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Off-Grid Solar Market Trends Report 2022: State of the Sector Executive Summary



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Foreword

The previous edition of our Off-Grid Solar Market Trends Report (MTR) was launched at the Global Off-Grid Solar Forum & Expo in Nairobi, Kenya in February 2020. The COVID-19 pandemic was declared only one month later, and within a few weeks, much of the world went into lockdown.

Before the pandemic, the off-grid solar (OGS) industry was experiencing double-digit growth. Over a decade of innovation and investment has created a strong core of products that have reached maturity, from solar energy kits to productive use appliances. These technologies have been embraced globally as essential tools in the fight to eliminate energy poverty and achieve a faster, more equitable clean energy transition.

However, the COVID-19 pandemic has presented major challenges for the industry and society as a whole. Millions of people were pushed, or pushed further, into poverty due to falling incomes, higher cost of living, and supply chain disruptions. Off-grid solar companies were confronted with price increases for raw materials and reduced incomes of their – often rural and relatively poor – customer base. Safety precautions made it difficult to connect with customers and partners, and investment was more difficult to access for many companies.

The pandemic has had a considerable adverse impact on markets, but the industry has also shown resilience. Many governments declared off-grid solar an essential service, allowing companies to operate even during strict lockdowns. Despite hardship, many customers prioritized energy spending, demonstrating the importance of electricity access and the benefits that OGS products provide.

As the pandemic abates and lockdowns are mostly lifted, the industry is showing early signs of a recovery. Sales numbers are increasing again, companies are expanding their services beyond energy, and 2021 recorded an all-time high of \$457 million investment, with 2022 set to be another record-breaking year. New technology segments are emerging that integrate low voltage power and appliances to strengthen the grid, and there is growing support from governments and donors to ensure that no one is left behind.

After a period of unprecedented shocks, the 2022 MTR provides in-depth insight into the latest key market dynamics and trends. The report is, for the first time, split into two parts. This first report focuses on the current ‘State of the Sector’, while the second report, to be published in October 2022, will provide an ‘Outlook to 2030’. We hope that this will improve readability and make it easier and more rewarding for readers to engage with the content.

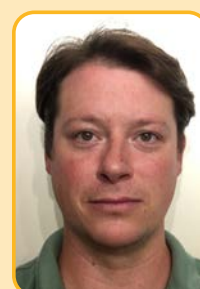
The past few years have been extremely challenging. However, the vision and commitment of many has strengthened the off-grid solar industry and its foundations, shown innovation and entrepreneurship, and the sector has become further recognized for its vital role in achieving a cleaner and more equitable energy transition.



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Lighting Global is the World Bank Group’s initiative to rapidly increase access to off-grid solar energy for the 733 million people living without electricity world-wide. Managed by the Energy Sector Management Assistance Program (ESMAP), we work with governments, the private sector, development partners, and end-users, continually innovating to unlock key market barriers and enable access and affordability to those that would otherwise be left behind. Our support has expanded to technologies that go far beyond lighting, including systems to power the needs of households, businesses, schools, and health centers. We operate with funding gratefully acknowledged from ESMAP and their donors. For more information, please visit www.lightingglobal.org



IFC—a member of the World Bank Group—is the largest global development institution focused on the private sector in emerging markets. We work in more than 100 countries, using our capital, expertise, and influence to create markets and opportunities in developing countries. In fiscal year 2021, IFC committed a record \$31.5 billion to private companies and financial institutions in developing countries, leveraging the power of the private sector to end extreme poverty and boost shared prosperity as economies grapple with the impacts of the COVID-19 pandemic. For more information, visit www.ifc.org



Efficiency for Access is a global coalition promoting energy efficiency as a potent catalyst in clean energy access efforts. Since its founding in 2015, Efficiency for Access has grown from a year-long call to action and collaborative effort by Global LEAP and Sustainable Energy for All to a coalition of 20 donor organizations. Coalition programmes aim to scale up markets and reduce prices for super-efficient, off- and weak-grid appropriate products, support technological innovation, and improve sector coordination. Current Efficiency for Access Coalition members lead 12 programmes and initiatives spanning three continents, 62 countries, and 34 key technologies. For more information, please see www.encyforaccess.org



GOGLA is the global association for the off-grid solar energy industry. We are proud to champion one of the world’s most innovative and impactful sectors. Hundreds of millions of people already benefit from affordable, high-quality, clean off-grid solar products and services. With the right support, our pioneering industry will be able to scale up rapidly to improve the lives of 1 billion people by 2030. To help make this happen, we promote, safeguard, and convene the industry, advocating for enabling policies and increased investment as well as supporting our 200+ members with effective services. To find out more, visit www.gogla.org



Open Capital Advisors is a management consulting and financial advisory firm that drives growth, enables investment, and builds markets across Africa. We help businesses, investors, development partners, and the public sector to identify opportunities and deliver unique, impactful solutions. Our mission is to advance African economies and build future generations of business leaders. Since 2010, we have completed over 1000 engagements across 25 countries in sub-Saharan Africa and raised over \$1billion in capital for impactful businesses across the continent. Our locally based team of over 150 full-time staff brings experience from the world’s top consultancies, private equity firms, investment banks, and development organizations. For more information, please visit www.opencapital.com

Abbreviations

AC	Alternate current	OEM	Original equipment manufacturer
ATL	Above the line	OGS	Off-grid solar
B2B	Business-to-business	PAYGo	Pay-as-you-go
B2C	Business-to-consumer	PnP	Plug and play
BoP	Bottom of the pyramid	PUE	Productive use of energy
BTL	Below the line	PV	Photovoltaic
CAGR	Compound annual growth rate	QV	Quality-verified
CO2e	Carbon dioxide equivalent	RBF	Results-based financing
DC	Direct current	RU	Refrigeration unit
EUS	End-user subsidy	R&D	Research and development
FCV	Fragility, conflict, and violence	SDG7	Sustainable Development Goal 7
IEP	Integrated electrification plan	SEA	Southeast Asia
IoT	Internet of things	SEK	Solar energy kit
LVSP&A	Low voltage smart power & appliances	SHS	Solar home system
LMD	Last mile distributor	SSA	Sub-Saharan Africa
MFI	Microfinance institution	SWP	Solar water pump
MLS	Multi-light system	\$	United States Dollars
MSME	Micro, small and medium enterprises	VAT	Value added tax
MTF	Multi-tier framework	W	Watt
MTR	Market trends report	Wp	Watt-peak

Context & Key definitions

For more than a decade, the biennial Off-Grid Solar (OGS) Market Trends Report (MTR) has been the anchor of the World Bank Group/GOGLA franchise of market data and trends reports, which are the go-to source of OGS sector information for investors, industry members, policymakers, and other stakeholders. The series includes semi-annual reports that track sales and impact results by country, region, and worldwide for VeraSol Quality-Verified and other branded solar devices sold by GOGLA affiliates.¹ The MTR is where we step back and dive deep into trends in the sector, alongside new research and data, to deepen understanding among market players and illuminate the pathway forward.

¹ VeraSol is an evolution of the World Bank's Group Lighting Global quality verification and assurance program. For more information, please see <https://verasol.org/>

Terms	Definitions
Off-grid solar products	Off-grid solar products include both solar energy kits and off-grid solar appliances and this term is used in the report to describe the breadth of technologies that it covers. See definitions below.
Solar energy kits (SEKs)	<p>These include solar lanterns, multi-light kits and solar home systems (SHS).</p> <ul style="list-style-type: none"> • Solar lanterns are typically packaged as a simple, one-light lantern with one LED light, an embedded 0.5–3.0 Watt-peak (Wp) solar panel, and an internal rechargeable lithium-ion (Li-ion) battery. Some models include USB charging for mobile phones. • Multi-light systems include up to three or four LED lights with a standalone solar panel rated up to 10 Wp and a rechargeable Li-ion battery with most models including USB charging for mobile phones. • Solar home systems (SHS) have a solar panel rated from 11 Wp to usually up to 350 Wp and provide multiple electricity functions, such as lighting and powering a wide range of appliances such as TVs and fans. SHS are offered plug-and-play (PnP) or based on open-market components. In this report, SHS refers to both plug-and-play and component-based systems unless specified.
Off-grid solar appliances	<p>These include solar-powered appliances which are energy-efficient and powered by direct current (DC), and include both household/small business appliances and productive use of energy (PUE) appliances</p> <ul style="list-style-type: none"> • Household and small business appliances are typically used within a home and include televisions, fans, refrigerators and radios. In some cases these products are used in small businesses, such as refrigerators in a shop. Note: a significant majority of solar-powered TVs and a proportion of fans are typically sold bundled with SHS especially in sub-Saharan Africa. • Productive use of energy (PUE) appliances are appliances that leverage solar energy to enable improved or new income generating activities, often in agriculture. These products include solar water pumps, refrigerators/cold rooms or agro-processing equipment.
Access to electricity: The Multi-Tier Framework (MTF)	<p>The MTF, developed by ESMAP, represents an effort to build global, aggregable metrics and a database for evaluating electricity access in a non-binary fashion, measuring the quality of access rather than merely access to any source of electricity. Developed in the context of the Sustainable Energy for All (SE4ALL) initiative, the MTF is being used as a more nuanced measure of progress towards Sustainable Development Goal 7 (SDG7), complementary to the binary methodology captured in the Tracking SDG7 report written by major development stakeholders.</p> <p>The MTF redefines energy access to a multi-dimensional definition as ‘the ability to avail energy that is adequate, available when needed, reliable, of good quality, convenient, affordable, legal, healthy and safe for all required energy services.’ That is, having an electricity connection does not necessarily imply having access to electricity under the new definition, which considers additional aspects, such as reliability and affordability. Energy access is measured on a tiered spectrum, from Tier 0 (no access) to Tier 5 (the highest level of access).</p>
Rural	Encompasses all population, housing, and territory not included within an urban area.
Urban	Encompasses all population, housing, and territory included within an urban area.
Unconnected households	Households that are not connected to national grids.
‘Under the grid’ households	Households that are near to but not connected to national grids. Even where a grid connection is nearby and a connection would be technically realistic, households may choose not to connect because of affordability constraints (either high connection costs to the grid or high tariffs to consume from the grid, or both) and poor reliability of service.

Terms	Definitions
Households with unreliable/weak grid	These households face frequent or lengthy outages of grid electricity or experience voltage fluctuations that can damage electrical appliances.
Households connected to reliable grid	These households rarely or never face outages of grid electricity and do not experience voltage fluctuations that could damage electrical appliances.
Potential market	The overall market of people (households and microenterprises) that either lack access to an electricity connection (off-grid) or have a poor-quality electricity connection (unreliable-grid), forming the total potential customer base for OGS devices. This estimate includes customers that currently use OGS devices, as they represent a continued market for additional sales, replacements, and upgrades.
Addressable market	The share of the potential market that can be addressed by current OGS business models. This report analyzes the affordability of devices against the potential market to arrive at an estimate for the addressable market.
Pay-as-you-go (PAYGo)	PAYGo business models allow users to pay for their products via technology-enabled, embedded consumer financing. A PAYGo company will typically offer a solar product (typically solar home systems and multi-light kits) for which a customer makes a down payment, followed by regular payments for a term ranging from six months to eight years. Payments are usually made via mobile money, though alternative methods include scratch cards, mobile airtime, and cash.
Quality-Verified	‘Quality-Verified’ products meet VeraSol Quality Standards, which implement minimum requirements for off-grid lighting product quality, durability, truth-in-advertising, warranty, and lumen maintenance. VeraSol offers Quality Standards for both solar lanterns and multi-light systems and SHS up to 350 W, and compliance is required to participate in VeraSol support programs. Quality Standards are one component of the VeraSol Quality Assurance Program. The International Electrotechnical Commission (IEC) has adopted the VeraSol testing methods as Technical Specification 62257-9-5. For more information, please visit VeraSol.org
Affiliate	Affiliate companies are connected to any of the partner organizations involved in the semi-annual GOGLA sales data reporting process. This matrix of companies includes GOGLA members, companies selling products that meet VeraSol quality standards, and appliance companies that participated in the Global LEAP Awards or are engaging with the Low Energy Inclusive Appliances (LEIA) program. It is important to note that not all products produced by affiliate companies meet VeraSol quality standards, but stakeholders assume that all products affiliate companies produce are of reasonably decent quality.
Non-affiliate	Companies that are not within the matrix of affiliate companies are considered non-affiliate companies. Products distributed by non-affiliate companies are considered non-affiliate products. These companies do not report their sales to GOGLA, and much less is known about the quality and level of Tier access their products provide.

Headline Trends



The sector has proven more resilient than many people expected when the COVID-19 pandemic erupted

While many companies have struggled in the face of the COVID-19 pandemic, the sector has shown resilience. After a 22% decline in solar energy kit sales in 2020, the OGS sector recorded a 10% increase in sales in 2021, indicating a nascent recovery from the impacts of the pandemic. The annual market for appliances is yet to recover from a sustained 19% decline since 2019.



Solar energy kits remain the most cost-effective solution to electrify hundreds of millions of off-grid homes and businesses, but ability to pay is a continuing challenge

In 2020, 733 million people were still living without access to electricity, of which 298 million people are in nascent OGS markets where there is little commercial OGS activity.

Off-grid solar technologies are the key technology in most regions to advance progress towards SDG7 in the near term. On a trajectory to achieve universal access to electricity by 2030, high-level analysis indicates off-grid solar technologies are expected to be the least-cost solution for 41% of new household connections between 2020 and 2030.

However, the affordability challenge was further exacerbated by declining income levels due to the pandemic. Assuming consumer finance is readily available, between 177 to 277 currently unconnected people are still unable to afford a Tier 1 solar energy kit. In the absence of consumer financing options, such as PAYGo, affordability levels drop even further.



