

TECH TRENDS IN ENERGY ACCESS: ASSESSING THE OFF-GRID REFRIGERATOR MARKET



Part of the
Efficiency for
Access Appliance
Tech Trends
Series

SEPTEMBER 2023

Efficiency for Access Coalition

*Revised in 2024

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CITATION AND COPYRIGHT

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

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Off-grid refrigeration plays a vital role in a warming world, providing essential cooling services to households and businesses. Efficiency for Access, along with its partners, is excited to present new research that underscores significant innovations and investments in this field.

In a world experiencing escalating global temperatures, refrigeration services have become a crucial cooling resource for households and businesses alike. However, 1.2 billion people are currently at risk from warming temperatures due to a lack of access to cooling, according to SEforALL.¹ Extending the reach of affordable and efficient cooling technologies, including refrigeration, can significantly advance multiple Sustainable Development Goals, from strengthening resilience and adaptation within communities to stimulating economic growth.

Our companion report in the [Efficiency for Access 2021 Solar Appliance Technology Brief series](#) celebrated the notable success in refrigerator efficiency improvements. However, the off-grid refrigerator market still faces challenges, including slow growth linked to affordability and accessibility barriers. There is considerable potential for positive impact and market expansion and this report offers an in-depth look at the current state and prospects of the off-grid refrigerator sector, highlighting key trends, challenges, and actionable strategies for scale.

Key findings:

- Despite low refrigerator ownership in sub-Saharan Africa, with approximately 822 million people (60% of the population) living without a refrigerator,² there are notable opportunities for market penetration, especially in reaching remote or last-mile consumers.
- The off-grid refrigeration sector, similar to other appliances, has been affected by the global economic downturn following the COVID-19 pandemic but is on a slow path to recovery.
- Light commercial applications continue to emerge as the most viable market for off-grid refrigerators, with an increase in popularity of freezers and multi-temperature units, showcasing the potential for income generation in small business settings.

OFF-GRID REFRIGERATOR MARKET AT A GLANCE

- Customer trust and satisfaction hinges on after-sales services, repairability, and warranty offerings, which are inadequately provided for some products. Training of local technicians not only promises to enhance service quality, but also creates job opportunities and supports community development.
- While the majority of surveyed and tested off-grid refrigerators are still using high global warming potential (GWP) refrigerants, the leading manufacturers in the sector have started transitioning to climate-friendly natural refrigerants. Policies in the Global North that prohibit the use high-GWP refrigerants can have a positive spillover effect and further accelerate this transition.
- Expansion of market-building forces, such as consumer financing, favorable policies, local manufacturing, and early risk investments, is crucial for creating conducive environments for sector growth.

This report provides valuable insights into the evolving off-grid refrigerator market, examining trends among manufacturers and consumers, identifying performance and affordability enhancement opportunities, assessing scalability barriers, and offering practical advice for stakeholders, including policymakers.

Addressing these challenges and opportunities with a keen understanding of regional specifics and market dynamics is vital for the success and growth of this crucial sector.

i Models were surveyed for EforA's study [Phasing Down HFCs in Off- and Weak-Grid Refrigeration: An Opportunity to Reduce Greenhouse Gas Emissions](#) and models tested since 2021 are listed on the [VeraSol Product Database](#).



MARKET TRENDS AND INSIGHTS

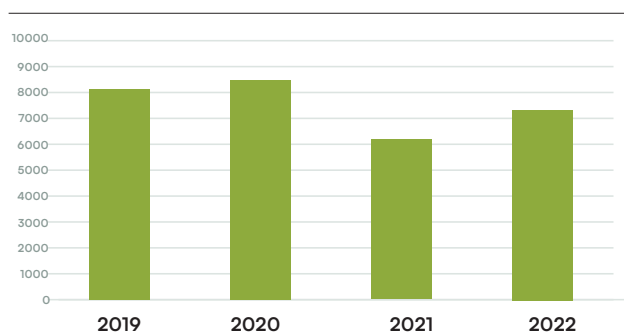
MARKET DYNAMICS AND CONSUMER CHOICES

In our 2021 market assessment, we estimated an ambitious 10% annual growth in the cumulative global market potential for off-grid refrigerators — projecting a tripling from US\$ 4.4 billion in 2018 to US\$ 14.3 billion by 2030, with greater affordability and increased efficiency.³

