



APPLIANCES FOR ALL:

**Assessing the Inclusivity of the Solar Lighting
& Appliances Sector**

SEPTEMBER 2022

EFFICIENCY FOR ACCESS COALITION

This report aims to promote inclusivity¹ as a critical component of achieving a just energy transition, especially for marginalised groups. It is a first step towards establishing a baseline to understand how well the sector is performing across different facets of inclusivity. We encourage stakeholders to use our checklist and commit to incorporating principles of diversity, equity, and inclusion across into their work, organisations, and communities.

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1. This report defines inclusivity as the ongoing act of creating environments in which any individual or group feels welcomed, respected, supported, and valued to fully participate, thrive and succeed. Full definitions of inclusivity-related terms are provided in Appendix A.

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ACRONYMS & ABBREVIATIONS

AC	Alternating Current
CEO	Chief Executive Officer
COVID-19	Coronavirus Disease (2019)
DRE	Decentralised Renewable Energy
GDC	Global Distributors Collective
HI	Humanity Inclusion
LED	Light Emitting Diode
LEIA	Low Energy Inclusive Appliances
NGO	Non-Governmental Organisation
PAYGo	Pay-As-You-Go
PPI	Poverty Probability Index
PV	Photovoltaic
RE4R	Renewable Energy for Refugees
R&D	Research and Development
SHS	Solar Home System
SACCOs	Savings and Credit Organisations
SDG	Sustainable Development Goals
SSA	Sub-Saharan Africa
UNESCO	The United Nations Educational, Scientific and Cultural Organization
UNHCR	United Nations High Commissioner for Refugees
USD	United States Dollar

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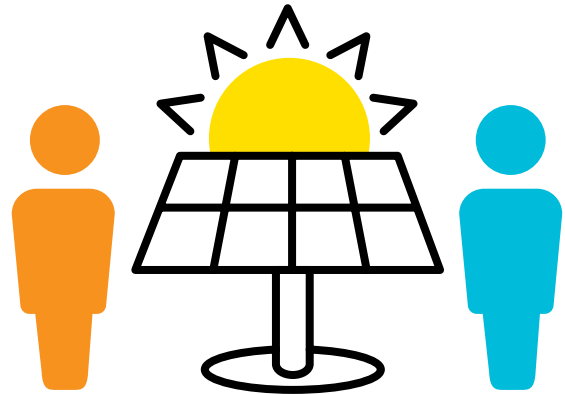
Photo Credit: SunCulture

Executive Summary

How Inclusive is the Solar Lighting and Appliances Sector?

This analysis assesses how well solar appliances are reaching key populations, as well as inclusion across solar company employment practices and product offerings.

Off-grid appropriate solar lighting products and appliances are reaching more people across the Global South. However, this meta-analysis of 19 household surveys and two surveys of private sector companies finds more can be done to reach marginalised groups and ensure the benefits of energy access are experienced equitably.



Survey data suggest that the solar lighting and appliances sector is serving a homogeneous demographic. The typical solar product user is:



A man in his early forties



Connected to the grid



In sub-Saharan Africa



Living in a rural or peri-urban area



With 4-5 members in his household



Employed, with at least a secondary education



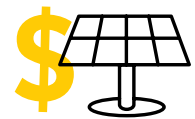
Above the poverty line of USD \$3.20 per day



Does not have a disability



Included in the formal financial sector



Able to leverage financing to purchase their appliance

Is the solar sector reaching marginalised groups?

Survey data for women, people with disabilities, and bottom-of-the-pyramid households is limited, suggesting the sector may not be doing enough to meet their needs.



Women comprised less than 40% of our sample. This may suggest access barriers to solar lighting and appliances across sales, ownership, and use. Female voices may be underrepresented in surveys that use random sampling methodology from existing company contact databases. Likewise, household surveys that interview the household head in patriarchal societies may also collect perspectives and usage data about solar products that are biased towards men.

70% of our sample was not asked to report whether they had a disability. Of the 30% who were asked, 12% reported living with at least one, lower than the global average of 15%. Missing observations and inconsistent definitions limit concrete conclusions.



Photo Credit: Wala



Roughly 40% of our sample earn less than USD \$3.20 per day, compared to over 65% people in sub-Saharan Africa and over 60% of people in India. This suggests the majority of solar product users are more affluent than their peers.

How Gender-Inclusive is the Private Sector?

A growing number of solar lighting and appliance companies are making an effort to hire employees from diverse backgrounds and design products that respond to diverse customer needs. However, more can be done to level the playing field for marginalised groups.

23%

Women make up 23% of the workforce in solar lighting and appliance companies, indicating the field is heavily male-dominated. This trend mirrors the broader energy sector where women make up just 22% of the total workforce.

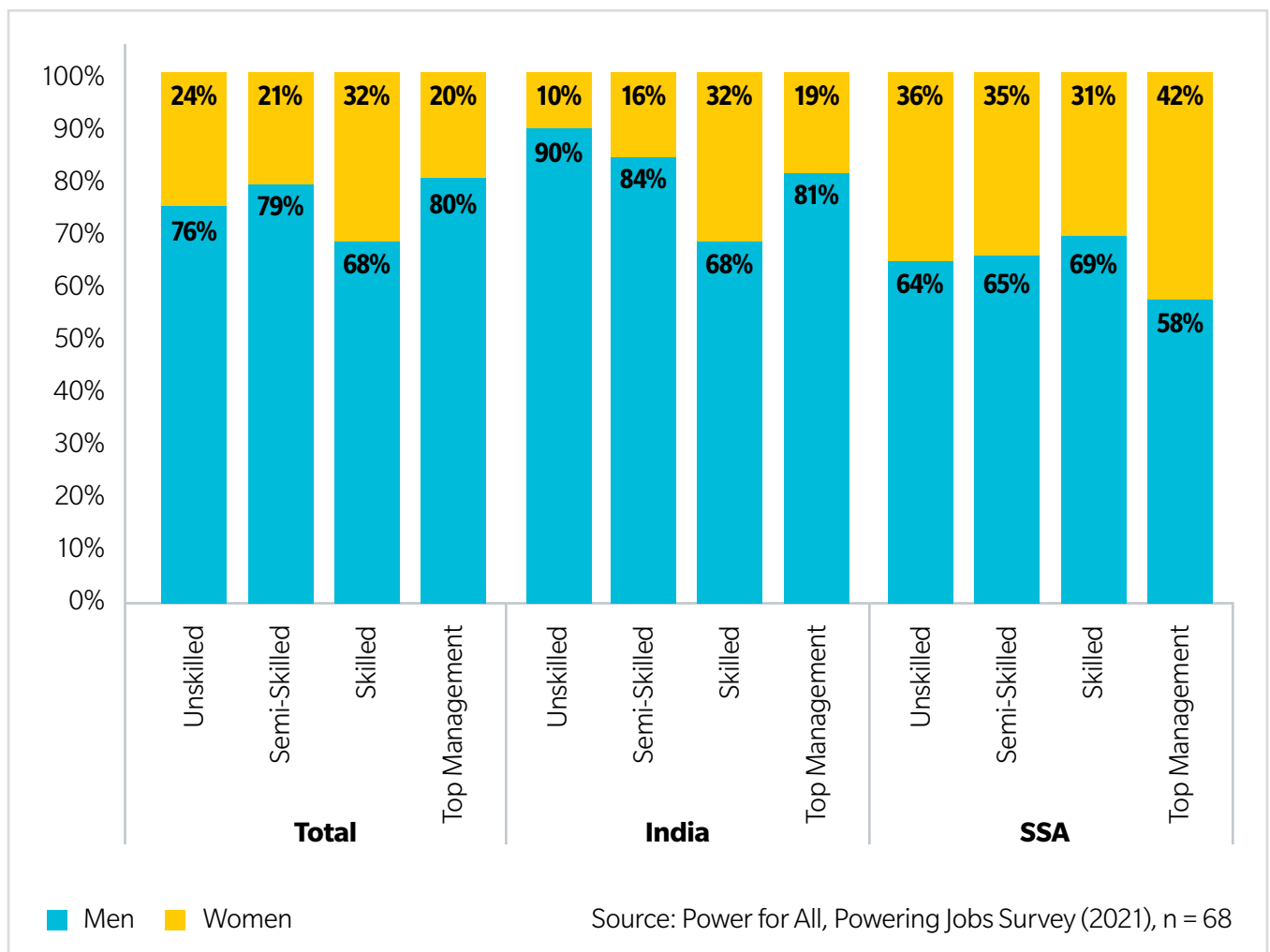
84%

84% of companies did not report gender-disaggregated employment data. Even fewer (4%) reported gender-disaggregated pay data. Better data and more inclusive company policies are vital to closing gender gaps in hiring and compensation.

72%

Many companies specialise in (72%) and/or distribute (25%) appliances and productive use equipment. However, only 5% of surveyed distributors carry the niche or nascent appliances traditionally perceived to benefit women.

The graph below shows self-reported gender-disaggregated employment data by employee skill level for 68 solar lighting and appliance companies.



Recommendations

The following recommendations should be implemented by sector stakeholders to empower marginalised groups, mainstream inclusivity best practices, and scale the gains achieved so far.



Leave No One Behind

While the sector has made great strides in delivering energy access, it may still be leaving some key populations behind. Companies, donors, NGOs, and programme implementers must all work together to ensure women, people with disabilities, bottom of the pyramid households, and other marginalised groups have equal access to solar products. Expecting a company to become sustainable while serving these communities is a difficult task that can rarely be achieved without subsidies or concessional financing. Relevant stakeholders must develop and fund interventions to level the playing field accordingly.



Set Targets, Manage Progress

To ensure principles of inclusivity are deeply ingrained within the sector, donors, market development programmes, businesses, investors and others should develop holistic and harmonised targets, indicators, and tracking mechanisms. There remains a dearth of gender, disability, and income-disaggregated data within the sector. When this data is collected, it is often not done in a uniform way. Efforts to get the sector “on the same page” about what it means to be inclusive and how or how often data will be collected and assessed is a critical first step towards establishing a baseline to measure progress against.



Address Affordability

Most solar product users do not live in poverty, suggesting these products may be out of reach for many. Companies should continue to work to drive product prices down without compromising quality. In the meantime, investors and donors should prioritise flexible loan terms and low-interest rates. End-user subsidies, results-based financing programmes like [the Global LEAP Awards Results-Based Financing Programme](#), and incentives for companies to operate where customers may not have traditional purchasing power or product awareness can help make solar lighting and appliances more accessible and lower first-cost barriers.



Design Products For and With Marginalised Groups

Businesses should assess the demand, growth and impact potential for products used by marginalised groups and work with those communities to ensure all product designs are appropriate to their needs. Successful implementation will require support from multiple actors. For example, applying a disability lens to all stages of product design, marketing, and sales may require difficult to source population statistics from public agencies, user feedback from distributors, and funding support for R&D from donors and market development programmes.



Make Inclusivity a Core Company Value

Communicating diversity as a core value signals to employees, investors, and customers that a company has a vested interest in addressing and dismantling barriers for historically marginalised groups. From there, it is critical that companies follow up with meaningful programmes and policy changes. This may include creating fair and equitable employee compensation and promotion procedures and developing targeted initiatives to improve the recruitment and retention of marginalised groups. Companies should track progress in these endeavors by collecting and analysing diversity data regularly. This data should be used to inform the direction of future diversity initiatives.



Background & Introduction

Background

Efficient solar lighting and appliances deliver many socioeconomic benefits in improved productivity, new business opportunities, greater comfort, and a higher quality of life.

Solar products² can also function as vital climate change mitigation, resilience and adaptation tools and improve health outcomes by delivering critical medical infrastructure and cooling.

However, the benefits of access to modern energy services and equipment are largely absent among marginalised and vulnerable populations.

Globally, 9 out of 10 refugees have no access to electricity.³ In one study, households with people with disabilities had lower levels of electricity access in 84% of countries surveyed.⁴ Female-headed⁵ households are less likely to have access to energy than male-headed⁶ households.⁷ Though solar PV is the cheapest source of electricity for many of the 572 million people across Africa,⁸ many bottom-of-the-pyramid households still struggle to afford even this entry into modern energy services.⁹ Even with access to PAYGo or other forms of consumer financing, 240 million unconnected people are still unable to afford a Tier 1 solar energy kit.¹⁰

To date, the solar lighting and appliances sector has heavily focused on the gender and poverty dimensions of diversity, equity, and inclusion. Efforts like gender mainstreaming and sector-organised working groups on gender have been an essential first step in working to develop more inclusive programmes and business models. It is also one of the more manageable dimensions of inclusivity to measure and improve.

Despite these valuable first steps, there is still a long way to go until the sector itself achieves full gender inclusion. Our 2020 Off-Grid Appliance Market Survey Report shows that year on year, sector stakeholders – who make all design and dissemination decisions on behalf of end-users – still do not consider gender a strong influencing factor in their perceptions of consumer demand for or the impact of solar appliances.¹¹ Most respondents did not think that solar products have gendered demand or impacts, but those that did revealed stark contrasts in line with existing gender expectations. Refrigerators and sewing machines were perceived as impactful for women, whilst hand power tools and mills/ grinders were perceived as more important to men, highlighting implicit gender biases.¹²

Men far outnumber women in managerial positions within solar lighting and appliances companies. There are only 3 female CEOs in over 200 solar companies in Uganda.¹³ This diversity gap within the private sector may lead to bias in the types of products developed and business decisions made, which may affect social impact. This gap may also contribute to limited efforts to measure the true extent of the diversity gap and evaluate the means to close it.

Diversity and inclusion efforts should go beyond gender and poverty, and in this report we make a case for better tools and more consistent measurements to be able to incorporate other aspects. Dimensions that are being overlooked, or where we did not find consistent and intentional surveying and reporting, include disability, youth, the extremely poor (i.e., those who cannot participate in commercial markets), and communities in fragile and conflict zones, among others.

2. In the context of this report, we refer to “solar products” as encompassing high quality, off- and weak-grid appropriate lighting (i.e. pico-solar products and solar home systems) as well as appliances for which we have enough data (i.e. televisions, solar home systems, solar water pumps, refrigerators, and electric pressure cookers). This decision was made both due to the nature of the datasets we have used, and in an attempt to showcase a measure of inclusivity in the off-grid solar sector as a whole.

3. Chandler Green, “5 Reasons to Care about Powering Refugee Camps,” United Nations Foundation (blog), February 1, 2018, <https://unfoundation.org/blog/post/5-reasons-care-powering-refugee-camps/>.

4. United Nations Department of Social and Economic Affairs, “Realization of the Sustainable Development Goals By, For, and With Persons with Disabilities: UN Flagship Report on Disability and Development 2018” (2018, <https://www.ohchr.org/sites/default/files/Documents/HRBodies/CRPD/UN2018FlagshipReportDisability.pdf>).

5. A household in which an adult female is the sole or main income producer and decision-maker.

6. A household in which an adult male is the sole or main income producer and decision-maker

7. ENERGIA, “The Case for a Gender Perspective on Energy Access,” n.d., <https://www.energia.org/case-gender-perspective-energy-access/>.

8. IEA, “SDG7: Data and Projections” (Paris, France, 2022), <https://www.iea.org/reports/sdg7-data-and-projections/access-to-electricity>.

9. Moussa P. Blimpo and Malcolm Cosgrove-Davies, *Electricity Access in Sub-Saharan Africa: Uptake, Reliability, and Complementary Factors for Economic Impact* (World Bank Publications, 2019).

10. GOGLA et al., “Off-Grid Solar Market Trends Report 2022: State of the Sector” (Washington, DC: World Bank, 2022).

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

12. Efficiency for Access.

13. Africa Clean Energy Technical Assistance Facility, “Women in Solar Energy: Managerial, Operational and Artisanal,” 2021, <https://www.ace-taf.org/wp-content/uploads/2021/05/Women-in-Solar-Energy-Managerial-Operational-and-Artisanal.pdf>.