Despite the pressure the pandemic has placed on supply chains and income levels, the number of people gaining electricity access from solar energy kits has continued to grow and has now reached 490 million

The number of people accessing solar energy kits has grown from 420 million people in 2019 to over 490 million people by the end of 2021, with more people gaining higher 'Tier 2' levels of access.

This is a result of continued sales, the longer lifespan of larger products and current customers beginning to move up the 'clean energy staircase'. This is where they have paid off, or made savings from their initial solar energy kit and are able to purchase a new, often larger product and additional service(s).

3.8 million customers have also gained access to solar TVs in 2020 and 2021, which were particularly critical for accessing news, health information and educational programs during COVID-19 lockdowns.



Investments have continued to grow since 2012, reaching over \$2.3 billion cumulatively. The sector is bifurcated into two streams: 7 companies operating at scale that absorb the vast majority of investments, and a large number of companies that are still in their seed and start-up phase

Between 2012 and 2021, the off-grid solar sector has raised \$2.3 billion in capital through debt, equity and grants. From 2016 to 2020, the industry saw yearly investment volumes plateauing between \$300 million and \$350 million, before reaching \$457 million in 2021. This year (2022) is set to be another record breaking year.

The largest share of funding has been assigned to East Africa (49%), as larger, scale-up companies are attracting debt in their most established markets. Companies that are in their seed or start-up phases have attracted significantly less capital.



Stronger focus by governments and development partners on productive use of energy and powering healthcare

Governments, investors and development partners are increasingly recognizing the potential of OGS solutions to power productive use of energy (PUE) appliances and healthcare.

In 2021, \$7.7 million of the total \$10.2 million grant capital invested in the industry was absorbed by PUE companies, while the World Bank, IKEA Foundation, EnDev, GIZ, UK Aid and Power Africa all committed funding to support the electrification of healthcare facilities and/or uptake of PUE appliances.



There have been rapid advancements in the maturity of productive use technologies

Solar water pumps (SWPs) and solar cooling, seen as ‘emerging’ technologies two years ago, are now classified as ‘near-to-market’. SWPs on the market today are more efficient, affordable, and impactful - they now typically feature brushless direct current motors, PAYGo capabilities (with firmware and GSM-enabled), and are IoT-enabled for enhanced monitoring, controls, and provision of information to the user.

Solar cooling is considered ‘near-to-market’ following intensive research and development efforts due to the increased demand for vaccine storage and high potential for productive use. Attention has focused on the potential to reduce food loss and waste in various agricultural value chains. Recent innovations in fridge insulation, efficient compressors, and better controllers are driving down costs, and improving efficiency and durability.

Solar irrigation and cooling systems are proving to be a key resource for rural communities. They are contributing to increased crop yields and preserving produce.



OGS products help achieve a faster and just clean energy transition

700 million climate-vulnerable people live without electricity access, yet have also contributed the least to climate change. Off-grid solar solutions provide a fast and affordable way to provide basic electricity access from clean energy sources while rapidly reducing CO₂e and building the adaptive capacity and resilience of climate-vulnerable people.

Replacing kerosene lanterns with solar lighting has already avoided an estimated 190 million tonnes of CO₂e, equivalent to taking 51 coal-fired power plants offline for a year, while replacing diesel generators also has clear emissions reduction benefits. Recent research conservatively estimates that diesel generators used to provide grid back-up emit more than 100 megatons of CO₂ every year. In sub-Saharan Africa alone, replacing these generators with solar alternatives would avoid as much CO₂ as 20% of the region's vehicles being replaced with clean alternatives.

Off-grid solar solutions also build the adaptive capacity and resilience of climate-vulnerable people. Contributors include better water supply, cooling and food security, improvements to health and health infrastructure, greater communications and connectivity, and increased savings and income.



There is growing recognition that more public funding will be needed to reach remote and lower income customers, and to bridge affordability gaps

Over \$211 million of public funding has been disbursed or is currently disbursing to the sector through Results-Based Financing since 2013, and more than \$100 million came on stream in 2020 alone.

Whilst supply-side subsidies have been used as a tool to drive the uptake of OGS for a number of years, a better understanding of the growing affordability gap has also led to increasing interest in and recognition for the need of end-user subsidies.



While rural homes and businesses make up the clear majority of OGS customers, the COVID-19 pandemic has accelerated a trend for companies to additionally service urban and weak grid markets

The majority of solar kit customers are rural, male and living under the poverty line of \$3.10. However, an estimated 775 million people are connected to weak grids, undermining the potential social and economic development of access to electricity.

New technology segments are emerging that integrate distributed solar and storage with weak grid to dramatically improve the quality and affordability of electricity access. The COVID-19 pandemic has accelerated a trend for some companies to service urban and weak grid markets, with these customers often buying larger solar kits and appliances.



‘PAYGo everything’ is here

The PAYGo technology that unlocked consumer financing for solar energy kits can be used with virtually any electronic device and is now being leveraged to offer consumer finance on smartphones, electric motorbikes, and many other devices, as well as offer digital financial services.

Companies are now also commonly ‘cross-selling’ their existing customers' new products and services, using their own PAYGo data on customer payments and energy usage to help them move up the ‘clean energy staircase’ and/or to access ‘beyond energy’ products.



The Global Electrification Opportunity and Challenge

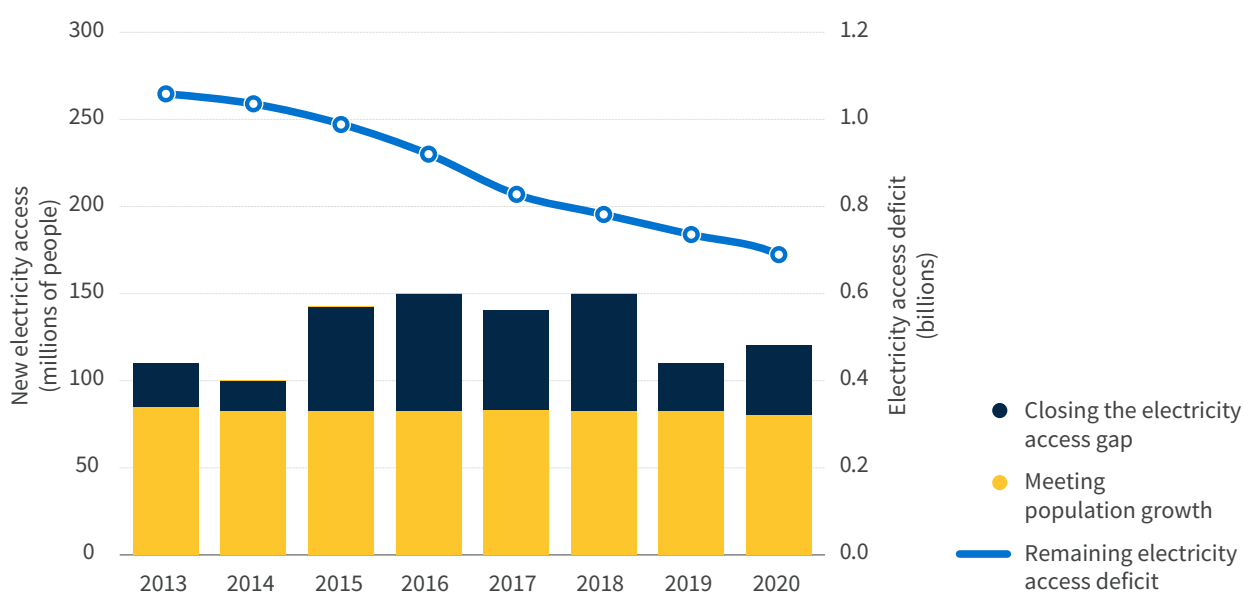


Off-grid solar is estimated to be the most cost-effective, feasible solution to electrify 55% of currently unconnected households in the next five years.

In 2020, 733 million people were still living without access to electricity, of which over 80% were in rural areas.^{2,3} While this number has steadily fallen over the past decade (Figure 1), the current rate of progress would still take at least 17 years to reach everyone with Tier 1⁴, clean and modern electricity.

Sub-Saharan Africa (SSA) accounts for 77% of the current electricity access gap.⁵ As shown in Figure 2, most countries in SSA still have an electricity access gap of at least two million people, with Nigeria (90 million), the Democratic Republic of Congo (DRC) (72 million), and Ethiopia (56 million) accounting for 30% of those without electricity access.

Figure 1: Tracking the electricity access gap over time⁶



2 For consistency with the SDG7 tracking reports we report the same electricity access figures here which represent either: [1] where surveys based on the Multi-Tier Framework have been conducted, access to electricity service from Tier 1 to Tier 5 is considered; [2] elsewhere, electricity access is calculated by a binary measure of 'connected' or 'not connected' derived from existing household surveys, such as the DHS and LSMS.

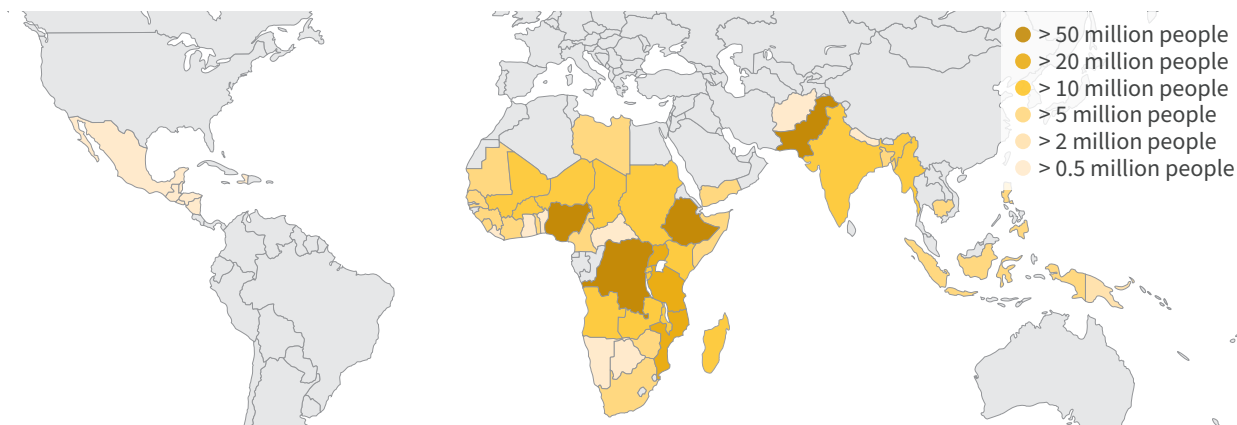
3 In each of the last three editions of the SDG7 Tracking estimates the share of the electricity gap in rural areas has been stable at around 84%.

4 The Tiers of energy access are described in the Multi-Tier Framework (MTF), developed by ESMAP. The MTF represents an effort to build global, aggregable metrics and a database for evaluating electricity access. Energy access is measured on a tiered spectrum, from Tier 0 (no access) to Tier 5 (the highest level of access).

5 Ibid.

6 Open Capital Advisors analysis of SDG7 tracking data.

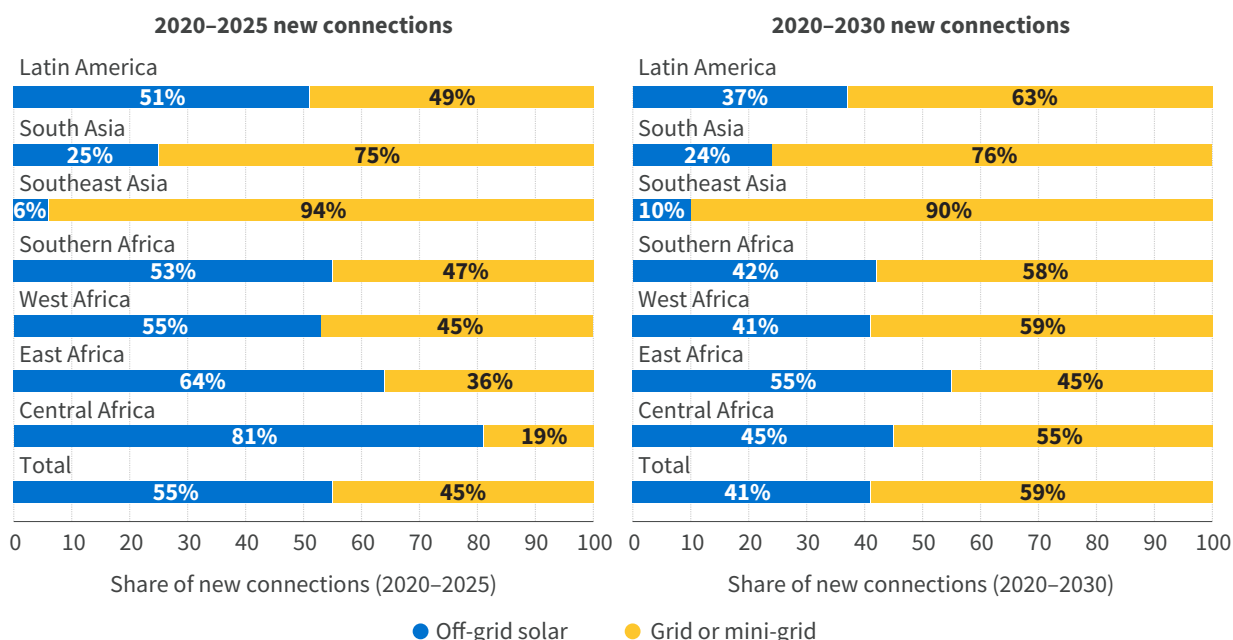
Figure 2: Electricity access deficit by country⁷



Off-grid solar (OGS) technologies are expected to be the dominant technology to unlock progress towards SDG7 in most regions in the near term, and will continue to play an important role in the medium term. On a trajectory to achieve universal access to electricity by 2030, OGS technologies are estimated to be the most cost effective and feasible solution for 55% of new household connections in the next five years (estimates from 2020 to 2025)⁸, as shown in the left panel of Figure 3, given that OGS technologies are able to expand faster than the main

grid and mini-grids in the short term. By 2030, the share of mini-grid and grid connections is expected to increase, but OGS is still expected to account for 41% of all connections realized, based on geospatial least-cost modeling of universal energy access scenarios. The ultimate share of grid, mini-grid and OGS technologies in the electrification mix of 2030, however, will depend not only on the least-cost pathway but also on the pace at which each technology is able to expand.