However, refrigerator ownership in distributed energy settings is yet to fully reflect the predicted growth. GOGLA affiliates represent just a part of the whole off-grid refrigerator market but provide some insight on sales trends since 2019. Reporting companies noted increasing sales above 8,000 units globally in both 2019 and 2020, indicating market growth. Sales fell in 2021, possibly due to COVID-19 or changes in reporting by affiliates. 2022 demonstrates an increase in sales over the previous year, but does not show a full recovery to pre-pandemic levels or a takeoff of the market (Figure 1).⁴

GOGLA cited supply chain uncertainties, lingering pandemic effects, and customers' inability to pay as possible indicators for the period of decreasing sales. However, sales trends show opportunities for growth as well. The surge in pay-as-you-go sales reported to GOGLA, particularly towards the end of 2022,⁵ suggests that this payment option might be enabling access to refrigerators for previously untapped customers. Our market research notes the growth of light-commercial refrigerator use and higher ability to pay in business settings.⁶ However, due to the early stage of the commercial solar refrigerator market and GOGLA affiliates representing just a portion of this crucial market, accounting for all the contributing factors remains challenging.

Figure 1. GOGLA Refrigerator Sales Data



The refrigerator landscape has not evolved significantly since we developed the [2021 Solar Appliance Technology Briefs](#), but different technologies and use cases are becoming more

prevalent.

The availability of DC (Direct Current) refrigerators remains limited in key off-grid markets, stemming in part from a lack of DC market investment and development in some countries, inability to pay and a lack of use case, and reliance on traditional AC (Alternating Current) models. This is further evidenced by announcements from a few solar companies that they are exiting the solar refrigerator business, making the availability of DC refrigerators in these key off-grid markets even lower.

In key off-grid refrigerator markets such as India⁷ and Pakistan⁸, there's a limited availability of DC models. This is because of the prevalent use of AC models, prompting consumers to rely on AC units paired with inverters instead. This inclination has also been observed by [VeraSol](#) stakeholders, who note that consumers tend to shy away from the more costly DC refrigerators that require a smaller PV module. Instead, many opt to invest in a medium-sized PV module or kit to power a highly efficient AC refrigerator using an inverter.ⁱⁱⁱ This is an example that highlights cost trade-offs consumers face when choosing how to invest in off-grid technologies. Other technologies, such as solar direct drive (SDD) models, are available in the market and research and development grants, such as those offered by EforA. These have helped SDD manufacturers improve the technology, expand their business model, and drive down the cost to buy an SDD.⁹

Our market scoping efforts show that freezers and multi-temperature refrigerators — those with a compartment that can act as either a refrigerator or a freezer — have become the most widespread in the market, edging out refrigerator-freezer combinations units (Figure 2). GOGLA affiliates and the [VeraSol Product Database](#) also note the rise in multi-temperature units in the market, highlighting the popularity of these flexible models. This trend might suggest reduced refrigerator adoption within household settings, marked by a decline in combination units. On the other hand, there appears to be an uptick in usage within small shop environments that bolster local food chains or in health centers where glass-fronted multitemperature units and large deep freezers could prove more advantageous.

i VeraSol tests and generates consistent and comparable performance data to support scalable markets for durable, high-performing, and affordable off-grid appliances and productive use equipment.

iii Based on an internal VeraSol stakeholder survey



REGIONAL VARIATIONS IN OFF-GRID REFRIGERATOR MARKETS

NIGERIA, PAKISTAN & UGANDA

While some obstacles to refrigerator market growth are shared globally, nuanced regional differences make for diverse market landscapes in South Asia, East and West Africa.