To deliver sustainable development through a just energy transition, solar products must be accessible to all who need or desire them. Accelerating progress towards SDG 7¹⁴ requires mobilising significantly more resources, particularly for those countries—and specifically for the vulnerable or marginalised groups there—who are currently the furthest behind the clean energy transition. Yet, international public financial flows to developing countries in support of clean energy decreased in 2019 for the second year in a row and remained heavily concentrated geographically, with 24 countries having received 80% of all commitments.¹⁵

Beyond “leaving no one behind”, a more inclusive sector is good for business: widening access to previously untapped populations can expand customer bases, leading to increased sales and enabling appliance markets to scale. Feedback from a diverse consumer base can lead to product improvements that benefit all customers, not just marginalised groups. To fully realise these benefits, the sector must regularly take stock of how well it is reaching marginalised groups.¹⁶

Report Purpose

This seminal report is a first step in establishing a baseline to understand how well the sector is performing across different facets of inclusivity.

It aims to answer the following questions:

- Who is the typical solar lighting and appliance user and is that person representative of those living in energy poverty?
- How well is the sector reaching marginalised groups, including women, people with disabilities¹⁷, and people living in poverty (i.e., is the sector really “leaving no one behind”)?
- How diverse are the staff and product offerings of solar lighting and appliances companies?

The findings presented in this report offer an illustrative gauge of inclusivity. We hope they will help donors, market development programmes and businesses develop holistic and harmonised targets, indicators, and tracking mechanisms needed drive more equitable outcomes for all.

14. The United Nations' Sustainable Development Goal 7 (SDG7, Affordable and Clean Energy) aims to ensure access to reliable, sustainable, and affordable energy for all. One of the goal's primary targets is to ensure universal access to modern energy services and clean cooking solutions by 2030. For more, see: <https://sdgs.un.org/goals/goal7>.

15. ESMAP, “2022 Tracking SDG7 Chapter 7: Indicators and Data,” 2022, <https://trackingsdg7.esmap.org/downloads>.

16. There is a need to streamline what the sector means by this term - for some, it refers to last mile populations, which traditionally are thought of as those living in very rural areas, but for some can also include communities of underserved people and those left behind by social and economic progress for other reasons, including discrimination, political or refugee status, instability, disabilities, poverty, gender, or socio-cultural impediments, and thus exploring more peri-urban or urban customer segments, like people living in slums.

17. People with disabilities include individuals who have long-term sensory, physical, psychosocial, intellectual, or other impairments that, in interaction with various barriers, may hinder their full and effective participation in society on an equal basis with others. This report elects to use “disability first” language over “identity first” (e.g., “a person with a disability” rather than a “disabled person”). Disability first language is widely used across major international conventions, such as the United Nations Convention on the Rights of Persons with Disabilities. Disability first language is widely viewed as a way to respect people with disabilities by putting the person first, rather than the disability, detaching their disability from their identity.



Photo Credit: SEforALL

Limitations and Interventions

The quantitative assessments presented in this report should not be taken as a comprehensive or exact summary. Instead, they should be seen as a lens through which we can see our sector's end-users, the technologies we support, and our organisations in a new light, and collectively initiate changes in the nature of our activities as well as our data collection efforts to make a bigger difference.

The data underpinning our analysis were not collected for the purpose of tracking inclusivity. One limiting factor we encountered in presenting quantitative assessments of any inclusivity category reviewed in the report depended solely on data availability rather than our perceived relative importance and/or prevalence of inequalities. The scope of our analysis of solar product users is limited to women, people with disabilities and people living under the international poverty line of USD \$3.20 per day. Our analysis of inclusivity within the private sector is limited to gender inclusion and diversity of product offering.

The second limiting factor we encountered in our quantitative assessment of inclusivity was the sheer volume of missing data. No survey included in this analysis required respondents to share demographic information on the three dimensions of this report dimensions of this report (gender, income, disability). In an effort to create the largest possible sample size, we did not drop observations with missing data from its analysis. These missing data introduce bias and underscore the need for standardised definitions, indicators, and data collection efforts.

When possible, we tried to benchmark our results. We aimed to include benchmarks from industry standards, other related sectors (e.g., agriculture, financial inclusion) or global assessments (e.g., World Bank poverty lines). Where we did not have sufficient data, we endeavoured to present a case study or text box of exemplary company(ies) or initiative(s) that are beginning to address relevant dimensions.

To provide overarching recommendations and integrate disparate partner datasets, the findings have been generally drawn across "all solar products", with call-outs for specific products where there are divergent findings. Most of the data used for the synthesis relates to the following appliances for which we have the most data: solar home systems, pico-solar products, televisions, solar water pumps, refrigerators, and electric pressure cookers.

A lack of standardised definitions, targets, and indicators makes it difficult for the sector to assess who is included and excluded from access initiatives.



Photo Credit: Futurepump



Inclusivity Assessment of Solar Product Users

The Profile of a Solar Product User

The typical solar product user in our sample is a man in his early forties living in a rural or peri-urban area with access to a grid connection in sub-Saharan Africa (Table 3). He has no disability, is employed and has completed secondary school. His household has between five and six family members and does not live under the international poverty line of USD \$3.20 per day. He is included in the formal financial sector and leverages financing to purchase his appliance.

Survey data suggest that the solar lighting and appliances sector is serving a homogeneous demographic.

Table 1. Attributes of the Typical Solar Product User: Sub-Saharan Africa and India

CHARACTERISTIC	AVERAGE/MOST FREQUENT RESPONSE
Age	41 (India: 43)
Gender	Male
Employment ¹⁸	At Least Part-Time
Education (Highest Level)	Secondary
Household Size	5 (India: 6)
Poverty (Under USD \$3.20/day)	No
Geographic Setting	Rural/Peri-Urban
Primary Electricity Source	Grid Connected ¹⁹
Financial Sector Participation ²⁰	Yes
Loan Required	Yes (India: No)
Financing Type	Savings Club or Self-Help Group (India: Other)
Disability Status	No (India: N/A)

NOTE: Any differences between sub-Saharan Africa and India are noted in parentheses.

18. A person was considered to be employed if they stated an occupation. It should be noted that few surveys provided details on whether the respondent was fully-employed, partially-employed, or seasonally-employed. No data about participation in the informal economy was available.

19. While a user might be grid-connected, the reliability/quality or affordability of their electricity may still be an issue. Surveys we examined did not collect information on these components for grid-connected users.

20. Financial sector participation requires that a respondent is in some way included in the financial sector, such as by having a bank account or using mobile money.

The attributes of the typical solar product user in our sample did not vary significantly depending on the appliance they own, indicative of a lack of diversity in consumer sales.²¹ Regardless of whether a respondent owns a refrigerator or a fan, for example, the average profile is essentially homogeneous. All profiles for individual solar products, excluding electric pressure cookers, show that the typical user is grid-connected, lives above the poverty line, without a disability and is in their early forties.²² Our sample suggests that the sector is consistently serving the same demographic. Whilst this may reflect the sector's nascency, it indicates the need for an intentional focus on expanding the market inclusively.

Contrary to expectation, 49% of our sample is connected to the grid. Solar products are critical to ensuring energy access and socioeconomic opportunity for users living in areas without grid access. However, they can also be important for users who live in areas where the grid is highly unreliable, providing an important source of backup during outages, or for those with limited access to traditional, AC-powered appliances. However, as we also note in Appendix B: Methodology, our final sample contained survey data from multiple surveys that collected and reported data in disparate ways. Not all surveys asked respondents about their electricity source, and 53% of respondents in our sample did not have data on electricity sources in general. While some respondents with missing data might be inferred as being off-grid, we did not attempt to fill in missing variables by speculation, which likely impacted our results.

The typical solar product user in our sample is better-educated than the average person in their region. According to UNESCO, only 22% of sub-Saharan Africans had achieved secondary education in 2018.²³ In our sample, however, roughly 57% of sub-Saharan African respondents reported having attained secondary education. Studies have shown that education levels are significantly

correlated with increased asset ownership rates, which could shed light on solar product users' higher education levels. Higher education levels can also open up greater economic opportunity and is often associated with higher income, which may further enable users to overcome the affordability challenge in accessing solar products.

The majority of respondents in our sample live above the international poverty line. Affordability is a major—if not the most significant—challenge to increasing the uptake of solar appliances. Higher incomes may better enable respondents to access solar products, providing them with more disposable income and, in some cases, more risk tolerance for purchasing new technologies. Whilst the majority of respondents reported household incomes above international poverty lines for low- and middle-income countries, the typical user still relied on financing. Given that respondents were more affluent and better-educated than the average citizen in their respective countries, our findings suggest that the sector may be leaving behind the poorest of the poor.

Most respondents (65%) report financial sector inclusion,²⁴ and many leveraged financing to purchase their product. A majority utilised savings groups rather than seeking loans from larger financial institutions, such as banks. Savings clubs or self-help groups are collectively-run mutual assistance organisations based on community trust in which members contribute savings at regular intervals.²⁵ These savings are pooled and then disbursed for productive investments per organisational guidelines.²⁶ In Kenya, for example, these groups can take the form of Savings and Credit Organisations (SACCOs). It is estimated that more than 50% of Kenyans have interacted with financial services from these informal savings groups.²⁷ The typical user may still turn to savings clubs rather than banks for various reasons. Some may have had negative experiences with banks, or may generally distrust financial institutions. Others have an entrenched preference for cash or may find that the offered loan product does not meet their needs.

21. The appliance categories include solar water pumps, fans, electric pressure cookers, televisions, refrigerators, milk chillers, and mills.

22. All profiles show that respondents are, on average, male, except for electric pressure cooker users. Women are traditionally more often charged with cooking for the household, which may explain this gender flip.

23. Mary Burns, "Sub-Saharan Africa's Secondary Education Challenges," International Institute for Educational Planning Learning Portal (blog), 2020, <http://learningportal.iiep.unesco.org/en/blog/sub-saharan-africas-secondary-education-challenges>.

24. We defined financial sector inclusion as a respondent engaging in the financial sector through a bank, financial institution, or mobile money provider.

25. Kimani, "With Money to Invest, Kenyans Say No Thanks to Banks," Africa Renewal, October 12, 2009, <https://www.un.org/africarenewal/web-features/money-invest-kenyans-say-no-thanks-banks>.

26. Evans School of Public Policy and Governance, "Explorable Data Around Self-Help Group Prevalence and Coverage," n.d., <https://epar.evans.uw.edu/blog/explorable-data-around-self-help-group-prevalence-and-coverage>.

27. Evans School of Public Policy and Governance.

Pay-As-You-Go (PAYGo) was a less common form of financing among respondents.

2021 GOGLA sales data show that PAYGo consumer financing is prevalent in sub-Saharan Africa, representing 85% of affiliates' total solar water pump sales in the first half of 2021.²⁸ In our sample, however, solar water pump users relied on savings clubs or self-help groups more frequently than PAYGo. While our data may indicate that GOGLA affiliates are more likely to offer PAYGo consumer financing than non-affiliates, it also reflects that many surveys we analysed did not include PAYGo as a financing option for respondents. PAYGo for appliances is relatively new in the sector and presents its unique challenges, whilst savings clubs and micro-finance institutions have had a longer tenure. Thus, they may be more prevalent among certain groups.

The majority of respondents live in a rural or peri-urban environment in sub-Saharan Africa, where over 53% of the population lacks access to electricity.²⁹

The majority of respondents in our sample live in East Africa, with over 50% living in Kenya. Sub-Saharan Africa, and East Africa in particular, has recently seen a great deal of donor, company and non-governmental organisation activity, helping to bolster the sector's growth. GOGLA sales data from the first half of 2021 shows that the Kenyan market makes up almost half of all sales in East Africa and that the region represents more than half of all sub-Saharan African sales.³⁰ The fact that Kenyans represent a large percentage of our sample may indicate that there are more solar appliance users there or that surveying tends to happen where the industry is often most actively operating.

28. GOGLA et al., "July - December 2021 Global Off-Grid Solar Market Report," 2021.

29. World Bank, "Access to Electricity (% of Population) - Sub-Saharan Africa," 2020, <https://data.worldbank.org/indicator/EG.ELC.ACCTS.ZS?locations=ZG>.

30. GOGLA et al., "July - December 2021 Global Off-Grid Solar Market Report."



Assessing Key Dimensions of Inclusivity

This section explores how well solar products have seemingly penetrated appliance markets for women, people with disabilities, and people living below the poverty line. Notably, we were unable to access any survey data on the solar appliance sector's inclusivity for refugees and displaced communities, indicating an opportunity and need for further data collection. Whilst we cannot assess this important component, Practical Action shared initial findings and recommendations on their work with inclusivity, solar products, and refugee communities in the box titled, "Renewable Energy for Refugees" on page 30.

Reaching Women

64% of our sample are men. Except for electric pressure cookers, the majority of solar product users across every product category are men (Table 4). In developing countries, especially in rural regions, men often have more power in the allocation of household resources, including how electricity is used or which appliances to purchase.³¹ This is attributed to reinforced social norms and practices that promote traditional gender roles and lessen women's bargaining power. Whilst men usually decide which solar products to purchase, these appliances are likely to be shared with, or in some cases predominantly used, by women in the household. Evidence suggests that even though women do not necessarily make purchase decisions, they are primarily responsible for managing household energy and appliance use.³²

Women are often the primary beneficiaries of solar lighting and appliances, but often lack power when deciding which products to purchase.



Our sample suggests women with access to solar products are better educated and more likely to be employed in some capacity than the average women in their region. The typical woman in our sample has a secondary education, is employed, lives above the international poverty line, is grid-connected and has access to the financial sector (Table 5). 72% of female solar product users in our sample living in sub-Saharan Africa have at least a secondary education, higher than the secondary education attainment rates for women across the region.³³ The same was observed for women living in India, where 30% of female appliance customers have at least a secondary education, compared to the national average of 19%.³⁴

The majority of women in our sample are employed. 73% of respondents in sub-Saharan Africa indicated they were employed, compared to the regional labour force participation rate of 60%.³⁵ 100% of respondents in India reported being employed, compared to the national labour force participation rate of 22%.³⁶ It should be noted that 92% of women in our sample did not provide information, or were not asked, about their employment status. Greater efforts should be taken to standardise the collection of employment information, such as adopting common definitions for what constitutes as full-time employment.

31. Tanja Winther et al., "In the Light of What We Cannot See: Exploring the Interconnections between Gender and Electricity Access," *Energy Research & Social Science* 60 (February 1, 2020): 101334, <https://doi.org/10.1016/j.erss.2019.101334>.
32. Joy S. Clancy et al., "Gender Equity in Access to and Benefits From Modern Energy and Improved Energy Technologies: World Development Report Background Paper," 2012, <https://research.utwente.nl/en/publications/gender-equity-in-access-to-and-benefits-from-modern-energy-and-im>.
33. World Bank, "Educational Attainment, at Least Completed Upper Secondary, Population 25+, Female (%) (Cumulative) - Sub-Saharan Africa," n.d., <https://data.worldbank.org/indicator/SE.SEC.CUAT.UP.FE.ZS?locations=ZG>.
34. World Bank, "Educational Attainment, at Least Completed Upper Secondary, Population 25+, Female (%) - India," 2022, <https://data.worldbank.org/indicator/SE.SEC.CUAT.UP.FE.ZS?locations=IN>.
35. World Bank, "Labor Force Participation Rate, Female (% of Female Population Ages 15+) (Modeled ILO Estimate) - India | Data," accessed April 8, 2022, <https://data.worldbank.org/indicator/SL.TLF.CACT.FE.ZS?locations=IN>.
36. World Bank, "Labor Force Participation Rate, Female (% of Female Population Ages 15+) (Modeled ILO Estimate) - India," 2022, <https://data.worldbank.org/indicator/SL.TLF.CACT.FE.ZS?locations=IN>.