Figure 3: Estimated role of off-grid solar in least cost electrification⁹



⁷ Open Capital Advisors analysis of SDG7 tracking data and UN Population Division data.

⁸ Estimate based on analysis of the Global Electrification Platform, 'Low Demand' scenarios.

⁹ Open Capital Advisors analysis of results from the Global Electrification Platform, 'Low Demand' Scenario.



Affordability is the key constraint to closing the electricity access gap.

Despite the fact that solar energy kits¹⁰ (SEKs) are the least cost way to electrify hundreds of millions of households, the ability to pay for SEKs remains a real challenge. Assuming that the unelectrified population is concentrated in the poorest strata of the population, and with end-user finance such as pay-as-you-go (PAYGo) available, affordability analysis estimates that 456 million of the currently 733 million unserved people would be able to afford a Tier 1 solar energy kit. If customers are facing the full cash price upfront, this number drops to only 3 million people. This indicates that end-user financing is essential to provide the poorest population with Tier 1 energy access, but that PAYGo is not sufficient to close the affordability gap.¹¹

Note that if we assume that the currently unconnected households are evenly distributed across all income strata, the number of people that can afford a Tier 1 SEK on PAYGo increases from 456 million to 556 million. On a cash basis, the number increases from 3 million to 167 million people.

However, it is unlikely that end-user finance will be able to be deployed for all households, especially given that many live in fragile and conflict affected states. Affordability may also be more limited than previously thought, as the ability to pay among the poorest communities may be lower than estimated and could worsen. As a result of the COVID-19 pandemic, per capita income has declined in many countries; for 40% of emerging market and developing economies it is not expected to return to pre-pandemic levels for several years.¹²

The pandemic has also resulted in job losses and deprivation in already vulnerable communities (largely rural and agricultural); overall it is estimated that COVID-19 pushed 100 million people into extreme poverty in 2020 alone.¹³ The global fuel and food security crisis caused by the war between Russia and Ukraine, as well as rapidly rising inflation, will lead to continued financial pressure on low income households. The World Bank expects this will push millions more people into poverty and tip countries into a debt crisis¹⁴, especially as countries have already stretched central resources and fiscal mechanisms to respond to the pandemic.



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10 Solar energy kits include solar lanterns, multi-light systems and solar home systems.

11 Please see the full report for the Affordability analysis methodology.

12 World Bank Group (2022), *World Economic Prospects*.

13 World Bank Group (2020), *Poverty and Shared Prosperity 2020: Reversals of Fortune*.

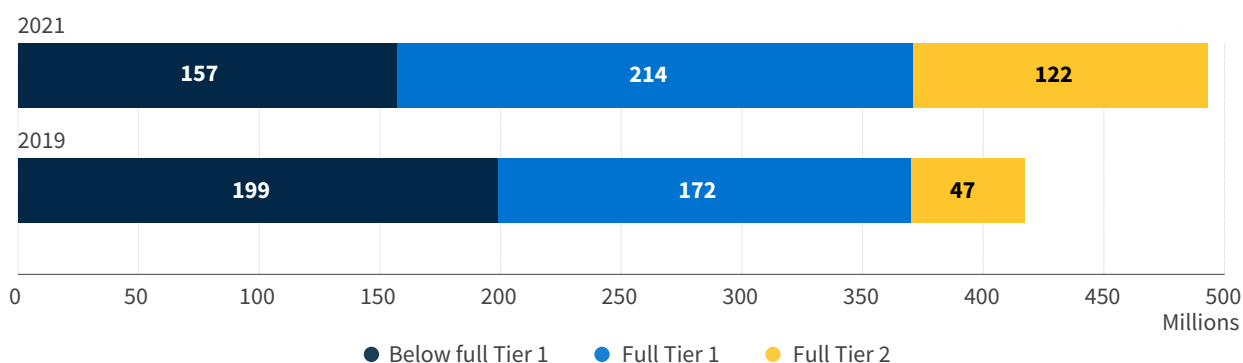
14 *Ibid.*

The Impact of Off-Grid Solar

Despite the challenges listed above, the number of people accessing solar energy kits (SEKs) has grown from 420 million people in 2019 to 490 million people by the end of 2021, with more people gaining higher 'Tier 2' levels of access (Figure 4). This is a result of ongoing sales,

longer lifespan of larger products, and current customers beginning to move up the clean energy staircase.¹⁵ In many cases, customers move up the clean energy staircase when they have paid off, or made savings from their initial SEK and are able to purchase new, often larger products or additional services. 3.8 million customers¹⁶ have also gained access to solar TVs in 2020 and 2021, which were particularly critical for accessing news, health information and educational programs during COVID-19 lockdowns.

Figure 4: People benefiting from access to electricity through solar energy kits (millions)¹⁷



SEKs provide the primary source of lighting for millions of rural households and provide both backup and first-time access in urban centers. Households which rely on solar for their primary lighting are predominantly rural. However, urban sales of SEKs are often assumed to provide grid backup, yet the data shows that many urban households use them for primary access.¹⁸ Amongst these, Uganda, Rwanda and Liberia, see SEKs more commonly used to provide urban households with first-time access than to provide backup power.¹⁹



In addition to SDG7 - access to affordable, reliable, sustainable and modern energy - the off-grid solar sector is demonstrating benefits that will help achieve a faster and more just clean energy transition.

While the industry has not yet developed a standard framework to fully capture and monitor its contribution to climate adaptation and resilience, there is increasing recognition of the role that OGS can play in addition to improving electricity access. Off-grid systems enable people, businesses and communities to absorb and recover from climate shocks and help them to adjust to and anticipate changes. OGS provide positive adaptation opportunities in terms of green jobs and solar-powered enterprise, increase the availability of water and food as climate change increases insecurity, and create clean energy communications infrastructure. They also boost resilience by creating savings and new revenue streams, strengthening energy systems and enhancing health and health infrastructure.

OGS also has significant mitigation benefits. For example, replacing kerosene lanterns with solar lighting has already avoided an estimated 190 million tonnes of CO₂e, equivalent to taking 51 coal-fired power plants

¹⁵ GOGLA consultations.

¹⁶ GOGLA and Open Capital Advisors analysis (2022), using the Off-Grid Solar Standardized Impact Metrics.

¹⁷ GOGLA and Open Capital Advisors analysis, using the Off-Grid Solar Standardized Impact Metrics. Please note that the adjustment in overall electricity access figures and Tier allocation between the Market Trends Report 2020 and 2022 is a result of a methodological update following additional research and insights

¹⁸ World Bank/ESMAP analysis of the Multi-Tier Framework Country-level Surveys. For more information, please see <https://mtfenergyaccess.esmap.org>

¹⁹ Ibid.

offline for a year^{20,21} while replacing diesel generators also has clear emissions reduction benefits. Recent research conservatively estimates that generators used to provide grid backup emit more than 100 megatons of CO2 every

year.²² In sub-Saharan Africa, replacing generators with solar alternatives avoids as much CO2 as 20% of the region's vehicles being replaced with clean alternatives.²³



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20 GOGLA and Open Capital Advisors analysis, using the Off-Grid Solar Standardized Impact Metrics.

21 [United States Environmental Protection Agency \(2022\), Greenhouse Gas Equivalencies Calculator.](#)

22 [International Finance Corporation \(2019\), The Dirty Footprint of the Broken Grid.](#)

23 *Ibid*

Global Off-Grid Solar Market Turnover and Product Sales Volumes



Following strong pre-pandemic growth, global sales of both solar energy kits and off-grid solar appliances declined.

Even though the number of people accessing off-grid solar products between 2019 and 2021 has grown from 420 to over 490 million, the pandemic resulted in slow-down in sales growth and an estimated 128 million people and 3.1 million businesses have missed out on access to solar energy kits in the last two years.²⁴

Global sales for solar energy kits - including solar lanterns, multi-light systems and solar home systems (SHS) - declined 22% in 2020 compared to 2019, largely due to the COVID-19 pandemic, but recovered by 10% from 2020 to 2021. This was mainly due to a strong recovery in sales of solar lanterns and multi-light systems sales (Figure 5). Please note: global sales include both affiliate and non-affiliate products (see Box 1).

Global sales of solar lanterns and multi-light systems declined by about 22% between 2019 and 2020 due to a decrease in cash sales, before increasing by 13% between 2020 and 2021. Global SHS unit sales also declined from 2019 to 2020 (21%), but have yet to fully recover to pre-pandemic levels, with unit sales increasing only 7% between 2020 and 2021.

The relative importance of key regional and country markets for affiliates has shifted. Solar energy kit affiliate sales reveal slowdowns in South Asia and mature East African markets, but growth in several West and Central African markets. Cash and PAYGo affiliate sales volumes showcase that sales across all product categories fell initially during the pandemic, but that PAYGo was more resilient and has already returned to growth.

Box 1: 'Affiliate' and 'non-affiliate' products

This report distinguishes between 'affiliate' and 'non-affiliate' products.

- Affiliate products are sold by companies that are connected to any of the partner organizations involved in the semi-annual GOGLA sales data collection and which share their sales data. This includes GOGLA members, companies selling products that meet VeraSol quality standards²⁵, and appliance companies that participated in the Global LEAP Awards or are engaging with the Low Energy Inclusive Appliances (LEIA) program.
- Non-affiliate products are sold by companies that are not within the matrix of companies distributing affiliate products listed above and often include mainly component-based systems as well as plug-and-play systems. These companies selling non-affiliate products do not participate in the GOGLA sales data collection process, and generally much less is known about the quality and level of Tier access their products provide.

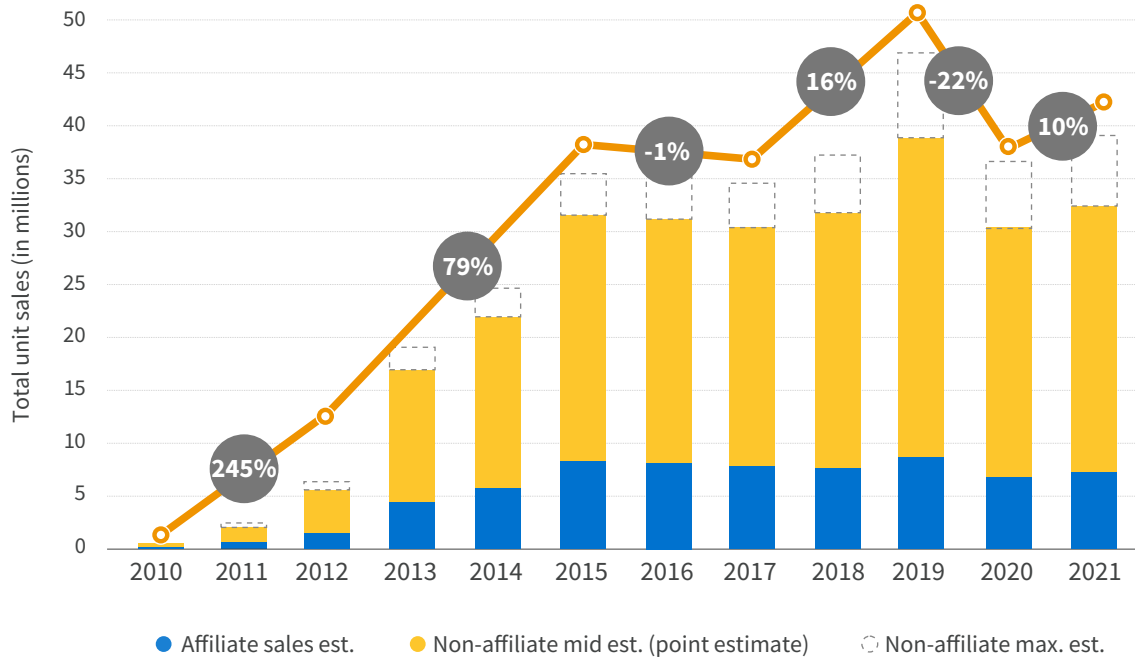
Based on 2022 estimates, non-affiliate products are still estimated to account for 72.1% of annual off-grid solar energy kits products sold on the market, compared to 71.5% in 2020.²⁶ Regarding market turnover, non-affiliates account for an estimated 62% of the total, driven by cash sales of solar lanterns and multi-light system solar products. Please see the full report for the methodology for estimating global OGS market value and sales volumes.

24 GOGLA and Open Capital Advisors analysis using the Off-Grid Solar Standardized Impact Metrics.

25 Launched in 2020, VeraSol is an evolution of the IFC/World Bank Lighting Global quality verification and assurance program. For more information, please see: <https://verasol.org/>

26 World Bank, IFC, GOGLA (2020), *Off-Grid Solar Market Trends Report 2020*; Notes: This is based on analysis of multiple sources of data and information, including: [1] MTF household survey data (11 countries), from which we estimate the total live products (solar lanterns, multi-light systems and SHS) per target country based on data on solar panel wattage; [2] GOGLA annual sales data and semi-annual sales and impact data reports; [3] Country assessments published by Lighting Global, Ipsos, and other organizations; and [4] Industry interviews and other secondary sources.