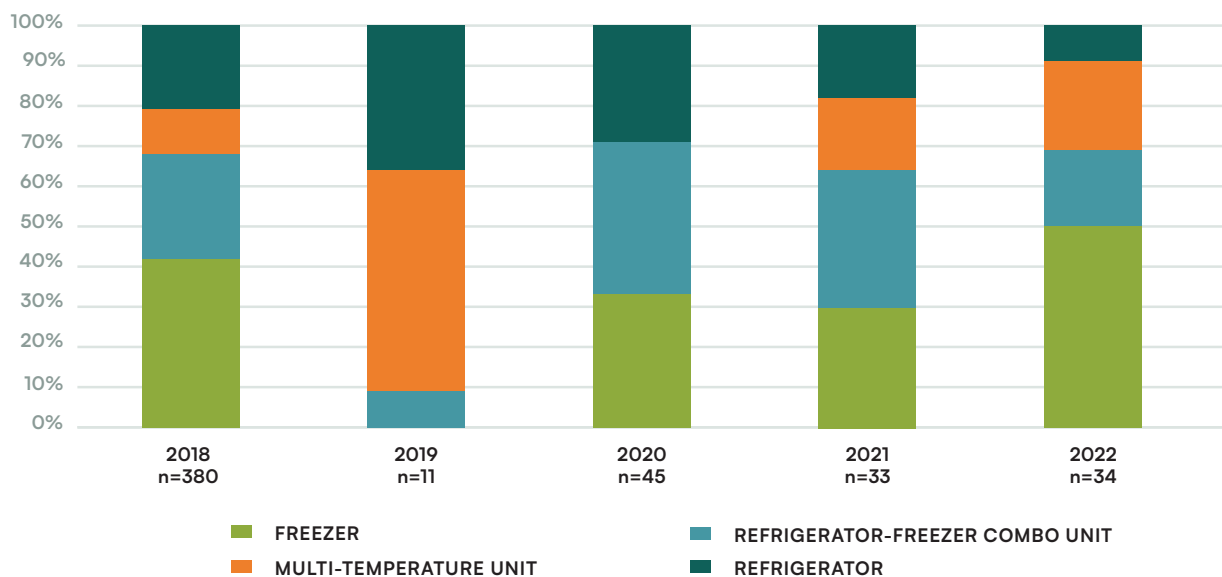
According to LEIA market surveys conducted in Pakistan in 2018 and 2022,¹⁰ the market for DC refrigerators remains notably limited. Numerous distributors point to high costs and minimal customer demand as primary factors contributing to their limited availability in the market. While Pakistan's extensive grid connectivity reinforces the prevalence of AC-dominated appliances in the market, the frequent voltage fluctuations and power outages caused by load-shedding can exert an impact on connected devices. Therefore, labels and marketing for models that can withstand voltage fluctuations are popular. Finally, Pakistani consumers prefer larger refrigerator models, with 70% of units surveyed in 2022 having a volume greater than 250L.

Similar trends were observed in market surveys in neighbouring India,¹¹ indicating wider regional market preferences.

LEIA market surveys conducted in 2018 and 2020¹² note that Nigeria has a nascent but growing off-grid refrigerator market, which has reported the highest sales of refrigeration units by GOGLA affiliates since the second half of 2021,¹³ though the retail market remains dominated by AC models. Medium units with volumes between 150L and 250L are preferred.

In contrast, Uganda, when surveyed by EforA in 2018 and 2021, reported a more available DC market and a preference for models smaller than 150L, indicating even more localised market patterns.

Figure 2. Percentage of refrigerator types sold in markets from 2018 to 2022, as reported in Efficiency for Access market scoping surveys



AFFORDABILITY ASSESSMENT

Predictably, enhancing affordability continues to pose a significant challenge in boosting the uptake of refrigerators in distributed energy sector markets.¹⁴ A 2022 EforA consumer impact survey of refrigerator owners in Kenya, Tanzania, and Uganda revealed that 50% of respondents reported having to make unacceptable sacrifices to make refrigerator payments, while 20% reported having to cut back on other consumption to make these payments. A vast majority of those respondents (79%) were using the refrigerator for income generation at their place of business, indicating that affordability is still a challenge for light-commercial users, as well as domestic users.¹⁵

