

TECH TRENDS IN ENERGY ACCESS:

ASSESSING THE OFF-GRID FAN MARKET



Part of the
Efficiency for
Access Appliance
Tech Trends
Series

FEBRUARY 2024

Efficiency for Access Coalition

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This market summary was authored by Siena Hacker (CLASP). We thank Jeff Stottlemeyer, Lisa Kahuthu, Monica Wambui, and Yasemin Erboy Ruff (CLASP), Jakub Vrba and Leo Blyth (Energy Saving Trust) for their review and input.

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CITATION AND COPYRIGHT

Efficiency for Access Coalition, Tech Trends in Energy Access: Assessing the Off-Grid Fan Market, February 2024, <https://efficiencyforaccess.org/publications/2023-tech-trends-in-energy-access>

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The global off-grid fan market is exhibiting signs of recovery, after facing a downturn triggered by the COVID-19 pandemic. However, the current pace of growth is not yet sufficient to meet the essential cooling needs of millions in the face of severe climate change. To broaden access and save lives, increased support is needed to scale the market.

In a companion report published as part of the [Efficiency for Access 2021 Solar Appliance Technology briefs](#), Efficiency for Access (EforA) initially projected a cumulative global market potential of US \$1.5 billion and a reach of 48 million households by 2030 for off-grid and weak-grid fans. Given the pandemic-induced sales downturn, these estimates now appear challenging.

Key findings:

- Global fan market sales are rebounding following a prolonged downturn caused by the pandemic.
- The Sub-Saharan Africa fan market, particularly driven by West Africa, has witnessed significant expansion, constituting 40% of total global sales in 2022.¹
- For the 1 in 7² people that do not have adequate access to cooling, fans will play an increasingly imperative and cost-effective role as climate changes continues to expose more people to extreme heat.
- Manufacturers, distributors, and consumers are all in need of financing. This is the biggest barrier to scaling the market.

As the impacts of climate change increase, fans can play a critical role in delivering cost-effective cooling services that can be life-saving, especially for those in extremely hot conditions. However, without robust support from sectoral stakeholders, millions of households will miss out on fans' widespread socio-economic benefits.

OFF-GRID FAN MARKET AT A GLANCE

This report provides valuable insights into the evolving off-grid refrigerator market. It examines trends among manufacturers and consumers, identifying performance and affordability enhancement opportunities. It also offers practical advice for stakeholders, including policymakers.

Call to action:

- Encourage manufacturers to develop efficient solar-powered fans suited for off-grid use. This will increase access to cooling within rural and hard-to-reach areas.
- Establish rigorous quality frameworks to protect consumers and encourage the use of energy-efficient fans, similar to the successful model in Pakistan.
- Conduct education campaigns to highlight the benefits of energy-efficient off-grid solar fans, to shift consumer purchase decisions from being price-focused to quality and efficiency-focused.
- Policymakers to create regulatory and policy frameworks that support the off-grid solar fan market, such as reducing taxes on off-grid fan components to promote local assembly and manufacturing, as seen in India.
- Provide a variety of financing options, such as microfinance and bank loans, to support stakeholders across the fan value chain.



MARKET TRENDS AND INSIGHTS

MARKET DYNAMICS AND CONSUMER CHOICES

Market Maturity

The off-grid fan market is comparatively more mature and leads all other solar appliances in global off- and weak-grid sales. This is partly because of the widespread commercial market for grid-connected fans worldwide, which benefits from economies of scale and encourages investment in product development. In South Asia, which has the highest off-grid fan sales globally, a rising number of on-grid fans now incorporate DC (direct current) circuitry and Brushless DC (BLDC)/permanent magnet motors technology. These technological features are much more common in off-grid fans, and demonstrate how the markets for off-and-weak grid fans are beginning to intersect and overlap in more prominent ways.

In the latest GOGLA sales and impact dataⁱ report, fans constituted a substantial 60% of all primary appliance sales,ⁱⁱ with over 385,000 units sold during the latter half of 2022.ⁱⁱⁱ In comparison, GOGLA affiliates sold just 15,272 solar water pumps in the same period.

