



# **RESILIENT APPLIANCES FOR RESILIENT PEOPLE AND PLANET**

Quality Assurance as an Underrated Tool in Building  
and Sustaining Climate Resilience

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EFFICIENCY FOR ACCESS COALITION





## Acknowledgements

This report was written by Abigail Kuria and Marion Kudla (CLASP), with review from Yasemin Erboy Ruff, Makena Ileri, Elisa Lai, and Ari Reeves (CLASP); and Sam Jewett (Acumen).



Transforming  
Energy  
Access



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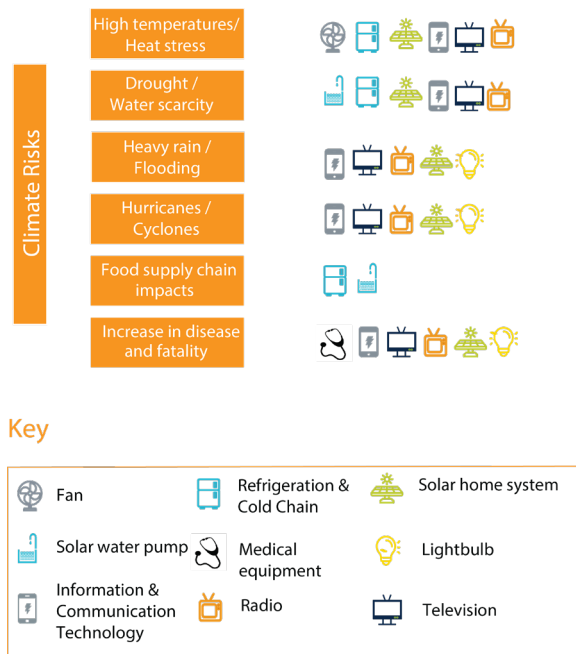
# Making the Case: The Crucial Role of Appliance Quality in Climate Resilience

**Recent data and modelling show that efforts to deliver universal access to affordable, reliable, sustainable and modern energy by 2030 (Sustainable Development Goal 7) are off-track. Last year, the number of people without access to energy rose for the first time in 20 years,<sup>1</sup> and climate change threatens to further de-rail ongoing efforts. Climate risks such as heat waves, water scarcity and natural disasters have already begun to displace people from their homes and threaten livelihoods.**

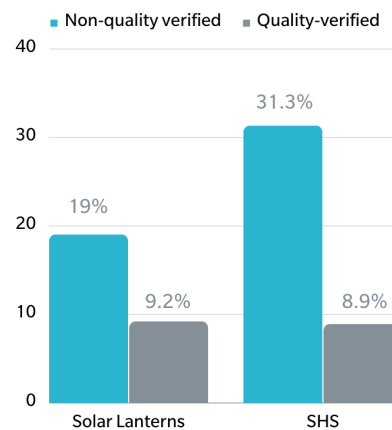
Productive use appliances can help people cope with these crises. Solar water pumps (SWPs), for example, offer a stable source of irrigation in the face of increasingly unpredictable weather patterns; e-cooking technologies such as electric pressure cookers reduce reliance on biomass fuels, helping to decrease deforestation rates and mitigate emissions generated through traditional cooking methods; fans reduce the risks of ever-increasing heat stress; and TVs, radios and mobile devices increase communities' climate preparedness through early disaster warning systems (Figure 1). Additionally, when natural disasters strike, traditional grid system infrastructure that provides critical energy services is often more vulnerable. Having a solar energy system to generate emergency power and to address the most critical energy needs can provide instant relief for communities or households impacted by climate disasters.

