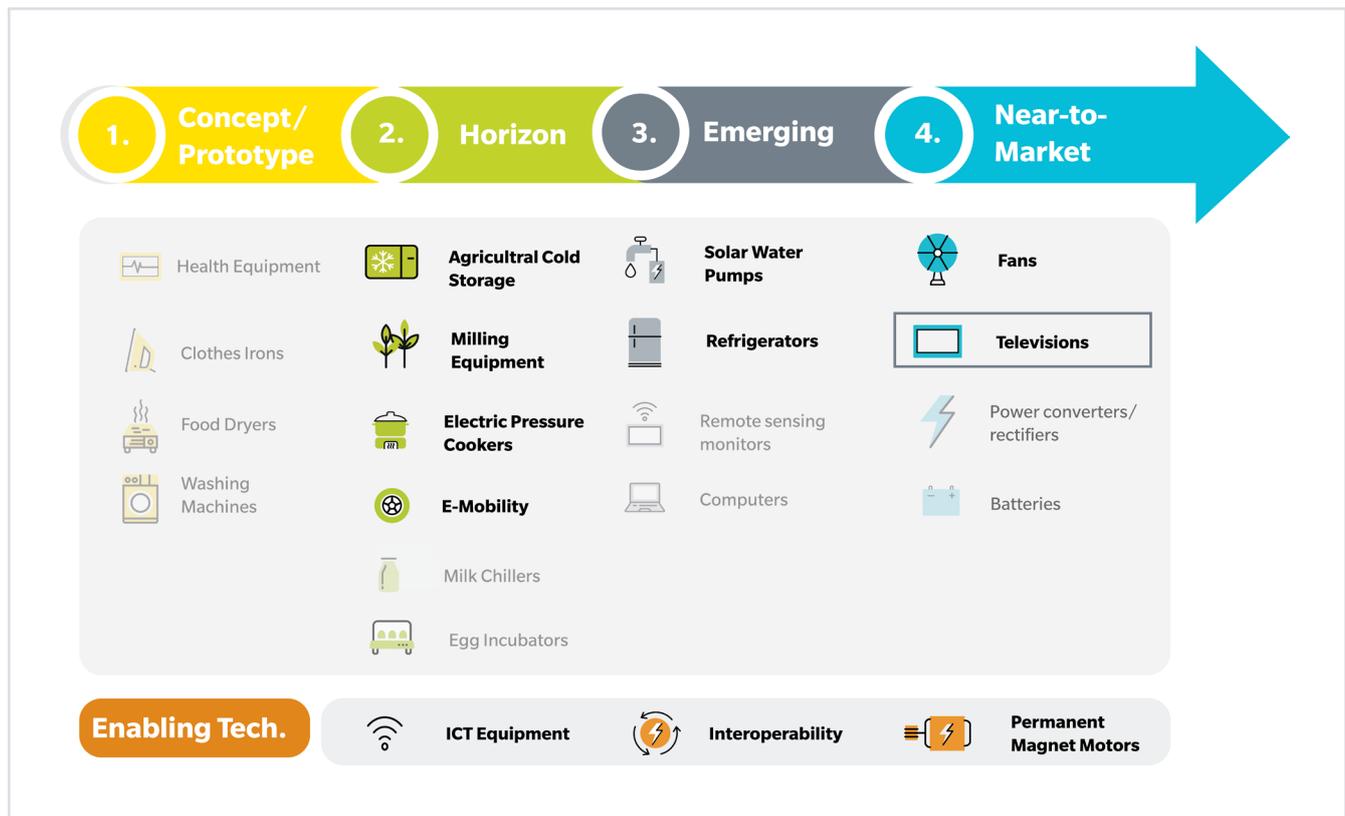
When solar companies first offered TVs with solar home system kits less than a decade ago, brand and screen size options were limited. In 2014, most screens were smaller than 20 inches. However, as the market matures and solar home system capacity increases, so does consumer demand for larger TVs. A growing number of off-grid TVs now have screens larger than 30 inches, with the largest measuring 38.6 inches.⁹