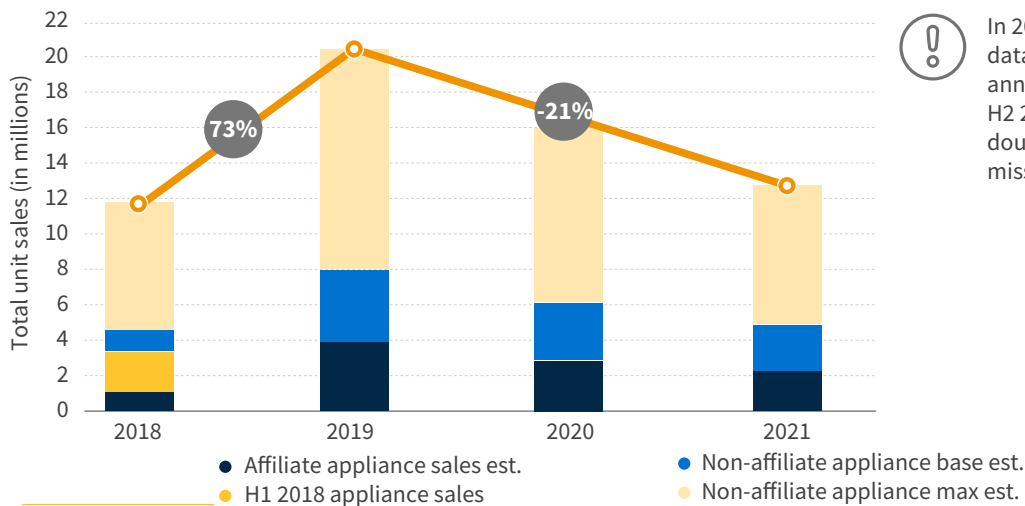
Figure 5: Global annual sales estimates of solar energy kits, including affiliate and non-affiliate sales (2010-2021)²⁷



Annual unit sales of off-grid appliances - including TVs, fans, solar water pumps and fridges - declined 21% from 2019 to 2021, falling from 8 million units to 5 million units sold in each year respectively (Figure 6). Pre-pandemic, this segment posted an estimated 73% year-on-year sales growth between 2018 and 2019, driven by sales of household appliances such as TVs and fans (note: affiliates

data collection for PUE appliances only began in 2018 and it is estimated that affiliate sales data in that year was significantly under-reported, potentially explaining the significant increase in market turnover between 2018 and 2019). Since 2020, aggregate sales of off-grid solar appliances have declined by 21% per year as effects of the pandemic impacted the sector.²⁸

Figure 6: Estimated appliance annual sales volumes (2018-2021)²⁹



In 2018, only H2 affiliate data was available; to annualize 2018 estimates, H2 2018 sales data was doubled to account for missing H1 2018 data

27 Open Capital Advisors analysis.

28 Note: Due to significant data limitations, global appliance sales trends mainly reflect sales trends in the affiliate market.

29 Note: Affiliates data collection for off-grid appliances only began in 2018 and it is estimated that affiliate sales data in that year was significantly under-reported (and only included H2 2018 sales estimates) an issue that has persisted in subsequent years; CLASP estimates less than 40% of affiliate companies reached out share their sales data. Additionally, due to significant data limitations, we have built off assumptions of affiliate vs. non-affiliate market proportions used in the 2019 State of the Off-Grid Appliance Market report which analyzed global trends in the off-grid appliance sector and estimated affiliate sales account for between 20% and 50% of total appliance market sales and hence assumed non-affiliates account for between 50% (base scenario) and 80% (maximum scenario) of total appliance market sales.



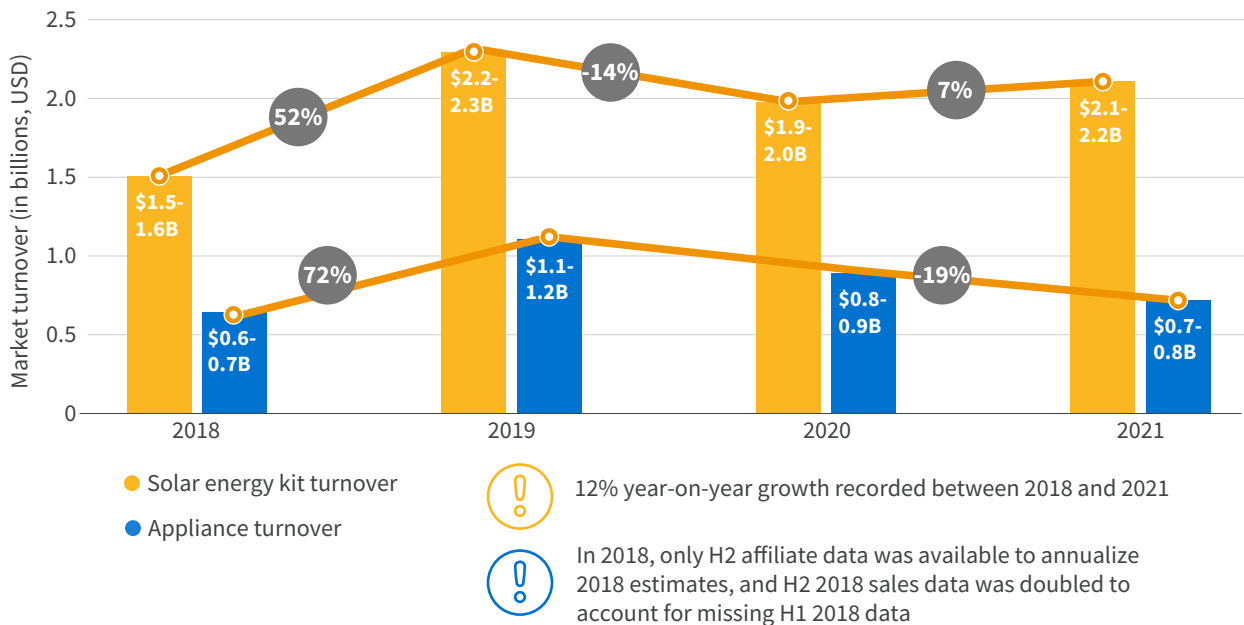
The total off-grid solar market is valued at an estimated \$2.8 billion annually (2021).

The solar energy kits market is estimated at \$2.1 billion annually, of which an estimated 4% consists of off-grid household appliances (TVs and fans) that are typically sold bundled with solar home systems (SHS) (Figure 7).³⁰ As mentioned above, sales volumes have rebounded since

2020, but not yet to 2019 levels, and the faster rebound of the lower cost solar lanterns and multi-light systems compared to higher cost SHS resulted in a 7% increase in market value for solar energy kits, compared to the 10% increase in volumes. In particular, cash sales for SHS remain depressed, negatively impacting market value.

The off-grid appliance market for TVs, fans, solar water pumps and refrigeration units not sold bundled with SHS is estimated at \$0.7 billion annually (Figure 7).³¹ Overall, year-on-year appliance market turnover declined 19% between 2019 and 2021, attributed largely to the COVID-19 pandemic and specific declines in appliance cash sales.

Figure 7: Estimated solar energy kit and appliance annual market turnover (2018-2021)³²



30 Note: An estimated 83% of solar-powered TVs and 17% of fans affiliate sales in sub-Saharan Africa are bundled with solar home systems. Given lack of sufficient data on non-affiliates, we are conservatively estimating the non-affiliate appliance market segment consists mainly of sales of component-based systems i.e. no overlap between appliance sales and off-grid solar energy kit sales.

31 Note: Off-grid appliance market data is extremely limited compared to the off-grid solar energy kit product category. The main sources of information used consisted of published reports available online including CLASP, VeraSol, GOGLA, internal firm knowledge as well as consultations. Key stakeholders approached for these consultations include appliance manufacturers and distributors based in key countries in sub-Saharan Africa and Southeast Asia. The analysis and insights included in this report thus reflects our understanding of key trends based on data available as at the time of writing.

32 Note: SEK sales volumes declined by 22% (2019-2020) then increased 10% (2020-2021) although this recovery is yet to bring total sales to pre-pandemic (2019) levels. More specifically, solar lanterns and multi-light system sales declined 22% (2019-2022), then increased 13% ('20-21) while SHS sales declined 21% then increased by 7% over the same period. In aggregate these solar lanterns and multi-light systems and SHS changes then contributed to combined changes in SEK sales volume and turnover i.e. even while SHS only increased by 7% (2020-2021) the higher increase from solar lanterns and multi-light systems (13%) raised the overall SEK growth to 10% over the same period.

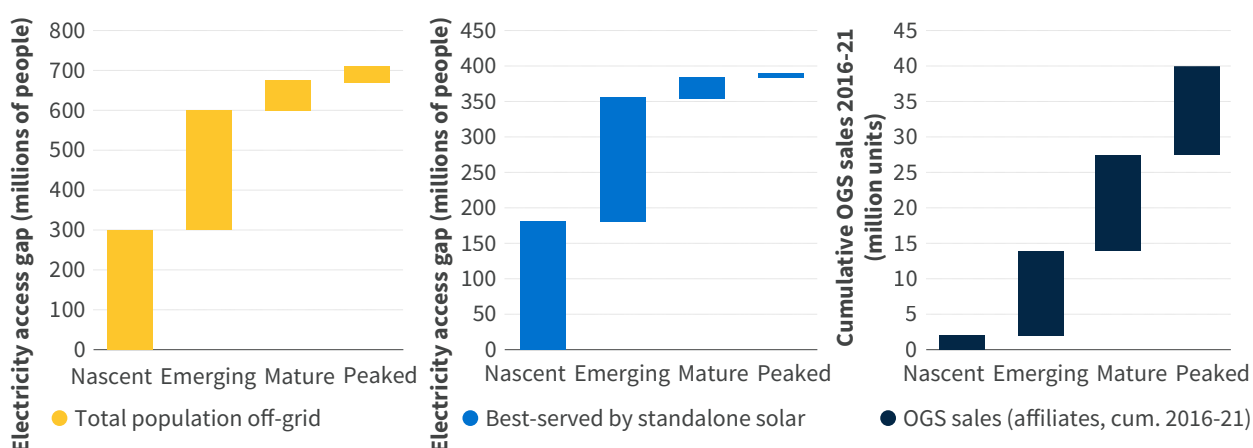
Market Landscape

OGS technologies have already made a very significant contribution to closing the electricity gap in relatively mature markets. Figure 8, shows affiliates have sold over 10 million units since 2016 in each of the emerging, mature, and peaked categories.



Most off-grid solar sales are into relatively mature markets, while much of the remaining need is concentrated in markets where the off-grid solar sector is nascent or still emerging.

Figure 8: Electricity access deficit and OGS sales by market type³³



However, penetration of OGS technologies is lagging in nascent markets, where the need is greatest. Just two million affiliate unit sales have reached nascent markets since 2016, representing 5% of total affiliate sales. Yet, around 298 million people (accounting for 41% of the remaining electricity access gap) still lack access to electricity in these countries, and most (61%) would be best served by OGS technologies.³⁴ Public finance, including subsidies, will have a key role to play in accelerating access while catalyzing commercially sustainable markets in contexts which are often highly fragile and conflict affected, with low ability to pay, and limited infrastructure to reach rural communities (see next section: Funding Flows).

Emerging OGS markets are characterized by both high penetration of sales and a large remaining electricity access gap. Since 2016, around 12 million affiliate units

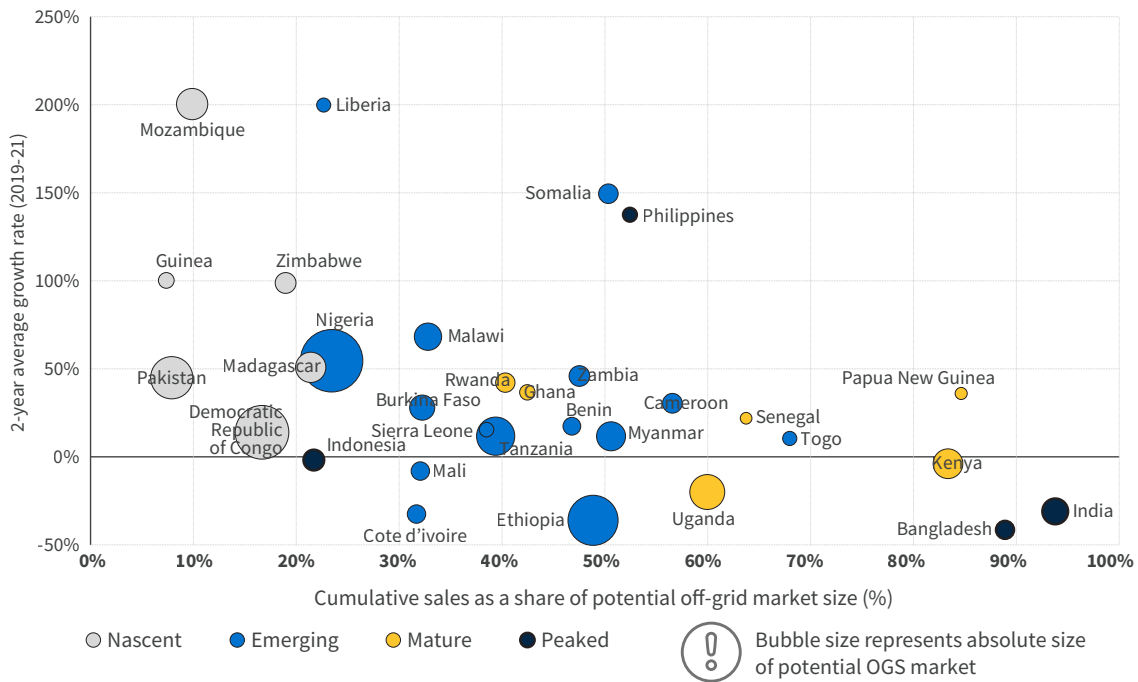
have been sold in these markets (30% of the total), but over 300 million people still lack access to electricity, of which 58% would be best served by OGS technologies.

In mature and peaked markets the electricity access gap is narrowing and OGS is playing a key role in making sure no one is left behind. The electricity access gap even in these mature markets remains over 5%, and those communities currently without access to electricity will often be those that are either extremely poor and/or remote, conflict affected, and expensive to reach. Their communities are not commonly served by commercial OGS market activity and will need support from public subsidies. Across mature and peaked markets more than 100 million people still lack access to electricity. Around 34 million would best be reached by standalone solar technologies.