However, not all appliances are created equal. The off-grid solar market is characterised by appliances with varying levels of quality and durability. Some are designed and manufactured well, while others fall short of expectations for safety, durability and performance. A 2021 study of a nationally representative sample of solar appliance users in Kenya found that quality-verified off-grid solar appliances are significantly less likely to break down than are non-quality-verified appliances (Figure 2).<sup>3</sup>

**Figure 1. Solar appliances mapped against climate risks they help address.<sup>2</sup>**



**Figure 2. Comparison of break-down rate between non-quality verified and quality-verified solar lanterns and solar home systems.**

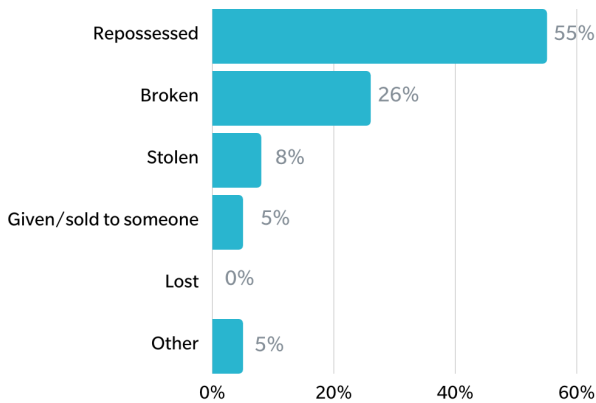


A recent study by 60 Decibels and CLASP on off-grid appliance impacts over time found that when asked why they no longer use an appliance, 26% of consumers said it was because the appliance had broken (Figure 3).<sup>4</sup> A broken and unreliable appliance does not do anyone any good if it is not able to deliver the necessary service at a moment of critical need. This highlights the urgent need for quality assurance measures to help protect consumers, as well as the sector, ultimately strengthening consumers' ability to respond to climate challenges.

1. IEA, [“For the first time in decades, the number of people without access to electricity is set to increase in 2022”](#).  
 2. Graphic developed in partnership with GOGLA and Acumen.  
 3. Adapted from EED Advisory Limited, [Quality in the Off-Grid Solar Market: An Assessment of the Consumer Experience in Kenya](#), 2021, page 21.  
 4. [Appliance Impacts Over Time: Longitudinal insights from off-grid TV, refrigerators, & solar water pump users](#), 40.

**Figure 3. Reasons for no longer having a previously purchased appliance<sup>5</sup>**

**Q: Why do you no longer have the [Company] [product]? (n=146)**



Durability and reliability, specifically, have a direct impact on building climate resilience. Durable and reliable appliances that can withstand challenging conditions can provide life-saving services for consumers during natural disasters. For these appliances to deliver consistent energy services in often harsh environments with limited to no auxiliary or repair services, they need to be designed and built accordingly to help consumers cope with increasingly irregular climate conditions.

Quality also encompasses aspects of recyclability and repairability. How well an appliance integrates into a circular electronic waste (e-waste) economy depends on whether its components are high-quality and can be repurposed. This helps avoid the excessive manufacture of products, which extracts scarce resources, and ultimately creates more e-waste. Between 2014 and 2020, for example, e-waste generated by Information & Communication Technology (ICT) devices increased by 53%, emitting 580 million metric tonnes of CO<sub>2</sub> in 2020 from manufacture and use.<sup>6</sup> By 2030, emissions could increase to 852 million metric tonnes if no proper e-waste handling interventions are made.<sup>7</sup> However, increasing the life expectancy of electronic appliances by 50%-100% (by ensuring high appliance quality, recyclability, repairability, etc.) can mitigate up to half of the total greenhouse gas emissions.<sup>8</sup>

From a consumer perspective, for many low-income consumers, purchasing a solar appliance is a major decision and investment. Over 80% of solar water pump and refrigerator customers purchased these appliances on credit, with about 50% reporting that their solar appliance repayments were a burden.<sup>9,10</sup> Spending limited funds on a poor-quality appliance that soon ceases to function properly or at all could be financially devastating for consumers, and reputationally so for the company and the sector as a whole.

**Figure 4. Solar appliance cost in comparison to geographical incomes.**

## Solar appliances are a significant investment for consumers.

In Kenya, the cost of a SunDanzer kit with a refrigerator is \$ 1,276, which translates to about 85% of an end user’s annual income.

In the state of Arizona in the United States, the same SunDanzer kit will cost 2% of an end-user’s annual income.