Larger TVs are becoming highly efficient, making the difference in power consumption between large and small or medium sized TVs minimal. This makes it possible for consumers to upgrade to a larger model without investing in larger solar panels or an expanded battery capacity. Large TVs therefore may present a good investment opportunity for commercial users by providing a better viewing experience for customers without increased energy requirements.¹⁰

Market Insights

TVs are the most desired appliances among off-grid consumers after lighting products.¹¹ They are a critical driver of off-grid solar adoption in many markets¹² and the most common motivation for existing solar home system customers with small systems to upgrade to larger systems. Increasing off-grid TV uptake has also spurred the development of a wider range of entertainment content developed specifically for off- and weak-grid customers (see Box 1 on page 7).

Figure 2. Relative Maturity of Select Appliances



4. Id.

5. Id.

6. Id.

7. This analysis is based on the information available in the [VeraSol Product Database for TVs](#).

8. Efficiency for Access, 2021 Appliance Data Trends.

9. Id.

10. Despite the trend of increasing off-grid TV efficiency, many distributors offer larger solar energy systems with TVs to match increases in average viewing time.

11. Efficiency for Access Coalition, 2020 Off-Grid Appliance Market Survey. (2020), <https://efficiencyforaccess.org/publications/off-grid-appliance-market-survey-2020>.

12. GOGLA, Powering Opportunity. (2020), https://www.gogla.org/sites/default/files/resource_docs/powering_opportunity_global_report.pdf.

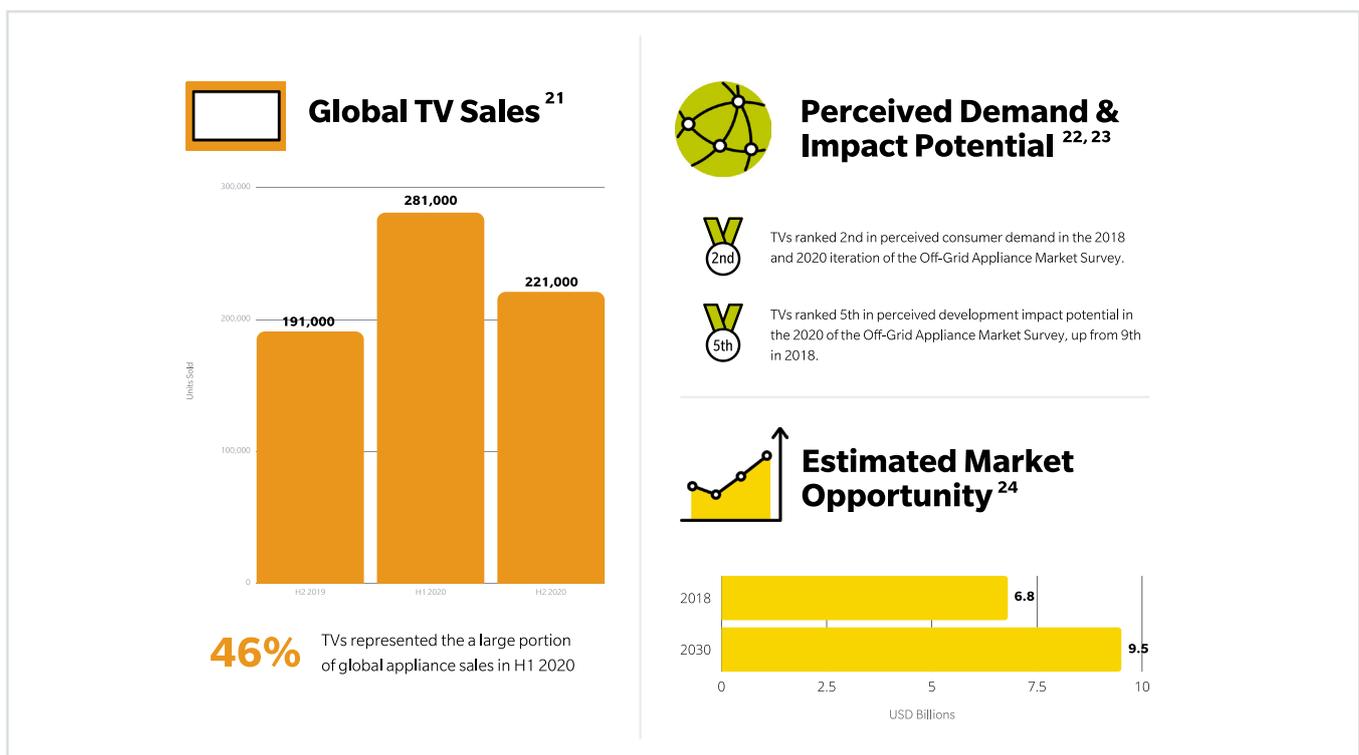
Global off-grid TVs sales are relatively high compared to other off-grid appliances. GOGLA affiliates sold 472,000 TVs in 2019, compared to just 8,200 refrigerators (link to fridge tech summary).^{13,14} The rapid growth of the off-grid solar sector, TV performance and quality enhancements and market improvements have all helped lower prices and make TVs more accessible for consumers. The most recent analysis estimates that the market opportunity for off-grid TVs stands at USD 8.2 billion globally by 2025 and at USD 9.5 billion by 2030 (Figure 3).¹⁵

