EFFICIENCY 4 ACCESS COALITION

A campaign to drive universal energy access beyond lighting

Global LEAP Off-Grid Appliance Market Survey

NOVEMBER 2017

The Efficiency for Access (E4A) Coalition is a global campaign to harness the game-changing power of energy efficiency to drive universal access to enhanced energy services beyond lighting by 2030.

E4A aims to accelerate progress towards the Sustainable Development Goal 7 (SDG7) through a comprehensive approach that integrates end-use efficiency within broader electrification efforts, making the most of every watt of electricity supplied and providing a critical pathway to expand access faster and at least cost.

E4A unites and amplifies global efforts to catalyze markets for super-efficient end-use technologies, strengthens linkages with broader supply-side energy access efforts, and mobilizes commitments from public- and private-sector partners to support the development and deployment of these technologies.

The Coalition was launched in 2015 at COP21 in Paris as part of the Lima-Paris Action Agenda by the Clean Energy Ministerial's Global Lighting and Energy Access Partnership (Global LEAP) initiative and Sustainable Energy for All.

This survey was developed by the United Nations Foundation and CLASP, and CLASP conducted the analysis. The United Nations Foundation is a Global LEAP Partner, and CLASP serves as Operating Agent for several Global LEAP activities. The survey was funded by the UK Department for International Development.

This material has been funded by UK aid from the UK government; however, the views expressed are those of the authors and do not necessarily reflect the UK government's official policies.

Executive Summary

Quality-assured, super-efficient off-grid appliances are essential to providing modern clean energy services to under-served communities at the least possible cost. Highly efficient off-grid appliances—such as refrigerators, fans, televisions, and others—provide enhanced energy services while reducing the costs associated with off-grid energy supply, maximizing the value of every available watt and putting life-changing modern energy services within reach of many for the first time.

In partnership with the UK's Department for International Development, the United Nations Foundation, Power Africa, and many others, the Global Lighting and Energy Access Partnership (Global LEAP) is undertaking a series of research efforts to enhance global understanding of the off-grid appliance market and provide a framework for stakeholders to identify business opportunities and high-impact policy and programmatic interventions.

In late 2016, Global LEAP conducted a survey of energy access professionals to assess the expected demand for and impact of off-grid, solar-powered appliances, including household, small-medium enterprise (SME), and clinical applications. The goal is to help market actors throughout the energy access value chain make better-informed decisions about off-grid appliances, from investment and policy, to manufacturing, procurement and marketing.

The survey asked three questions across two product applications—household and SME, and healthcare and clinical (illustrated in Table 1, next page)—to assess energy access professionals' perceptions of the off-grid appliance market now and in the near future:

- Of the following appliance product categories that might be appropriate for **off-grid households and small- to medium-sized enterprises,** please rank the top five (5) product categories that—in your estimation—will see the most off-grid consumer demand over the next three to five years.
- Of the following **household/small- to medium-sized enterprise appliance product categories,** please rank the top five (5) product categories in terms of their potential contribution to socioeconomic development and poverty reduction over the next three to five years.
- Of the appliance product categories relevant to **healthcare and clinical facilities**, please rank the top five (5) product categories in terms of impact upon healthcare outcomes (i.e. the relative importance of each in delivering healthcare services to rural and/or under-electrified populations).

The survey received 174 responses from industry, policy, and development stakeholders all over the world, including China, East Asia, and the Middle East; the majority of respondents were from East or West Africa.

This survey follows a **2014 survey** on the same topic. These surveys indicate that demand—or perceptions of demand—have shifted over time. Notably, this latest survey indicates increased consumer demand for off-grid refrigeration—including household, agricultural, and commercial applications. Nevertheless, off-grid lighting and mobile phone charging are still identified as top priorities by most respondents.

Surveys such as this are limited by their structure and the number and characteristics of respondents. The survey results are intended to provide a glimpse of the current thinking of clean energy access professionals. Additional market research efforts taking deeper, more systematic looks at these and related questions would enhance the global understanding of off-grid appliances.

Throughout this document, we refer to this survey—which was conducted in 2016 but published in 2017—as the "2016 survey". The survey conducted in 2014 and published in 2015 is referred to as the "2014 survey".