In India, a solar home system kit with a fan costs about \$80, which translates to 53% of an end-user’s monthly income.



Image: SunDanzer website

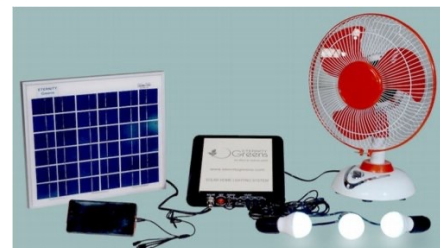


Image: IndiaMart website

5. Developed in partnership with 60 Decibels for the [Off-Grid Energy Appliance Impacts Over Time](#) report.

6. 'Disentangling the worldwide web of e-waste and climate change co-benefits'.

7. Ibid.

8. Ibid.

9. Efficiency for Access, [Uses and Impacts of Solar Water Pumps](#).

10. Efficiency for Access, [Uses and Impacts of Off-Grid Refrigerators](#).



## Quality Assurance is Crucial to Identify Appliances that Deliver

**Well-performing and high-quality solar appliances can deliver more reliable services, making the people and communities that are the most vulnerable to weather-related climate risks more resilient. A robust quality assurance framework makes it possible for market players to identify high-performing appliances and improve consumers' access to high-quality appliances that truly deliver climate resilience benefits.**

[VeraSol](#), an initiative of Efficiency for Access, is a global quality assurance programme for modern off-grid solar solutions. VeraSol works to ensure appliances sold in the off-grid communities are high-quality and perform as advertised, protecting buyers and consumers from negative experiences. Through rigorous testing and benchmarking performance against quality standards, VeraSol ensures consumers are getting appliances that are built with quality and durability. The programme focuses on verifying truth-in-advertising, safety, consumer protection and durability.

Various test procedures can also be used to assess an appliance's resilience to changing weather patterns. Below are a few examples of how VeraSol's testing can help ensure an appliance is also more resilient in extreme environmental conditions.

- **High temperature/Heat Stress** - Climate change has led to changing weather patterns, including increased temperature and humidity. Climate change made deadly heatwaves in South Asia, particularly in India and Pakistan, 30 times more likely.<sup>11</sup> The harsher environment also impacts how well appliances can function. Environmental testing evaluates an appliance's functionality and energy performance

when operated in and exposed to high temperature and high humidity over a prolonged period of time. Through procedures adapted from IEC 60068-2-78<sup>12</sup>, fans and TVs are exposed to a harsh environment with 40°C temperature and 93% humidity prior to testing.<sup>13,14</sup> For refrigerators, the energy consumption is measured at 43°C ambient temperature to ensure the refrigerators can deliver sufficient cooling in that environment.

- **Drought/Water scarcity** - Drought in East Africa has worsened, with parts of Somalia, Djibouti, Ethiopia and Kenya experiencing the driest conditions due to irregular and reduced seasonal rainfall.<sup>15</sup> Evidence in Indonesia has shown that solar water pumps could help farmers resist drought,<sup>16</sup> but the appliance needs to be designed to adapt to water scarcity conditions. Through VeraSol testing, we evaluate a solar water pump's ability to withstand periods of inadequate water supply through dry run protection tests. The dry run protection prevents pumps from operating without water, reducing risks of overheating pump motors and breaking the mechanical seals which would cause malfunction and permanent damages to pumps.



11. Imperial College, [Climate Change Made Deadly Heatwave in India](#).

12. IEC 60068-2-78: Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state (2012)

13. VeraSol, [Off-grid fan test method](#).

14. VeraSol, [Off-grid television test method](#).

15. UNEP, [On verge of record drought, East Africa grapples new climate normal](#).

16. One Earth, [Solar irrigation: how Indonesian farmers resist drought and save money](#).





Photo Credit: FuturePump

- **Heavy rain/Flooding** - Floods are one of the most common and severe natural disasters induced by climate change, and they pose a greater risk in low-income countries where infrastructure systems to manage floods tend to be weaker.<sup>17</sup> Several countries in Sub-Saharan Africa and South Asia face a high risk of flooding and have a high level of poverty. Floods damage the energy infrastructure in developing countries and lead to the displacement of people. While repairs are being made to the system, households can rely on quality solar home systems and can move with them when displaced to have access to electricity in a new location. We test water ingress protection to assess a solar home system's degree of protection from water damage based on IEC TS 62257-9-5. This procedure measures the potential for water and solid objects to enter and damage or degrade the solar photovoltaic module.<sup>18</sup>