Table 2. Reported Appliance Ownership by Respondent's Gender

APPLIANCE	FEMALE	MALE
TV (n = 1,480)	27%	73%
Fan (n = 119)	22%	78%
Solar Water Pump (n = 696)	27%	73%
Fridge (n = 542)	39%	61%
Electric Pressure Cooker (n = 531)	51%	49%
Milking machine (n = 62)	24%	76%

Table 3. Attributes of the Typical Solar Product User Who Identifies as a Woman

CHARACTERISTIC	AVERAGE / MOST FREQUENT RESPONSE
Average Age	40
Employment	At Least Part-Time
Education (highest level)	Secondary
Poverty (living below USD \$3.20 per day)	No
Geographic Setting	Rural/Peri-Urban
Primary Electricity Source	Grid Connected
Financial Sector Participation	Yes
Loan Required	Yes
Financing Type	Savings Club or Self-Help Group
Disability Status	No

Table 4. Financial Inclusion by Gender

FINANCIAL INCLUSION	WOMEN	MEN
Included	73%	63%
Excluded	27%	37%

n=1156



In our sample, we also observed greater financial inclusion among women than men

(Table 6), despite general knowledge that women are more likely to be unbanked and have greater difficulty accessing financing when purchasing a solar product.³⁷ Financial inclusion for women is growing and may no longer be a significant barrier for appliance ownership, rather there may be unconscious biases in the targeting of potential customers.

To understand the reach and benefits of solar products for women, a more holistic approach beyond capturing the gender of the survey respondent is required. Winther et al. (2020)

look at who in the household makes the purchase decisions, goes on to purchase and who owns and uses an appliance.³⁸ They found that when men are the primary decision-makers, their solar product purchases have consequences for the distribution of benefits by gender. Women and men have different energy needs and priorities due to their societal roles and, therefore, will benefit differently from different solar products. For example, women have traditionally been the primary caretakers and housekeepers and, therefore, would benefit from appliances that reduce drudgery and save time. Greater access to productive use appliances can also help women business owners expand their enterprises and advance their careers. A better understanding of appliance users and their needs can inform gender-inclusive appliance design and intentional messaging for awareness-raising and marketing activities.

Reaching Users With Disabilities

Solar products can greatly improve the living conditions of people with disabilities in developing countries. Less than 50% of households in developing countries containing people with disabilities have electricity access.³⁹

Despite this limited access, people with disabilities typically have higher energy needs, as they often require electronically-powered assistive technologies for independent living.⁴⁰

Prioritising the needs of people with disabilities is critical when conducting consumer preference and user-centred research to inform product design.

Since most households in this demographic will be purchasing solar products for the first time, ensuring inclusive design from the outset can help this sector leapfrog inaccessibly designed traditional appliances. Box 1, SDG-Led Livelihood Solutions for People with Disabilities, demonstrates how solar products can be more inclusive. Improving the rural solar lighting and appliances market in South Asia and sub-Saharan Africa can benefit the livelihoods of individuals with disabilities in those regions, which accordingly comprise 80% of the world's population living with disabilities.⁴¹

37. Asli Demirgüç-Kunt et al., "The Global Findex Database 2021: Financial Inclusion, Digital Payments, and Resilience in the Age of COVID-19" (World Bank, 2021), <https://www.worldbank.org/en/publication/globalfindex/Report>.

38. Winther et al., "In the Light of What We Cannot See."

39. United Nations Department of Social and Economic Affairs, "Disability and Development Report: Realizing the Sustainable Development Goals by, for and with Persons with Disabilities" (New York, New York, USA: United Nations, 2018), <https://www.un.org/development/desa/disabilities/publication-disability-sdgs.html>.

40. WHO, "Assistive Technology," 2018, <https://www.who.int/news-room/fact-sheets/detail/assistive-technology>.

41. WHO, "World Report on Disability," 2011.



Hanumanthappa, in Balligere village of Belagavi District, Karnataka, India with his family.

Photo Credit: SELCO Foundation

**SELCO FOUNDATION:
SDG 7-Led Livelihood Solutions for People
with Disability**

The correlation between poverty and disability is well documented. In India, the 2011 census estimated that the number of people with disabilities is nearly 27 million.⁴² People with disabilities in low-income groups struggle with a lack of support, livelihoods, income and social mobility. Due to these barriers, people with disabilities in low-income communities tend to take up low-investment businesses, which also offer low returns. To improve the wellbeing of people with disabilities, it is critical to develop and promote inclusive and accessible livelihood solutions.

The SELCO Foundation's approach includes designing accessible productive use technologies powered by decentralised renewable energy and enabling financial linkages and capacity building. A future consideration for the sector should be targeting people with disabilities as potential solar entrepreneurs or for other employment in the sector; however, more data is needed to understand what accommodations or support people with disabilities may need to fulfil those roles successfully.

42. Census of India, "C-30: Disabled Population by Type Of Disability, Type of Households and Sex (India & States/Uts) - 2011," 2011, <https://censusindia.gov.in/nada/index.php/catalog/43469>.



Hanumanthappa, has a home based livelihood setup, making rotis on a solar powered roti rolling machine. His mother supports him in his business.

Photo Credit: SELCO Foundation

Hanumanthappa, who resides in Balligere village, Belagavi district, Karnataka, has a disability due to a spinal cord injury. His family engages in marginal farming and daily wage labour, and earns an income of USD \$1,248 per year, with Hanumanthappa unable to access livelihood opportunities.

A solar-powered roti (Indian flat bread) rolling machine has enabled Hanumanthappa, who uses a wheelchair, to have a home-based livelihood by replacing the traditional leg-operated machine with one that is hand-operated. This intervention has helped the entrepreneur access a sustainable source of income, averaging USD \$11.24 per day, and is assisting the family in making ends meet.

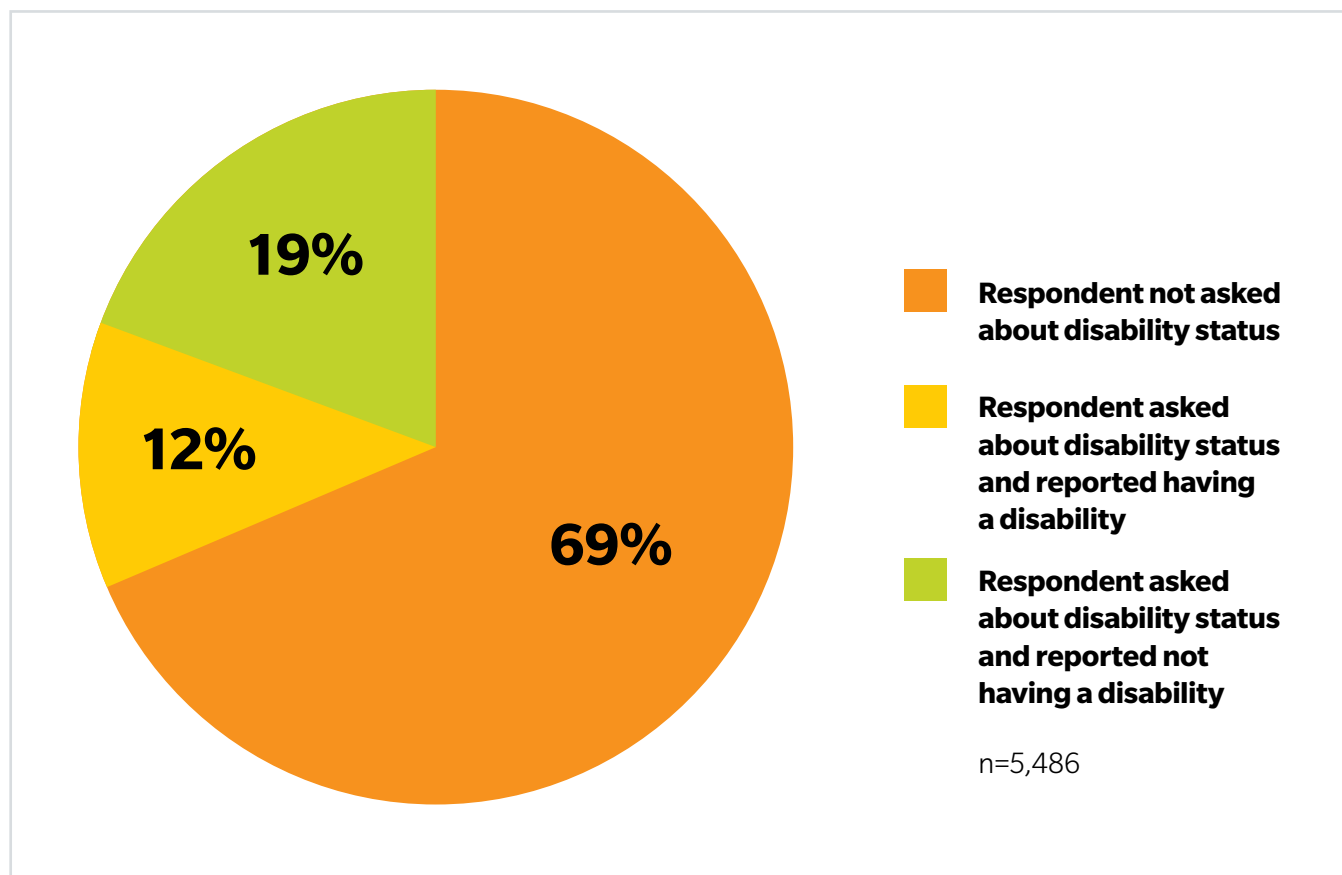
Making similar considerations for inclusivity in the selection of technologies and livelihoods, ergonomics in the machinery, and the overall built environments can ensure reduced physical stress, increase ease of work, and create new opportunities for livelihoods.

Data on the disability status of solar product users is limited. Nearly 70% of users in our sample were not asked to report whether they live with a disability (Figure 1), highlighting a need for improved data collection. When respondents were asked to report whether they had a disability, the framing of the question varied. Inconsistencies in data collection make comparisons across surveys difficult. In addition, most surveys only inquired about the disability status of the survey respondent, neglecting potential household members who may identify as a person with a disability and may also use or benefit from the solar product in question.

Our results align with market trends suggesting individuals with disabilities have unequal access to solar products. Only 12% of solar product users in our sample reported having a disability, compared to a global estimate of 15%.⁴³ Due to our limited sample size and the absence of a common metric, we are unable to draw any further conclusions.

A standard set of metrics or indicators should be adopted to improve data collection efforts. The Washington Group (WG) on Disability Statistics' questionnaires on disability can serve as a useful resource to achieve this standardisation. The WG has developed several data collection tools on survey questions related to disability that can be easily incorporated into existing surveys. The WG Short Set on Functioning – Enhanced (WG-SS Enhanced) offers a simple and effective way of incorporating questions around disabilities in surveys that focus on other topics.⁴⁴

Figure 1. Disability Status of Solar Product Survey Respondents



43. World Bank, "Disability Inclusion," 2022, <https://www.worldbank.org/en/topic/disability>.

44. Washington Group on Disability Statistics, "WG Short Set on Functioning (WG-SS)," Washington Group on Disability Statistics, 2022, <https://www.washingtongroup-disability.com/question-sets/wg-short-set-on-functioning-wg-ss/>.

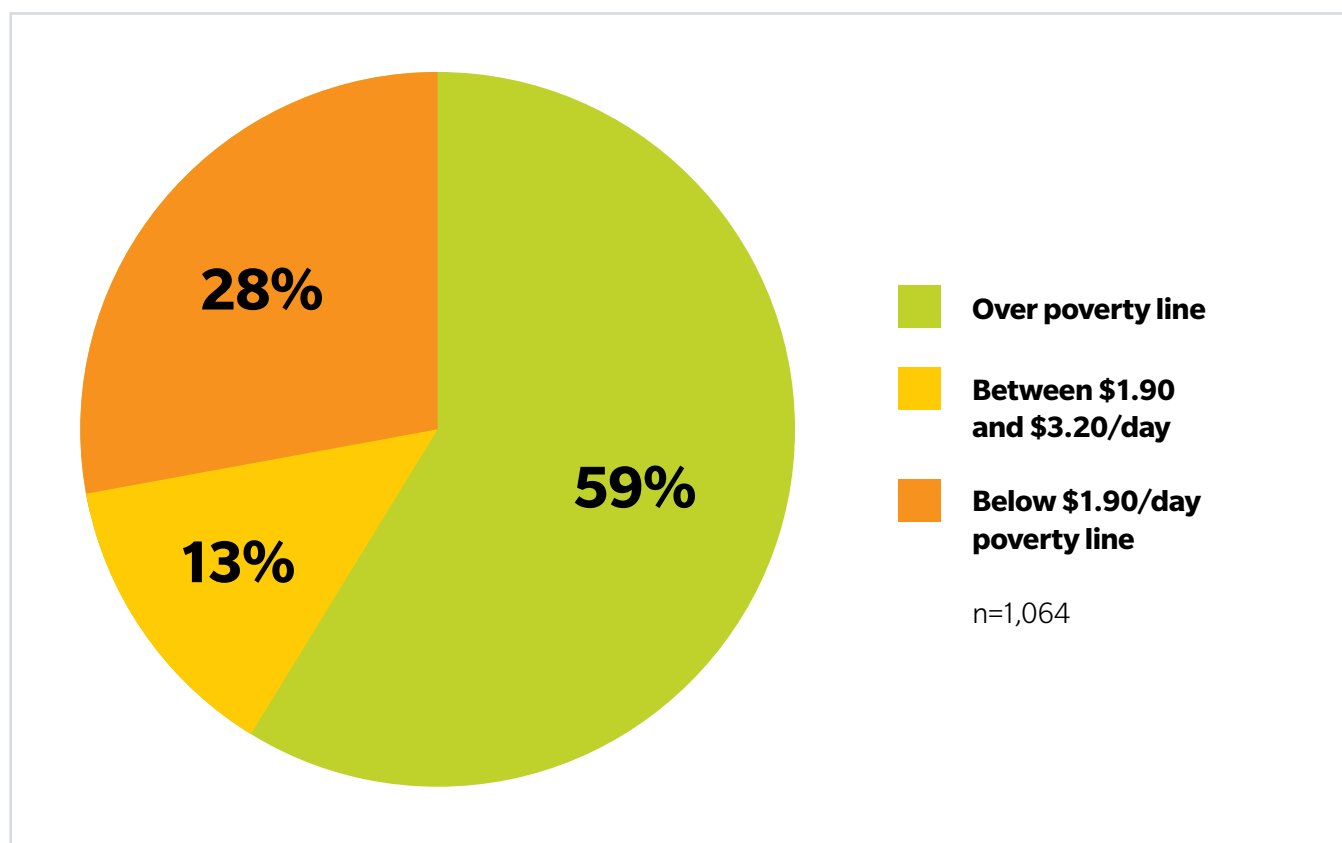
Reaching Users Living in Poverty

Affordability is a significant challenge to increasing the uptake of solar lighting and appliances. High upfront product costs and a lack of consumer financing are top barriers for most consumers. Many companies must sacrifice either the performance or the efficiency aspect of product design when attempting to bring down costs. Even for comparatively wealthy users, solar products can still represent a significant investment. In Kenya, a SunDanzer solar kit with a refrigerator costs USD \$1,276—about 85% of an end user’s annual income.⁴⁵ Whilst refrigerators tend to be relatively expensive compared to other products, even less costly technologies can be inaccessible. In India, a solar home system kit with a fan costs roughly USD \$80—over 50% of an average consumer’s monthly income.⁴⁶

Our analysis suggests that the solar lighting and appliances sector may not be equitably serving consumers who live below the poverty line.

A failure to correct this imbalance risks perpetuating or exacerbating existing inequalities. Almost 90% of respondents in our sample live on more than USD \$1.90 per day, whilst 60% live on more than USD \$3.20 per day (Figure 2). Demographic data suggests the solar lighting and appliances customers in our sample are better off than the typical household in their country. 70% of Ugandans live on less than USD \$3.20 per day,⁴⁷ compared to just over 20% of Ugandan respondents in our sample. 67% of people in sub-Saharan Africa live below the poverty line, compared to around 40% of survey respondents from that region in our sample (Figure 3). Respondents’ higher incomes may help them to overcome the affordability hurdle and the pervasive lack of access to consumer financing to access solar products.