A survey of VeraSol stakeholders reveals that manufacturers and distributors of off-grid refrigerators grapple with substantial production costs, import duties, and restrictions, varying national regulations and quality enforcement, as well as diminished consumer ability to pay. These factors collectively impede refrigerator sales while making it even more difficult to offer unit prices that are attainable for off-grid end-users.^{iv}

However, over the last few years, it has been encouraging to observe the continued drive towards growing the off-grid refrigerator market through funding and technical support schemes. Examples include:

- The [Efficiency for Access Research and Development \(R&D\) Fund](#)¹⁶
- Ashden and K-CEP [Fair Cooling Fund](#)

- United States African Development Foundation's [Off-Grid Energy Challenge](#)¹⁷
- [Beyond the Grid Fund for Africa](#)¹⁸
- The Basel Agency for Sustainable Energy (BASE) and the Clean Cooling Cooperative's [Cooling as a Service \(CaaS\) incubator programme](#)¹⁹
- [Novastar Ventures Africa Fund II](#)²⁰
- Engineers Without Borders USA's "[Chill Challenge](#)"
- EEP Africa's partnership with [Taatisolar](#)
- [Powering Renewable Energy Opportunities \(PREO\)](#)
- Refrigerator brand Koolboks' [fundraising of US\\$2.5 million](#) to support pay-as-you-go cooling with a focus on off-grid businesses

Several of these initiatives pair support for household and small-business refrigeration with larger cold storage, investing in the full, integrated supply chain that keeps produce, meat, and fish fresh. Collectively, these initiatives have provided programmatic support, development resources, and over US\$ 66.4 million^v in financial assistance to cooling companies in the distributed energy sector. This support enables them to develop innovative technologies, implement creative business models, and expand their reach to underserved markets.

Policy programs remain essential in improving affordability. Aligning policy frameworks with the specific needs of communities, governments, and regulatory bodies can foster market growth, encourage investment, and facilitate the widespread availability of cost-effective refrigeration options.

^{iv} Based on an internal VeraSol stakeholder survey.

^v Estimate based on EforA calculations and desk research.

Programs like the ECOWAS Refrigerators²¹ and Air Conditioners Initiative ([ECOFRIDGES](#)) in Senegal and Ghana, along with the [R-COOL with Green On-wage financing initiative](#) in Rwanda²² leverage green on-wage financing^{vi} and on-bill financing^{vii} to make cooling products, including refrigerators, more affordable to consumers. Similar programs designed for off-grid refrigerator products and communities have the potential to stimulate their adoption.

QUALITY ASSURANCE AND END USER SUPPORT

Given that purchasing a refrigerator constitutes a significant investment for consumers, ensuring quality is key. VeraSol continues to test and report the performance of refrigerators submitted by development programs, manufacturers, and distributors, and sourced from retail markets.

In response to requests for the inclusion of refrigerators in its established solar lighting product certification scheme and growing interest in using refrigerator quality as eligibility criteria for incentive programmes and procurement, VeraSol has drafted a quality standard for off-grid refrigerators, Requirements for VeraSol Certification of Refrigerators.²³ This policy outlines the pathways to refrigerator certification as part of a solar home system and a standalone appliance while addressing four core elements of product quality: **truth in advertising, health and safety, durability, and consumer protection.**

In parallel, VeraSol works with the International Electrotechnical Commission (IEC) to develop and adopt test methods for off- and weak-grid refrigerators, including solar direct-drive models, aiming to assure refrigerator quality internationally, and expanding on current certification work. These methods build on the [Global LEAP Off-Grid Refrigerator Test Method](#)²⁴ to simulate real-world conditions, from fluctuating voltage in areas that experience frequent brownouts to solar irradiance patterns that affect solar direct-drive refrigerating performance.

The World Bank, UK aid, IKEA Foundation, and other funders are contributing funding to the development of these quality standards and the United Nations Environment Programme under United for Efficiency is also developing voluntary quality and performance guidelines.²⁵ These efforts recognize that product testing and quality assurance remain an important pathway toward improving affordability by protecting consumer investments and helping unlock preferential tax treatments.