- **Hurricanes/Cyclones** – The warming of ocean temperatures from climate change is making hurricanes and cyclones more intense and destructive.<sup>19</sup> While some outdoor components of solar appliances, like a solar panel or an outdoor lantern, should be permanently fixed on a building structure, they are prone to be knocked down with damaging wind speeds. We test the durability of several portable off-grid solar appliances through drop tests. Off grid fans, solar water pumps and solar energy kits are tested in accordance with IEC 60529 (Drop Test) to evaluate robustness against rough handling or dropping due to strong wind.

In addition to tests performed on appliances, quality of installation is another key element that contributes to long-term performance and durability for off-grid solar appliances. For example, the [installation guidelines](#) for component-based energy systems outlines procedures, requirements and best practices to ensure better installation, thus maximising the performance and lifetime of the appliances.

17. Brookings, [Figure of the week: Flood risk and poverty in sub-Saharan Africa](#).

18. VeraSol, [Solar Home System Kit Quality Standards](#).

19. Climate.gov, [Climate change is probably increasing intensity of tropical cyclones](#).





Photo Credit: Shell Foundation

## CASE STUDY: HOW SOLAR APPLIANCES BUILD RESILIENCE FOR PEOPLE IN KENYA

**Kenya has experienced prolonged droughts since 2000, with moderate drought events recorded on average every three to four years and major droughts every ten years.**<sup>20</sup> The drought of 2020 – 2022 was one of the most severe and longest spells; it was widespread and led to livelihood losses and massive displacement of people. As reported in a statement by the ASAL Humanitarian Network (AHN), more than 4.2 million people representing 24% of the arid and semi-arid lands (ASAL) population were facing high levels of acute food insecurity, with about 2.7 million people in the crisis phase and 785,000 people in an emergency state. This is a 10% increase from 2021 where 2.1 million people were categorised as in an emergency and crisis state<sup>21</sup>.

Farmers have been unable to get any substantive crop production for five consecutive seasons and pastoralist communities have lost their livestock. More than 2.4 million livestock, which pastoralist families rely upon for nourishment and livelihood, have died in Kenya due to the prolonged drought. To address the drought situation, AHN together with local and international partners are safeguarding access to clean and safe water for the local communities through the rehabilitation and solarisation of boreholes.

Solar water pumps can also help farmers build resilience to climate shocks such as droughts. As reported in the uses and impacts of solar water pumps report by the Efficiency for Access Coalition, 23% of farmers cited improved health of crop and livestock with the use of a solar water pump. “Crops were wilting due to shortage of water but now I have access to water and can farm without caution. I also lacked money to buy fuel but now I use solar and don't have to pay for it.”<sup>22</sup>

Kenya has also experienced at least 17 major floods since the 1960s, with each flooding disaster affecting at least 70,000

people.<sup>23</sup> A study by The Kenya Institute for Public Policy Research and Analysis reveals that many counties in Kenya experience increased power outages during periods of floods. This is mainly due to weak installation and poor maintenance of power transformers and electric poles that are easily destroyed and swept away by floods. Dams that support generation of hydro-electricity fail to handle huge volumes of water during the heavy rain seasons. There are several instances of water overflow in the dams leading to disruption of power provision, thus increasing the number of power outages. It was observed in this study that when power outages occur due to incidences of floods, respondents turned to alternative sources of energy for lighting such as solar.<sup>24</sup>

According to data collected by the National Disaster Management Agency, more than 311,000 people have been displaced by floods across Kenya.<sup>25</sup> Solar lights are usually designed to be portable single units, and solar home systems can be easily dismantled and transported when necessary. In the event of extreme weather events, such as droughts and floods that lead to the displacement of people, smaller solar systems may be more transportable. This could enable households to take their solar system with them when displaced and to have access to electricity in a new location.<sup>26</sup>