Figure 2. Percentage of Respondents Living Below USD \$1.90/Day and USD \$3.20/Day



45. Efficiency for Access, "Appliance Data Trends Report, 2021," 2021, <https://efficiencyforaccess.org/publications/2021-appliance-data-trends>.

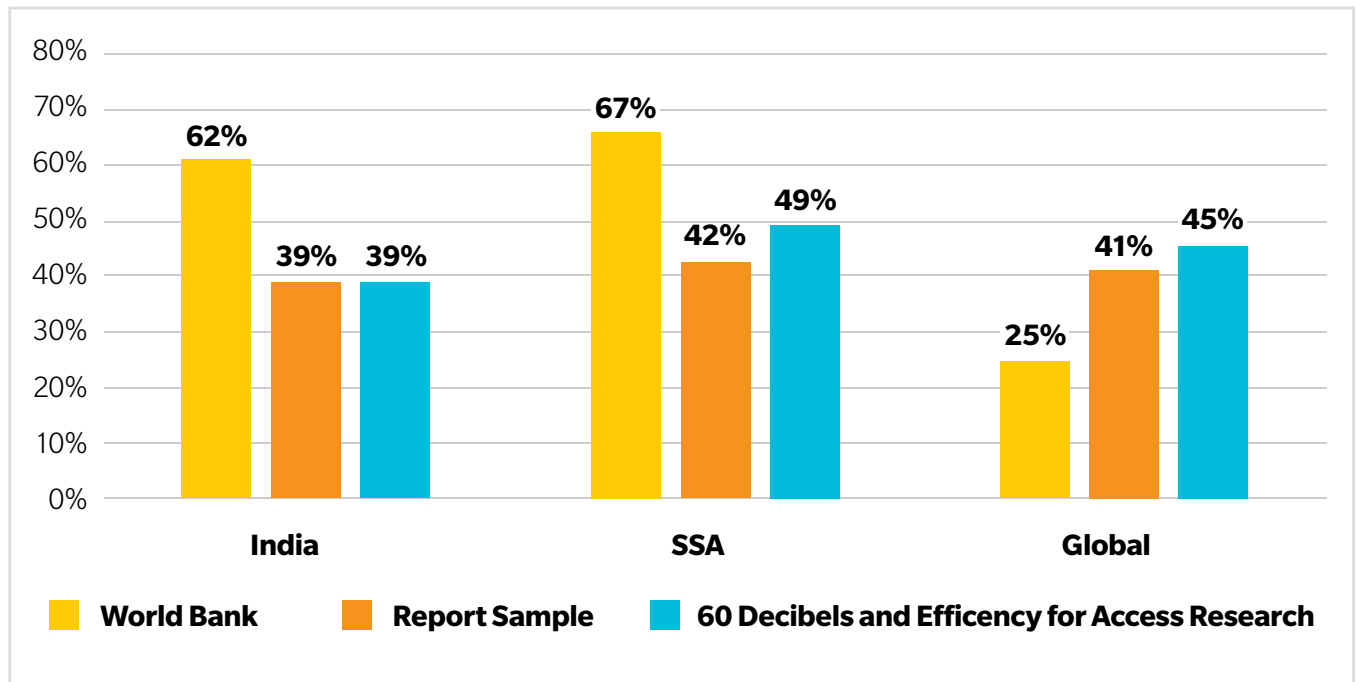
46. Efficiency for Access.

47. World Bank, "Poverty Gap at \$3.20 a Day (2011 PPP) (%) - Uganda," 2022, <https://data.worldbank.org/indicator/SI.POV.LMIC.GP?locations=UG>.



Photo Credit: ZOLA-Electric, courtesy of GOGLA

Figure 3: Percentage of Respondents Living Below USD \$3.20/Day by Region



Without targeted support for those living below the poverty line, the sector risks excluding them from the transformative benefits of solar products. At the current rate of progress, 670 million people will lack access to electricity in 2030—10 million more than was projected in 2021.⁴⁸ Achieving a “leave no one behind” mandate requires that those at the bottom-of-the-pyramid,⁴⁹ who are often most at risk from the effects of climate change and other external shocks, are equally able to access appliances. Donors, NGOs, and other stakeholders must therefore develop and fund interventions to level the playing field. End-user subsidies, results-based financing programmes, increased consumer financing, and other financial mechanisms are all powerful ways to improve access for those most at risk of being left behind.

Solar products, especially solar appliances, are still relatively new in emerging markets. Most potential users are unfamiliar with them, which can increase early adopters’ perceived risk of purchase. Whilst several factors can influence a consumer’s personal risk tolerance, higher income levels can make consumers more willing to purchase new products.⁵⁰ They can afford taking a chance on a new product that they have no previous experience with. Low-quality solar products may also fail to function, stranding users with an expensive loss. This challenge emphasises the need for quality assurance in the market, to de-risk appliance purchases for consumers and ensure that they have positive experiences with high-quality products.⁵¹

48. IEA et al., “Tracking SDG 7: The Energy Progress Report 2022.”

49. The bottom of the pyramid in this report refers to those living on less than USD \$2 per day.

50. Ozgur Dedeayir et al., “Innovators and Early Adopters in the Diffusion of Innovations: A Literature Review,” *International Journal of Innovation Management* 21, no. 8 (2017), <https://www.worldscientific.com/doi/abs/10.1142/S1363919617400102>.

51. Efforts like VeraSol’s quality assurance program, however, are working to ensure that safe, affordable, and durable products are the default option in the market, reducing risk for users. Learn more about VeraSol at <https://verasol.org/>.

Table 5. Percentage of Respondents Living Below USD \$3.20/Day with Comparison to Other Sector Benchmarks

POVERTY LINE (USD \$3.20/DAY)	TELEVISION	FANS	SOLAR WATER PUMPS	REFRIGERATORS	SHS	PICO-SOLAR
This Report's Sample	40%	57%	2%	13%	38%	21%
60 Decibels and Efficiency for Access Research ⁶⁵	30%	N/A	25%	23%	N/A	N/A

n = 1,059

Some solar products have better-penetrated households living in poverty, which might be a factor of availability and price rather than desire or specific needs.

The findings from our sample are similar to those from recent 60 Decibels and Efficiency for Access research.^{52,53} Around 40% of television users and 57% of fan users live on less than USD \$3.20 per day, and few respondents living below the USD \$3.20 poverty line reported using solar water pumps and refrigerators, which are generally more expensive appliances (Table 7). Refrigerators, however, ranked in the top four for both perceived consumer demand and development impact in our 2020 Off-Grid Appliance Market Survey.⁵⁴ The fact that they seem to be out of reach for many users below the poverty line may indicate that poorer respondents in our sample are missing out on their benefits, despite the demand.

Accurately measuring household incomes and poverty rates is challenging and time-consuming, and misrepresentations can lead to inaccurate analyses.

Some respondents may not know what their total income is, or it may fluctuate widely over months, seasons, or years. One pilot, for example, found that twice as many Kenyan farmers were living in poverty before the harvest compared to after.⁵⁵ Income data collection is not standardised in surveys: some respondents provide annual household level data, whilst others provide monthly individual data. Currency varies

between surveys, with some using respondents' local currency, whilst others relying on income converted into US Dollars at the time of reporting. Our sample included 2,193 solar product users in Kenya, but only 63 had usable income data due to incomplete or missing responses. Overall, only one-fifth of respondents in our entire sample had usable income data.

To combat these complexities, some sector stakeholders, such as 60 Decibels, have adopted or modified Innovations for Poverty Action's Poverty Probability Index, which can substantially simplify poverty measurements.⁵⁶ The index is a quick ten-question survey that, by posing a series of objective questions, can produce a probabilistic estimate of respondents' poverty levels.⁵⁷ **Adopting the Poverty Probability Index or any standardised, more robust income measurement practice across sector survey efforts could yield higher quality, reliable data that would better enable stakeholders to identify and address inequities in the sector.**

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

53. Efficiency for Access, "The Use and Benefits of Solar Water Pumps," 2019, <https://efficiencyforaccess.org/publications/use-and-benefits-of-solar-water-pumps>.

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

55. Venu Aggarwal and Ashley Speyer, "The Risk of Leaving Farmer Vulnerability Undetected: How Remote Surveys Can Measure Changes in Poverty," Pioneer's Post (blog), May 26, 2020, <https://www.pioneerspost.com/news-views/20200526/the-risk-of-leaving-farmer-vulnerability-undetected-how-remote-surveys-can>.

56. Innovations for Poverty Action, "Poverty Probability Index," 2022, <https://www.povertyindex.org/>.

57. According to Pioneer Post, "The PPI primarily asks questions about a respondent's possessions and home (e.g. if they own an iron, what their roof is made of) and about demographic characteristics (e.g. where they live, how many people are in their family) to determine the probability of their household living in poverty." "The Risk of Leaving Farmer Vulnerability Undetected: How Remote Surveys Can Measure Changes in Poverty," May 26, 2020. <https://www.pioneerspost.com/news-views/20200526/the-risk-of-leaving-farmer-vulnerability-undetected-how-remote-surveys-can>.



Beneficiaries of the program sitting outside their SHS-installed home

Photo Credit: Practical Action

PRACTICAL ACTION Renewable Energy for Refugees

Delivered in partnership between Practical Action and UNHCR, the UN Refugee Agency, and with support from the IKEA Foundation, RE4R has worked directly with communities in refugee camps in Rwanda and Jordan. RE4R provided energy access, training and access to finance to more than 60,000 refugees to improve their quality of life, build livelihoods and strengthen their economic independence. RE4R’s innovative approaches strengthened local energy markets and promoted economic activity in humanitarian settings to provide affordable and sustainable solutions.

Barriers and Interventions

When working to provide solar home systems for households and small businesses, RE4R worked with two suppliers (Belecom and Bboxx) to sell 3,543 solar home systems (SHS) across three camps in Rwanda in 2021. Whilst the intervention’s existing market-based inclusivity strategy had resulted in approximately 50% camp-wide household energy access, certain sections of the refugee community had yet to be reached. These included the most vulnerable, the severely disabled and those over 60.

Through consultations with UNHCR, Humanity Inclusion (HI), MINEMA, refugee group leaders and the refugees themselves, Practical Action identified a vulnerable group of refugees who faced additional barriers in accessing SHS. RE4R estimated approximately 300 such refugees were unable to afford a SHS, and the main barriers to accessing a SHS included:

- **Low purchasing power:** Family members were unable to provide financial support or engage in income-generating activities.
- **Low mobility:** People in this group had difficulty accessing shops, operating SHS and engaging with customer support mechanisms (e.g. telephone hotlines).
- **Limited knowledge:** People in this group had a limited understanding of solar products and services, preventing informed decision-making.

BOX 2 (CONT.)

On identifying the main access barriers, RE4R developed a targeted inclusivity strategy to maintain the project's sustainability and ownership elements of a market-based approach while incorporating a highly subsidised model. The programme provided a fully subsidised SHS to vulnerable beneficiaries procured by Practical Action, with support structures in place to ensure ongoing usage, maintenance and upkeep, partially paid for by a minimal ongoing financial commitment from the beneficiaries.

With this additional component, the intervention reached 4,279 households with SHS, representing 58% of camp-wide household energy access by the end of the project in February 2022.

Recommendations

To ensure an inclusive market-based approach in a refugee context, adopting a phased implementation approach can enable market development and access to customised and specific products and individuals.

The following recommendations also support inclusion:

- Employ a gender transformative approach to reduce the barriers to renewable energy access for women and girls and explore opportunities to further engage men and boys as change agents for gender equity and transformation.
- Advocate for gender-sensitive approaches in private sector recruitment of employees and customers to further support a gender transformative approach.
- Reduce financial barriers that inhibit the uptake of renewable energy products and advocate for financial institutions to develop financial products suitable for displaced communities. Where possible, work with existing structures to facilitate the formalisation and registration of informal businesses.
- Encourage private sector suppliers to address affordability through tailored payment structures and access to finance, for example, by replicating Belecom's revolving funds, which created community savings and lending groups.



A technician installs a light bulb powered by a solar home system

Photo Credit: Practical Action



Photo Credit: Devidayal, courtesy of GOGLA

Inclusivity Assessment of Solar Product Companies

Private sector companies in the solar lighting and appliances sector have the potential to be a large vehicle for local job creation and wealth building.

However, a concerted effort is needed to promote diversity, equity and inclusion at all levels to ensure equitable distribution of job creation and wealth generation benefits.

We analysed data from Power for All's 2021 Powering Jobs survey and the Global Distributors Collective's 2021 annual member survey to assess how private sector actors are cultivating diverse workforces and designing and marketing products that meet various solar product customer needs.

Both surveys include responses from some companies that do not manufacture, sell, or distribute solar appliances (e.g., commercial mini-grid companies, solar home system providers, etc.). It was impossible to disaggregate the data to only assess inclusion among solar product providers. The analysis, therefore, is an indicator of broader market trends rather than a reflection of the solar product sector specifically.

Gender Equality

Diverse workplaces are not only good for employees but also good for business.

Companies with more gender-diverse workforces are more productive and may perform better in decision-making, innovation, customer acquisition and retention, and talent recruitment and retention.⁵⁸ A Shell Foundation study earlier this year found that among small and medium-sized enterprises that have tracked impacts of gender-inclusive policies, 74% self-reported positive impacts on employee satisfaction, productivity, and retention.⁵⁹ Furthermore, a pilot of five small-to-medium enterprises suggests gender inclusion strategies can drive positive financial returns and increase the potential for businesses to have long-term scalable impact. For example, sales increased by 85%

after training women sales agents to sell solar products in discrete locations, and technical support calls reduced by 32% after call centre agents began using gender-specific messaging in customer service calls.⁶⁰

Women sales agents can be assets to companies. They often have a better understanding of female customers and their needs, and are able to interact with female customers in spaces where men cannot.⁶¹ Some companies have already started to expand initiatives to screen for potential new sales agents. For example, Sumba Sustainable Solutions has three criteria for agent selection: the sales agent must be a woman with at least a junior high education and money management and business experience.⁶²

Despite an abundance of data demonstrating the positive impact of diversity in the workplace, the energy sector remains one of the least-diverse workforces globally.⁶³

Men make up 78% of the workforce in the energy sector.⁶⁴ Regarding occupational roles, women make up a more significant proportion of the workforce for non-technical, non-leadership roles. A 2018 survey found that women comprised 46% of administrative positions, 25% of technical staff, and 35% of senior management posts in the renewable energy workforce.⁶⁵ Research also indicates that women continue to earn less across all occupational categories within the renewable energy sector.⁶⁶

58. Morgan Stanley, "The Gender Advantage: Integrating Gender Diversity Into Investment Decisions," 2016, <https://www.morganstanley.com/pub/content/dam/msdotcom/ideas/gender-diversity-toolkit/Gender-Diversity-Investing-Primer.pdf>.

59. Shell Foundation and Value for Women, "Driving Growth and Improved Business Performance: The Opportunity of Investing in Gender-Inclusive Strategies," July 2022.

60. Value for Women, "A Business-First Approach to Gender Inclusion: How to Think About Gender Inclusion in Small and Medium Enterprise Operations," 2019, <https://v4w.org/resource/a-business-first-approach-to-gender-inclusion/>.

61. Global Distributor's Collective and Value for Women, "Gender in Business: Lessons Learned for Last Mile Distributors," 2022, <https://v4w.org/resource/gender-in-business-lessons-learned-for-last-mile-distributors/>.

62. Global Distributor's Collective, "Selling Productive Use of Energy Products to Last Mile Consumers: Lessons Learned," Forthcoming.