³³ Analysis of SDG7 tracking data, population data from UN Population Division, least-cost electrification pathways from the Global Electrification Platform for new connections between 2020-25 (low demand scenario), GOGLA sales data, and a mapping of national markets to each classification.

³⁴ The share of population best served by OGS is based on analysis of the Global Electrification Platform, 'Low Demand' scenario between 2020 and 2025. Affiliate sales are based on data reported to GOGLA, while the population without access to electricity is based on SDG7 tracking data.

Figure 9: Market classification³⁵



While productive use of energy technologies are still at an early stage of market development, they tend to follow established off-grid solar markets. For example, the emerging solar water pump (SWP) markets are all in relatively mature (including peaked) off-grid solar markets. Kenya, Senegal, Uganda, Bangladesh all have recorded SWP sales from affiliate companies, while India has also deployed tens of thousands of SWPs. Togo is also rolling out SWPs supported by public subsidies. In general, emerging markets for SWPs appear to have both relatively developed SHS ecosystems, and support from public funding. This seems to suggest that specific PUE technologies may be following markets which have previously developed supporting policy and regulatory environments for solar energy kits, and where how to unlock demand for productive use of solar energy products is better understood.



35 Notes: [1] 2-year growth rate is an average of the last two year on year growth rates, calculated from GOGLA half-yearly market reports, [2] Cumulative sales as a share of off-grid market size is estimated based on the cumulative sales since the beginning of 2016 of both GOGLA-affiliate and non-affiliate sales, divided by the total sales PLUS the remaining electricity access gap as reported in the SDG7 tracking reports, [3] Bubble sizes are based on the absolute market size of the remaining electricity access gap, as reported in the SDG7 tracking reports, [4] Sales growth is capped both at the top and the tail at 200% and -50% respectively for display purposes only. So some countries appearing at 200% may have had a higher growth rate than 200%, and some appearing at -50% may have shrunk by more than 50%, [5] Counties included in this classification exclude those with high levels of energy access and/or where there is no previous record of OGS sales - this comprises around 710 million people of the total global electricity access gap of 733 million people.

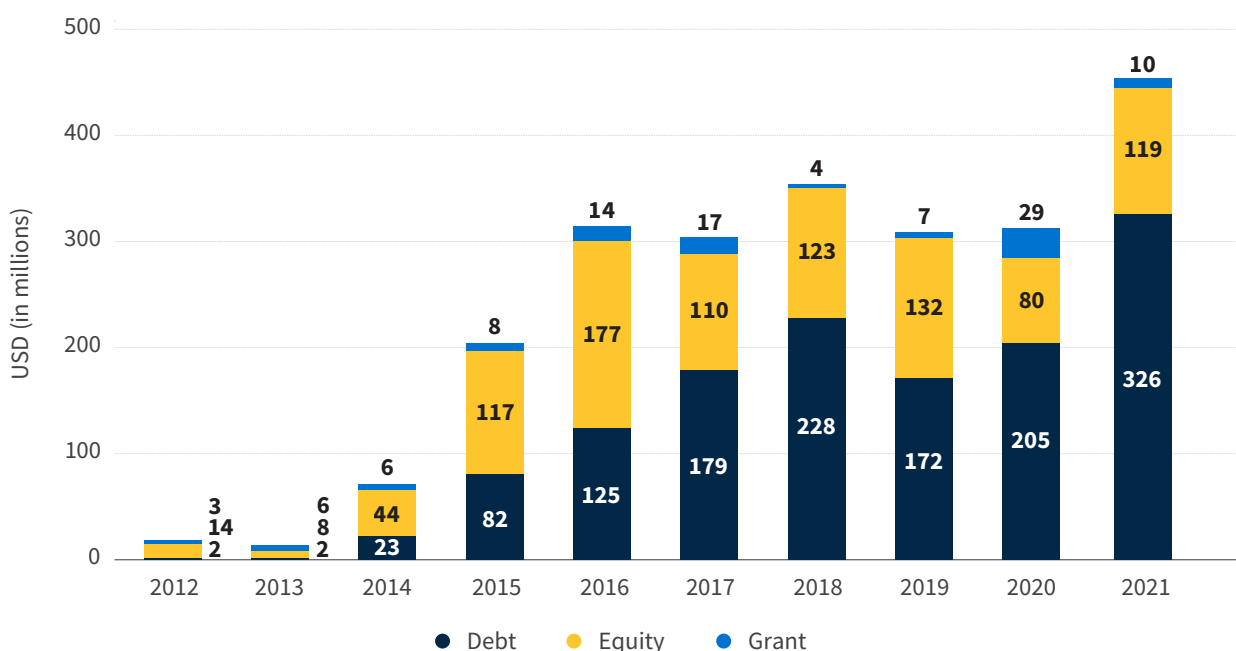
Funding Flows



In 2021, the off-grid solar sector surpassed \$2 billion in total financing commitments since 2012 (equity, debt and grant). Investment volumes grew by 44% from 2020 to 2021, a strong return to growth after five years of flat annual investments.

From 2012 to 2021, the off-grid solar sector raised \$2.3 billion in external capital in debt, equity, and grants according to the GOGLA Investment Database.³⁶ From 2016 to 2020, the industry saw yearly investment volumes plateauing between \$300 million and \$350 million, before reaching \$457 million in 2021, mainly driven by debt financing raised by industry's largest companies (Figure 10). Productive use of energy (PUE) companies attracted almost 10% of the total investment volume in 2021 (\$44.9 million). Although not tracked in the investments database yet, 2022 is set to be another record year in terms of investment volumes.

Figure 10: Investment amount by investment type



The increased investment showcases that despite a slow-down in sales, investors continue to see the potential and impact of the OGS industry. This is underlined by results from the GOGLA Investor Survey. In mid 2020, the early days of the pandemic, only 13% of investors stated that their off-grid solar portfolio was underperforming compared to their financial expectations. When asked the same question in 2021, the result was 28%. Investors expect this trend to be short-term, and remain bullish in their financial expectations for 2022, claiming that

performance of their off-grid solar portfolio assets will realign with their expectations in the year. Only 5% advised that they expect their portfolio to underperform.

In addition, investors with current exposure in the industry remain committed to the sector: 86% of investors surveyed in 2021 expect to either increase or maintain their exposure in the industry in 2022. This is a result of their long-term strategic interest in the industry, an understanding of the difficult market conditions and

³⁶ The GOGLA Investments Database was launched in 2017 to showcase investment trends in the off-grid solar industry. The database contains equity, debt and grant commitments reaching companies since 2012 and is updated every 12 months using information shared by industry respondents in interviews, and/or publicly announced deals in press releases, news reports and research reports.

the more positive picture seen around performance in the industry as a whole. Investors remain optimistic about the sector's impact and 90% of investors cite this as a key reason they plan to maintain or increase their investment exposure going forward.



The 7 companies in scale-up phase are solidifying their market position through their ability to attract capital, diversification of their investor base, and access to increasingly higher ticket sizes.

OGS companies are bifurcating into two streams: players that are attracting the biggest share of the funding, described as scale-ups, and companies that are in their seed or start-up stages that have attracted significantly less capital. GOGLA Investments Database tracked 7 companies in the scale-up phase (attracting over \$100 million each), and over 150 companies that are in their seed or start-up phase (attracting up to \$100 million).³⁷ 72% of current industry investment has been directed to the 7 scale-ups, with the remaining 26% directed to the other 150 companies in the database.³⁸

In the last two years, the 7 companies in their scale-up phase have expanded their consumer portfolio in established markets through large debt transactions. These companies have been able to access innovative debt financing structures, such as Special Purpose Vehicles (SPVs), which provide off-grid solar companies with flexible capital to finance continued growth and allow companies to focus on operations rather than financing. The most prominent case of this type of financing in the last two years was led by d.light, with over \$127 million raised via an off-balance sheet financing vehicle in local currency that is dedicated to acquiring PAYGo accounts receivables from d.light's Kenya subsidiary.³⁹ In 2022, d.light announced a \$238 million expansion of this vehicle, with multi-currency

financing over a two-year commitment period to expand to other African countries.⁴⁰



Investment volumes in start-up companies were negatively affected by the pandemic, slowing their growth.

COVID-19 has negatively affected the volume of investments in start-up companies. In 2020, the volume of debt towards start-up companies decreased, substituted by larger volumes of equity and dominated by convertible debt deals, that translated into larger equity raises in 2021. In 2021, levels of debt bounced back, but have not yet reached pre-pandemic levels.

The number of companies accessing equity in the last two years has remained relatively constant (Figure 11). Nevertheless, the pace of growth is behind the amount required to accomplish universal electrification. In 2018, a Shell Foundation study estimated that to achieve SDG7 electricity access goals, around 300 OGS companies raising significant equity and operating in both emerging and mature markets would be needed.⁴¹ Growth-stage companies report that accessing equity capital has been challenging, resulting in some being over leveraged, and others facing business difficulties.

Lack of early stage equity has resulted in the stifled growth of many companies. This is a barrier to the expansion of off-grid solar in new markets; as equity, grants, or output based incentives, such as results based financing, are generally best placed instruments for market expansion. However, the renewed confidence from investors in the 7 scale-ups could yield positive effects for start-up and growth-stage companies. Early stage capital could be released via secondary sales proving that the industry is viable and is poised for growth in multiple markets.

37 The 7 scale-ups include Bboxx, d.light, Engie Energy Access, Sun King, Lumos, M-KOPA and ZOLA.

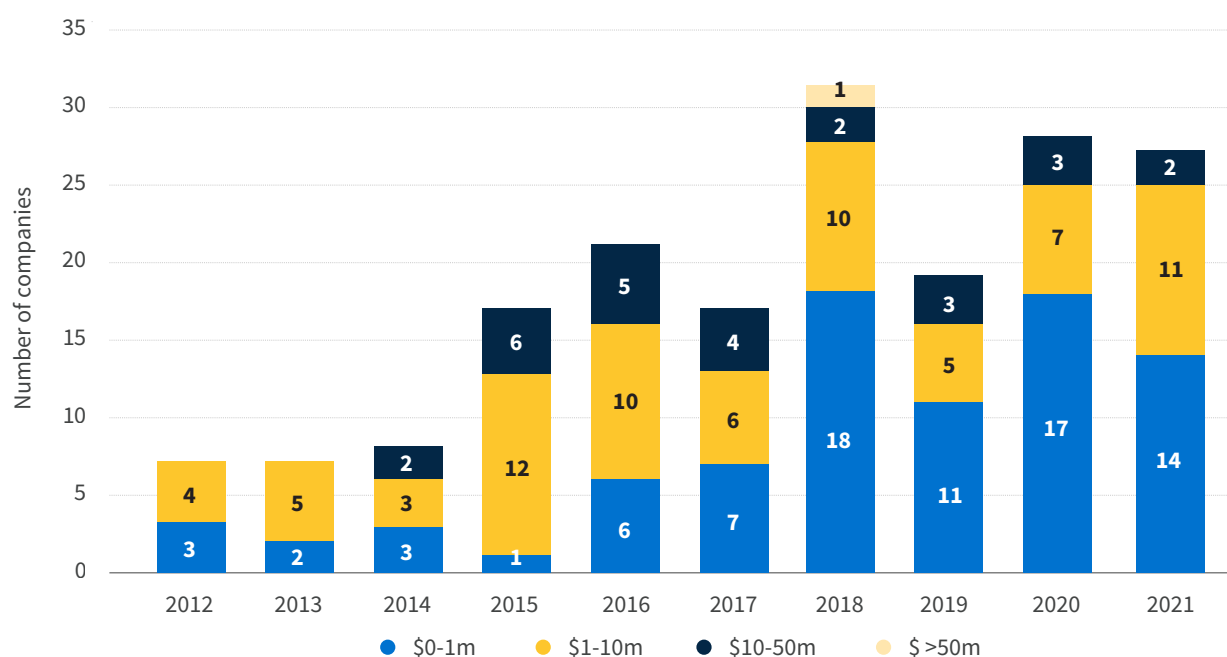
38 The remaining 2% could not be assigned to companies due to confidentiality.

39 [Norfund \(2021\), Press Release BLK-1.](#)

40 The 2022 expansion is not included in the Investment Database yet.

41 [Shell Foundation \(2018\), Achieving SDG7: The Need to Disrupt Off-grid Electricity In Africa.](#)

Figure 11: Number of companies receiving equity per year (per ticket size)



Only start-up and seed companies received grant capital in 2021, illustrating that grant makers are shifting their attention away from companies in their scale-up phase.⁴² The recipients of grant financing were largely local and PUE companies. Out of \$10.2 million grant capital provided in 2021, \$7.7 million was assigned to PUE and almost half of the capital was dedicated to locally-owned and managed companies.



Development Finance Institution (DFI) investments and bilateral donors continue to be critical for the sector, through both direct investments, syndications and investments made through funds.

DFIs, bilateral and multilateral donors have maintained their commitment and exposure to the sector through multiple investment channels and via the creation of new

funds.⁴³ An example is the Energy Entrepreneurs Growth Fund (EEGF), which began disbursing equity or capital to venture-stage companies in 2021. The EEGF was created by Shell Foundation, co-funded by UK Aid, and the Dutch Entrepreneurial Development Bank (FMO) and is managed by Triple Jump.⁴⁴ The fund completed its first investments in 2021 to Yellow and Baobab+. Other examples include the Africa Go Green Fund backed by KfW and SunFunder's SET fund backed by DFC.