While the market potential for off-grid TVs is growing, estimated market penetration remains limited at 66% in India, 35% in Sub-Saharan Africa and just 18% in rural Sub-Saharan Africa.¹⁶ Last-mile distribution challenges and the insufficient consumer financing prevent the market from reaching its full potential. When taking existing distribution and financing challenges into account, the available off-grid TV market is 36 million households.¹⁷ If financing were widely available, the market would encompass 221 million households, roughly half of all off- or weak-grid households.

Figure 4 highlights the critical role of consumer financing in TV sales. 94% of the 221,000 TVs GOGLA affiliates sold in the first half of 2020 (January through June 2020) were sold via Pay-as-You-Go (PAYGo).¹⁸ Though TV affordability is improving, upfront costs are still too high for consumers to pay out of pocket. Furthermore, 80% of TVs are sold with a power system, a larger investment typically requiring consumer financing. The large share of PAYGo-financed TVs also reflects that the biggest market for TV sales is currently in Sub-Saharan Africa, where the PAYGo market is strong.

TVs sales vary widely by region, with sales in Sub-Saharan Africa far outpacing sales in South Asia (see Table 3 page 6), where sales of other appliances far outpace TV sales. Between July and December 2019, GOGLA affiliates sold more than 111,000 fans in South Asia, compared to less than 500 solar TVs.¹⁹ This is partly due to a higher demand for cooling in South Asia's hotter, more humid climate, but also low awareness and limited market presence of DC TVs.²⁰ Within Sub-Saharan Africa, East Africa has the largest regional off-grid TV market, due in part to higher disposable incomes and a more developed off-grid solar market.

Figure 3: Off-Grid Television Market Overview



13. Affiliates include GOGLA members, companies selling products that meet Lighting Global Quality Standards, and appliance companies of the Global LEAP Awards or the Low Energy Inclusive Appliances (LEIA) programme.

14. GOGLA, Efficiency for Access and World Bank, Global Off-Grid Solar Market Report H1 2020 (Sales and Impact Data). (2020), <https://www.gogla.org/resources/global-off-grid-solar-market-report-h1-2020-sales-and-impact-data>.

15. Efficiency for Access, 2019 State of the Off-Grid Appliance Market.

16. Efficiency for Access, 2019 State of the Off-Grid Appliance Market. (2019), <https://efficiencyforaccess.org/publications/2019-state-of-the-off-grid-appliance-market-report>.

17. Id.

18. GOGLA, Efficiency for Access and World Bank, Global Off-Grid Solar Market Report H1 2020.

19. Efficiency for Access, 2020 Off-Grid Appliance Market Survey.

20. Efficiency for Access, Off- and Weak-Grid Solar Appliance Market: India. (2020), <https://efficiencyforaccess.org/publications/off-and-weak-grid-solar-appliance-market-india>.

