Photo: © Gettyimages

CHAPTER 1
ACCESS TO ELECTRICITY

Main messages

- **Global trend.** The year 2022 saw a reversal in progress in efforts to expand access to electricity, with the number of people living without it growing for the first time in over a decade.[1] While the proportion of the global population with access held steady at 91 percent, the 53 million new connections added between 2021 and 2022 did not keep pace with a 63 million increase in global population over the same period. Thus in 2022, 685.2 million lacked access, compared with 675.1 million in 2021. The reversal of progress can be attributed in part to global shocks, notably COVID-19 and the disruption in energy markets caused by the war in Ukraine, as well as regional shocks, such as the increasing frequency and severity of droughts and floods in Sub-Saharan Africa because of climate change. Those still lacking access are becoming harder to reach because they live in more remote areas and have lower incomes. They are heavily concentrated in the least-developed countries, many of which are affected by fragility, conflict, and violence.
- **Regional highlights.** Sub-Saharan Africa is home to most of the global population lacking access, and the disparity between regions is widening. Sub-Saharan Africa now accounts for 83 percent of the global access deficit, up from 50 percent in 2010. While significant progress has been made toward universal access in Central and Southern Asia, where the access gap shrank from 414 million in 2010 to less than 33 million in 2022, the gap has flatlined in Sub-Saharan Africa as population growth has outstripped new connections. In that region, 571.1 million people lacked access in 2022, up from 566.1 million in 2010. Meanwhile, the region faces a shrinking fiscal space owing to persistent inflation, high interest rates, and low affordability thresholds.
- **Urban-rural divide.** Against a backdrop of rapid urbanization, eight out of ten people living without electricity in 2022 reside in rural areas. While progress in closing the access gap has been more rapid in rural areas than urban ones, the gain was largely driven by significant improvements in Central and Southern Asia, where the rural population without access shrank from 383 million in 2010 to around 24 million in 2022. Progress in other regions has been far slower.
- **Top 20 access-deficit countries.** Eighteen of the 20 countries with the largest access deficits in 2022 are in Sub-Saharan Africa. The top three—Nigeria (86 million), the Democratic Republic of Congo (78 million), and Ethiopia (55 million)—accounted for nearly a third of the entire global deficit. Concentrated efforts in these countries will be needed to ensure universal access to affordable, reliable, and modern energy services. This effort should also include a deeper focus on improved data collection and use of modern analytical tools to track progress and support data-driven decision-making.

1 Access to electricity is defined as having electricity for desired services. In about 20 countries where surveys based on the Multi-Tier Framework have been conducted, access includes Tier 1 and above (ESMAP 2022c). For other countries, electricity access is a binary measure drawn from national household surveys. Detailed datasets with country data for the SDG 7 indicator discussed in this chapter can be accessed at no charge at https://trackingsdg7.esmap.org/downloads.

- **Decentralized renewable energy.** Stand-alone off-grid solar solutions, including solar lights and solar home systems, were estimated to serve 490 million people in 2022, with the majority using it as their main source of light and power, and the rest using it as backup. Of the 490 million, 158 million had access to solar lights and home systems meeting international quality standards.[2] Mini-grids were estimated to be serving 47 million people; half of those mini-grids were powered by fossil fuels, with hydropower and solar accounting for 20 and 13 percent, respectively. The proportion of mini-grids powered by solar is expected to rise rapidly in the future. Least-cost modelling suggests that 439 million new connections from 2022 to 2030 will have to come from the grid (53 percent), with 363 million (44 percent) coming from stand-alone solar photovoltaic (PV) and a further 24 million (3 percent) from mini-grids. There is no viable path to Sustainable Development Goal (SDG) target 7.1—that is, to ensure universal access to affordable, reliable, and modern energy services—without accelerated deployment of decentralized solutions. But current investment flows fall far short of what is required for the sector to achieve its potential. This indicates a need to develop "self-help" eco-systems whereby consumers' knowledge and implementation capacities can be enhanced so as to productively absorb larger flows of capital and technology.
- **Strengthening interlinkages with other SDGs by promoting the productive use of renewable electricity.** Productive use is linked to increased productivity, income growth, and improved quality of life, contributing to SDG 2 on hunger, SDG 6 on clean water and sanitation, and SDGs 8, 9 and 12 on business, industry, and the economy. In on-grid and mini-grid settings, productive uses of renewable energy enhance the viability of rural electrification by stimulating demand. (Another benefit is that this increased demand helps strengthen the financial viability and performance of the grid where available.) In energy access settings, most productive uses of energy initially occur in agrifood settings, but as access improves these uses spread to a wide variety of sectors, from vocational work to the service-based economy. Hence, collaboration across energy, water, agriculture, and other economic sectors is needed to address challenges related to consumer awareness and affordability, as well as access to finance and capacity constraints at both the end-user and company levels.
- **Strengthening interlinkages with other SDGs by electrifying public institutions.** Affordable, reliable, and modern electricity services are key to improving nutrition, health, education, jobs, and skills, thus contributing to SDG 3 on good health and well-being, and SDG 4 on quality education, among others. Conventional approaches to the electrification of public institutions such as health facilities and schools have struggled to achieve sustainability because of limited capacity and funding to pay for ongoing maintenance costs. Innovative approaches can be used to leverage private sector expertise and investment, while ensuring that financing and incentives are structured to ensure sustainability over the long term.