Fans' popularity is largely attributable to their comparatively lower price point and technological complexity when contrasted with other solar appliances. While fan demand remains robust around the world, significant regional disparities exist, as explored further in the Regional Variation section.

Market Sizing

In 2021, EforA projected that the global off- and weak-grid fan market would reach USD \$1.5 billion and deliver cooling to 48 million households by 2030.³ However, these projections need to be modified down in light of recent declines in fan sales. The onset of the COVID-19 pandemic triggered a substantial slowdown, as global lockdowns, decreased incomes, and other pandemic-related impacts resulted in a 54% reduction in sales compared to the preceding year.

Following the gradual return to a business environment more akin to the pre-COVID context, fan sales have shown signs of resurgence. Figure 1 shows how fan sales reached an impressive 788,469 units during the the first half of 2023, reflecting the market's continued annual growth since 2021. These numbers are evidence of the market's resurgence, especially when considering the severity of supply chain disruptions and other pandemic-related challenges that companies worked to overcome.

It is essential to note that this increase is partly attributed to the expansion in the number of companies participating in fan sales reporting, rendering direct comparisons with prior years somewhat challenging. Despite this resurgence, further sales acceleration is imperative to realize the ambitious 2030 targets outlined in our initial assessment.

Regional Variation

South Asia's Cooling Dominance

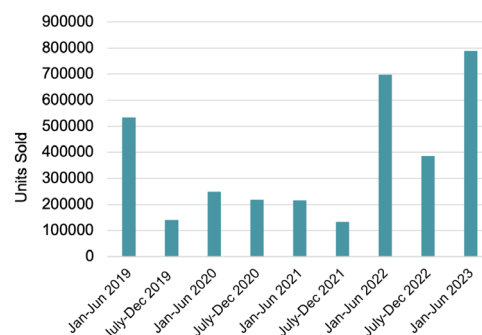
Historically, South Asia has dominated the global fan market, representing an impressive 73% of GOGLA affiliates' total fan sales in the first half of 2023.⁴ This can be attributed to the scorching and humid climates experienced across many countries in the region. In these conditions, fans play a pivotal role in maintaining comfortable living environments, particularly crucial for vulnerable populations such as women and children. In South Asia, solar fan sales extend to grid-connected households frequently plagued by power outages, where off-grid fans serve as a dependable alternative cooling solution.

Sub-Saharan Africa's Growing Influence

Our 2021 assessment⁵ identified the Sub-Saharan African (SSA) fan market as relatively modest, accounting for approximately 25% of the global market during the second half of 2019.^{iv} However, as indicated in Figure 2, the SSA fan market has experienced significant expansion in recent years, primarily driven by West Africa.

In the latter half of 2022, fan sales by GOGLA affiliates in SSA surged to represent 40% of the total global sales volume, reflecting substantial growth.^{vi} Notably, the Nigerian market emerged as the key driver in the region,⁶ boasting rural penetration rates nearly five times higher than other regions.

Figure 1. GOGLA Affiliates Global Fan Sales



i GOGLA Affiliates represent 28% of the off-grid solar market. Affiliates are GOGLA members, companies selling products that meet VeraSol quality standards, and appliance companies that participated in the Global LEAP Awards or are engaging with the Low Energy Inclusive Appliances (LEIA) program.

ii Key appliances include fans, televisions, refrigerators, and solar water pumps.

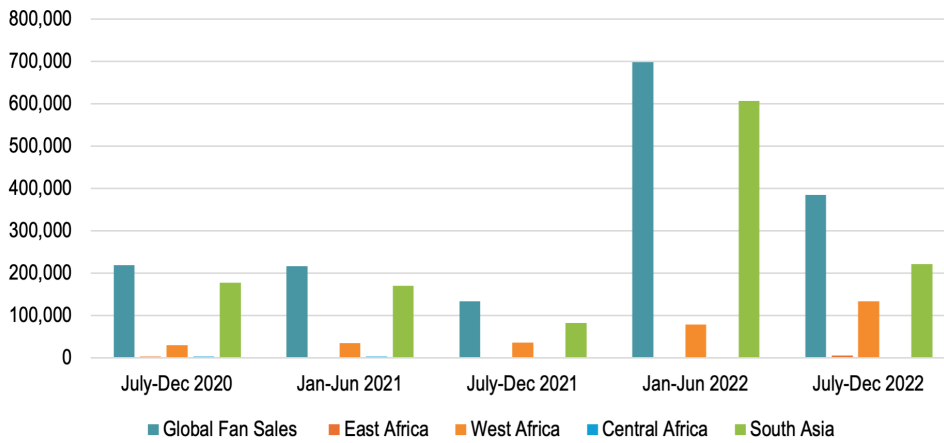
iii Importantly, this total represents a 28% decrease from the first half of 2022. This decrease is expected and is tied to strong seasonal sales trends, with sales increasing in South Asia during the warmer first half of the year.