TABLE 1: Product Categories of Household/SME & Healthcare and Clinical Appliances

Household /SME Appliances				
Clothes Irons	Fans	Grinders	Hair Clippers	Hand Power Tools
Laptops	LED Lighting Appliances	Mobile Charging Banks	Mills	Mobile Phone Charging Banks
Mobile/Smart Phones	Radios	Refrigeration (Agricultural Cold Chain)	Refrigeration (Household)	Refrigeration (Light Commercial/SME)
Rice Cookers	Sewing Machines	Small (e.g. USB) Speaker Systems	Solar Water Pumps	Soldering Irons
Tablets	Tea Kettles	Televisions		

Healthcare and Clinical Appliances			
Anesthesia Machines	Cautery Machines/ Diathermy	CD4 Machines	Centrifuge
ICT Equipment (computer, cell phone chargers, printer, radio)	Lighting	Neonatal Infant Warmers	Oxygen (O2) Concentrators
Patient Monitor for Vital Signs Measurements (e.g. NiBP, SpO2, HR, RR, EtCO2 and ECG)	Portable Ultrasound Machines	Refrigeration (e.g. vaccine refrigerators)	Regulated IV Pumps
Sterilizers/Autoclaves	Surgical Suction Machines		

A NOTE ON DEFINITIONS

For the purposes of this survey and other Global LEAP activities, "appliances" are energy-consuming products that can operate in an off-grid energy system, such as low-voltage DC solar home systems or AC mini-grids.

Results

Off-Grid Household & Small- to Medium-Sized Enterprise Applications

The survey indicates that LED lighting, televisions, mobile phones, mobile phone charging banks, household refrigerators, fans, and light commercial/SME refrigeration are viewed as the household/SME appliances with the highest likely demand. According to respondents, the appliances with the highest potential contribution to socioeconomic development and poverty reduction are LED lighting, mobile/smart phones, solar water pumps (SWPs), agriculture cold chain refrigeration, and light commercial/SME refrigeration.

Comparing these results to those of the 2014 survey, in terms of anticipated consumer demand LED lighting remained the highest ranked product, while televisions replaced mobile phones and phone charging as the second-highest ranked product. In terms of anticipated impacts, only slight adjustments in the ranking were seen—SWPs replaced refrigeration as the second highest impact product.

Demand for these appliances is consistent across regions, with a few exceptions. In East and West Africa, televisions ranked highest in demand; in India, household refrigerators ranked highest; and off-grid fans are ranked highest in Bangladesh.

Healthcare & Clinical Applications

Only 10 people responded to the third survey question regarding healthcare and clinical applications, a noted change from the 2014 survey which received 104 responses. Those 10 survey respondents reported vaccine refrigeration, lighting, ICT equipment (computer, cell phone chargers, printer, radio), neonatal infant warmers, and vital sign monitors (e.g. NiBP, SpO2, HR, RR, EtCO2 and ECG) as the highest impact applications. Sterilizers/autoclaves had ranked as the highest demanded healthcare applications in the 2014 survey, but in 2016, they dropped to the sixth. Refrigeration for clinical applications, such as vaccine refrigeration, is ranked highest by survey respondents.

Analysis

Household & SME Appliances

The following section describes respondent rankings for the anticipated off-grid consumer demand and potential impact on socioeconomic development and poverty reduction of the 22 products in the household/SME appliance product category, as depicted in Figure 1 .