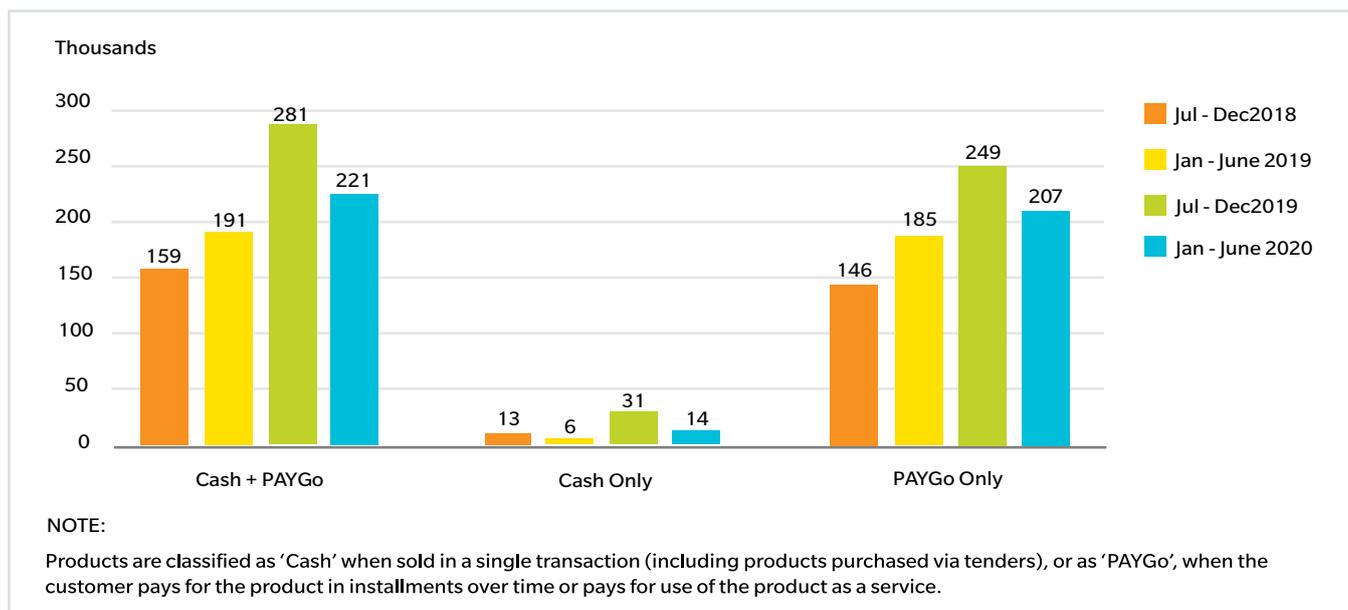
19. GOGLA, Efficiency for Access and World Bank, Global Off-Grid Solar Market Report H1 2020.

20. Efficiency for Access, 2020 Off-Grid Appliance Market Survey.

21. Id.

22. Efficiency for Access, 2019 State of the Off-Grid Appliance Market.

Figure 4. Semi-Annual Evolution of Global TV Sales by GOGLA Affiliates



Source: GOGLA

Table 3. Semi-Annual Evolution of Global TV Sales by GOGLA Affiliates³³

Time Period	Global	South Asia	Central Africa	West Africa	East Africa
Jan - Jun 2019	191,000	4,328	15,000	52,000	113,000
Jul - Dec 2019	281,000	4,858	24,000	67,000	180,000
Jan - Jun 2020	221,000	159	22,000	40,000	157,000

Consumer Impacts

Existing research shows that TVs unlock significant social and economic impacts, and contribute to ten of the United Nation’s [Sustainable Development Goals](#) (see SDG Interlinkages on page 3). TVs are a vital conduit for national, regional and global information and insight, especially for those women and children with limited to access education. According to a 2017 survey of 250 first-time M-KOPA TV customers, 47% of respondents reported that their primary reason for buying an off-grid TV was “to be informed by news/educational programmes.”²⁵

During the COVID-19 pandemic, interest in TVs has grown, as they have provided essential public health information and offered entertainment while stay at home orders were in place. Prior to the pandemic, many people in rural off-grid communities received news and health guidance from members of their community. With social distancing and lockdowns in effect, however, many lost their source of news and information. Off-grid TVs have helped ensure that households receive up-

to-date pandemic information directly during lockdowns.²⁶ Educational content can also enable home schooling programmes so that children may continue their education when schools are closed.