iv These numbers reflect the seasonal variation mentioned earlier: Distributors stock up on fans in the first half of the year due to rising heat and humidity, and there was a change in company participation in the second half of 2022.

v Inconsistent company participation in data collection for fans in South Asia makes confirming trends challenging. Anecdotal evidence, however, points to decreased market size after restrictions and slowdowns related to the COVID-19 Pandemic.

vi Note that this data is based on GOGLA data from the second half of 2022, as this region-specific information was not released in for the first half of 2023.

Figure 2. Fan Sales Over Time, by Region



This remarkable performance can be attributed to Nigeria's relatively advanced off-grid market compared to its West African counterparts, the persistent demand for fans in the country's sweltering and humid climate, as well as the country's supportive enabling environment, including solar subsidy programs, that have helped drive the solar sector's growth.

As fan sales continue to flourish across both regions, key differences surface between these markets. These distinctions encompass variations in sales mechanisms and fan types:

- **Market Diversity:** In the South Asian solar appliance market, GOGLA affiliates' fan sales account for a remarkable 99% of all appliance sales in the second half of 2022.⁷ In contrast, the SSA market exhibits slightly greater diversity, with fan sales constituting approximately 90% of the market. Solar water pump and refrigerator sales in the region have also risen in recent years.
- **Sales Mechanism:** In South Asia, fans are typically sold on a cash basis, with component-based sales being the norm, and they are infrequently bundled with solar energy kits. Conversely, in SSA, 86% of fans are bundled with power systems, often solar home systems, and 98% are sold through pay-as-you-go arrangements.^{vii}
- **Fan Type:** SSA predominantly favors table and pedestal fans, often bundled with solar home system kits. In contrast, South Asia exhibits a preference for ceiling fans, which are larger and more powerful.
- **Seasonal Variation:** South Asia experiences a distinct seasonal variation in fan sales, particularly in countries like Pakistan, where rising temperatures prompt distributors to stock up on fans during the

first half of the year. In contrast, fan sales in SSA remain relatively consistent throughout the year, with seasonal fluctuations being less pronounced.

Technology Advancements

Since our 2019 market assessment, there have been notable strides in enhancing the performance and efficiency of off-grid and weak-grid fans. As highlighted in our 2021 report, fan blade design enhancements showed significant efficiency potential. Particularly, the adoption of tapered and twisted blade designs demonstrates the potential to increase efficiency by up to 15%,⁹ ensuring a more robust airflow.

Moreover, the integration of brushless DC and permanent magnet motors represents a significant development for elevating fan efficiency,⁹ as well as bolstering their reliability and ease of repair.¹⁰ In certain instances, incorporating these highly efficient motors has shown the capacity to curtail energy consumption by nearly 50%.¹¹ However, it is important to acknowledge that such advancements may come at an increased cost. For instance, one Pakistani fan manufacturer reported a 32% price escalation (approximately USD \$6) when using a BLDC motor.

Although the higher upfront cost may raise concerns among price-sensitive consumers, this increase is mitigated, to some extent, by the reduced size of the required solar home system to power these more efficient fans. A successful push to improve the efficiency of the Pakistani market is detailed in the Case Study 1.

vii These figures are based on the GOGLA affiliates' sales data from the second half of 2022.