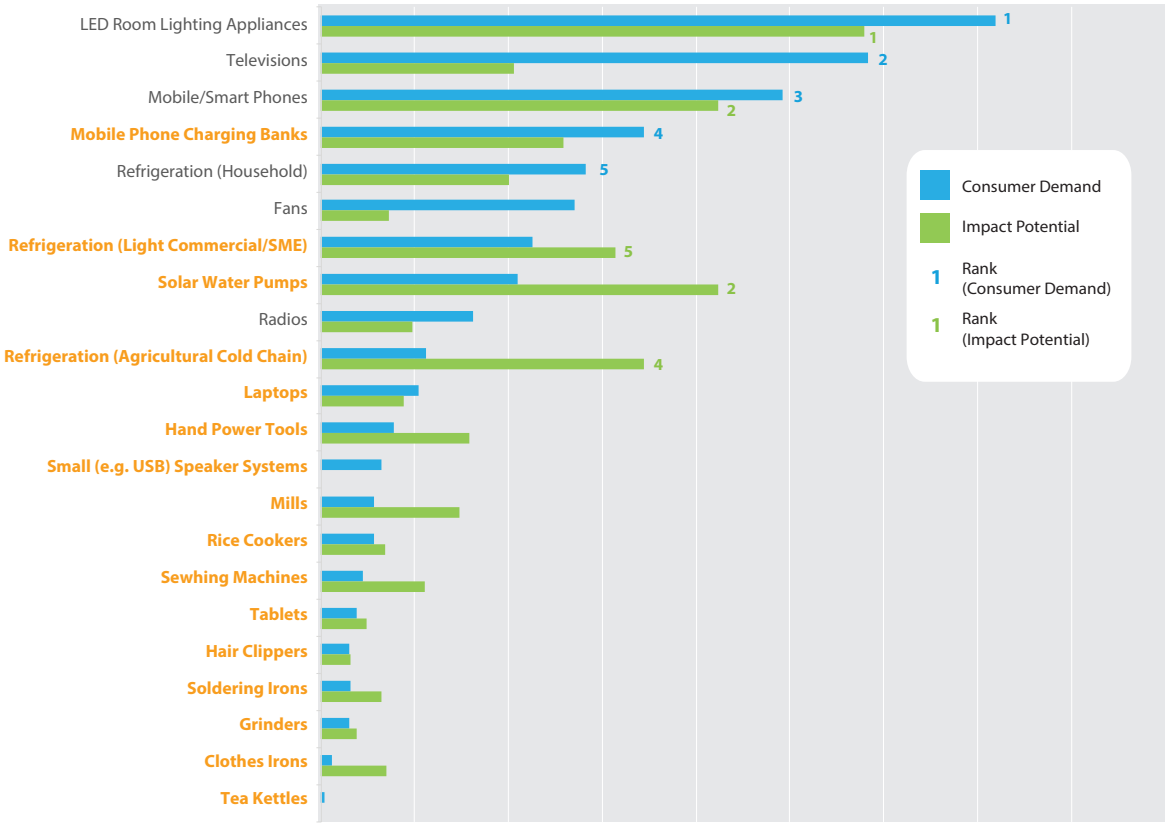
Notable findings regarding anticipated consumer demand:

- Globally, the top five household/SME appliances are LED room lighting appliances, televisions, mobile/smart phones, mobile phone charging banks and household refrigeration.
- Fans rank sixth in consumer demand, but ranked very highly in hot and humid climates like South Asia.
- While agricultural refrigeration and solar water pumps are not ranked in the overall top 5 consumer-demanded products, their impact potentials are ranked higher.

Notable findings regarding potential contribution to socioeconomic development and poverty reduction:

- LED lighting is seen as the top ranked product for development impact potential.
- Mobile/smart phones and SWPs are seen as the next highest impact products, followed by agriculture cold chain refrigeration.

Figure 1: Ranking Overview: Household or SME Off-Grid Appliances



Orange = "Productive Use" applications, as commonly understood. Conceivably, nearly every product here could be used to directly make, or augment, income.

** The survey respondents were asked to rank top 5 household/SME off-grid appliances based on anticipated off-grid consumer demand and potential contribution to socioeconomic development and poverty reduction for the next 3-5 years.*

Anticipated Consumer Demand Ranked by Anticipated Consumer Demand Ranked by Region

Global LEAP examined product rankings by region, looking for variation in product priorities across off-grid markets. As discussed in the previous section, respondents across regions consistently ranked LED lighting, mobile phones, and mobile phone charging banks highly, in terms of demand. As these products tend to factor in most distributed energy service company (DESCO) product offerings, we removed these products from Figure 3 to demonstrate each region's demand for "advanced" household services compared to more basic and widely available products (i.e. phones, chargers and lights).