DFIs have also continued lending directly to companies. This is mainly through debt, but also through equity investments such as the \$10 million investment made from Norfund to Baobab+ in 2021, the \$10 million raised by d.light from PROPARCO, and Simusolar's \$1.5 million convertible debt raise from ElectriFi.^{45,46,47}

Another role that DFIs and bilaterals have undertaken has been to provide risk guarantees, which are vital for leveraging more sector investments. Guarantees provided to the sector take different forms: MIGA provided guarantees to sector funds that invested in Bboxx to address political and currency convertibility risks, while SIDA provided guarantees to help launch and catalyze investments in industry funds such as the SET Fund by

42 Note: Grant capital excludes results based financing schemes.

43 The GOGLA Investments Database tracks lead investors. In 2021, DFIs supported several commercial deals but not with majority stakes.

44 Shell Foundation (2021), [Energy Entrepreneurs Growth Fund Announces three new Investments in African Energy Access](#).

45 Norfund (2021), [New Investment Aims to Equip One Million Households with Solar and Digital Products](#).

46 Proparco (2021), [Proparco Supports d.light: A Global Leader in Solar Energy](#).

47 ElectriFi (2021), [Simusolar Secures \\$1,5 Million Convertible Note from EDFI](#).

Sunfunder.^{48,49} The European Commission also approved a guarantee for TCX to reduce the costs of hedging in 2021.⁵⁰



The challenge of reaching the poorest has led to greater focus on funding via results-based financing and an emerging interest in end-user subsidy schemes.

Interest in using results-based finance (RBF) schemes to reach consumers and scale markets continued to grow. Of \$211 million that has been disbursed or is currently disbursing to the sector through RBFs since 2013, over \$100 million came on stream in 2020 alone. The results show that a relatively low level of investment can help to create significant impact. The success of RBFs is expected to lead to an expansion of this type of financing in the years ahead.

RBFs are being designed to meet a growing range of objectives. As well as broad market stimulation for quality-verified OGS products, RBFs are being used to meet a number of other goals. For example, the KOSAP Program is designed to reach specific marginalized customer groups while Global Leap RBFs have been developed to drive uptake in emerging technologies.^{51,52} RBFs are also partnered with other public funding mechanisms so each mechanism can be targeted at the market barrier or objective it is most able to address. A common concern is that RBFs are more attractive to larger actors and that, as payments are only paid on results, smaller companies do not have the upfront finance to participate. RBFs such as the BRILHO scheme in Mozambique have therefore been teamed with catalytic grant finance to make it easier for smaller companies to take part in the initiative.⁵³ As the sector develops, continued innovation is expected.

A better understanding of the growing affordability gap has also led to increasing interest in end-user subsidies (EUS). An EUS directly reduces the cost of a product for a

consumer and is designed to specifically help those on very low incomes access off-grid products. EUS may be applied to the off-grid product price directly by the company, which then receives a grant to make up the difference, or customers may get a voucher or direct cash transfer to help them buy a product.

While the risk that EUS could make some markets less commercial remains, they also have the potential to open up fragile, conflict and violence (FCV) affected markets and reach new and more vulnerable customer segments, creating more opportunities for investment in the long term. EUS may also be needed to unlock markets and investment opportunities for larger, more expensive, PUE technologies, where affordability for lower income customers is already a well documented barrier.

Amongst others, the Pro-Poor RBF pilot program in Rwanda supported by EnDev, and the Togo CIZO program, supported by the AfDB and EU, have proven successful in reaching low income households. This success has been translated into nationwide scale up of the pilots.⁵⁴ The ESMAP/Lighting Global program is also supporting the development of end-user subsidy programs in several other countries, as part of larger World Bank lending programs, including in DRC, Niger and Nigeria.



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48 [Africa Energy Portal \(2021\), MIGA Guarantees Bboxx Solar Systems in Rural Areas.](#)

49 [SunFunder \(2021\), SunFunder Completes SET Fund.](#)

50 [European Commission \(2021\), A Range of Financial Guarantees to Boost Investment in Africa and the EU Neighbourhood.](#)

51 *The Kenya Off-Grid Solar Project (KOSAP) is an RBF that is designed to drive electrification in 14 high energy deficit counties through OGS solutions.*

52 *Global LEAP RBFs, implemented through the Efficiency for Access Coalition and managed by CLASP, aim to catalyze the uptake of high-quality, super-efficient appliances.*

53 *For more information, please see <https://brilhomoz.com/>*

54 *The scale up of the Pro-Poor RBF in Rwanda is funded by the World Bank.*

Company performance and profitability



While investment in the sector has grown, many companies have struggled in the face of the pandemic. This has led some companies to exit the market.

Whilst the sector did not experience a widespread liquidity crunch as was feared in early 2020, and some companies report healthy reserves, it appears many companies are in a weak cash position. Data from 26 company country operations in the PAYGo PERFORM Monitor⁵⁵ showed that the Median Liquidity Rate (the availability of liquid assets over 90 days) increased from 34% in 2020 to 44% in 2021.⁵⁶ Whilst this shows a promising move in the right direction the figures remain low in absolute terms and need to increase further if these players are to become more resilient. There are a notable few company operations that report a much healthier position with figures well over 100% thanks to recent investments, prudent cash conservation, and strong financial and operational performance. Achieving higher liquidity and healthier finances more broadly in the PAYGo solar market will be dependent on the future investment landscape and companies' ability to control costs and move towards profitability.⁵⁷

Companies with insufficient cash positions pre-pandemic experienced cash flow shortages, with some forced to shut down. Some start-up companies, already over-leveraged, continue to find it difficult to raise capital, especially equity; debt providers also steered clear, as default risk seemed high.⁵⁸ Some companies have faced

financial difficulties due to a high cost structure and cash burn rate, which creates a pressing need for the leadership team to focus heavily on fundraising, sometimes at the expense of operational excellence. This struggle resulted in a number of companies closing shop during the pandemic. Whilst the Energy Access Relief Fund has been a life-saver for some companies, the disbursements starting in the second half of 2021 arrived too late for others.⁵⁹ With the global economic outlook remaining difficult and supply chains still under stress, market entries and re-entries will be limited, and more market exits are anticipated in the immediate future, paving the way for acquisitions.



In addition, there has been a decline in the portfolio health of the PAYGo sector in 2020 and 2021 that represents a loss of income for PAYGo companies.

The industry averages for customer portfolio health KPIs show room for improvement, though there are high-performing companies with good portfolios that offer success stories for lower-performing companies to follow. The Mean Collection Rate (the percentage of customer payments received compared to payments expected for a given period) dropped from 67% in 2019 to 66% in 2020 and 62% in 2021 (Figure 12). Consumers can be segmented as 'fast', 'moderate', and 'slow' payers – a low collection rate indicates a large proportion of slow payers, i.e. people who take a much longer time than expected to complete their payments, though eventually do enjoy free use of their system, when fully paid off. The OGS business model is relatively tolerant of slow payers due to the powerful payment incentive from the lock-out technology, the in-built flexibility and length of the payment plans, and the repossession value of the assets.

55 The PAYGo PERFORM Monitor (PPM) started in early 2022 (building on the PAYGo COVID Impact Monitor in 2020-21) to provide benchmarks and market trends on industry KPIs for companies and investors. The initiative will collect, analyze, and share these insights semi-annually on an ongoing basis. PPM has (so far) collected data from more than a dozen PAYGo companies (representing nearly 40 country operations) selling SHS and appliances, covering 2019 to 2021. Participating companies have a combined portfolio of nearly \$600 million, and represent three quarters of the total B2C sales volumes generated by GOGLA Affiliates in 12 countries in sub-Saharan Africa. While this is a significant sample it leaves out a share of the sector, which makes results illustrative but not comprehensive.

56 Liquidity (next 90 days/Total Costs). This is an indicator of how easily a company is able to pay its financial liabilities e.g. through cash reserves or assets that can be quickly liquidated.

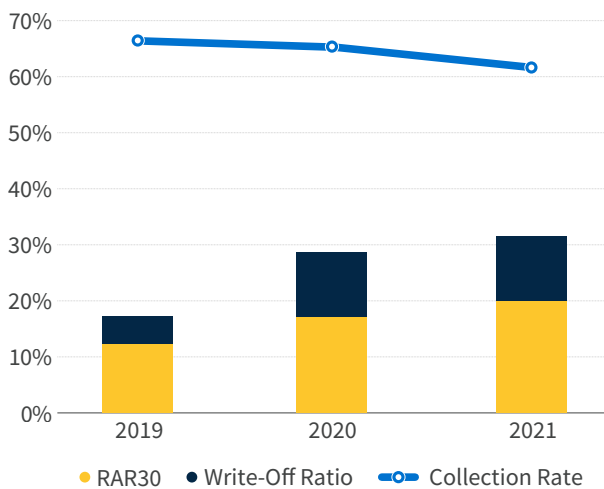
57 [NextBillion \(2022\). Understanding COVID-19's Impact on PAYGo Solar: Data From a Pioneering Study Reveals Key Insights About the Sector's Financial Sustainability.](#)

58 OCA and GOGLA consultations.

59 For more information, please see: [SIMA Funds \(2022\)](#), [Energy Access Relief Fund](#).

The Write-Off Ratio + RAR 30 indicator (a measure of non- and slow- payments)⁶⁰ increased from 18%, to 29%, and 32% in the same period (Figure 12). The Write-Off + RAR 30 results worsened for three-fifths of companies between 2020 and 2021, and worryingly, one-fifth of companies have more than half of customers in this category. Simultaneously, two-fifths of companies' Write-Off + RAR 30 results improved between 2020 and 2021, and one-sixth have less than one in ten customers in this category.

Figure 12: Trends in non-weighted mean PAYGo Collection Rate and Write-Off Ratio + RAR 30⁶¹



Low collection rates are a concern for companies as they put a strain on their financial health. Whilst most companies target and plan for a higher collection rate than the mean of 62%, this figure isn't inherently unviable if it is baked into the business plan. The 15% of PAYGo country firms with collection rates above 80% are likely close to or exceeding targets, whilst the 15% below 40% are undoubtedly well off the mark. The company benchmarks help identify an individual company's performance relative to peers, and the detailed results show the trends by

country and region, and company size. Notably, three of the four worst performers on collection rate are in a single country, pointing to the market context such as lockdown measures or other macroeconomic trends driving results, as opposed to company strategy.



A handful of off-grid solar companies now report to be fully profitable, whilst others report to be partly profitable (e.g. for operations in key country markets or business functions such as manufacturing).

Even though COVID-19 has had a big impact on portfolio health, nearly one-third of country firms (29%) reported a positive EBT margin (cashflow)⁶² to the PAYGo PERFORM Monitor in 2021, and many of these firms are on a positive upward trend from 2019 and 2020. Companies reporting profitability have established strong portfolio quality and unit economics. The profitability of industry leaders represents a significant new development as it is a potential tipping point to unlock long-term growth and sustainability for the sector. Sun King's recent series D equity round of \$260 million, d.light's \$238 million debt raise, and other scale-ups exploring an initial public offering (IPO), points to a step-change in the ability of market leaders to access new sources of capital on the back of strong financial performance.

However, many companies in the industry have further to go on the path to profitability. A survey of GOGLA's members in early 2022 revealed that 25% of respondents reported being profitable using net profit (including cost of goods sold, operating expenses, cost of financing, and

⁶⁰ Write-Off Ratio: The percentage of payments expected from customers that have been written-off due to customer non-payment during a given period. The Receivables at Risk on 30 consecutive days unpaid (RAR 30) is used alongside the Write-Off ratio to offer more comparable results (since it neutralizes differences in accounting practices arising from variations in when companies record a write-off). Note: Write-offs are removed from the Collection Rate calculation (since they are no longer active customers with expected payments), thus an increase in Write-offs can improve the Collection Rate.

⁶¹ [GOGLA, World Bank/Lighting Global, MFR \(2022\), PAYGo PERFORM Monitor.](#)

⁶² Profitability remains a challenging characteristic to define and measure in the off-grid solar industry due to the complex business models, variety of metrics, and different accounting methods. The PAYGo PERFORM initiative concluded that EBT Margin (on cashflow) is the most meaningful and comparable single metric for profitability, though Contribution Margin (on cashflow) may be more useful for young companies despite it being more difficult to calculate. For companies with multiple countries of operation, milestones of profitability include positive EBT margin (cashflow) in each country and then at the group level (with other business units such as manufacturing and software further complicating the picture for vertically integrated players).

taxation)⁶³, a further 13% were profitable using operating profit (which excluded the cost of financing and taxation). This left the majority of respondents, 53%, reporting that they made a gross profit, excluding operating expenses, and a further 9% were not profitable, failing to cover the cost of goods sold. The reduced purchasing power of consumers and increase in costs over the last two years

has been a setback for many companies on the path to profitability, though despite this, respondents were almost universally optimistic about their prospects going forward, with 97% expecting their financial sustainability to improve in the next three years.



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63 GOGLA (2022), *Financial Sustainability Survey* (unpublished). The survey included responses from 38 companies, predominantly distributors and manufacturers, mostly under six years old, with a smaller proportion between 7 and 12 and over 12 years old. The majority of respondents operated in just one country, with smaller proportions operating in 2-5 or over 6 countries. The survey was conducted before the outset of the Ukraine war, which as we know has changed the outlook on the global economy.