AFFORDABILITY ASSESSMENT

In our 2021 assessment, we observed a downward trend in fan prices, with reductions of up to 47% between 2016 and 2018. However, the onset of lockdowns and restrictions during the COVID-19 pandemic reversed this trajectory. Fan prices increased due to supply chain disruptions that raised costs for electrical components, raw materials such as aluminum and copper, and shipping.¹² Consequently, fan affordability has decreased, limiting accessibility for many consumers. Recent survey data reveals a notable 9% increase in average consumer prices for fans over the past two years.^{viii}

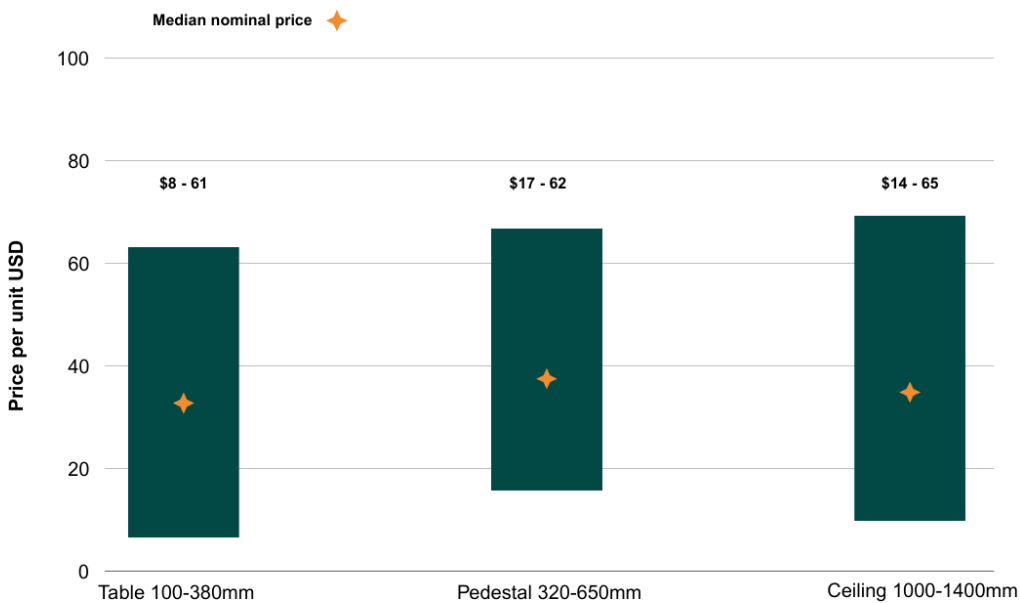
Solar fans, while subject to variations based on factors like type, brand, and location, exhibit average price ranges of USD \$14-65. Figure 3 shows how pedestal and ceiling fans are often more expensive than table fans due to their larger size. Fan pricing is also influenced by the type of motor used, with motors contributing 25 to 36% of fan costs. On average, fans equipped with DC motors are 1.7 times more expensive than their counterparts utilizing AC motors of similar size.¹³

QUALITY ASSURANCE AND AFTER-SALES SUPPORT

For consumers, purchasing a fan is often a significant investment, underscoring the importance of ensuring product quality. [VeraSol](#) diligently conducts testing and performance assessments on fans sourced from development programs, manufacturers, distributors, and retail markets. Currently, the VeraSol website showcases 136 different fans from 90 brands, with ongoing additions each year.¹⁴

Effective quality assurance frameworks play a pivotal role in driving enhancements in the efficiency and performance of fan markets.

Figure 3. Global Indicative Cash Price Ranges for Solar Fans



viii Data from the GOGLA Outlook report mentioned above, this is the footnote they included on this stat: "GOGLA (2022), Supply Chain Disruption Survey (unpublished) and Open Capital Advisors analysis and consultations. Note that these are unbundled prices i.e., TV sold as a standalone appliance instead of part of a solar home system kit; also there are no 2020 prices included given this data was not collected as part of developing the 2020 MTR." Note that the survey is based on a limited number of manufacturer responses

CASE STUDY 1

EMPOWERING EFFICIENCY: TRANSFORMING PAKISTAN'S OFF-GRID FAN MARKET

PAKISTAN

End-User Spotlight: “Summers are usually very tough on the body due to the heat and humidity. I was using a basic pedestal fan to keep cool in the extreme temperatures. Unfortunately, paying the bills for my workshop has become difficult due to the rising cost of electricity and business losses during COVID-19. I heard about this efficient solar fan from a nearby retailer, so I purchased it in instalments from Harness Energy. The fan has turned out to be a blessing as my bill has reduced from \$21 USD per month to \$13 USD. With this saving I have paid off the cost of the fan already.”