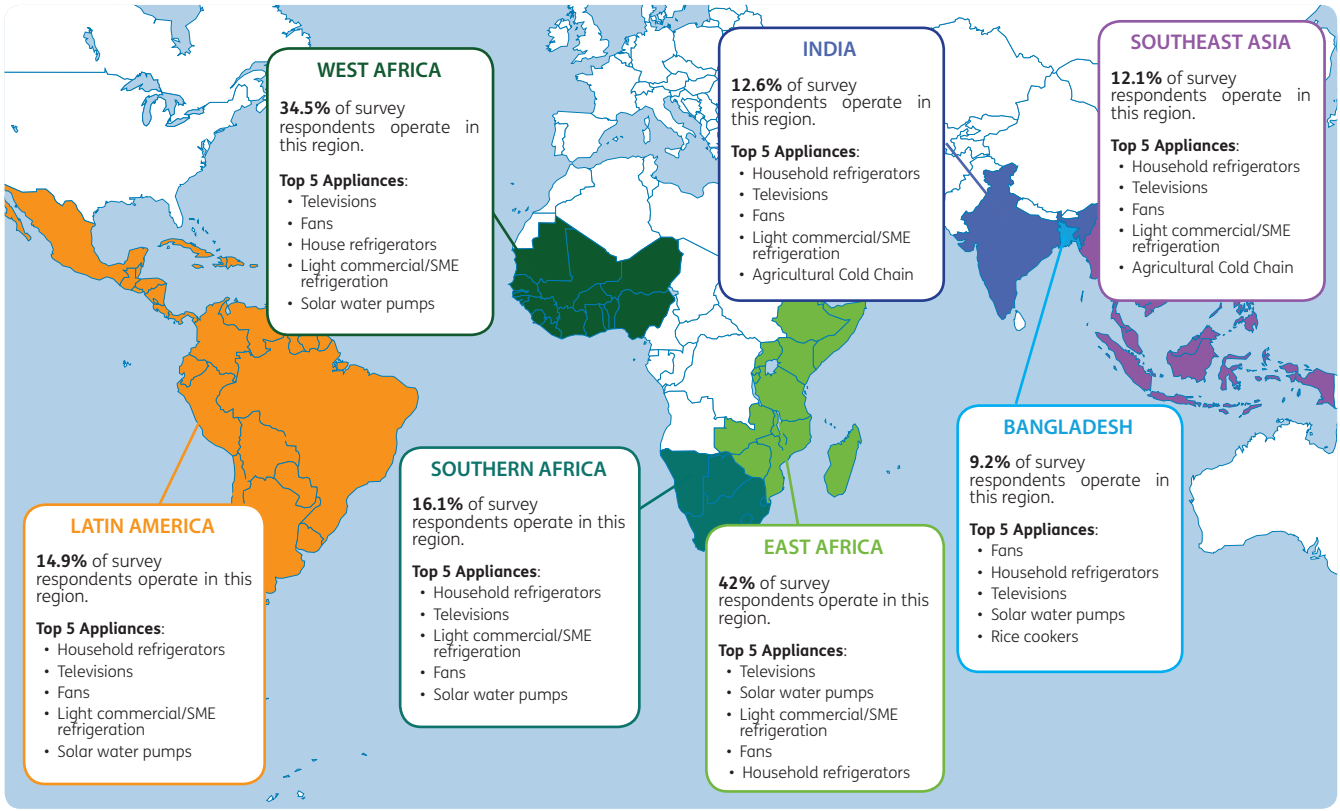
Overall, respondents were similar across regions, but expressed some distinctive regional characteristics. For example:

- Fans and rice cookers are among the most highly demanded products in Bangladesh.

- Household refrigeration is seen as the most demanded product in India, South Asia, Latin America, and South Africa, while televisions are first in West and East Africa.
- SWPs are among the top five highly demanded household appliances in almost all regions, with the exceptions being Southeast Asia and India. In East Africa, SWPs are seen as the second most highly demanded product.

These regional perspectives from energy access professionals and DESCOs suggest that while consumer demand for off-grid appliances remains broadly similar across regions, regional preferences are important and should be considered by industry, policymakers, and other stakeholders.

FIGURE 2. PRODUCT PRIORITIES (IN TERMS OF ANTICIPATED CONSUMER DEMAND) IN KEY REGIONS (N=174)