As noted in the 2017 version of this brief, research shows associations with the introduction of cable TV and positive changes in school enrollment, literacy, family planning, financial decisions and health. In India, it was associated with a “significant decreases in the reported acceptability of domestic violence toward women and son preference, as well as increases in women’s autonomy and decreases in fertility.”²⁷ The same study found evidence that “exposure to cable [television] increases school enrollment for younger children, perhaps through increased participation of women in household decision making.”²⁸

Consumer perspectives highlight TVs’ many impacts. In a survey of over 2,300 TV customers, 93% of respondents reported an improvement in their quality of life after purchasing

25. M-KOPA, Tuned In: Television and civic engagement in off-grid society, 2017, https://sun-connect-news.org/fileadmin/DATEIEN/Dateien/New/TUNED_IN.pdf.

26. Power Africa, “Information Needs Drive Demand for Off-Grid Solar Products,” 2020, <https://powerafrica.medium.com/information-needs-drive-demand-for-off-grid-solar-products-984cd316bfc0>.

27. Efficiency for Access, Low-Energy Inclusive Appliance Technology Summaries. (2017), <https://efficiencyforaccess.org/publications/low-energy-inclusive-appliance-technology-summaries>.

28. Id.



Kenya

INCREASING CONTENT OPTIONS AND INTEGRATED SOLAR TVS

Entertainment content is particularly important for television owners. Distributors have observed increases in off-grid TV sales around major sporting events. Azuri has partnered with Zuku, a Kenyan television service provider, to launch a pay-as-you-go satellite television package offering customers a suite of Zuku-branded channels. Once customers own the equipment, they only pay for the content subscription service.

As customers' average viewing hours rise – in part due to the increasing availability of content – TVs are expected to operate for longer periods. Cello Solar, an associate company of leading LED TV brand, Cello Electronics, offers the first TV with an integrated battery. In addition to the battery, their standalone solar TV incorporates the charge controller, battery, satellite tuner and USB for device charging.

Kenya

DRIVING DEVELOPMENT WITH CREATIVE CONTENT

Targeted educational TV content can drive important development impacts for off- and weak-grid consumers. In East Africa, the Mediae Company has been producing their “[Shamba Shape Up](#)” series for over 5 years. The show targets farmers and provides both entertainment and accessible education on a range of topics, including soil fertility, poultry,

crops and livestock. The show's tenth season saw weekly audiences of more than [6.8 million Kenyan adults](#), with 96% reporting that they learned something new while watching. 63% of farmers who made changes after watching the series reported better yields and incomes.

a TV.²⁹ 32% of respondents reported improved well-being/joy and connectedness, 25% reported increased access to information and education and 10% reported improved family connections.³⁰

In addition to domestic benefits, many business owners and entrepreneurs use TVs for commercial purposes. 9% of respondents reported using their TV to generate additional income.³¹ Some respondents established viewing halls, while others installed their TVs in bars to attract more customers. Field research also indicates that the increasing availability of larger TVs can inspire the development of new businesses such as village theaters.³²

Current Success and Remaining Challenges

The off-grid TV market has shown promising improvements in price, efficiency and innovation since 2017. However, the market must still overcome new and remaining challenges to reach more households.

Successes

Increasing Efficiency: The 2017 iteration of this brief identified ample opportunity for TV efficiency gains. At that time, initial research indicated that improvements in backlight technology alone could reduce the average TV's total energy consumption by 20-24%.³⁴ Since 2016, average TV efficiency has improved by 48%, effectively doubling that estimate and representing an important success story for the broader off-grid appliance market.³⁵

Innovative Technology: Technology improvements are rapidly enabling customers to enjoy larger, higher-performance TVs at similar prices to much smaller models just a few years ago. Recent design innovations, such as TVs with integrated batteries or internet connectivity, have helped improve customer experience further.

Decreasing Prices & Growing Sales: TV prices continue to decrease, falling by 44% since 2016.³⁶ TV sales have increased since 2017, with GOGLA affiliates' global TV sales reaching 472,000 in 2019.³⁷ Moving forward, achieving a balance between cost, efficiency and quality will be key to realising the market's full potential size.