- vi Green on-wage financing allows local financial institutions to provide a zero-interest loan to eligible salaried employees, where the repayment is deducted from their paycheck each month during the repayment period.
- vii On-bill financing allows the utility to incur the cost of the clean energy upgrade, which is then repaid in installments on the utility bill.



Credit: Gavi Alliance

CASE STUDY 2

ENVIRONMENTAL SUSTAINABILITY IN OFF-GRID REFRIGERATION

Beyond assuring quality for consumer health and safety, minimising the environmental impacts of refrigeration appliances is essential and requires the consideration of several components of a refrigerator's life cycle: refrigerants, insulation materials, system lifespan, recycling, and end-of-life management, as well as solar photovoltaic panels and energy storage type, if included.²⁶ Refrigerants are an important aspect of this holistic assessment and off-grid refrigerator manufacturers primarily rely on three types of refrigerants for refrigerators under 600 litres in size: propane (R290) and isobutane (R600a), both of which are natural refrigerants, and 1,1,1,2-tetrafluoromethane (R134a), classified as a hydrofluorocarbon. While R290 and R600a exhibit a low global warming potential (GWP), R134a is a potent greenhouse gas possessing a high GWP of 1430 over a 100-year timescale. (Table 1)

Our 2021 study²⁷ found that among the analysed refrigerator models, 40% used R600a, and 47% hydrocarbons (R600a or R290), while over 50% of manufacturers continued to use R134a. Based on [VeraSol Product Database](#) data since that study, 7 of

9 tested refrigerator models used R134a, noting that the problem continues. This trend is different from on-grid markets in high-income countries where many manufacturers are transitioning to using an intermediate refrigerant technology — hydrofluoroolefins (HFOs) — before adopting natural refrigerants. This indicates that the off-grid refrigerator market, with the right guidance, could follow best practice in Europe, where R600a has replaced R134a as the dominant refrigerant in the domestic refrigerator and freezer market.

The Global LEAP test method for refrigerators includes an environmental rating scale that examines refrigerant type, insulation materials, and end-of-life management, and underlines the importance of this aspect in assessing overall quality and safety. Encouraging manufacturers to transition to natural refrigerants is vital for sustainable and environmentally friendly refrigeration systems. While some may consider transitioning to HFOs (hydrofluoroolefins) a temporary solution, it is crucial to recognise that it only postpones the inevitable shift towards natural refrigerants.

Table 1. Types of refrigerants and their global warming potential over a 100-year timescale

TYPE	REFRIGERANT CODE	CHEMICAL NAME	GLOBAL WARMING POTENTIAL (100 YR.)
Natural	R-744	Carbon dioxide	1
	R-290	Propane	3
	R-600a	Isobutane	3
Hydrofluorocarbon (HFC)	R-134a	1,1,1,2-tetrafluoroethane	1430
Hydrofluoroolefins (HFOs)	R-1234yf	2,3,3,3 Tetrafluoropropene	4
	R-1234ze(E)	1,3,3,3 Tetrafluoropropene	7

After products reach last-mile users, safeguarding that investment to ensure a prolonged product lifespan is important and currently represents a gap in the off- and weak-grid refrigerating market. Survey respondents indicated that 48% experienced issues with product parts or the battery, and many noted that

an improved customer experience would encourage them to recommend the product to friends, family, and neighbors.²⁸ The required product support to address these challenges is three-pronged: building local capacity for technical support and maintenance and providing robust product warranties, and consumer awareness.