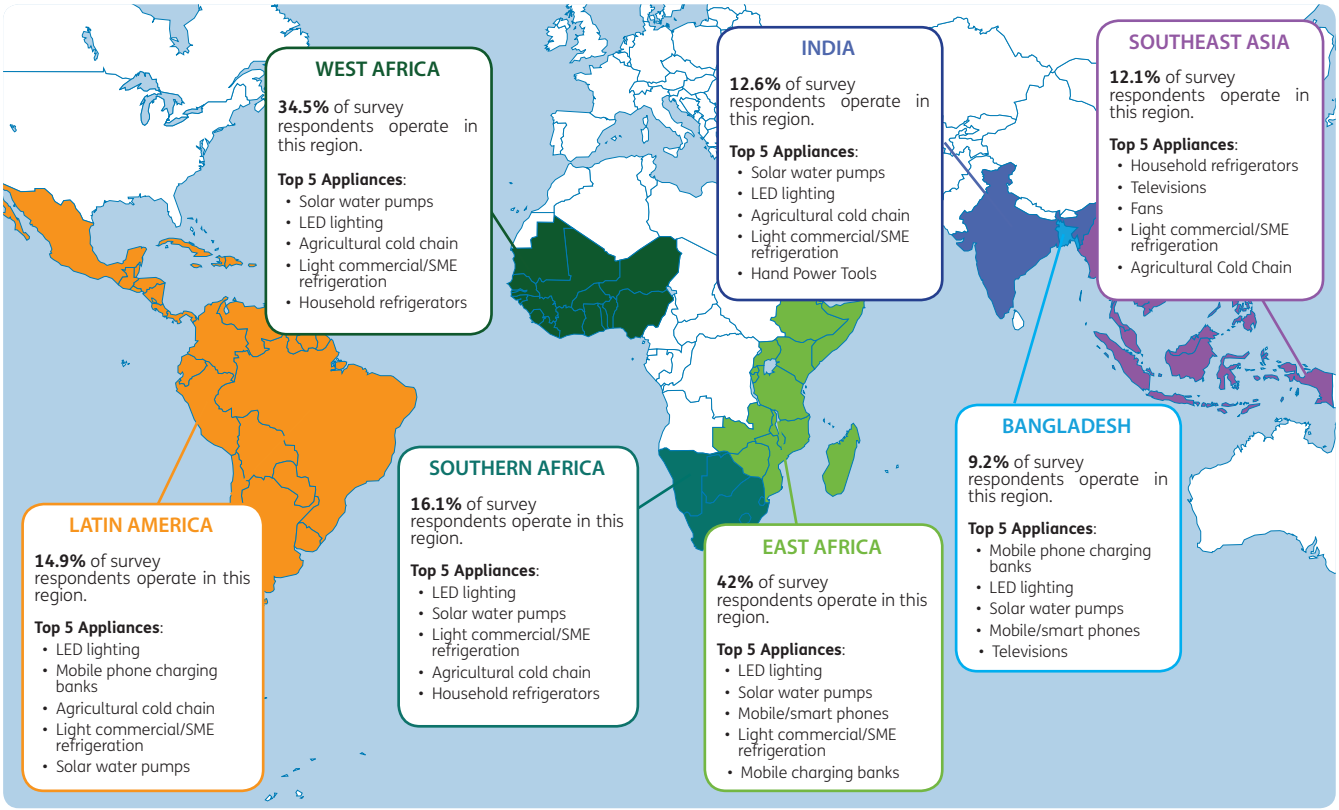
* Geographical sub-region groupings in Figure 4 are indicative based on definitions of the United Nations Geoscheme. The assignment of countries or areas to specific groupings is for statistical convenience and does not imply any assumption regarding political or other affiliation of countries or territories.

Socioeconomic Impact Potential Ranked by Region

The survey results indicate that LED lighting, mobile phones, SWPs, and refrigeration are seen to have the highest potential to drive socioeconomic impacts across all regions, but product priorities vary slightly region by region. For example, respondents considered LED lighting the product with the highest impact potential in most of the regions except for West Africa and India, where SWPs are ranked highest.

Respondents expect refrigeration—including household, light commercial/SME, and agricultural cold chain applications—to drive significant socioeconomic impacts across regions. In West Africa, India, Latin America, and South Asia, agricultural cold chain refrigeration products are the product category with the 3rd highest anticipated impacts, after LED lighting and SWPs.

FIGURE 3: PRODUCT PRIORITIES (IN TERMS OF POTENTIAL SOCIOECONOMIC DEVELOPMENT AND POVERTY REDUCTION IMPACTS) IN KEY REGIONS (N=174)



* Geographical sub-region groupings in Figure 4 are indicative based on definitions of the United Nations Geoscheme. The assignment of countries or areas to specific groupings is for statistical convenience and does not imply any assumption regarding political or other affiliation of countries or territories.

Perceptions of Off-Grid Appliance Demand and Impacts through Time

Global LEAP conducted surveys of the off-grid product market two years apart (2014 and 2016), which were published the following years. The intention of the follow-on survey was to learn whether understandings of demand and impacts had shifted as the market evolved and further developed. Compared to the 2014 survey, the 2016 survey results show that priorities for household appliances may have shifted, if only slightly. LED lighting appliances remain the most demanded product in both 2014 and 2016, but rankings for radios dropped from 4th in 2014 to 9th in 2016. Respondents also reported increased demand for hand power tools and rice mills, jumping from 13th and 16th in 2014 to 12th and 14th in 2016, respectively.