-Ghulam Mustafa, Harness Energy customer, Pakistan; Ghulam has run his own furniture repair workshop since 2009

Identifying an Efficiency Opportunity: In rural Pakistan, where sweltering heat and humidity present formidable challenges, the quest for effective cooling solutions is paramount. Air-conditioners, with their high initial costs and relatively high electricity consumption, remain beyond the reach of most. Solar-powered fans offer a cost-effective solution.^{ix,15} Following market surveys and fan testing, the Efficiency for Access (EforA) Coalition identified a pivotal opportunity to enhance fan efficiency and performance.

Establishing Robust Testing and Regulatory Frameworks: The Pakistani fan market, while sizable, suffered from a lack of regulation, leading to the prevalence of subpar fans with inadequate efficiency. EforA's assessment of DC and AC/DC pedestal fans sold in Pakistan documented their alarming electricity consumption, which exceeded the global average by 16% to 68%. Prompted by these findings, EforA collaborated with the World Bank to develop a quality assurance framework for fans and simultaneously bolstered the testing capabilities of a local laboratory. This framework was introduced to the Pakistan Council of Scientific and Industrial Research and is now utilized by the World Bank and other development partners as a performance standard for the screening of fans for solar financing programs.

Engaging Local Manufacturers: In addition to crafting a robust framework, EforA initiated dialogue with local manufacturers to enhance the quality, energy efficiency, and design of off-grid fans. Manufacturers recognized that BLDC motors, although pricier, held immense potential for elevating both quality and energy efficiency. As BLDC motors were uncommon in the Pakistani off-grid fan market, EforA, in collaboration with IFC Lighting Pakistan, provided critical support to enhance the adoption and integration of these highly efficient motors.

Optimal Fan Performance: Following recent sampling and testing of 25 DC and AC/DC fans from the Pakistani market, EforA found that these fans are now, on average, 19% more efficient than the global average. When benchmarked against NECCA's voluntary star labeling program for AC fans, an impressive 94% of the off- and weak-grid appropriate fans were classified as three-star, the highest efficiency rating.¹⁶ EforA, alongside diverse stakeholders, has played an instrumental role in the transformation of the off-grid fan market in Pakistan.

^{ix} The resource cited above finds that the average temperature has risen 0.1 degree Celsius more than the global average, with this trend either holding or growing.

CASE STUDY 2



FAN-POWERED RESILIENCE: COOLING SOLUTIONS FOR VULNERABLE COMMUNITIES FACING CLIMATE RISKS

BANGLADESH

Every year, extreme heatwaves claim the lives of more than 20,000 people worldwide, while over a billion people are at risk from exposure to the heat. The perils of climate change, with its surging temperatures and erratic weather patterns, further intensify the threat to lives, food security, and livelihoods. Amidst these formidable challenges, fans emerge as a pivotal solution, particularly for the vulnerable low income and no income communities. The table below delves into these perils and their far-reaching consequences.

While air conditioners can maintain a comfortable indoor climate, their cost and impracticality often render them inaccessible to communities without electricity access. In countries like Bangladesh, where 15-30% of the population still lacks electricity access and numerous grid-connected households endure frequent power outages,¹⁷ air conditioners are an unattainable luxury. Moreover, their substantial energy consumption contributes to global carbon emissions. Notably, their energy-intensive nature often clashes with distributed solar energy systems, rendering them unfeasible for low income households without grid connections.^x

In contrast, fans present a promising alternative: they are significantly more energy-efficient than conventional central air conditioning and deliver effective cooling under diverse conditions.^x In 2019, Efficiency for Access conducted interviews with 1,600 off-grid fan customers in Bangladesh to understand the impacts of owning an efficient off-grid fan. The vast majority of our sample (81%) believed that their lives had improved after the fan purchase. Benefits reported by the respondents include users' ability to work more efficiently as well as improved health benefits and energy access for households.¹⁸

^x It's important to note, however, that fans only offer effective space cooling in temperatures up to 35 degrees Celsius.