63. EA, "Energy and Gender," IEA, 2022, <https://www.iea.org/topics/energy-and-gender>.

64. IRENA, "Renewable Energy: A Gender Perspective," 2018, <https://www.irena.org/publications/2019/Jan/Renewable-Energy-A-Gender-Perspective>.

65. IRENA.

66. Zsofia Beck and Andrea Panczel, "Women in Energy: Gender Diversity in the CEE-SEE Energy Sector" (Boston Consulting Group & Women in Energy Association, n.d.), https://www.womeninenergy.eu/wp-content/uploads/2018/12/Women_in_Energy_in_the_CEE-SEE_Region_Dec2018_final.pdf.

Whilst some initiatives are making strides in improving workplace diversity, more can be done to reduce critical barriers that prevent women and other marginalised groups from entering the labour force and rising into positions of power. Sosai Renewable Energies Company found that most women interested in managing solar dryers cannot go out during the day because their husbands will not allow them. They found that speaking to the husbands and socialising the idea of the women working was an effective way to get across to the women.⁶⁷ Models like Solar Sister work well for women as they meet prospective women agents where they are, provide ongoing training, mentorship, and support through Sisterhood Groups with other women. They also provide a flexible business opportunity, which is critical for women who often have competing household responsibilities.

Gender Parity

We evaluated gender-disaggregated employment data for 68 companies operating in Ethiopia, India, Kenya, Nigeria, and Uganda, many of whom make or sell solar products.

Companies were asked to report the total number of men and women employed across four categories: top management, skilled workers, semi-skilled workers, and unskilled workers. 345 companies (84% of respondents) did not report gender-disaggregated survey data, suggesting opportunities to improve data collection and reporting.

Women represented 23% of all employees, suggesting a significant gender gap on par with gender-disaggregated employment trends in the broader energy sector, where women make up 22% of the workforce.⁶⁸ To achieve gender parity, companies would need to hire and promote women across all levels, but not simply for the sake of hiring women over men. From a business perspective, each position should be filled with a professional who will add the most value for the company, which shifts the conversation to equal access and opportunity to quality education. Companies can, and should, provide opportunities for career progression and in-house training, but some roles require a skill set that is usually acquired from vocational schools and universities, especially as we begin to consider larger and more complicated productive use appliances.

The private sector has few tools to solve cultural and societal structures that prevent disadvantaged groups from accessing education and pursuing careers, which donors should address.

Women represented 23% of all employees, suggesting a significant gender gap.

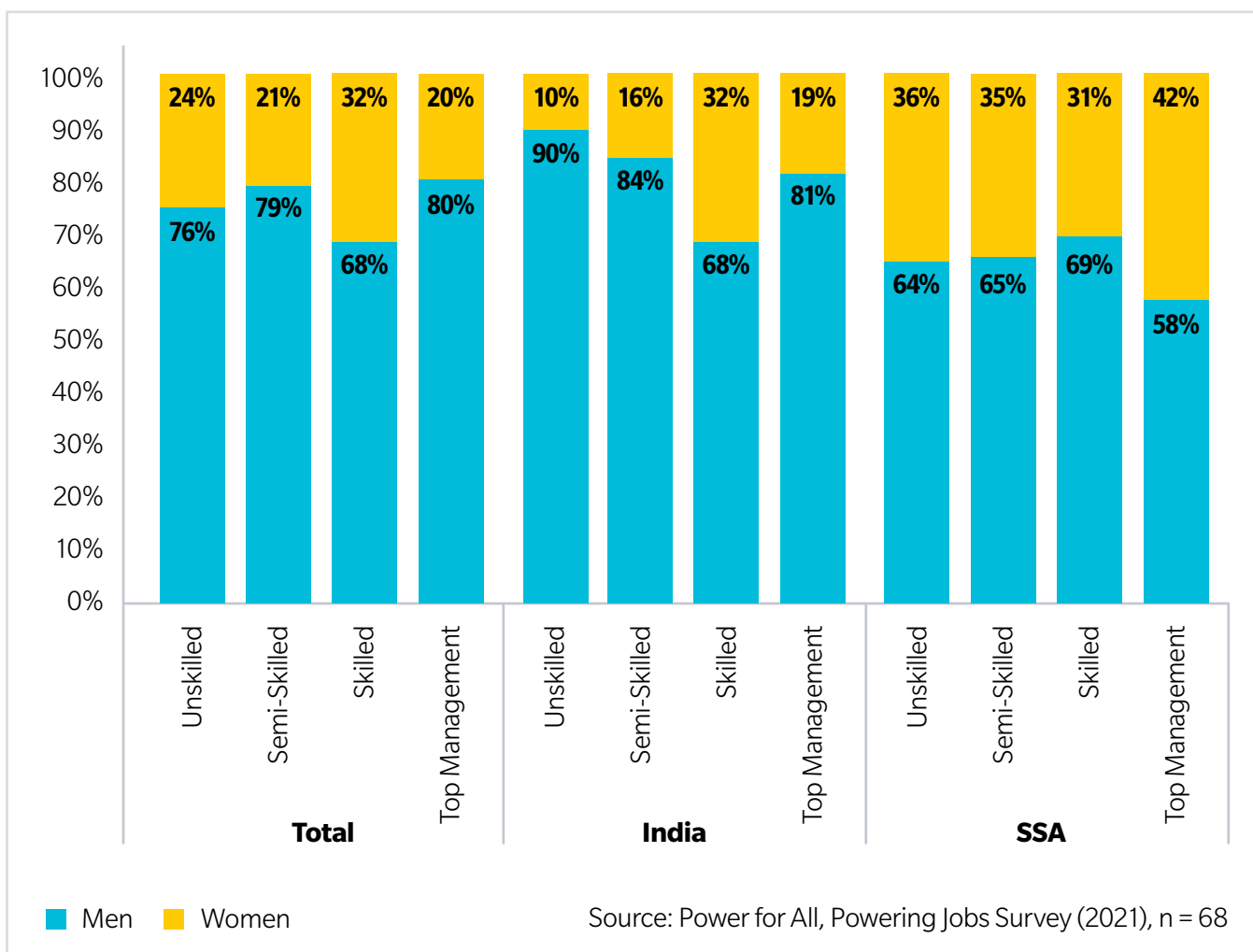
Analysis of gender-disaggregated data by skill level finds men far outnumber women in all occupational categories, especially in top management positions (80% male) and semi-skilled worker positions (78% male) (Figure 4). The gap between the number of men and women employed closes minimally for skilled and unskilled workers, with men accounting for 63% and 76% of employees at each level, respectively.



67. Global Distributor's Collective, "Selling Productive Use of Energy Products to Last Mile Consumers: Lessons Learned," Forthcoming.

68. IRENA, "Renewable Energy: A Gender Perspective," 2018, <https://www.irena.org/publications/2019/Jan/Renewable-Energy-A-Gender-Perspective>.

Figure 4. Gender-Disaggregated Employment Data by Region and Occupational Category



Regional Gender Gaps

Sub-Saharan Africa

Women remain vastly underrepresented in the energy sector and larger workforce in sub-Saharan Africa. A 2019 International Union for Conservation of Nature (IUCN) and USAID report found women only comprise 16-20% of the power sector workforce in sub-Saharan Africa.⁶⁹ The World Economic Forum’s 2021 Gender Gap Report, which benchmarks gender-specific gaps for 156 countries, found the gap in Economic Participation and Opportunity in Ethiopia, Kenya, Nigeria and Uganda must close between 30-40% to reach gender equality.⁷⁰

We observed the gender gap in employment closing slightly for companies operating in Ethiopia, Kenya, Nigeria, and Uganda; however, this trend may result from selection bias.

According to company-reported data, women comprise 35% of the workforce and 40% of leadership positions (Figure 4). Whilst these results seem promising, the limited sample size⁷¹ (43 companies) means the results may not fully reflect hiring trends. Those reporting gender-disaggregated data are likely to have more inclusive hiring practices and policies. If all companies in the sample were required to report gender-disaggregated employment, we might observe different results.

69. International Union for Conservation of Nature and USAID, “Energizing Equality: Unlocking the Potential Of Women’s Participation in Sub-Saharan African Energy Utilities” (Washington, DC, 2019), <https://portals.iucn.org/union/sites/union/files/doc/iucn-egi-utilities-brief-web-final.pdf>.

70. World Economic Forum, “Global Gender Gap Report,” 2021, <https://www.weforum.org/reports/global-gender-gap-report-2021>.

71. Private sector responses by country: Ethiopia, 5; Kenya, 4; Nigeria, 21; and Uganda, 13.



Photo Credit: Wala

Similar to other regions, labour market segregation is deeply entrenched by gender across much of sub-Saharan Africa, often influenced by unequal division in unpaid housework. For example, women are over-represented in the informal economy, taking jobs as farmers or traders out of an immediate need for income or the need to juggle competing family demands. The relegation of women to the informal economy limits their earning potential and income stability, along with clear opportunities for career advancement.⁷²

As countries in sub-Saharan Africa transition to service economies, a concerted effort to train, employ, and promote women in new industries will be critical to achieving gender equality and promoting inclusive economic growth.

There are already several initiatives in the solar product sector striving to create new spaces and leadership opportunities for women in sub-Saharan Africa, including:

- Power Africa’s [Women in Rwandan Energy](#) and [Young African Leaders Initiative](#), which aim to increase the participation of women across the energy sector and invest in the next generation of African leaders.

- Global Energy Alliance for People and Planet and Shortlist’s [Women for Green Jobs](#), a collaboration to create 750 green jobs for women across six sub-Saharan African countries.
- Sustainable Energy for All’s [Women and Youth at the Forefront programme](#) encourages female participation in the energy sector by providing women with the hands-on experience and mentorship they need to cultivate the knowledge and leadership needed to succeed in the energy sector.

Organisations like [Solar Sister](#), [Pollinate Group](#), [Frontier Markets](#), [ElleSolaire](#), [Yellow Solar Power](#), and [Jaza Energy](#) work to recruit and train women as entrepreneurs to sell solar products directly to households in their communities.

Women are over-represented in the informal economy, taking jobs as farmers or traders out of an immediate need for income or the need to juggle competing family demands.

72. International Development Research Center, “Women’s Economic Empowerment in East Africa,” International Development Research Center (blog), 2021, <https://www.idrc.ca/en/research-in-action/womens-economic-empowerment-east-africa>.

India

Women's participation in the solar lighting and appliances sector in India is lower than in Ethiopia, Kenya, Nigeria and Uganda. Survey data from 23 companies reveals women make up 22% of employees among 25 companies. The gender gap is most notable among semi-skilled and unskilled workers (Figure 4). The share of reported women employed in the solar products sector is higher than in other areas of the broader energy sector, such as utilities, oil, gas, and coal, where women make up less than 10% of the workforce but lower than in other fields like communications, financials, and technology services, where women make up to 30% of the workforce.⁷³

Low rates of women's participation in India's solar lighting and appliances sector may result from broader market trends. Women's labour force participation rate in India has declined in recent years, falling from 26% in 2005 to 19% in 2019.⁷⁴ Historically, labour force participation rates among women have followed a U-shaped curve as countries develop. The participation rate initially declines due to economic growth when women who were forced to work to make ends meet withdraw from the workforce. However, as educational opportunities expand, fertility rates decline, and larger cultural shifts occur, women gradually re-enter the workforce at higher rates. India has yet to observe an increase in the female labour force participation rate, despite a strong history of economic growth.

Women in India perform 9.5 times the unpaid work men do.⁷⁵ This unequal division of labour limits the time and opportunities available to them. 90% of working women in India work in the informal sector, where they face high degrees of gender bias with low and fluctuating wages.⁷⁶ Companies looking to develop a more gender-inclusive workforce will need to adopt more inclusive policies addressing these social and cultural barriers.

The impact of unequal pay may compound to a lifetime of income inequality that puts women at a financial disadvantage, even into retirement.

Compensation

Worldwide, women earn 38% less than men in similar roles.⁷⁷ Whilst the gender pay gap has narrowed, progress in closing the gap remains painfully slow. Based on the current trajectory, the World Economic Forum estimates it would take 268 years to reach gender parity in the area of economic participation and opportunity, which includes equal pay.⁷⁸ Evidence suggests that the earnings gap between women and men is even larger for women with children in sub-Saharan Africa and South Asia.⁷⁹ The impact of unequal pay may compound to a lifetime of income inequality that puts women at a financial disadvantage, even into retirement.⁸⁰

We analysed the highest and lowest reported gross annual income for men and women for 16 companies in India across four discrete occupational categories: top management, skilled workers, semi-skilled workers, and unskilled workers. Our findings reveal a gender pay gap between men and women across all levels, particularly among the highest-paid top management and skilled workers.

Due to the small sample size, we cannot draw conclusions about wage gaps in the solar lighting and appliances sector. However, the large data gaps and preliminary findings can illustrate the type of gender-disaggregated pay data companies and investors may wish to collect to inform more inclusive hiring and compensation practices. The data presented below highlight several inequalities in compensation and should be viewed as a first attempt to encourage more transparent reporting of compensation data across the sector.

73. IEA and CCEW, "Women Working in the Rooftop Solar Sector" (Paris, France: International Energy Agency, 2019), <https://www.ceew.in/publications/women-working-rooftop-solar-sector>.

74. International Labour Organization, "ILOSTAT Database," Database, 2021, <https://ilostat.ilo.org/data/>.

75. Umberto Cattaneo Laura Addati, "Care Work and Care Jobs for The Future of Decent Work," Report (ILO, June 28, 2018), http://www.ilo.org/global/publications/books/WCMS_633135/lang--en/index.htm.

76. International Labour Organization, "Women and Men in the Informal Economy: A Statistical Picture," Report (Geneva, Switzerland: International Labour Organization, April 30, 2018), http://www.ilo.org/global/publications/books/WCMS_626831/lang--en/index.htm.

77. World Economic Forum, "Global Gender Gap Report."

78. World Economic Forum, 5.

79. UN Women, "Wage Gap," Infographic, accessed April 11, 2022, <https://interactive.unwomen.org/multimedia/infographic/changingworldofwork/en/index.html>.