2 This figure encompasses Asia (excluding China), Africa, Central America and the Caribbean, the Middle East, Oceania, and South America. The main quality standard used for off-grid solar lights and home systems up to 350 W is IEC Technical Standard 62257-9-8:2020, with other standards covering specific components. For more information, see IEC (2024).

Are we on track?

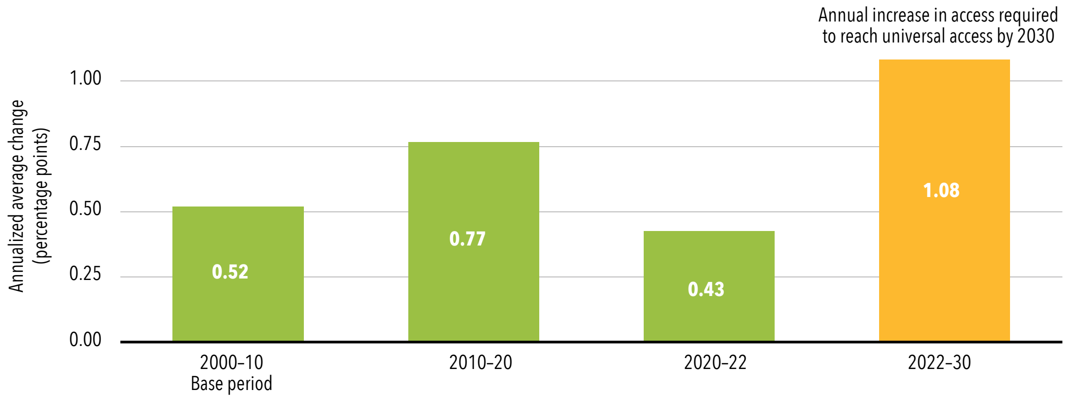
The number of people living without electricity around the world increased in 2022 for the first time in more than a decade. Although the percentage of people with access held steady at 91 percent, the number of people grew faster, leaving 685.2 million people still living without access—about 10 million more than in 2021 (figure 1.1). The reversal of progress can be attributed in part to global shocks, such as COVID-19 and the war in Ukraine. Those still lacking access are heavily concentrated in Sub-Saharan Africa and in least-developed countries, many of which have been more deeply affected by the ongoing global crises or are beset by fragility, conflict, and violence. Many governments in these areas continue to face a shrinking fiscal space owing to persistent inflation and high interest rates on borrowings. Moreover, those still lacking access are increasingly hard to reach because they live in more remote areas and have lower incomes. Under current scenarios, the energy access gap is projected to stall at 8 percent in 2030, leaving an estimated 660 million people without access. SDG target 7.1 is still achievable, but time is running out.

FIGURE 1.1 • PERCENTAGE OF POPULATION WITH ACCESS TO ELECTRICITY, 2000–30

Source: IEA and World Bank 2024b.

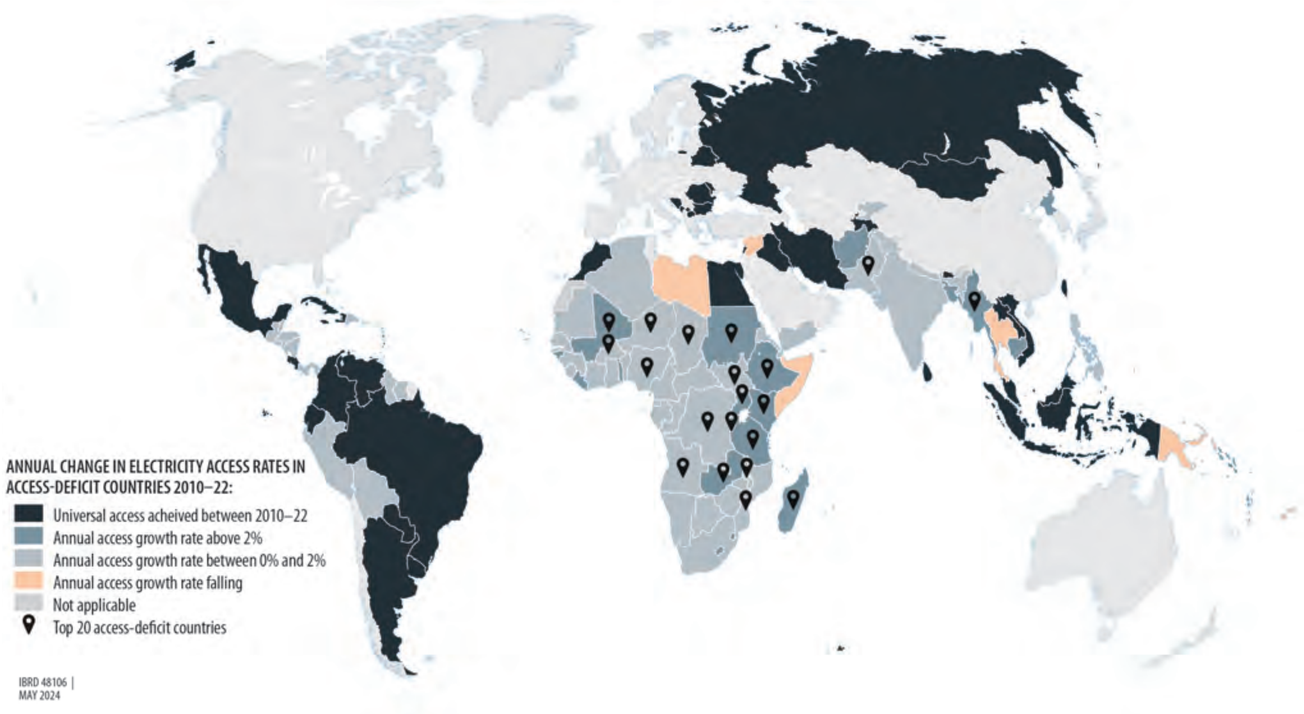
Significant progress was made between 2010 and 2020, with access to electricity growing by an average of 0.77 percentage points per year during the period. That pace dropped to 0.43 percentage points between 2020 and 2022, putting increased pressure on future efforts to achieve SDG target 7.1, which will now require an average annual increase in access of 1.08 percentage points through 2030 (figure 1.2).