**Kenya has a high penetration of solar appliances and implements robust quality standards, thus remaining a clear market leader with around one million sales recorded by GOGLA in the first half of 2022.**<sup>27</sup> The Off-Grid Solar Market Trends 2022 report on the state of the sector points to the tremendous potential of off-grid solar technologies, including for lighting, communications, irrigation and cooling systems, that will help fortify Kenya's response to increasingly erratic climatic challenges.

20. WorldBank, [Climate Risk Country Profile: Kenya](#).

21. ReliefWeb, [Drought situation in the Kenya ASAL areas now at crisis level](#).

22. Efficiency for Access, [Uses and Impacts of Solar Water Pumps](#).

23. Science Direct, [Nexus between flooding impacts and coping strategies in Nairobi's settlements](#).

24. Research Gate, [Effects of floods on infrastructure users in Kenya](#).

25. ReliefWeb, [Impact of floods in Kenya: Heavy rains leave thousands of families without homes as World Vision Kenya provides Non Food Items kits in Nakuru County](#).

26. ODI, [How solar household systems contribute to resilience](#).

27. GOGLA, [Global Off-grid Solar Market Report Semi-Annual Sales and Impact Data](#).



## Enhanced Appliance Quality for a More Resilient Future

Appliances are critical to help the most vulnerable consumers cope with climate-related risks. Quality assurance helps market actors identify high-quality and durable appliances, enabling consumers to enhance resilience through the deployment of these technologies. In order to realise this potential, however, significant investment will need to be channeled into the off-grid solar sector to reach SDG7 targets and help the most vulnerable consumers cope with climate-related risks.

According to estimates from IEA and IRENA<sup>28</sup>, achieving SDG7 by 2030 would require annual renewable energy investments of approximately \$680 billion—around \$45 billion on energy access and \$625 billion on energy efficiency.<sup>29,30</sup> Furthermore, data from the World Economic Forum (WEF) estimates that the cost of adaptation in developing countries is expected to reach \$300 billion per year by 2030<sup>31</sup>; in 2020, finance in global adaptation reached \$46 billion,<sup>32</sup> of which only \$28.6 billion went to developing countries. As WEF states in their report, this is insufficient.<sup>33</sup>

As the finance catches up to respond to climate demands, investments will need to be informed by and anchored in a strong quality assurance programme like VeraSol. VeraSol will not only be crucial in determining a baseline of appliance quality, but will be key to making the link between climate resilience and quality in conversations with manufacturers. Quality assurance programmes, and all other market stakeholders invested in the delivery of high-quality, climate resilient appliances to the most vulnerable communities, have a role to play in encouraging manufacturers to develop appliances that are built specifically to withstand challenging climatic conditions. Quality assurance data, and the measures implemented to protect those standards, will be life-saving tools to ensure that consumers have access to reliable energy services and can reap technologies' climate resiliency benefits.



Photo Credit: Simusolar

28. International Renewable Energy Agency 2020 Global Renewables Outlook Energy Transformation 2050 Abu Dhabi

29. IEA, IRENA, UNSD, World Bank, and WHO Tracking SDG7 2021 [The Energy Progress Report](#) (Washington DC: World Bank).

30. IOP Science: Strategic low-cost energy investment opportunities and challenges towards achieving universal electricity access (SDG7) in forty-eight African nations.

31. UNEP: '[Adaptation Gap Report 2021](#)'.

32. Climate Policy Initiative: '[Global Landscape of Climate Finance 2021](#)'.

33. The World Economic Forum: '[Climate adaptation: the \\$2 trillion market the private sector cannot ignore](#)'.





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 [efficiencyforaccess.org](http://efficiencyforaccess.org)

 [info@efficiencyforaccess.org](mailto:info@efficiencyforaccess.org)

 [@EforA\\_Coalition](https://twitter.com/EforA_Coalition)