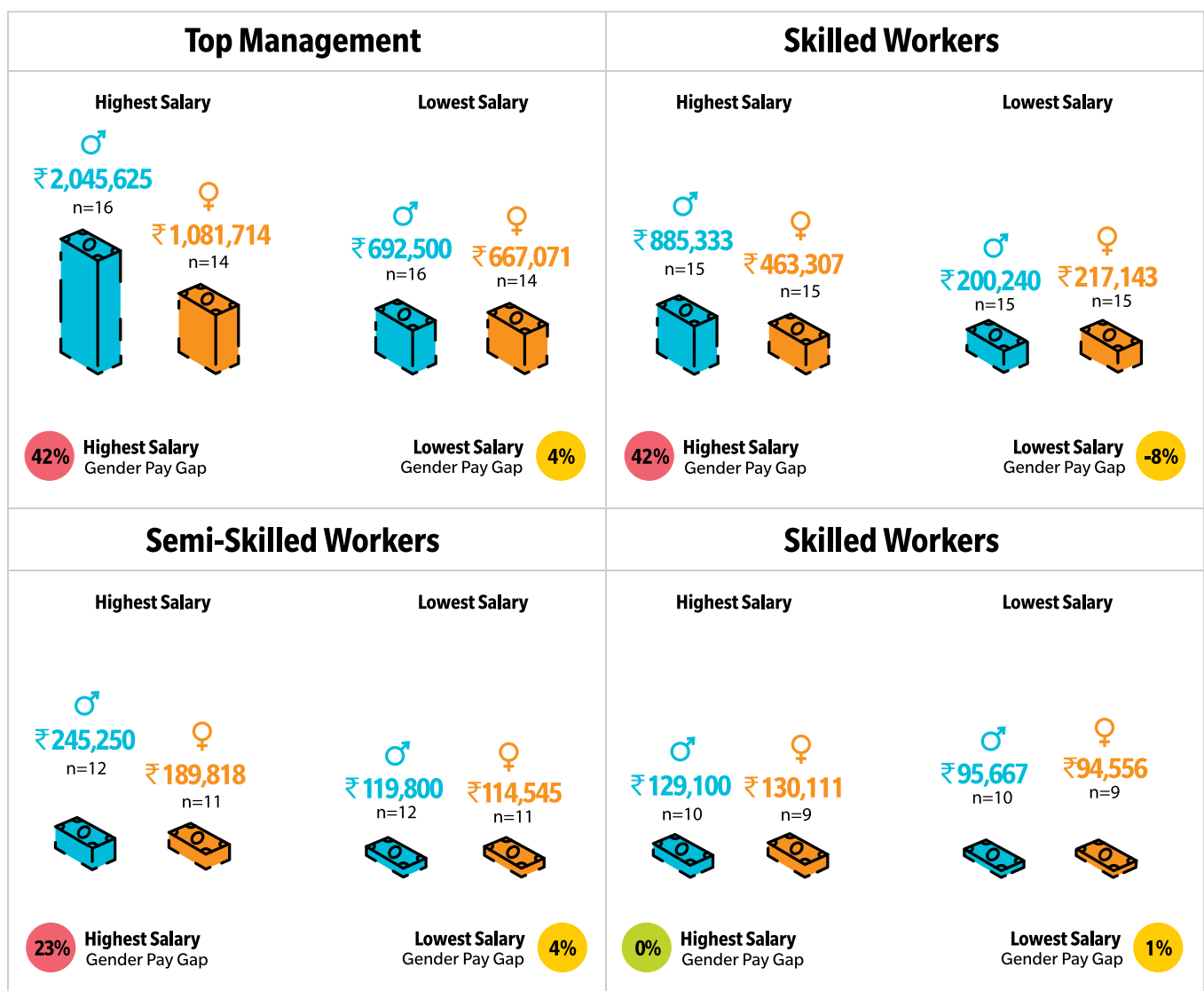
80. OECD, "Gender and the Environment: Building Evidence and Policies to Achieve the SDGs," in Gender and the Environment: Building Evidence and Policies to Achieve the SDGs, n.d., <https://www.oecd-ilibrary.org/sites/c7cbe91b-en/index.html?itemId=/content/component/c7cbe91b-en>.

The average highest reported salary for men among top management in the solar lighting and appliances sector is nearly two times that of women (Figure 5). A similar trend emerges for skilled workers, where the average highest salary for men is nearly double that of women.

Reported salary data show that the gender gap narrows significantly for the lowest-paid employees in each category (Figure 5). This may indicate one of the driving forces behind the gender pay gap: that men are more likely to realise faster wage growth earlier in their careers.⁸¹ One study of garment

workers in Bangladesh found men progress faster out of entry-level positions because they move companies frequently, resulting in higher salaries and titles, and are promoted faster internally, especially in the early stage of their career.⁸² Assuming employees in the top management roles moved up within their company, the widening gap between salaries may reflect an unconscious bias towards men, wherein small practices that undervalue female performance compound into significant disadvantages for women that prevent job mobility across all levels within a company.⁸³

Figure 5. Average Gender Pay Gap in 2021 (Indian Rupees)



Source: Power for All, Powering Jobs Survey (2021)⁸⁴

81. Andreas Menzel and Christopher Woodruff, "Gender Wage Gaps and Worker Mobility: Evidence from the Garment Sector in Bangladesh" (Cambridge, MA: National Bureau of Economic Research, June 2019), <https://doi.org/10.3386/w25982>.

82. Menzel and Woodruff.

83. Jessica Nordell and Yaryna Serkez, "This Is How Everyday Sexism Could Stop You From Getting That Promotion," The New York Times, October 14, 2021, sec. Opinion, <https://www.nytimes.com/interactive/2021/10/14/opinion/gender-bias.html>.

84. Note: These numbers were reported in 2021, and thus do not represent the full findings of the most recent round of Power for All's data collection e

Solar Product Expertise & Offering

Growing investment in solar lighting and appliance companies has led to a proliferation of new technologies and business models, many with the intent to reach and improve the lives of vulnerable populations. Leveraging 2020 and 2021 survey data from Power for All and the Global Distributor's Collective, we analysed the diversity of product expertise for over 200 companies and distributors.

In assessing how inclusive a solar lighting and appliance company is, it is helpful to analyse their product expertise and offering. The benefits of a solar product may vary by end user. Data from India, for example, suggest that use is heavily gendered, with female end users preferring and using certain products over male users.⁸⁵ Appliances typically favoured by men (e.g., televisions, non-kitchen fans, and mobile devices) far outnumber those preferred by women (e.g., kitchen fans and lighting, irons, and sewing machines).^{86,87}

There is a need to increase the diversity of products offered in target communities in concert with efforts to address the social and economic barriers that prevent women from realising the full benefits of energy access. While no appliance is “gendered”, the sector must be more responsive to the needs and demands of all customer segments. For example, while men and women can both

benefit from solar mills and solar water pumps, women bear the disproportionate burden of time-consuming tasks like water collection or grain processing. Efforts to design, market, distribute and sell these products to women could help companies expand their reach and impact. Finally, there needs to be a larger effort to expand the lens through which we view inclusivity beyond gender. Efforts to understand the use and benefits of certain appliances among people with disabilities, refugees, and other groups are needed to gauge how well a company's product offering aligns with their wants and needs.

Product Expertise

The majority of companies surveyed by Power for All state their primary product expertise is in solar home systems (39%), followed by standalone mini-grids (27%) and productive use equipment (26%). However, when asked to identify up to two areas of primary expertise, productive use energy systems and productive use assets were the most frequent responses, with 48 companies out of 66 indicating expertise (Figure 6). This trend may reflect the solar lighting and appliance sector's growing interest in productive uses of energy. A 2020 poll of energy access practitioners found that attitudes on the impact potential of staple solar products, like LED lighting, have shifted. Whilst access to lighting remains a vital first step onto the energy ladder for many households, survey data show that larger, productive use appliances rank higher in development impact potential for households.⁸⁸

85. Meital Rosenberg et al., “Evidence of Gender Inequality in Energy Use from a Mixed-Methods Study in India,” *Nature Sustainability* 3, no. 2 (February 2020): 110–18, <https://doi.org/10.1038/s41893-019-0447-3>.

86. Rosenberg et al.

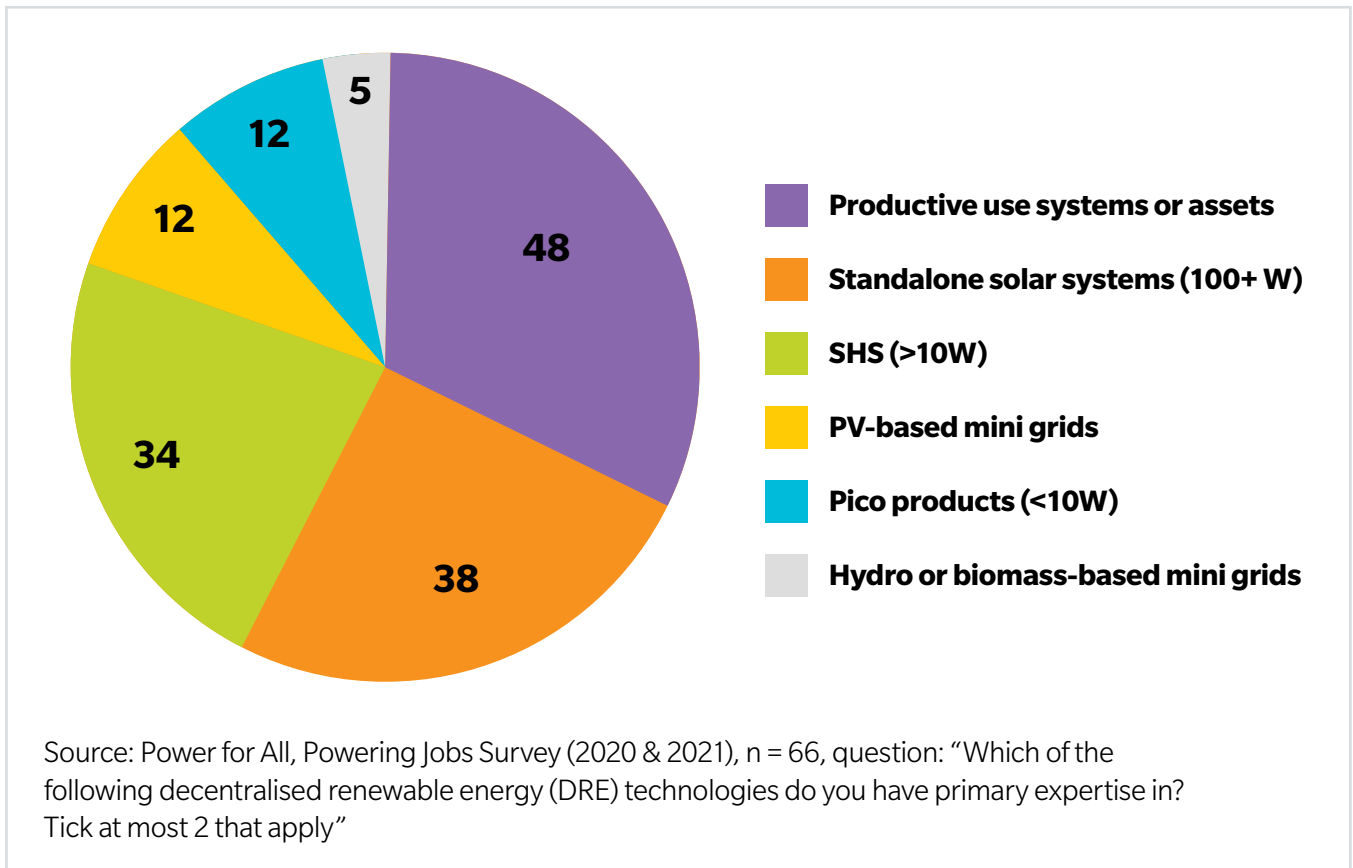
87. Implicit gender bias may also exist, even among women. If women do not see themselves as being users of appliances or able to run small businesses due to a lack of representation, they may not demand appliances.

88. Efficiency for Access, “Off-Grid Appliance Market Survey 2020,” 12.



Photo Credit: d.light courtesy of GOGLA

Figure 6. Percentage of Primary Expertise Among Solar Lighting and Appliance Companies



Product Offering

Among solar lighting and appliance distributors, cookstoves, solar water pumps, and televisions were the most common appliances carried/sold after solar lights, home systems and consumer electronics (Figure 7).

Other household and productive use appliances distributed included electric pressure cookers, domestic hot water, mixer-grinders, solar water heaters, power banks, e-bikes, irrigation equipment, small farm tools, solar washing machines, solar ice-makers, and efficient iceboxes.

Few distributors sell appliances that have a high perceived development impact for women. Our 2020 Off-Grid Appliance Market Survey ranked household and business/productive use solar products according to perceived development impact for women.⁸⁹ Many of the highest-ranked products are not currently distributed to last-mile communities. For example, solar sewing machines and solar mills ranked first and seventh in development impact out of 20 business/productive use appliances, yet only seven GDC members distribute them.⁹⁰ This suggests current product offerings may not reflect the demand and preferences toward certain products. The relative nascency of these products compared to televisions, fans, and refrigerators, which have been sold on the market for years, could also be a factor. The limited number of distributors offering these products may therefore be a reflection of the limited number of companies manufacturing these products and little expertise or understanding of more niche productive use appliances among distributors.

89. Efficiency for Access, “Off-Grid Appliance Market Survey 2020.”

90. Efficiency for Access.



Photo Credit: Wala

Absent from both Power for All and the GDC's survey data was information about whether specific products offer accommodations for people with disabilities. 80% of people with a disability live in developing nations,⁹¹ the vast majority of them in rural areas.⁹² To better serve people with disabilities, solar product manufacturers and distributors should ensure they are creating and distributing products that are accessible to their target customers. Expanding future surveys to ask about accommodations for people with disabilities could be an important first step. Beyond developing products with accommodations, there are also opportunities for solar lighting and appliances companies to expand into assistive technologies. Efficiency for Access' 2020 Introductory Note on disability-inclusive energy access programmes outlines concrete steps the sector can take to ensure products and interventions are more inclusive for people with disabilities.⁹³

80% of people with disabilities live in low to middle-income countries, the vast majority of them in rural areas. Companies should make a greater effort to design inclusive products with and for this market segment.

91. United Nations, "Factsheet on Persons with Disabilities," accessed April 15, 2022, <https://www.un.org/development/desa/disabilities/resources/factsheet-on-persons-with-disabilities.html>.

92. Sophie Mitra, Aleksandra Posarac, and Brandon Vick, "Disability and Poverty in Developing Countries: A Multidimensional Study," *World Development* 41 (2013): 1–18.

93. Efficiency for Access, "How Can Energy Access Programmes Address the Needs of People with Disabilities?," 2021, <https://efficiencyforaccess.org/publications/how-can-energy-access-programmes-address-the-needs-of-people-with-disabilities>.



A farmer club demonstrates its use of the Wala solar water pump during an EEP Africa field monitoring visit. [Location: Mzimba, Malawi]

Photo Credit: Wala

EFFICIENCY FOR ACCESS R&D FUND

Enabling Agricultural Livelihoods for All Through Inclusive Solar Appliances

A holistic and inclusive approach to solar product accessibility is crucial to achieving the SDGs and ‘leaving no one behind’ in the global energy transition. Wala, an Efficiency for Access Research and Development Fund grantee and female-owned social enterprise based in Malawi, is developing and field-testing inclusive and enabling technologies and business models for irrigation and agricultural processing across sub-Saharan Africa that allow people with physical disabilities to irrigate their farms.⁹⁴

Wala provides farmers with access to loans for high-quality solar water pumps through micro-financing partners, education and training to grow crops outside of the rainy season, and connections to off-takers and contract-farming to ensure market access.

The high-quality, user-centric solar water pumps Wala loans have features that increase accessibility, allowing users with disabilities to perform irrigation. One farmer group using the pumps, called the Chiladza Disability Club, comprises predominantly women farmers who either have a disability or are caring for a child with a disability at home.

An accessibility feature of the pump is its portability. Users can easily transport their solar water pump to a certain part of the field for use. The pump’s detachable hose makes it easy for farmers to easily control the reach and direction of water without much physical effort. Farmers, particularly those with a disability, have reported great satisfaction with the usability of the pump and anticipate an abundant harvest which is expected to lead to increased incomes.

Wala loans provide farmers with access to user-centric solar water pumps that users with disabilities can operate.

94. The Efficiency for Access Research and Development Fund is supported by UK aid from the UK Government’s Department for International Development (DFID) and the IKEA Foundation.



Photo Credit: Futurepump

Recommendations

The following recommendations for companies, donors, investors, non-governmental organisations and other stakeholders of the solar lighting and appliances sector shed light on how to fill data gaps and work towards best practices for inclusivity.

Governments play an important role in promoting inclusivity through public funding, subsidy schemes, welfare schemes, and company regulations, among others. A policy brief, on the same topic, will accompany this report and specifically address government and policy-maker recommendations around the inclusivity of solar products in regional contexts.

Recommendations for policymakers and governments will be included in a complementary policy brief that will examine inclusivity through regional lenses.

Private Sector

Top Recommendations

- **Make inclusivity a core value and follow through with meaningful action.** A shift in a company's core values can transform employee treatment. Communicating diversity as a core value signals to employees, investors, and customers that a company has a vested interest in addressing and dismantling barriers for historically marginalised groups. From there, it is critical that companies follow up with meaningful programmes and policy changes to address any existing biases and barriers that will hinder diversity efforts. Simple efforts such as bias awareness training, diversity audits, and developing short- and long-term diversity goals are good starting points.