Key Trends and Innovations Affecting Competition in the Sector



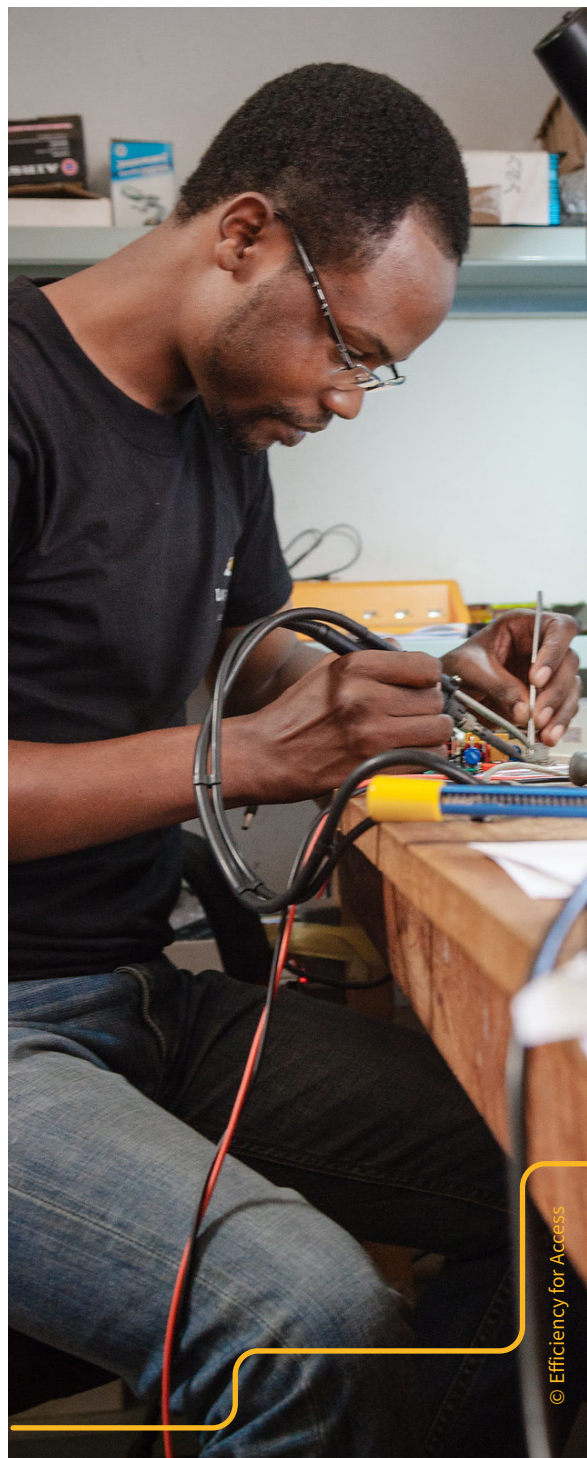
COVID-19 has further increased the pressure on companies to implement clear paths to profitability, spurring trends on cost cutting and offering products and services ‘Beyond Energy’.

To cut costs and optimize business models, companies continue to outsource niche, non-strategic functions and digitalize operations. Specialized service providers targeting the OGS sector are slowly emerging in more mature markets. A few years ago, the market trended away from vertically integrated companies into specialized OGS companies focusing on a few segments of the value chain (e.g., distribution and financing), allowing for more partnerships across the OGS sector (e.g., vertically integrated companies, doing both manufacturing and distributions.) As the next step in market maturity, we now see a rise in non-OGS companies providing specialized services to the sector, such as after-sales services and payment collection.

OGS companies across different markets also move into ‘beyond energy’ products and services to diversify their income streams. Companies are for example integrating PAYGo technology in more devices, such as smartphones, laptops, electric cookstoves, and biodigesters to public toilets and electric vehicle charging points. Furthermore, PAYGo companies’ data infrastructure, credit risk algorithms, and software platforms enable them to offer a range of financial products such as small business loans, school loans, and health insurance. These digital financial products are typically secured against the original solar energy kits using the PAYGo locking mechanism.

Large PAYGo players have invested significantly in recent years to build the technology and teams to enable this expansion. Further innovation driven by advancements in data infrastructure and analytics are on the horizon. For example, Vitalite, a local OGS company in Zambia,

partnered with an insurance agency to pilot an innovative agriculture insurance product for SHS customers that provides smallholder farmers in Zambia a ‘payment holiday’ on their SHS in the case of a severe drought.⁶⁴ These innovations offer the potential to make the sector more impactful, profitable, and resilient to climate change.



© Efficiency for Access

64 [Shell Foundation \(2021\), How can Agri-insurance Reduce the Risk Associated with Solar PayGo?](#)

Technological Innovations

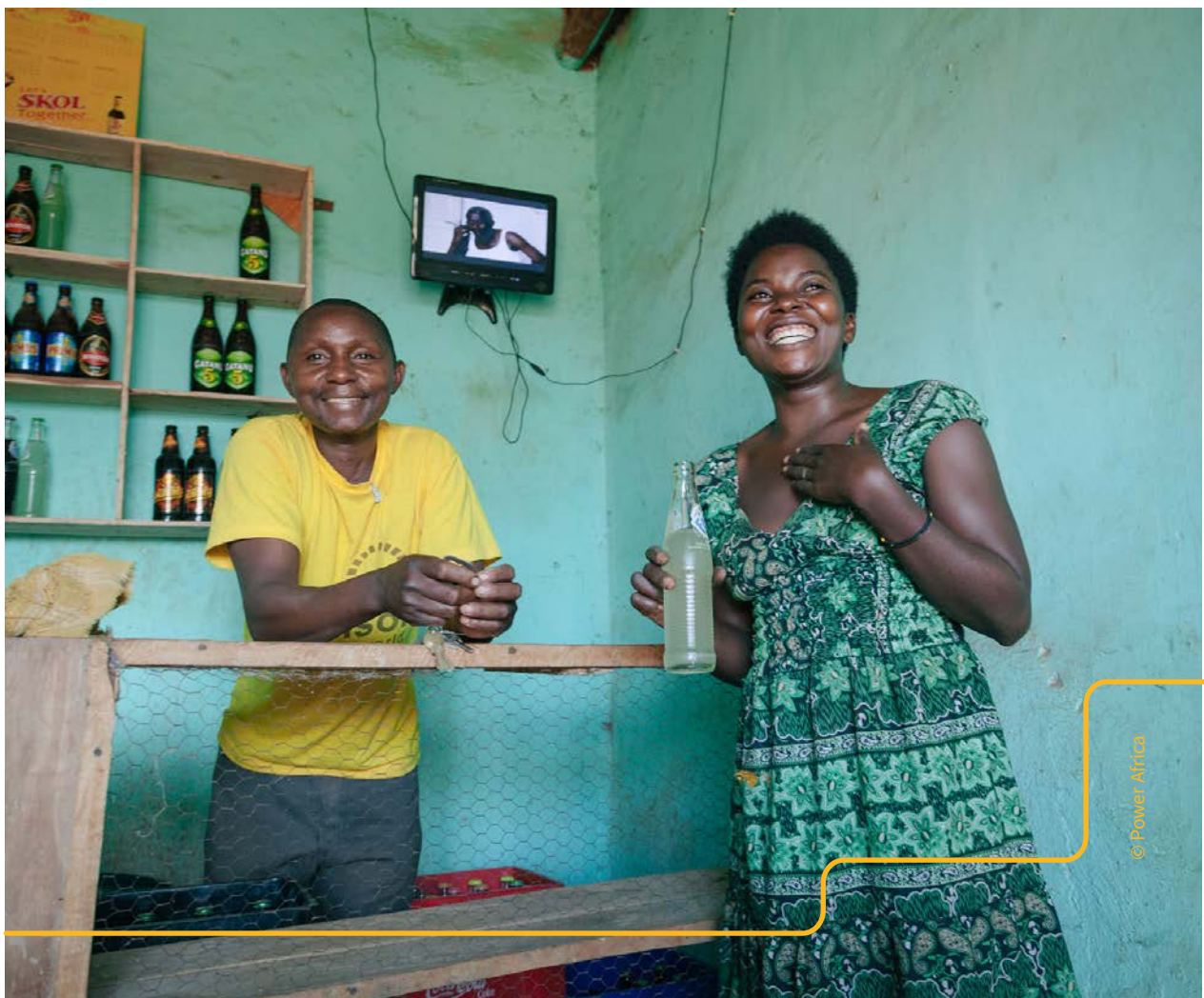


As the off-grid industry counts more than 12 years of development, it has a strong core of products and brands that have reached maturity.

While companies are starting to sell beyond energy products, product offering of solar energy kits continues to grow. There were 261 quality-verified solar lanterns and

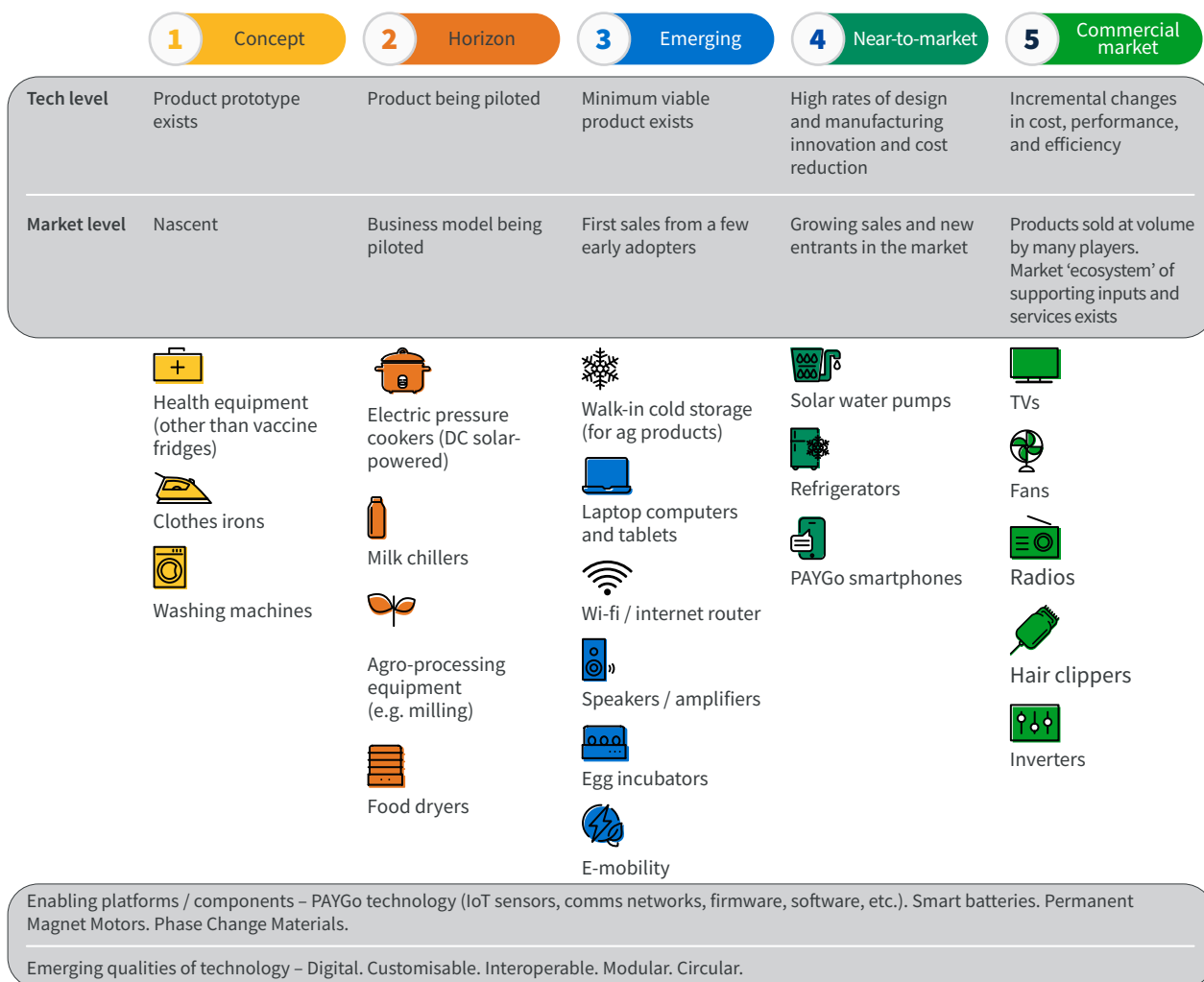
solar home systems (SHS) from 67 brands listed by VeraSol in 2021, up from 201 products from 51 brands in 2019.

SHS are increasingly sold with appliances and there have been rapid advancements in the maturity of a few appliances and productive use technologies, but more R&D investment is needed to accelerate a wider array of technology onto the market. Highly-efficient direct current (DC) appliances purpose-made for off-grid customers are now commonplace in the product range of PAYGo companies. These appliances have benefited from intense research and development (R&D) efforts that have spurred improvements in the efficiency, performance, durability, and cost. People with grid electricity have access to a much wider range of affordable appliances and productive uses, which can also be available to people in off-grid areas with further R&D. The Technology and Market Maturity Map below shows the many other potential use cases that could collectively transform the lives and productivity of people in off-grid areas.



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Table 1: Technology and Market Maturity Map of solar appliance technologies for off-grid use cases^{65,66}



Distributed solar and storage technologies combined with high-efficiency appliances could transform electricity access for homes and businesses on the weak grid.

As technologies are maturing and companies are innovating, off-grid solar has the potential to improve electricity access not only in off-grid areas, but also for an estimated 775 million people living with a weak grid connection.⁶⁷ The electricity supply for weak-grid customers is typically inadequate, unavailable, unreliable, and unsafe - though the quality of supply varies significantly, with some areas experiencing only minimal disruptions, whereas others have only a few hours of power per day, including 160 million grid

⁶⁵ Adapted from [Efficiency for Access Coalition \(2021\), Solar Appliance Technology Briefs.](#)

⁶⁶ The technologies have been classified based on the authors' understanding of the market and stakeholder consultations. It should be noted that some technologies such as refrigerators defy simple classification as they include a range of product sub-segments that are at varying stages of maturity, for example vaccine fridges have been sold for decades, whereas domestic fridges using phase change materials are an innovation. Furthermore, there may be products or brands that are ahead of (or behind) the curve compared to the level designated on this map.