According to 2014 and 2016 survey respondents, LED lighting has the highest potential to impact development goals (e.g. education, women's empowerment, income generation, etc.). SWPs have the 2nd highest impact potential, tied with mobile phones and followed by refrigeration. Respondents commonly identify these products as "productive use" applications that directly generate or augment income.

TABLE 2: RANKING IN 2014 VS 2016: HOUSEHOLD OR SME OFF-GRID APPLIANCES

	2014 Survey Results		2016 Survey Results	
Anticipated Consumer Demand	1	LED lighting appliances	1	LED lighting appliances
	2	Mobile charging banks	2	Televisions
	3	Televisions	3	Mobile/Smart phones
	4	Radios	4	Mobile phone charging banks
	5	Refrigeration	5	Refrigeration (household)
	6	Fans	6	Fans
	7	Laptops	7	Refrigeration (Light commercial/SME)
	8	Solar Water Pumps	8	Solar Water Pumps
	9	Tablets	9	Radios
	10	Rice Cookers	10	Refrigeration (Agricultural cold chain)
	2014 Survey Results		2016 Survey Results	
Socioeconomic Impact Potential	1	LED lighting appliances	1	LED lighting appliances
	2	Refrigeration	2	Mobile/Smart phones
	3	Mobile charging banks	2	Solar Water Pumps
	4	Solar water pumps	4	Refrigeration (Agricultural cold chain)
	5	Televisions	5	Refrigeration (Light commercial/SME)
	6	Laptops	6	Mobile Phone Charging Banks
	7	Radios	7	Televisions
	8	Fans	8	Refrigeration (Household)
	9	Rice mills	9	Hand power tools
	10	Rice Cookers	10	Mills

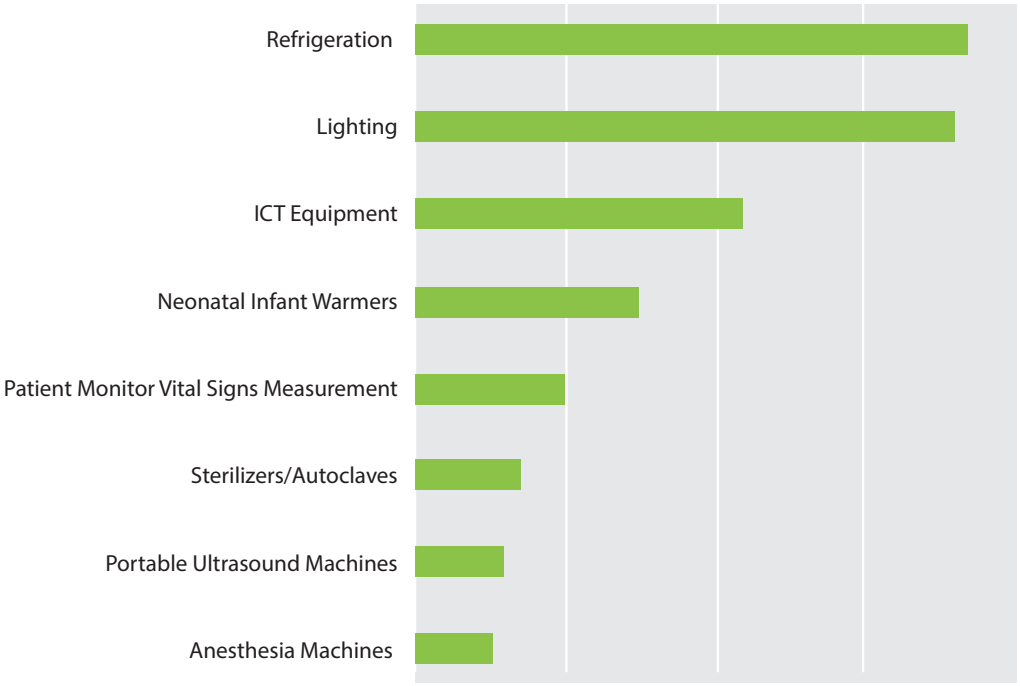
Healthcare and Clinical Appliances

As indicated in Figure 4, the top five healthcare and clinical appliances ranked by impact are refrigeration (e.g. vaccine refrigeration), lighting, ICT equipment (computer, cell phone chargers, printer, radio), neonatal infant warmers, and patient monitor for vital signs measurements (e.g. NiBP, SpO2, HR, RR, EtCO2 and ECG).