CASE STUDY 3

LOCALISING REFRIGERATOR MANUFACTURING, MAINTENANCE, AND REPAIR

INDIA, NIGERIA & SOUTH AFRICA

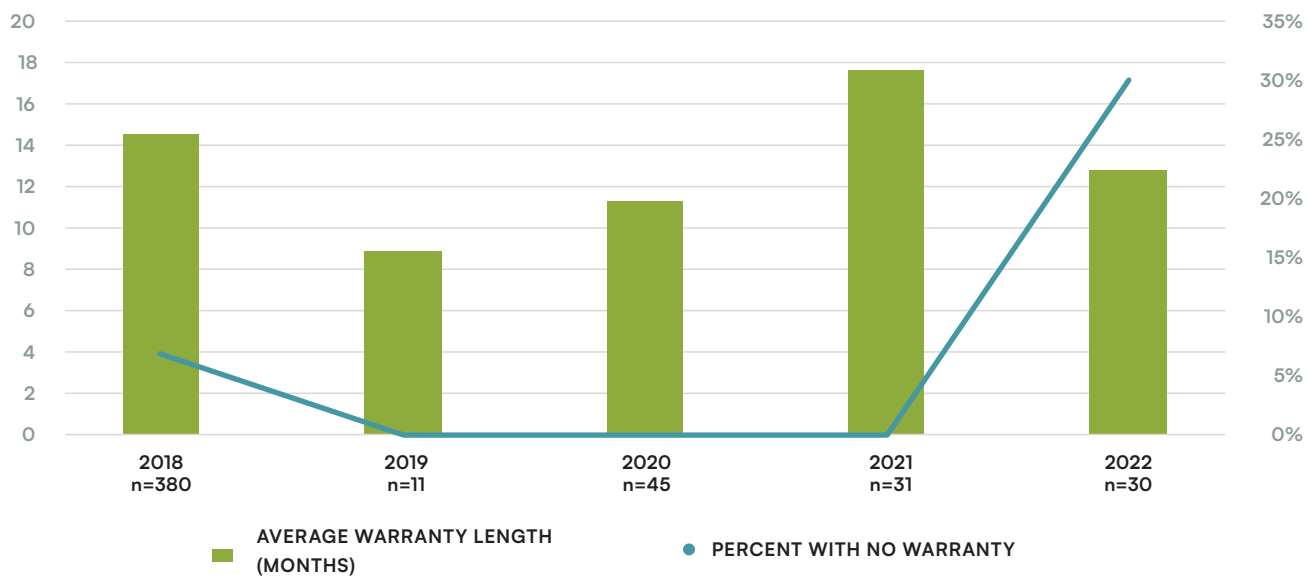
Using local assembly and manufacturing to decrease the cost of producing and importing products, as well as ensuring access to reliable maintenance and repair services for distributed energy refrigeration solutions is another pathway toward better affordability. Training programs and vocational courses for assembly, installation, and maintenance can help create jobs and boost local assembly. [The Solar Power Naija \(SPN\) scheme](#) in Nigeria is designed to create 250,000 new jobs and support the financing of upstream companies dealing with manufacturing and assembly of off-grid value chain components, such as solar panels, inverters, and batteries.²⁹ India's [Production Linked Incentive \(PLI\) scheme](#) offers an incentive for establishing manufacturing facilities in the country. The scheme provides a direct payment, amounting to a 4–6% subsidy on the incremental sales of goods manufactured in India, and includes a dedicated budget for the solar manufacturing sector.³⁰

South Africa's [Air Conditioning and Refrigeration, Infrastructure, Apprenticeships, and Skills Development Project](#) allocated EUR 3 million to address the lack of specialised skills in the heating, ventilation, air-conditioning, refrigeration, and natural refrigerants sector. It aims to benefit 2,500 trainees, 30 percent of whom are women, 90 percent of youth aged 15 to 30, and 80 percent coming from low-income and vulnerable groups.³¹ Finally, the Africa Centre of Excellence for Sustainable Cooling and Cold-chain ([ACES](#)) has also made commitments to develop capacity by building after-sales capability.

Flexibility on product order quantities, reduced production lead times, and customisation of products help meet community-specific needs enabled by local manufacturing, assembly, installation, and repair services. This can empower communities to become self-sufficient in meeting their refrigeration needs while generating economic benefits and local technical expertise.



Figure 3. Market scoping data collected by EforA from 2018 through 2022, examining refrigerator warranty length and percentage sold without a warranty AC, DC, and AC/DC models.