- **Develop more inclusive business operations, from marketing to after-sales support to ensuring quality warranty, repair, and replacement processes.** Resources such as Value for Women's guide, A Business-First Approach to Gender Inclusion: How to Think About Gender Inclusion in Small and Medium Enterprise Operations,⁹⁵ list actionable steps for companies interested in adopting more gender-inclusive policies, while Efficiency for Access' Research Note, How can Energy Access Programmes Address the Needs of People with Disabilities, offers a wide range of recommendations for market actors.⁹⁶
- **Design products with people rather than for them.** There is a need to include people with disabilities, women and other marginalised groups in market research that informs appliance design and identifies existing market barriers. For example, people with disabilities should be included among respondents when researchers conduct user needs assessments prior to product design. They also should be consulted when testing product prototypes. The needs of marginalised groups have historically been overlooked and are therefore not well-understood within a design context. Companies should work closely with last-mile distributors, who have close connections to these customers, and can provide valuable insights into market demand and customer feedback.
- **Assess demand, growth, and impact potential for emerging solar products.** Expand expertise and diversify product offerings to include more productive use appliances for women, people with disabilities, and other marginalised groups where potential is high. This includes products such as sewing and milling machines, as well as assistive technologies or features. Companies should conduct an in-depth demand analysis to understand what technologies various customer segments need at what prices and with what financing mechanisms.

95. Value for Women, "A Business-First Approach to Gender Inclusion: How to Think About Gender Inclusion in Small and Medium Enterprise Operations."

96. Efficiency for Access, "How Can Energy Access Programmes Address the Needs of People with Disabilities?"

Efficiency for Access, "How Can Energy Access Programmes Address the Needs of People with Disabilities?"

Additional Recommendations

- **Create fair and equitable employee compensation and promotion procedures.** Seek to correct the gender pay gap and other pay gaps between historically marginalised and privileged groups. Promoting pay transparency (e.g., publishing salary bands for all positions within the company) and creating systems for routine equity pay audits can help empower marginalised groups and create opportunities for managers to assess whether current employee compensation is equitable throughout the company.
- **Develop targeted initiatives to improve the recruitment and retention of marginalised groups.** This can include simple efforts such as setting soft and hard targets for monitoring and evaluating progress towards parity at all levels in the hiring process. Requiring neutral language in job postings and involving multiple people in the hiring process can level the playing field during the application and interview process. Finally, adopting a gender or disability retention plan can help companies support a roadmap for how they will improve retention for marginalised groups informed by an internal audit of existing retention policies and practices. Companies should also collect data to track and provide insight into the efficacy of these targeted initiatives.
- **Reference existing accessibility standards and technical specifications.** Various country or region-specific disability or accessibility standards and technical specifications are available that focus on various disability sub-fields such as built environment, education, transport, products, web content, et cetera. One useful reference includes the European Standard BS EN 17161:2019 (Design for All) enables organisations to use a consistent approach to address accessibility for people with disabilities.⁹⁷ The requirements set out in this standard are generic and apply to all relevant parts of businesses.

- **Tailor customer service to different product users.** Users have different preferences and experiences with products and services. Tailoring customer service to different audiences throughout the customer experience – from product marketing to sales and after-sales support – allows companies to account for diverse user experiences. Ultimately, this can help companies save time and money by serving their customers more efficiently. Examples of this include gender-tailored messaging for call centres and ensuring that all written content, digital or print-based, is accessible to people with disabilities. The content should also be easily adaptable for voice, sign language, or pictograms. Also, consider marketing products in new ways to attract new customer segments.

Impact Investors

Top Recommendations

- **Expand funding criteria that evaluate how well potential investees include marginalised groups.** In addition to funding criteria, consider developing or adopting existing metrics to assess performance across consumer inclusivity dimensions. For example, Acumen and Unilever's toolkit, A Lean Data How-to Guide: Understanding Gender Impact,⁹⁸ allows organisations to collect high-quality data that offers gender insights rapidly and cost-effectively. The report also includes a diagnostic tool to help investors and enterprises assess how they impact women and men across business models and uncover opportunities to improve their impact. It is worth noting that impact investors may need to coordinate with donors and market development programmes to ensure investees have the training and resources necessary to track and report inclusivity metrics to investors.

97. European Standards, "BS EN 17161:2019 Design for All. Accessibility Following a Design for All Approach in Products, Goods and Services. Extending the Range of Users," 2019, <https://www.en-standard.eu/bs-en-17161-2019-design-for-all-accessibility-following-a-design-for-all-approach-in-products-goods-and-services-extending-the-range-of-users/>.

98. Acumen and Unilever, "A Lean Data How-to Guide: Understanding Gender Impact," 2018, <https://acumen.org/investinwomen/>.

Market Development Programmes

Top Recommendations

- **Standardise data collection efforts and survey questions to capture comparable inclusivity metrics.** When developing survey questionnaires, non-governmental organisations and programme implementers should tailor their questions to meet the aims and objectives of their programme. However, adopting a standardised set of questions when collecting gender or disability-disaggregated data or asking households about their income or ability to repay their loan can enable more accurate comparisons for market actors to better assess the market as a whole. The sector already collects disaggregated data on primary energy connections, and expanding these efforts to include standardised metrics for inclusivity is an important first step to tracking progress.⁹⁹
 - **Gender:** Collecting gender-disaggregated data is essential to understanding how well solar products reach women and how women use and interact with appliances. Many non-governmental organisations (NGOs) and programme implementers already collect gender-disaggregated data. However, they should consider expanding data collection efforts to capture feedback from all product users. Most data collection efforts aim to interview the head of the household. In most cases, this person is a man. Collecting information from the experiences of other users can unearth additional information about the reach and benefits of solar products for women and men.
 - **Disability:** Very few survey instruments ask the respondent to indicate whether they have a disability or whether anyone with a disability uses the product in question. Collecting disability-disaggregated data will provide a more complete picture of who uses and benefits from solar appliances. Adopting a standardised approach to collecting information on appliance users with disabilities, such as the Washington Group Short Set on Functioning (WG-SS), can help ensure that market actors are using a common set of definitions and collecting data in a uniform way that will allow for uniform comparison.
 - **Poverty:** Accurately reporting household income can be difficult for many appliance users. Household members may engage in a wide array of livelihood activities that are difficult for one household member to track and recall accurate income data. Further, when households are asked to report their income, the period they are asked to reflect upon varies by the survey. Widespread adoption of the Poverty Probability Index or another more robust form of income collection can help overcome inaccuracies in household income reporting.¹⁰⁰ Rather than asking respondents to estimate their total household income within a given year, they are asked questions about their living conditions and daily lives that estimate the probability that that household is living in poverty.
 - **Over-indebtedness:** Similar to disability data, very few surveys collect information that can be used to assess whether a household has taken on an amount of debt that they may struggle to repay without making significant sacrifices that threaten their quality of life. Collecting household-level financial data or asking a standardised series of questions on the sacrifices respondents have made to pay their loans (see Table 6, page 52) is a good first step to understanding which customers may be over-indebted.

99. Some suggestions are provided here based on this research, but note that it is not exhaustive (for example, youth, refugees and internally displaced people are not included but should be considered where possible). More information is available in Table 7.

100. Innovations for Poverty Action, "Poverty Probability Index."

Additional Recommendations

- **When conducting surveys, interview users from marginalised groups.** Surveys often choose respondents who are the household head or the product purchaser. However, understanding the needs of different appliance users and the basis on which they make decisions, acquire, and interact with their appliances can unearth a wealth of information about existing market barriers and how to overcome them. Specifically targeting users from marginalised groups will require additional effort from the survey implementers. Interviewing multiple household members will take time and add to survey costs, as some members of these groups may be difficult to reach or engage. NGOs and programme implementers should also work to ensure that survey instruments are inclusive. In some cases, modifications may be necessary for different respondents. Developing questionnaires in tandem with individuals specialising in gender or disability research in the design and/or implementation of surveys can save time and may produce better results.
- **Develop an inclusivity strategy to codify impact metrics, data collection strategies, and targeted interventions for reaching marginalised groups.** Many programmes do an excellent job of tracking and reporting key impact metrics, such as the number of people who gained access to electricity through a programme, tons of greenhouse gas emissions avoided, etc. However, many do not collect, analyse and report the diversity in solar product users they are reaching throughout the intervention. Developing more robust impact indicators can help NGOs and programme implementers assess their impact on marginalised groups throughout the project's lifespan, enabling them to reach and target groups that might otherwise have been overlooked or unintentionally excluded. Developing a dedicated inclusivity strategy for each programme (see Box 2 on page 29) can codify a process for how NGOs and programme implementers will define success and reach a wider range of beneficiaries.

- **Promote knowledge sharing of best practices on diversity, equity, and inclusion.** Where inclusive hiring practices, business operations, and product design are accomplished, market development programmes should aim to scale up impactful programmes by sharing best practices, case studies, and resources with the private sector. Reports highlighting successes and failures can be a useful starting point for businesses and communicate to the sector which initiatives are working and which are not. Donors and market development programmes may also wish to offer additional sources of funding or support to companies wishing to grow their expertise in this area.

Donors

Top Recommendations

- **Look beyond a fully commercial, private sector-led approach to deliver more inclusive energy services.** Private sector companies are reaching more customers than ever before. However, they may be reluctant to extend lines of credit to groups of customers that they deem to be a high-risk factor. To ensure no one is left behind, donors should intentionally create programmes and incentives to target these groups. Interventions like heavy subsidies coupled with appropriate communications and consumer education campaigns for bottom-of-the-pyramid households will help make solar products more affordable and accessible to families and lay the groundwork for the development of a local market that is more investment-ready.
- **Explore funding more local non-governmental organisations, which tend to be closest to marginalised communities.** Local non-profit organisations often have closer ties to their communities and can therefore better assess needs and identify barriers to implementation in advance of implementation. Donors and market development programmes should also note that investments in these organisations may require greater risk appetite and lowered qualification barriers.



Photo Credit: LE PICTORIUM-Alamy Stock Photo courtesy of SEforALL

- **Avoid funding a single inclusivity dimension in isolation.** Intersections of disadvantage can amplify negative effects for marginalised groups and thus must be understood together. These intersections can often be most successfully addressed holistically.
- **Prioritise marginalised groups.** Women and children/youth, people with disabilities, bottom-of-the-pyramid households, and people in humanitarian settings continue to have the greatest need for sustainable energy service delivery. Donors and their supporting market development programmes should centre these groups on energy access efforts and develop a concerted, well-funded plan of action to ensure the benefits of modern energy services are delivered equitably.

Donors and survey funders need to put the necessary financial resources into the interventions to understand the needs of marginalised groups. Donors should also consider how to create entrepreneurship and/or employment opportunities for these groups. This may include understanding what accommodations may be needed and incorporating these into business models to equalise the playing field. Requiring gender mainstreaming and action plans for reaching marginalised groups can help develop a culture of inclusion and enable more robust data collection and tracking efforts across the sector.



Considerations for Future Surveys and Checklist for Data Collection Efforts

Our analysis of 21 survey instruments finds large variations in the type of social and demographic information collected. Each market actor has adopted their own approach to data collection. Standardising this process through the creation of common metrics or indicators will help the solar lighting and appliances sector better assess diversity and inclusion efforts. Tables 6 and 7 below contain considerations for market actors when surveying solar product customers and employees of off-grid solar companies.

Table 6. Standardisations and Guidance for Data Collection on Solar Product Users

CATEGORY	CONSIDERATIONS	TOOLS OR EXAMPLES
Gender	<p>Problem: Gender representation of the survey respondent alone is insufficient to assess solar product reach.</p> <p>Limited gender-disaggregated product usage and impact data hinder efforts to recognise the need for and design gender-focused interventions.</p> <p>Solution: Collect gender-disaggregated quantitative and qualitative data on patterns in solar product usage and distribution of benefits to understand how an appliance affects women, men and gender relations within a household.</p> <p>The information should be analysed alongside the customer characteristics (e.g., gender, disability and poverty level) to understand customer segments that are particularly vulnerable to over-indebtedness to inform the market and mitigate the potential negative impacts of over-indebtedness.</p>	<p>In addition to the survey respondent’s gender, collect gender-disaggregated data on the following:</p> <ul style="list-style-type: none"> • The product’s primary users • How the product is used by the primary users • The impact of the product on the primary users <p>During data collection, the following points should be considered:</p> <ul style="list-style-type: none"> • Gender-inclusive sampling approach to ensure equal representation of women and men • Conducting intra-household interviews to hear from men and women in the same household • Disaggregation of stakeholder groups during interviews or focus groups to ensure women are given the opportunity to express themselves freely • Use of female and male interviewers or data collectors, provision of gender sensitivity training
Poverty	<p>Problem: Income in many households may be irregular, or it can be a sensitive topic that respondents may feel discomfort around reporting. A focus on income can also belie the importance of a household’s assets and strategies. All of these factors can make it difficult for respondents to accurately report their household income, which in turn prevents an accurate assessment of the off-grid sector’s reach of people living below poverty.</p> <p>Solution: Rather than asking respondents to report their household income, use tools such as the Poverty Probability Index (PPI) to estimate that household’s probability of living below the poverty line.</p>	<p>The PPI is a measurement tool for organisations and businesses that service the poor.¹⁰¹ It uses 10 questions about housing characteristics and asset ownership to calculate the likelihood that the household lives below the poverty line. The tool is free, with survey instruments and scorecards available for 25 countries.</p>

101. Innovations for Poverty Action.

Table 6. Standardisations and Guidance for Data Collection on Solar Product Users (Cont.)

CATEGORY	CONSIDERATIONS	TOOLS OR EXAMPLES
Disability	<p>Problem: The lack of a standardised approach to defining and collecting disability data prevents assessment of the solar sector’s reach of disabled people.</p> <p>Solution: Use of the internationally recognised definition of disability and standardised approach to collecting disability data.</p> <p>Collecting sensitive data, like one’s disability status, requires a high level of security. Individual records containing confidential information should never be shared without taking active steps to protect that person’s identity.</p>	<p>The Washington Group Short Set on Functioning (WG-SS) of six questions on functioning for use on national censuses and surveys.¹⁰² The questions reflect advances in the conceptualisation of disability and use the World Health Organisation’s International Classification of Functioning, Disability, and Health (ICF) as a conceptual framework.</p> <p>More information on collecting disability disaggregated data and other inclusivity best practices is available in MercyCorps’ Inclusive Energy Access Handbook.¹⁰³ While the handbook pays special attention to access in emergency settings, its guidance on data collection and practical tools to improve inclusive energy access applies to many off- and weak-grid contexts.</p> <p>Efficiency for Access’ report, How Can Energy Access Programmes Address the Needs of People with Disabilities?, is another resource geared towards practitioners and companies.¹⁰⁴ The report also includes a helpful checklist for energy access programmes and solar product manufacturers to ensure they address the needs of people with disabilities.</p>
Data Privacy	<p>Problem: Consumer protection is critical when collecting sensitive data on users. However, many organisations have insufficient standards or practices to ensure data privacy.</p> <p>Solution: Consenting users should be well-informed of what data is being collected and how it will be used. Surveyors should follow best practices to ensure that they comply with relevant consumer data laws and regulations and keep data confidential and secure. They should only collect and utilise the information that is strictly necessary and aligned with what provisions users agreed to.</p>	<p>In addition to complying with the European General Data Protection Regulation, which has become a global reference for data protection laws, consider GOGLA’s consumer protection toolkit.¹⁰⁵ The resource provides a framework for ensuring that practices uphold respondents’ interests and empower them to take charge of their personal data.</p>

102. Washington Group on Disability Statistics, “WG Short Set on Functioning (WG-SS).”

103. Mercy Corps, “Inclusive Energy Access in Emergencies: A Handbook for Humanitarians,” 2020. <https://www.mercycorps.org/research-resources/inclusive-energy-access-emergencies>.<https://www.mercycorps.org/research-resources/inclusive-energy-access-emergencies>

104. Efficiency for Access, “How Can Energy Access Programmes Address the Needs of People with Disabilities?”

105. GOGLA, “Tools,” n.d., <https://www.gogla.org/tools-resources-news/consumer-protection-tools>.

Table 6. Standardisations and Guidance for Data Collection on Solar Product Users (Cont.)