Challenges

Affordability & Access to Consumer Finance: Compared to the broader off-grid market, TVs are one of the cheapest appliances – especially as prices continue to fall. However, their upfront cost still keeps them out of reach for many off-grid consumers. Only 4.5 million households – 1% of all off- and weak-grid households globally – are able to afford a TV in a cash sale.³⁸ The success of the PAYGo market illustrates how consumer financing can help improve TV affordability. However, traditional lenders, like banks, often choose not to provide loans to off-grid solar customers because of the high cost to serve and reach them, as well as their perceived higher risk profile.

Last Mile Distribution: Off- and weak-grid TV distributors often struggle with supply chain logistics. Last mile distribution can be very costly given the fragility of TVs, the remoteness of some customers and the frequently poor quality of rural roads. One off-grid TV distributor reported that transportation challenges have limited the size of TVs they offer to last mile consumers. Screen sizes above 32 inches have proven too large to carry on the back of motorcycles. Managing distribution issues while keeping TV costs affordable presents a challenge for the sector.

Lack of Quality Guidance: Inconsistencies in performance reporting and lack of reliable data make it difficult for buyers to identify high-performing TVs among what is offered in the market. TVs are a significant expense for most off-grid consumers. Ensuring that products are high-quality and perform as expected is crucial. Existing regulations – or the lack thereof – pose another problem for stakeholders. Though some off- and weak-grid TVs already meet or exceed the standards of the European Union or other stringent countries, others still fall short of being both high-performing and efficient. Developing appropriate regulations and standards can help guide the market to improved TV quality, but will require alignment on key quality criteria among product manufacturers, programs and policymakers.

Increasing Competition for Manufacturers: The off-grid market for TVs has developed and commoditised since 2017, and its growth is projected to continue. As the market matures and becomes more competitive, it is becoming increasingly challenging for TV manufacturers to differentiate their products. Quality considerations (including durability, warranty and safety) and additional user-friendly features will likely be elevated in purchasing and investment decisions in the near future. Ultimately, an increasingly competitive and mature market should benefit off-grid consumers.

31. Id.

32. Efficiency for Access, 2021 Appliance Data Trends.

33. GOGLA, Efficiency for Access and World Bank, Global Off-Grid Solar Market Report H1 2020

34. Efficiency for Access, Low-Energy Inclusive Appliance Technology Summaries, page 14.

35. Efficiency for Access, 2021 Appliance Data Trends.

36. Efficiency for Access, 2021 Appliance Data Trends.

37. GOGLA, Efficiency for Access and World Bank, Global Off-Grid Solar Market Report H1 2020.

38. Efficiency for Access, 2019 State of the Off-Grid Appliance Market.

39. Efficiency for Access Coalition, The Use and Impacts of Solar TVs. (2020), <https://efficiencyforaccess.org/publications/the-use-and-impacts-of-solar-tvs>.

40. Id.



Increase access to consumer financing

Improving access to consumer financing remains critical to reaching new customers. In India, only 5% of customers living in off-grid and weak-grid areas could afford a TV. However, that number jumps to 75% if financing is available.³⁹ Specialist financiers—such as microfinance institutions, mobile money providers and other technology-enabled companies—can target customers not typically served by traditional finance institutions and design business models tailored to the needs of base-of-the-pyramid customers. Utility-enabled appliance financing offers an alternative for weak-grid customers who are often not served by traditional lenders nor specialist financiers.⁴⁰



Make TVs more affordable to consumers

In 2019, the average retail price of off-grid TVs was USD \$100.⁴¹ While improved access to financing can increase TV adoption, prices must decrease for the market to reach its full potential. Innovative programmes like Global LEAP Results-Based Financing (RBF)⁴² can help catalyse cost reductions and increase market growth. Under the Global LEAP RBF, off-grid solar companies receive financing incentives to purchase and distribute best-in-class off-grid appliances. The programme catalyses the uptake of high quality super-efficient appliances by lowering the cost to procure large volumes of best-in-class off-grid appliances for early mover off-grid solar companies and making products more affordable for customers. Similar financing or incentive efforts can help drive down product distribution costs and move products into new markets.