Strengthening warranties is a key piece in providing after-sales service, and ultimately builds consumer trust in nascent markets. Surveys conducted in local retail markets reveal that when warranties are provided, coverage length often averages over a year, though obtaining a product warranty at all remains a challenge in some surveyed markets, (Figure 3). Often, offering a warranty falls to the distributor, not the manufacturer, of a product and a market survey in 2022 in Pakistan noted that none of the surveyed refrigerators were sold with warranties.³² This is unusual for markets surveyed by EforA but can be a factor in dissuading consumers from making purchases, as they perceive a lack of assistance in case the product fails. Improving warranty offerings will be vital to building trust in end-users.

Product user manuals, user training at the point of purchase, and increased experience with refrigerators can minimise the negative effects of user operating errors. User experiences also provide valuable feedback for manufacturers to make changes to their product, packaging, and user manual to encourage efficient refrigerator use.

Finally, consumer awareness building is the final piece to ensure high performance and user satisfaction. From field testing studies in Rwanda and India, user behavior such as prolonged door openings or manual shut off of standalone solar-powered refrigerators overnight affected refrigerator performance. The study found that 85% of users in India and 32% of users in Rwanda who participated in the study reported that they do not know how to operate the refrigerator to reduce power consumption.³³



FUTURE OUTLOOK

An off- and weak-grid refrigerator can be transformative at all scales- for a household, small business, or fresh food supply chain.

Demand for these products, particularly for small business needs, is underscored by requests for greater refrigerator capacity, better affordability, quality assurance via certification, and improved consumer and product support. Some of the strongest and most recent evidence for demand to grow this sector comes from [CLASP and Nithio's Productive Use Appliance Financing Facility public auction for procurement subsidies](#). Submissions by last-mile distributors indicate a sustained demand for refrigerators while highlighting the massive investment gap in the way of affordability and driving scale in markets. Of six technologies within the scope of the Facility, refrigerators were the second most sought-after product for subsidies by distributors, amounting to over US\$ 5.1 million. When distributed across the projected sales of 24,000 units, this equates to approximately US\$ 212 in subsidies for each refrigeration unit. This insight indicates that unless the necessary investment is provided to support companies through their maturity journey — where they can

provide products at affordable levels to their customers and profitable terms for their operations — the off- and weak-grid domestic refrigeration market will remain subdued.

ADDRESSING AFFORDABILITY REQUIRES A HOLISTIC APPROACH

The off-grid refrigeration market grapples with steep initial production expenses and supply chain costs. Consequently, consumers encounter high prices and limited market availability, fostering a stagnant cycle that can prove challenging to overcome. To propel the market towards its optimal potential, it will be essential to channel increased investment into innovative and blended finance instruments tailored to the economic circumstances of communities within energy-constrained environments. Combined with investments aimed at improving the efficiency of refrigeration technologies through research and development, more companies can enter the market, offer competitive pricing, and scale up the production and distribution of affordable refrigerators.

An EforA R&D grantee, Amped Innovation, has used this support to tackle affordability, developing a high-performing off-grid refrigerator retailing for under US\$735 with PAYGO financing. As they scale, they aim to reduce production costs and offer units for less than US\$ 600 at higher volumes, offering a success story for reducing costs through cost-saving components, innovative design, and local assembly.³⁴



Building economies of scale, where refrigerator manufacturers can utilise the same key components across different brands and refrigerator types, can also increase affordability.

RECOGNISE AND SUPPORT QUALITY PRODUCTS THROUGHOUT THEIR LIFETIME

Upcoming mechanisms in the form of VeraSol certification of refrigerators and international test methods offer key initial steps toward a global quality assurance framework for off- and weak-grid refrigerators. However, this framework can only be rounded out by local assembly and installation, after-sales support and repairability, and strong warranty coverage to help consumers alleviate repair costs. When a refrigerator constitutes a potentially significant expenditure for a household, business, or health center, ensuring the availability of only high-quality models to consumers becomes essential. Additionally, guaranteeing that their investment remains well-preserved over an extended duration is crucial for enhancing their quality of life and augmenting their income.