The survey included other healthcare and clinical products that did not receive responses including cautery machines/diathermy, CD4 machines, centrifuge, O2 Concentrators, regulated IV pumps and surgical suction machines. Of course, there is likely to be both demand for and impacts from these products.

Importantly, the response rate for the healthcare and clinical appliances is significantly lower than for household and SME appliances. As noted above, only 10 out of 174 survey respondents provided full or partial responses for these questions. These 10 respondents are affiliated either with the healthcare industry (2 respondents) or academics/researchers (8 respondents). While these responses are useful and interesting, because of the sample size Global LEAP would not recommend drawing broad conclusions.

Figure 4: RANKING OVERVIEW: IMPACT POTENTIAL OF HEALTHCARE AND CLINICAL APPLIANCES



** Global LEAP asked survey respondents to rank top 5 healthcare and clinical appliances based on impact upon healthcare outcomes (i.e. the relative importance of each in delivering healthcare services to rural and/or under-electrified populations).*

Methodology

Global LEAP conducted the 2016 survey to assess the demand for and impact of off-grid solar-powered appliances, including household, small-medium enterprise, and clinical applications. Global LEAP reached out to participants online via their affiliation with the following groups: United Nations Foundation's Energy Access Practitioner Network (EAPN), the Global Off-Grid Lighting Association (GOGLA), the International Finance Corporation's Lighting Global, and the Clean Energy Access Network (CLEAN)—our thanks goes out to these partners and their members/stakeholders. Global LEAP and our partners also disseminated the survey through Twitter and several energy access LinkedIn Group pages.

The survey was open from 22 November to 15 December 2016. It organized 36 product categories into two groups:

- Off-grid households and (SME) applications
- Healthcare and clinical facility applications

We asked clean energy access professionals to answer three key questions on consumer demand, socioeconomic development, and healthcare and clinical applications:

- Of the following appliance product categories that might be appropriate for **off-grid households and small- to medium-sized enterprises**, please rank the top five (5) product categories that—in your estimation—will see the most off-grid consumer demand over the next three to five years. The product for which you expect to see the most demand will be #1, the second most demanded product will be #2, etc.
- Of the following **household/small- to medium-sized enterprise appliance** product categories, please rank the top five (5) product categories in terms of their potential contribution to socioeconomic development and poverty reduction over the next three to five years. The product with the greatest potential for benefits will be #1, the product with the second greatest potential will be #2, etc.
- Of the following appliance **product categories relevant to healthcare and clinical facilities**, please rank the top five (5) product categories in terms of impact upon healthcare outcomes (i.e. the relative importance of each in delivering healthcare services to rural and/or under-electrified populations). The product with the greatest impact upon healthcare outcomes will be #1, the product with the second greatest impact will be #2, etc.

For each question, survey respondents picked their top five appliance product categories and ranked them one through five, with one being the "most anticipated consumer demand" or "greatest anticipated contribution to development impacts." Additionally, Global LEAP asked respondents to add other appliance product categories they deem important. We chose appliance categories in consultation with several market experts and then randomized the list to control for bias based on order or presentation.