⁶⁷ [IFC, World Bank Group \(2019\), The Dirty Footprint of the Broken Grid: The Impacts of Fossil Fuel Back-up Generators in Developing Countries.](#)

customers in Africa that have less than 12 hours per day.⁶⁸ This particularly constrains businesses from investing in appliances and machinery, since their ability to use them reliably for income generation is hindered. 16% of households in India have also experienced a safety issue with their 230V electricity supply in the last year,⁶⁹ and nearly 30 people die every day across the country.⁷⁰

Weak-grid customers are forced to rely on back-up technologies that are dangerously polluting, and expensive. Fossil-fuel generators proliferate as a back-up technology. In Nigeria alone there are an estimated 22 million small petrol generators being used to power homes and small businesses, this is eight times the grid's peak capacity.⁷¹ Generators are also expensive, with an average service cost of \$0.30 per kWh for the fuel alone. In India, there are 55 million homes with a lead-acid battery and inverter for back-up power though a further 218 million with little or no back-up.⁷² These systems are typically inefficient and expensive as they feature basic battery technology, low-cost inverters, and conventional AC appliances with low efficiency.

New technology segments are emerging that integrate distributed solar and storage with the weak grid to dramatically improve the quality and affordability of electricity access. Distributed solar and storage can be integrated with the grid supply⁷³ in a way that increases the availability and reliability of power for a home or business. The battery is charged by the grid and/or solar panel and provides power to the loads during the grid outage. The power can be used in low voltage (e.g 12V or 48V) mode on direct current (DC) with high-efficiency lights and appliances, or the power can be at grid voltage, with an inverter taking power from the battery to alternating current (AC) for conventional loads and appliances. There is also an emerging class of smart lights and appliances that have inbuilt batteries that can continue working during outages, and appliances that work in both DC and AC mode. Digital technology is a key feature, with Internet of Things (IoT) system monitoring and management, and smart metering, billing, and payments. If deployed at scale, distributed solar and storage technologies would transform electricity networks into smart grids.

Enabling Environment



Governments recognize the importance of OGS as a viable electrification solution. OGS technologies have been mainstreamed in electrification strategies but implementation is lacking.

With just eight years left to achieve universal access, governments are increasingly embracing OGS as a viable electricity access solution. Off-grid solar has become widely acknowledged as the least-cost electrification solution for hundreds of millions of off-grid households, particularly in sparsely populated rural communities. Many governments are including OGS in their Integrated Electrification Plans (IEPs) alongside the national grid and mini-grids; at least 12 more countries completed their IEPs in the last two years.⁷⁴ Governments have also increased their efforts to support the deployment of OGS technologies and the scale up of off-grid markets in their countries.

While at least 12 countries completed the development of their IEPs over the last two years, only a few governments are adopting and implementing them at a pace that matches their SDG7 ambitions. Implementation of OGS electrification is currently under-prioritized due to limited technical skills and implementation capacity of the public and private sector, slowing progress and, in some instances, resulting in the reprioritization of status quo technologies including the grid. There is a clear skills gap for OGS solutions in many public sector electricity access agencies, compared to longer standing experience and education of key members on more traditional power solutions, such as electricity generation and distribution at grid level. This often affects the implementation of OGS targets set out by IEPs. For example, a number of countries are still lacking dedicated government bodies creating policies, regulations and programs to assist OGS players to serve areas identified as ideal for OGS electrification.

68 [World Economic Forum \(2021\), Closing the Loop on Energy Access in Africa.](#)

69 [Smart Power India, The Rockefeller Foundation, NITI Aayog \(2020\), Benchmarking Distribution Utilities.](#)

70 [Times of India \(2019\), Electrocutation kills nearly 30 Indians a day.](#)

71 [Access to Energy Institute \(2019\), Putting an End to Nigeria's Generator Crisis: The Path Forward.](#)

72 [GOGLA \(2020\), Opportunities for Hybrid AC-DC Infrastructure in India.](#)

73 Note: Whilst the analysis in this report focuses on integration with the grid, the innovation could likewise relate to mini-grids.

74 Open Capital Advisors analysis.

As a result, OGS continues to be under-prioritized in planning, budgeting and implementation compared to grid solutions.



New programs and a widening of scope by governments and development partners has led to more focus on productive use and powering healthcare.

Although the implementation of IEPs is slow, governments and development partners increasingly see the potential of off-grid solutions to power healthcare and climate-smart agriculture. The World Bank/ESMAP Lighting Global program has expanded its remit to include PUE technologies such as solar water pumps, mills and sewing machines. ESMAP will also contribute to human capital development by supporting electrification of public health centers and schools. As World Bank's activities are driven by government demand, this illustrates the evolving interest of national leaders.

Between July 2015 and June 2022, World Bank programs which include OGS have been approved in more than three quarters of the countries in sub-Saharan Africa. Including technical assistance (TA), the total amount committed to accelerating adoption of OGS since July 2015 is over \$2 billion (Figure 13). Of the \$2 billion committed by the World Bank, more than \$470 million in specific support for OGS and \$160 million in related TA has been approved since 2020. Note that the chart below includes funding allocated to off-grid solar standalone solutions, including residential, productive uses, and public institutions. Several activities supporting the off-grid solar market development are carried out under the TA components, such as consumer awareness campaigns or market intelligence. However, the TA funding is not exclusively allocated to off-grid solar and also supports other project objectives, such as strengthening the utilities or enhancing the capacity of governments.

Other development partners have also broadened their scope and/or continued their support for healthcare electrification and PUE products. For example, in 2022, Power Africa announced a new public and private sector alliance that plans to electrify 10,000 healthcare facilities in sub-Saharan Africa⁷⁵, while EnDev and the IKEA Foundation launched a three-year Sustainable Energy for Smallholder

Farmers (SEFFA) program (\$8.1 million) in 2021 to increase the use of PUE appliances, including cooling, across dairy and horticultural value chains in Kenya, Uganda and Ethiopia.⁷⁶

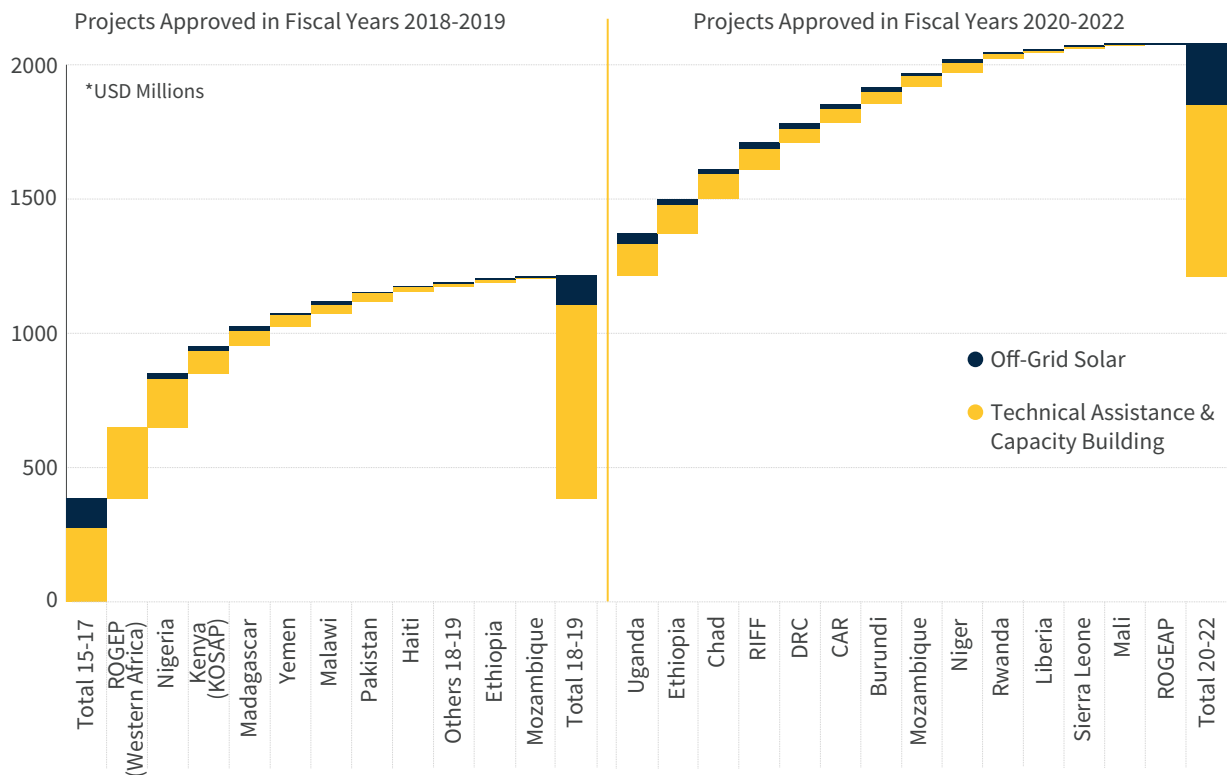


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⁷⁵ [USAID/Power Africa \(2022\), USAID's Power Africa Launches Partnership to Electrify Health Facilities Across Sub-Saharan Africa As Part Of President Biden's Global Infrastructure Initiative.](#)

⁷⁶ [EnDev \(2021\), Sustainable Energy for Smallholder Farmers \(SEFFA\).](#)

Figure 13: World Bank funding for off-grid solar⁷⁷



More governments are offering VAT and tax exemptions for OGS, including solar water pumps.

Since 2020, Senegal, Mali, Benin and Liberia joined other countries in sub-Saharan Africa⁷⁸, and more around the globe, in providing VAT or duty exemptions for solar energy kits and components, while several countries have expanded border tax exemptions to productive use technologies. Mali, Senegal and Sudan included solar water pumps (SWPs) in their exemptions and Liberia exempted SWPs amongst a full range of other solar equipment and DC appliances. Similarly, Togo’s CIZO program provides border tax exemptions for SWPs from

eligible providers. This illustrates growing recognition by governments of the role that PUE technologies can play in boosting climate smart agriculture and could lead to a greater adoption of exemptions for PUE across the continent.

However, border tax laws can be unpredictable, creating uncertainty and risk for companies and investors. Adding to this unpredictability, implementation of exemptions often remains inconsistent. In some countries, the ability to avail of tax exemptions can vary from company to company, or even shipment to shipment. Efforts to simplify customs procedures are emerging. For example, in 2020 and 2021 ACE TAF developed importation guides in Kenya⁷⁹, Senegal⁸⁰, Zimbabwe⁸¹ and Nigeria⁸² in collaboration with customs authorities to provide clarity on importation processes and the tax exempt status of OGS products. The national renewable energy associations in East Africa, with the support of the UK’s FCDO funded PowerUp! program, also developed importation guides for the East African Community, with updates in

77 Analysis based on data from 2015-19: Off-Grid Solar Market Trends Report (2020); Data from 2018 - 2022: ESMAP (2022).

78 Power Africa, GOGA (2022), Off-grid VAT and Duty Tracker.

79 Africa Clean Energy (2019), Importation Guidelines For Solar PV Products and Systems in Kenya 2019.

80 Africa Clean Energy (2021), Sénégal – Elaboration de la Stratégie Genre et Inclusion Sociale (GESI) du PANGE.

81 Africa Clean Energy (2021), Customs Handbook for Solar PV Products in Zimbabwe.

82 Africa Clean Energy (2021), Importation Guide for Solar PV Products and Technologies in Nigeria 2020.

2022.⁸³ Ongoing support for customs authorities in the implementation of VAT and tariff exemptions, for example within future programs and capacity building initiatives, will continue to ease doing business for OGS companies, ultimately supporting electrification efforts.



The appropriate handling and disposal of electronic products at their End-of-Life (EOL) is a subject of increasing concern for governments and the industry.

Given the millions of products that have been sold over the last decade, concerns on the appropriate handling and disposal of e-waste have emerged for governments, development partners and the broader industry. Over the last two years, several countries have sought to strengthen their existing waste management laws and regulations to introduce or enhance extended producer responsibilities and address current e-waste management challenges, including from OGS.

Companies will increasingly need to plan for e-waste regulation and build it into their operational plans and processes. It also creates space for innovation and strategic partnerships with other parts of the electronics sector, due to the current lack of e-waste infrastructure in countries with high energy access deficits. For example, only a few countries in sub-Saharan Africa (including Rwanda, Nigeria, Kenya and South Africa), have e-waste management facilities that are equipped to handle end-of-life products from off-grid solar, and cross-boundary movement is expensive and complex.



Countries have increasingly adopted the International Electrotechnical Commission (IEC) quality standards for solar energy kits.

Adopting quality standards is a key way of reducing electronic waste and helps to protect customers from low quality OGS products. Low quality products that break

easily not only create additional e-waste and harm the environment, but also erode customer confidence in OGS products. This can have a knock-on impact on sales of OGS by companies that are producing high quality products - potentially slowing the pace of electrification.

The World Bank Group's Lighting Global program developed quality standards for solar kits to drive up, and maintain, a base level of quality within off-grid technologies. These were integrated into the globally recognized International Electrotechnical Commission (IEC) standards in January 2021. The process for national standards bodies to adopt standards for solar energy kits has consequently improved and created greater uptake. Ethiopia, Zambia, Uganda, Zimbabwe, Sierra Leone and Senegal have fully adopted the IEC standards and Nigeria has adopted national standards that are harmonized with the IEC. Tanzania and Papua New Guinea are in the final stages of adopting the IEC standards, while DRC has begun the process. China has adopted the standards on a voluntary basis.

Despite the increased adoption of quality standards for OGS products, several challenges hinder effective implementation. These include limited capacity among standards authorities to undertake market surveillance and enforcement activities and misalignment between national and IEC standards. There has been some progress in the development of accompanying measures to enforce compliance to quality standards. For example, a joint initiative by the International Finance Corporation, VeraSol and ACE TAF between 2020 and 2022 built the capacity of market surveillance solar test laboratories by training personnel and upgrading lab equipment in Zambia, Nigeria, Kenya and Ethiopia. However, capacity building and surveillance infrastructure in other regions is still needed to ensure that quality products are reaching consumers and providing reliable electricity access.



83 [National Renewable Energy Associations in East Africa \(2022\), The East African Regional Handbook on Solar Taxation,](#)