FOSTERING THE PATH TOWARDS MARKET MATURITY REQUIRES A HARMONIOUS COLLABORATION BETWEEN PUBLIC AND PRIVATE SUPPORT

Establishing policy regulations that foster an environment conducive to facilitating the sales and distribution of refrigerators in energy-constrained communities is imperative, despite existing challenges. Favourable policy can reduce financial barriers for refrigerator companies and signal support and encouragement for early risk investment in growing local refrigerator production.

For instance, the initiative to unlock local manufacturing urgently demands solutions for issues such as import tariffs that diminish the economic advantages of local assembly,³⁵ the absence of international off- and weak-grid refrigerator quality standards to ensure the quality of domestically assembled products, suboptimal or inefficient execution of incentives, and uncertainties surrounding the demand for off-grid products, as highlighted in the 2021 ACE TAF report.³⁶ Some cooling actors have targeted these issues already: India-based Ecozen, a cooling and agricultural innovator, has raised US\$ 25 million in equity and debt capital, in part to expand its export activities and ease associated costs.³⁷

Applying lessons learned from the innovative initiatives explored in this publication will help establish appropriately and effectively designed financing mechanisms, incentives, subsidies, and training programs to overcome obstacles to growth, increasing local manufacturing, providing after-sales service and honouring warranties, and building consumer awareness. It also requires the public and private sectors to engage and collaboratively work together to address these obstacles and advance the market.

Empowering homeowners, shopkeepers, farmers, and the fishing community to invest in these technologies will build cold storage networks and get fresh produce, dairy, meat, and vital medicines directly to last-mile communities, improving livelihoods, health, and economic growth.



FURTHER READING



TECHNOLOGY-SPECIFIC RESOURCES:

[Uses and Impacts of Off-Grid Refrigerators](#)

A summary of the benefits and challenges experienced by off-grid refrigerator users in Kenya, Tanzania, and Uganda over several years.

[Designing and Implementing Field Testing for Off- and Weak-Grid Refrigerators](#)

A practical guide on monitoring refrigerator performance and efficiency in the field to inform decisions about product design, financing, business models and more.

[Evaluating Appliance Performance in the Field: Results from Refrigerator Testing](#)

An April 2023 follow-up to the above guide for field testing refrigerators to present data and observations from field tests carried out in Rwanda and India. These tests were conducted to assess how various usage scenarios and user practices influence the operational efficiency of direct current refrigerators.

[Life Cycle Greenhouse Gas Emissions Assessment of Off- and Weak-Grid Refrigeration Technologies](#)

A comprehensive life cycle greenhouse gas emission assessment was carried out on three cooling technologies used in low- and middle-income off- and weak-grid markets.

[Phasing Down HFCs in Off- and Weak-Grid Refrigeration An Opportunity to Reduce Greenhouse Gas Emissions](#)

A research note to raise awareness around the use of refrigerants with high global warming potential in off- and weak-grid refrigerators and provide actionable recommendations for reducing their use.

[Efficiency for Access Research and Development Fund: Innovator Series Case Studies](#)

Explore profiles on pioneering companies in the global refrigerator market.



MARKET-SPECIFIC RESOURCES:

[Efficiency for Access Country Profiles](#)

Off- and weak-grid sector and appliance performance data, including for refrigerators, for key markets, including India, Sierra Leone, Nigeria, Uganda, Ethiopia, and Pakistan.

[Kenya Consumer Experience Study](#)

A market snapshot providing insights into the ownership of and consumer experience with off-grid solar appliances, including refrigerators, in Kenya.



APPLIANCE-INCLUSIVE RESOURCES:

[Appliance Impacts Over Time](#) — A longitudinal study exploring how customers' relationship with their off-grid appliances, including refrigerators, changes over time. Over 4,000 off-grid customers were interviewed to track product quality, durability, satisfaction, impact, and uptake.




[Appliances for All](#) — This report examines how well solar lighting and appliances, including refrigerators, are reaching key populations, and assesses inclusion across solar company employment practices and product offerings.

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