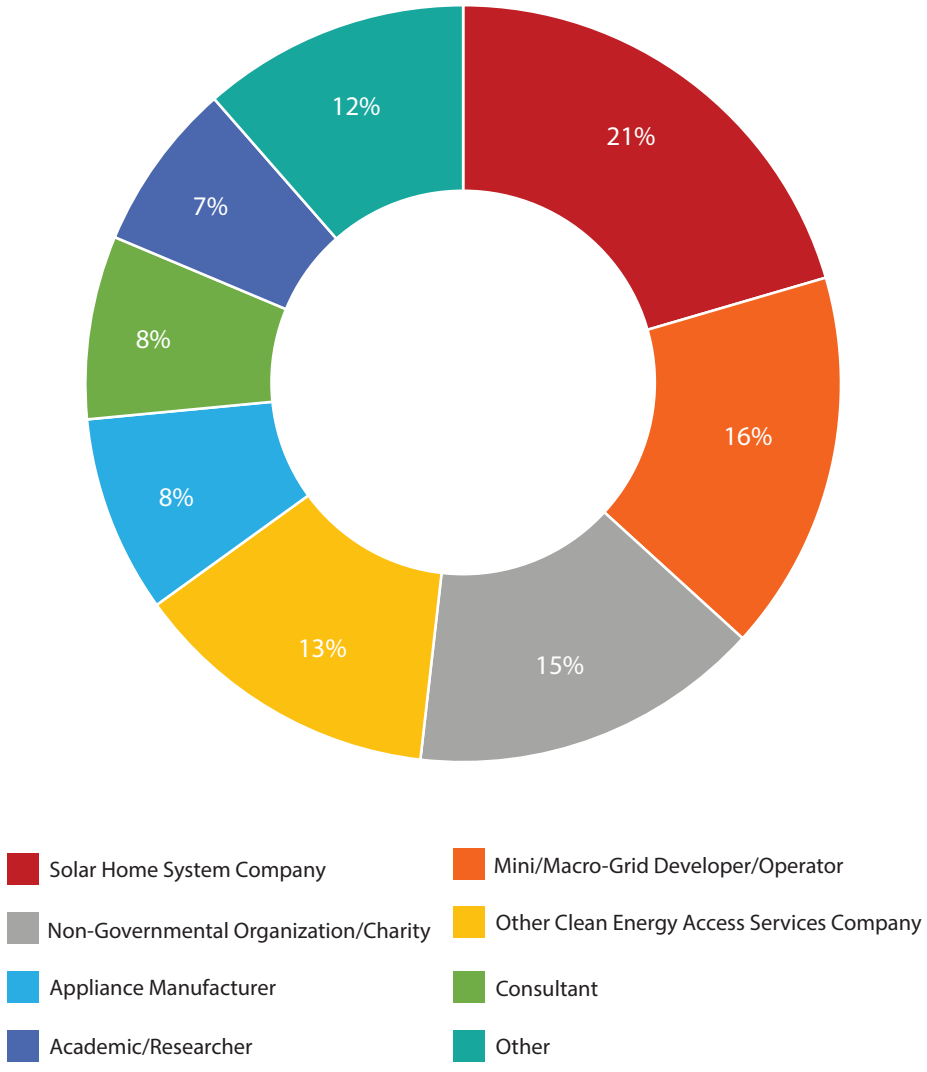
Global LEAP assigned points to products based on their rankings. A '1' ranking earns fifty (50) points, a '2' ranking earns forty (40) points, and so on. Products outside of the top five ranking received zero (0) points. We summed the points earned by each product, and ranked the products based on total cumulative points.

Respondent Characteristics

The survey received 174 responses from industry, policy and development professionals from around the world.

The majority of the respondents (49%) are from clean energy access service companies, including solar home system companies, mini/micro-grid developers/operators, and others, while appliance manufacturers account for 8% of the total response. Consultants and academic researchers account for 16% of the responses and other respondents include international development organizations, investors/finance institutions, government agencies, and healthcare or healthcare equipment providers.

FIGURE 5: DISTRIBUTION OF RESPONDENTS' AFFILIATIONS



Conclusion, Recommendations & Next Steps

The 2016 Global LEAP Off-Grid Appliance Market Survey results suggest—consistent with the 2014 survey—off-grid LED lighting and cell phone charging remain the most highly demanded products. But there was movement elsewhere—for example, the survey showed significant increased perceived demand for off-grid refrigeration and water pumps. Information developed by this survey about healthcare applications is interesting but limited and inconclusive due to the small respondent size.

The off-grid appliance market is still nascent, and there is limited market intelligence to help actors throughout the supply chain make informed decision and target resources more efficiently. The 2014 and 2016 surveys are intended to provide a high-level overview of expected demand for and impacts of off-grid appliances, and is intended as a touchpoint for actors interested in market action and support. But much more work of this nature is needed.

Online surveys such as this are limited by their structure and the number and characteristics of respondents. Additional market research efforts such as supply chain mapping, appliance pricing, and market size estimates might take a deeper and much more systematic look at these and related questions. Enhanced market analysis would improve the overall ecosystem of the global off-grid market and inspire high-impact market coordination to drive further energy access and sustainable development impacts.

EFFICIENCY 4 ACCESS COALITION

A campaign to drive universal energy access beyond lighting

Photo Credit: Ti el Attar/NIWA

Contact Us

Efficiency4Access.org info@Efficiency4Access.org @E4ACoalition