CATEGORY	CONSIDERATIONS	TOOLS OR EXAMPLES
Over-indebtedness	<p>Problem: Whilst pay-as-you-go financing can improve the affordability of solar products, some customers with limited or irregular incomes may struggle to make regular payments, causing them to make financial sacrifices on essentials such as food, and education, etc. Beyond company-reported data (e.g., customer repayment rates), there is a need to better understand the extent to which monthly repayments are a burden on off- and weak-grid households and customer segments that are particularly vulnerable to over-indebtedness.</p> <p>Solution: Collect quantitative and qualitative data to understand how households are affected by monthly loan repayments and energy-related expenses.</p> <p>The information should be analysed alongside customer characteristics (e.g., gender, disability and poverty level) to understand customer segments that are particularly vulnerable to over-indebtedness to inform the market and mitigate the potential negative impacts of over-indebtedness.</p>	<p>Where possible, collect the following quantitative data to calculate the ratio of income/saving to loan repayment:</p> <ul style="list-style-type: none"> • Loan repayment amount • Household's disposable income • Household's savings made as a result of the appliance • Additional income generated as a result of the appliance <p>60 Decibels has devised a list of questions to assess over-indebtedness,¹⁰⁶ including:</p> <ul style="list-style-type: none"> • How the customer is paying off their loan • Whether the customer finds the repayment a burden • Whether the customer has cut back food consumption for the repayment • Whether the customer has made unacceptable sacrifices to make repayment

106. Efficiency for Access, "The Use and Impacts of Solar TVs."

Table 7. Solar Lighting and Appliance Companies

CATEGORY	CONSIDERATIONS	TOOLS OR EXAMPLES
Workplace Diversity	<p>Problem: The energy sector remains a heavily male-dominated field.</p> <p>Solution: Collect quantitative and qualitative gender-disaggregated data across all levels within a company and use this data to highlight any disparities in hiring or compensation.</p>	<p>ESMAP developed a Human Resources (HR) focused questionnaire¹⁰⁷ that can help companies assess progress toward gender parity, integration of gender-inclusive policies, and availability of training and mentorship opportunities.</p> <p>IRIS catalogue of metrics also includes a range of indicators around diversity and inclusion.¹⁰⁸</p>
Data Privacy	<p>Problem: Many solar products sold and marketed by companies may not fully-represent the diverse wants and needs of all customers.</p> <p>Solution: Mainstream marginalised voices in company research efforts. Collect gender, income, and disability disaggregated data to explore new customer segments and reveal previously overlooked or missed business opportunities. Data may be collected through customer feedback surveys. Conduct additional market research to assess how these new market segments may desire different products or demand different uses or features from existing products.</p> <p>Design products with excluded communities rather than for excluded communities. Include people with a diverse range of backgrounds when testing products with users. As much as possible, companies should hire people with disabilities who can help overcome design biases and inform more inclusive design and business practices.</p>	<p>Shell Foundation and Value for Women developed and piloted various tools and strategies for gender inclusion in business operations, including sales, marketing, market research, customer care and hiring for sales. Their published report also includes a step-by-step guide for implementing the tools.¹⁰⁹</p> <p>Efficiency for Access created a checklist for solar appliance manufacturers to ensure they address the needs of people with disabilities.¹¹⁰</p> <p>To ensure that products comply with existing accessibility standards, reference the European Standard: EN17161:2019 Design for All.¹¹¹</p>

107. ESMAP, "Power Sector Questionnaire on Human Resources, Training and Gender Practices," n.d., <https://esmap.org/sites/default/files/Documents/Power%20Sector%20HR%20Gender%20Survey%20Final.pdf>.

108. Global Impact Investing Network, "IRIS Catalog of Metrics," IRIS+ System | Standards, n.d., <https://iris.thegiin.org/metrics/?search=&sortBy=alphabetical>.

109. Value for Women, "A Business-First Approach to Gender Inclusion: How to Think About Gender Inclusion in Small and Medium Enterprise Operations."

110. Efficiency for Access, "How Can Energy Access Programmes Address the Needs of People with Disabilities?"

111. European Standards, "BS EN 17161."



Appendix

The definitions provided below pertain to the varied interests of individuals and groups in the solar lighting and appliances sector. They are not meant to make sweeping statements on the overall inclusivity dimensions of a particular individual profile, group or country context.



Gender is a social construct and not a biological determination. It encompasses and refers to the lived experiences of individuals based on the roles, behaviours, and responsibilities that others expect from them based on the individuals' identification as man, woman, or non-binary.¹¹² One's gender identity can be the same or different from the sex assigned at birth. Whilst gender is primarily framed in terms of the binary adjectives male and female - this report will use the terms "women" and "men" for consistency.



Diversity refers to the unique identities and differences, both seen and unseen, at the individual and group level. Whilst diversity often refers to race, ethnicity, and gender, this report embraces a broader definition of diversity - including age, national origin, geographic location, class, religion, disability, sexual orientation, socioeconomic status, education, marital status, language, and physical appearance. We recognise that we cannot measure or benchmark many of these aspects for our sector at a company or community level at this time.



Equity refers to the fair treatment, access, opportunity, and advancement for all people while striving to identify and eliminate barriers that have prevented the full participation of some groups. It is a commitment to distribute resources based on the needs of individuals/groups (as opposed to giving the same to everyone, i.e., equality).¹¹³



Equality refers to equal rights and opportunities (equal pay for equal work, equality of access to human capital, and other productive resources), and equal voice (ability to influence and contribute to the development process, including policy discussions on energy) for all persons.¹¹⁴



Accessibility is a measure of how easily a person can participate in an activity. Whilst accessibility is usually referred to in the context of disability, for the solar lighting and appliance sector, we consider a broader definition encompassing consumer awareness of options as well as availability and ease of access of said options in local markets.



Inclusion is the ongoing act of creating environments where any individual or group feels welcomed, respected, supported, and valued to participate fully, thrive, and succeed. Inclusion is realised through the combined recognition of each individual's sense of uniqueness and belonging, creating a culture where we are all seen, heard, valued, and respected in a safe environment. Within our sector, it may include the development of inclusive institutions and practices, including financing, employment, energy policies and behaviours that allow previously marginalised groups to increase their voice and access to assets and opportunities, thus enhancing equity.

112. Greene, J., et al. Good practice for gender inclusion and equity in energy. 2020. Energy Saving Trust. www.energysavingt.org

113. Africa Clean Energy Technical Assistance Facility, "Gender and Social Inclusion in Off-Grid Solar: A Handbook for Sub-Saharan Africa," 2020, <https://www.ace-taf.org/wp-content/uploads/2020/04/GESI-Handbook-2020041001.pdf>.

114. "Gender and Social Inclusion in Off-Grid Solar: A Handbook for Sub-Saharan Africa." Africa Clean Energy Technical Assistance Facility, March 2020. <https://www.ace-taf.org/wp-content/uploads/2020/04/GESI-Handbook-2020041001.pdf>.

To assess the inclusion in the solar lighting and appliances sector, we analysed 19 consumer and two company surveys from nine organisations.¹¹⁵ This section provides an overview of the methodology for how consumer and company data was collected, prepared, and analysed.

The data in our analysis come from a wide array of surveys, each with its own objectives and sampling methodology. Whilst the pooled consumer sample may be the largest of its kind, the results drawn from our analysis do not represent any population. We did not remove or seek to fill in any missing data via interpolation. This approach enabled us to use the largest sample size possible, it also introduced bias into this study’s results. The percentages presented in this section were calculated using only those respondents that had provided data for the characteristic in question. Certain valuable segments within our target population, such as people with disabilities, may be heavily underrepresented in our analysis due to a lack of data. Therefore, the results of this analysis may not reflect the actual solar lighting and appliances market. Moving forward, standardising metrics and data collection efforts across sector actors could improve the ability to analyse different datasets from disparate sources.

Customer Data

Data Collection: Over the past five years, the Low Energy Inclusive Appliances (LEIA) Programme collected a wealth of data from field surveys with solar appliance users. To help build a more comprehensive dataset, we collected anonymised raw data from 19 household surveys obtained from nine organisations.

Data Preparation: Several steps were required to prepare the customer data for analysis. First, we developed a codebook to define how survey data would be re-coded for analysis. Second, we cleaned and re-coded all survey data according to our codebook. Finally, we pooled and cleaned all survey data for analysis. We did not fill in any missing data through methods such as replacing missing values with the mean or mode or applying nearest neighbours imputations.¹¹⁶ This approach enabled us to use the largest sample size possible; however, it also introduces bias into this study’s results. Certain valuable segments within our target population, such as people with disabilities, may be heavily underrepresented in our analysis due to a lack of data. Therefore, the results presented may not represent the actual market.

Our final sample contained 5,483 respondents spanning eight countries and two continents (Table 8). In total, respondents in our sample reported owning 7,784 solar products spanning nine categories (Table 9).

Table 8. Geographic Distribution of Respondents in Sample

COUNTRY	NUMBER OF RESPONDENTS	PERCENTAGE OF SAMPLE
Kenya	2916	53%
Uganda	1186	22%
India	497	9%
Tanzania	397	7%
Ethiopia	351	7%
Rwanda	115	2%
Senegal	11	<1%
Zambia	10	<1%

115. For a full list of data sources, please see Appendix C: Data Sources.

116. Method of filling in missing data where missing values are replaced by a value from related cases in the data set.

Table 9: Appliance Ownership of Sample

APPLIANCE	NUMBER OF RESPONDENTS	PERCENTAGE OF SAMPLE
Television	2260	41%
Pico Solar Product	2048	37%
Solar Home System	932	17%
Solar Water Pump	771	14%
Refrigerator	601	11%
Electric Pressure Cooker	554	10%
Other Appliance	438	8%
Fan	118	2%
Milking Machine	62	1%

Data Analysis: Once we obtained our final sample of customer data, we constructed different profiles to identify the average or most frequent response for each variable. To assess how well the solar lighting and appliances sector is reaching marginalised groups, we used data on the respondent’s gender, income, and disability status to calculate the percentage of respondents that identify as a woman and have a household income lower than the international poverty lines of USD \$1.90 or USD \$3.20 daily, or live with a disability. We used data from 60 Decibels and the World Bank to construct benchmarks for the broader solar lighting and appliance sector and the relevant region/country to draw comparisons to the wider solar lighting and appliance sector and population. Establishing a benchmark enables us to more accurately assess how inclusive the solar appliance sector is by comparing our results to similar diversity, equity, and inclusion metrics.

Company Data

Data Collection: We obtained self-reported company data from from two surveys conducted in 2021, Power for All’s Powering Jobs Survey and the Global Distributor’s Collective’s Member Survey.

Data Preparation: Power for All and the Global Distributor’s Collective provided raw and aggregated survey data. Power for All’s Powering Jobs survey

solicits responses from a wide array of actors. To ensure responses reflected the solar lighting and appliance sector, we used company-provided data to exclude enterprises that self-identified their main line of business as ‘commercial and industrial.’ Once we had a viable sample of solar lighting and appliances market, we used company-provided data on business location and operations, product expertise, and gender-disaggregated employment and compensation data to assess diversity and inclusion among the private sector companies. Our final sample consisted of 68 companies. We used aggregate data from the Global Distributor’s latest member survey to complement Power for All data on business operations and product expertise/offering.

Data Analysis: To assess workplace diversity and inclusion efforts among private sector companies, we analysed gender-disaggregated employment and compensation data from Power for All’s 2021 Powering Jobs survey. Gender-disaggregated data was reported across four employee skill categories: top-level management, skilled workers, semi-skilled workers, and unskilled workers. We also analysed company-reported data on the location of company offices, company expertise and product offering using data from Power for All’s Powering Jobs survey and the Global Distributors Collective’s member survey. Because companies did not collect disaggregated data on any other inclusivity dimension, we used gender as the primary dimension of company analysis.

APPENDIX C: DATA SOURCES

Between November 2021 and February 2022, we initiated a call for data among Efficiency for Access Coalition Members and Program Partners. During this time, we also collected additional open access survey data from the World Bank and relevant academic studies. By March 2021, we collected 19 household surveys and two private sector surveys from 9 organisations, featuring data collected between 2017 and 2021 (Table 10).

Table 10. Data Sources Used in Analysis

SOURCE	CONSIDERATIONS	APPLIANCES	COUNTRY	SAMPLE SIZE	SAMPLE COLLECTION DATES(S)
LEIA Programme	Baseline survey for solar appliance field testing program	Refrigerators	Rwanda	22	2021
LEIA Programme	Baseline survey for solar appliance field testing program	Refrigerators	India	20	2021
LEIA Programme	Baseline survey for solar appliance field testing program	Solar Water Pumps	Kenya	33	2021
LEIA Programme	Baseline survey for solar appliance field testing program	Milking Machines	India	62	2021
LEIA Programme	Baseline survey data used to inform appliance financing pilot between the LEIA program, EnerGrow, and Equatorial power	Multiple	Uganda	3,081	2018
LEIA Programme	Baseline survey data used to inform appliance financing pilot between the LEIA program, EnerGrow, and Equatorial power	Multiple	Uganda	104	2019
LEIA Programme	Follow-up survey data collected through an electric pressure cooker pilot with Power Gen Renewable Energy funded by Modern Energy Cooking Services	Electric Pressure Cookers	Tanzania	24	2019
CCEW	Data from India's largest energy access survey, covering more than 9000 households, 756 villages and 54 districts, across Bihar, Jharkhand, Madhya Pradesh, Odisha, Uttar Pradesh, and West Bengal	Multiple	India	9,072	2018

Table 10. Data Sources Used in Analysis (Cont.)

SOURCE	CONSIDERATIONS	APPLIANCES	COUNTRY	SAMPLE SIZE	SAMPLE COLLECTION DATES(S)
60 Decibels	Customer impact data collected on behalf of one electric pressure cooker company	Electric Pressure Cookers	Kenya	195	2020
60 Decibels	Consumer impact data collected on behalf of two refrigerator companies	Refrigerators	Kenya, Uganda	260	2020
60 Decibels	Consumer impact data collected on behalf of multiple solar water pump companies	Solar Water Pumps	Tanzania, Kenya, Rwanda, Senegal, Uganda, Zambia	554	2020
60 Decibels	Consumer impact data collected on TV owners	TVs	Kenya, Tanzania, Uganda	1,826	2018
Rural Senses	Customer data collected for the development of an off-grid appliance impact assessment framework	Multiple	Uganda	116	2021
Rural Senses	Customer data collected for the development of an off-grid appliance impact assessment framework	Multiple	India	154	2021
Simusolar	Customer data collected for report on the use and benefits of solar water pumps	Solar Water Pumps	Tanzania	176	2018
VeraSol	Survey data of solar home system and pico-solar customers in Kenya	Multiple	Kenya	4,195	2021

Table 10. Data Sources Used in Analysis (Cont.)

SOURCE	CONSIDERATIONS	APPLIANCES	COUNTRY	SAMPLE SIZE	SAMPLE COLLECTION DATES(S)
World Bank	Household survey data collected for Multi-Tier Framework Survey for Measuring Energy Access	Multiple	Kenya	4,051	2018
World Bank	Household survey data collected for Multi-Tier Framework Survey for Measuring Energy Access	Multiple	Rwanda	3,295	2018
World Bank	Household survey data collected for Multi-Tier Framework Survey for Measuring Energy Access	Multiple	Ethiopia	19,441	2018
Power for All	2021 Power Jobs survey results	Multiple	Ethiopia, India, Kenya, Uganda	415	2021
Global Distributors Collective	2021 Member Survey	Multiple	Multiple	135	2021



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