CLIMATE CHANGE THREAT

IMPACT OF FANS

Jobs

Rising temperatures are cutting economic productivity and jobs. In 2020, approximately 300 billion hours of work were lost to heat stress.¹⁹ By 2030, heat stress will lead an estimated 80 million people across the world's poorest countries to lose their jobs.

Research shows that using a fan plays a crucial role in regulating core body temperatures and reducing the risk of heat strokes during heatwaves. By delivering comfort to individuals residing and working in hot and humid settings, fans can contribute to heightened productivity, enabling people to work more comfortably and efficiently for extended periods indoors. A survey of over 1,600 off-grid fan users in Bangladesh unveiled that fans extended their daily productive hours by an average of over 2 hours. Moreover, by assisting business owners in serving or attracting more customers, fans have the potential to bolster incomes.

Health Risks

Climate change can worsen indoor air pollution and increase the prevalence of certain diseases and health ailments.²⁰ Indoor air pollution is already attributed to over 100,000 premature deaths annually, while mosquito-borne illness may increase as populations grow with rising temperatures.²¹

Vulnerable groups such as women, children, and the elderly, who tend to spend more time in poorly ventilated households, face heightened exposure to indoor air pollution and mold allergens. By mitigating humidity and enhancing ventilation, fans play a pivotal role in minimising health risks linked to indoor air pollution and curbing the proliferation of mold allergens that trigger respiratory ailments. The increased airflow facilitated by fans also acts as a deterrent against mosquitoes, essential in regions where these insects transmit life-threatening diseases like dengue fever and malaria.²²

Productivity

Women and children are most at risk for heat-related stress and health-issues. Increasing temperatures can make learning environments distractingly or unbearably hot for students, while household chores performed inside can cause great heat stress for women.

Fans offer increased productivity and comfort for women performing chores in hot and humid conditions. Productivity gains can also help women save time from household chores allowing them to pursue higher-value paid work and education, contributing to women's empowerment. Fans can regulate ambient temperatures for children and in classrooms, enabling more productive learning environments.

Energy Crisis

Increased demand for cooling will exacerbate the global energy crisis, leading to higher energy costs and access issues.

Highly efficient, solar fans reduce reliance on grid electricity and alleviate peak demand, ensuring equitable, sustainable access to cooling, even in energy-constrained regions.

Vulnerable Populations

The most marginalized communities lack access to cooling technologies, amplifying their vulnerability to heatwaves.

Off-grid fans play a pivotal role in narrowing the cooling gap for BOP communities. By providing affordable and accessible cooling solutions, fans safeguard the well-being of those with limited resources and enhance community resilience.



FUTURE OUTLOOK

The fan market is poised for expansion, not only rebounding from its COVID-induced slowdown but also surpassing pre-pandemic sales levels.

Achieving the ambitious 2030 targets^{xi} set in our previous fan market assessment necessitates increased support from various sector stakeholders.

It is noteworthy that these recommendations have remained largely consistent since our last market assessment in 2021. The fan market has stayed at a relatively consistent level of maturity for the past few years, aside from the COVID-driven market interruptions. As climate change makes millions of people more susceptible to extreme heat, especially vulnerable populations, it is increasingly imperative that the fan market grow. Without robust support to facilitate increased penetration, numerous households may miss out on the potentially life-saving benefits of fans.

EforA urges stakeholders to utilise and implement these recommendations to grow the fan market and steer it towards greater resilience, affordability, and sustainability, enhancing the well-being of off- and weak-grid communities worldwide.

ENHANCE FANS STANDARDS AND QUALITY ASSURANCE

Establish stringent, energy-efficient fan standards and implement comprehensive labeling initiatives at both national and international scales. In many solar-powered fan markets, regulation is lacking, and formal testing of fans is a rarity. This regulatory void frequently exposes customers to subpar, low-quality products. Pakistan's experience underscores the critical importance of effective quality frameworks in fostering energy-efficient fans and protecting the interests of consumers.