Improve last mile distribution

Distributors need to establish a strong supply chain and effective last mile distribution strategy to reach more rural consumers. A tight network of distribution points are vital to efficient and secure TV delivery. While last mile distribution of TVs can be costly, it is crucial to increasing penetration among off- and weak-grid customers, especially in rural areas. The Global Distributors Collective is an example of one initiative working to address last mile distribution challenges. With over 200 members in 50 different countries, the collective provides centralised resources like training, innovation pilots and learning events.⁴³



Promote interoperability

Promoting interoperability for TVs and the broader off-grid appliance market would lower costs, increase customer flexibility and enable a secondary resale market. Some stakeholders are already working to enhance product interoperability and raising awareness of its importance. Solaris Offgrid has developed an open source standardised PAYGO appliance communication protocol⁴⁴ and the GOGLA Technology Working Group is currently focusing on an interoperability initiative. Companies like Angaza are already embracing interoperability.⁴⁵

41. Efficiency for Access, 2021 Appliance Data Trends.

42. Global LEAP Awards, "Results-Based Financing" (2021), <https://globalleapawards.org/results-based-financing>.

43. Global Distributors Collective, "Global Distributors Collective," 2020, <https://globaldistributorscollective.org/>.

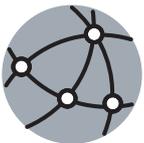
44. Efficiency for Access, "Solaris Offgrid develops innovative OpenPAYGO Link project with support from Efficiency for Access Research and Development Fund," 2021, <https://efficiencyforaccess.org/updates/solaris-offgrid-develops-innovative-openpaygo-link-project-with-support-from-efficiency-for-access-research-and-development-fund>.

45. PaygOps, "PaygOps, Paygee and Angaza are becoming interoperable!" 2021, <https://www.paygops.com/post/paygops-paygee-and-angaza-are-becoming-interoperable>.



Define product quality standards

Despite the prominence of TVs in off-grid markets, stakeholders lack the resources they need to compare and differentiate the quality of standalone products independent from solar home system kits. Furthermore, while many off-grid TVs are more efficient than on-grid European models, the least efficient off-grid TVs are far below the EU's minimum TV efficiency requirements. Although there is no formal framework in place to evaluate the quality or efficiency of off-grid TVs or other appliances on a continuous basis, quality assurance programmes like VeraSol⁴⁶ act as an important first step in closing the information gap on appliance performance.⁴⁷ Through this work, Efficiency for Access has developed and piloted a quality assurance (QA) framework.⁴⁸ This includes developing a set of quality criteria, product testing and evaluations using the established quality criteria, and sharing testing data with stakeholders to promote quality products. Scaling up this initiative and developing stronger performance regulations, especially minimum energy performance standards, will help increase the number of efficient, high-quality TVs in the market.



Build a strong enabling environment

Supportive import policies can level the playing field for manufacturers and distributors of high-performing TVs. Governments can impose new policies, improve existing policies, and develop strategies (e.g. reduce import taxes, tariffs and value added taxes) that favour high-quality, energy-efficient TVs. They can specifically refine existing tax exemption codes for solar energy kits, which are difficult to utilise due to the absence of solar appliance-specific codes. Furthermore, most existing tax exemption schemes are not tied to quality standards. Reorienting these codes to create a favourable tax policy environment for high-quality products can help drive market growth and prevent spoilage.

46. VeraSol supports high-performing, durable off-grid solar solutions that expand access to modern energy services. An evolution of Lighting Global Quality Assurance, VeraSol strives to make safe, affordable, and durable products the default option in the market. VeraSol builds upon the strong foundation for quality assurance laid by the World Bank Group and expands the quality assurance framework to encompass appliances and productive use equipment.

47. Verasol, "Verasol: Quality Assurance for Modern Off-Grid Solar Solutions," 2021, <https://verasol.org/>.

48. To view the quality assurance framework, visit: <https://efficiencyforaccess.org/publications/quality-assurance-for-off-grid-tvs-and-fans>.

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