EXPAND ACCESS TO FINANCING

Streamline access to financing across the entire fan ecosystem, including manufacturers, distributors, and consumers. Diverse financing options such as microfinance, bank loans, results-based financing, and PAYGo can serve as pivotal enablers to boost sales and invigorate the market. Initiatives like the [Productive Use Appliance Financing Facility](#)²³ can drive fan sales by offering procurement subsidies for companies and

extending consumer financing options to end users.

INVEST IN MARKET RESEARCH AND RESEARCH AND DEVELOPMENT

Many manufacturers focus on fans suitable for grid-connected households, rather than those compatible with a solar-home system. Research and development can help sustain efforts to tailor solar-powered fans for off-grid areas. [The Efficiency for Access Research and Development Fund](#), for example, awarded Harness Energy, Pakistan a grant to develop highly efficient solar-powered fans for use in rural and hard-to-reach areas. Generating market research is also critical to addressing the longstanding dearth of high-quality data and knowledge gaps across national fan markets.

RAISE CONSUMER AWARENESS:

Conduct awareness campaigns to educate consumers about the benefits of energy-efficient solar fans and how they can improve livelihoods and reduce energy costs. Many consumers have a limited understanding of fan technical specifications and quality, primarily relying on price to make purchase decisions. Addressing misconceptions and promoting environmental advantages can drive demand.

IMPLEMENT SUPPORTIVE POLICIES

Collaborate with policymakers to advocate for regulatory and policy frameworks that foster the growth of the off-grid solar fan market. Implementation of favorable tax policy is vital to overcoming affordability barriers and accelerating energy-efficient off-grid appliance market growth. India, for example, reduced its tax on off-grid fan components by 5% to encourage business-to-business imports and local assembly and manufacturing.

SUPPORT LOCAL ASSEMBLY

Promote local manufacturing and assembly to mitigate importation and distribution costs, which are usually passed to consumers. A 2022 survey in Pakistan found that locally made fans are 16% to 46% less expensive on average than imported alternatives. Local manufacturing and assembly can also be a gateway to better warranty coverage and better repair options, as local technicians are more familiar with the technology.

xi In our 2021 market assessment, we estimated that the cumulative global market potential for fans will reach USD \$1.5 billion and 48 million households by 2030.

FURTHER READING



TECHNOLOGY-SPECIFIC RESOURCES:

Standardized Impact Metrics for High-Performing Appliances: Fans and TVs: [This standardized framework](#) impact measurement helps ensure that energy access decision-makers understand the transformative impact of high-performing appliances. The standardized approach for TVs and fans measures social impact and attract investment, working capital, and regulatory support for the high-performing appliances sector.

Impact Assessment Framework: Fans: This fan-specific framework represents an updated and comprehensive set of formulae that will help facilitate the financing, planning, measuring, and reporting of these impacts, and in doing so help stakeholders identify opportunities and minimise risks.



MARKET-SPECIFIC RESOURCES:

Fans: Solar Appliance Technology Brief: [This brief](#) is intended to continue supporting the energy access sector's understanding of this fast-paced fan market. It provides in-depth and up-to-date technology and market insight and analysis for a wide audience including, donors, new entrants to the appliance sector and seasoned players who want an easy resource to reference.

BACKGROUND READING



The Socio-Economic Impact of Super-Efficient Off-Grid Fans in Bangladesh: This report summarizes 1,600 telephone surveys with customers to understand the impact and socio-economic value of super-efficient off-grid fans in Bangladesh. Results shed light on the real impact and socio-economic value of fans and underscore their role in expanding access to modern energy services.

Solar-Powered Fans Can Help Support Sustainable Futures: This brief details how efficient, solar-powered fans serve as a cost-effective, practical solution to mitigate the effects of climate change. It features the experiences of some people living in Pakistan and Bangladesh who discuss the challenges of limited access to electricity and fans, and the many benefits of solar-powered fans.




Resilient Appliances for Resilient People and Planet: This whitepaper unpacks for fans, in addition to other appliances, dimensions of quality that are important to measure and assess, such as safety, performance, durability or repairability and ease of handling e-waste. It then maps how these quality metrics can fortify products in the face of specific climate risks.

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