FIGURE 1.2 • AVERAGE ANNUAL INCREASE IN ACCESS TO ELECTRICITY, 2000–30



Source: World Bank 2024b.

Since 2010, 48 additional countries were able to achieve universal access to electricity[3] (figure 1.3). The greatest progress was seen in Latin America and the Caribbean (18 of the 48 countries), whereas only 2 countries in Sub-Saharan Africa—Seychelles and Mauritius—were able to reach universal access. Ninety-three countries around the globe still fall short of this goal, the vast majority of them in Sub-Saharan Africa. A serious scale-up of efforts and fresh thinking is needed in order to more than double the average annual percentage increase in access (from 0.43 percent to 1.08 percent) that is needed to achieve universal access by 2030.



Source: World Bank 2024b.

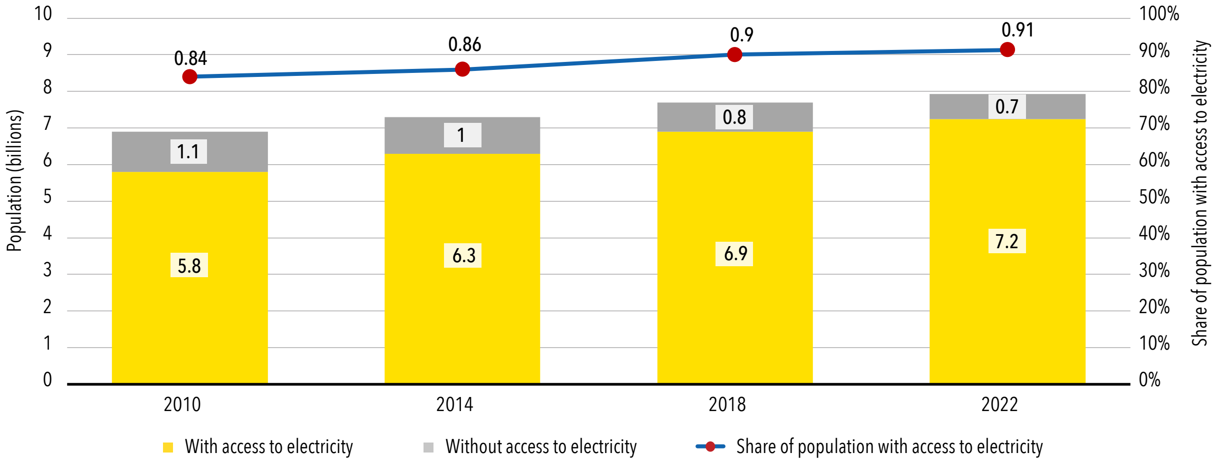
3 Universal access to electricity here is defined as everyone in a country having Tier 1+ access on MTF surveys (ESMAP 2022c) or according to binary measurements in existing household surveys, such as those of the DHS and LSMS (World Bank and IEA).

Looking beyond the main indicators

ELECTRICITY ACCESS AND POPULATION GROWTH

The percentage of the population with access to electricity grew from 84 percent in 2010 to 91 percent in 2022 (figure 1.4). A slowing of progress in the last five years of the period can be attributed in part to a combination of global shocks, notably COVID-19 and the disruption of energy markets stemming from the war in Ukraine, and regional challenges such as the increasing frequency and severity of droughts and floods caused by climate change in Sub-Saharan Africa. People still lacking access are also becoming harder to reach than those reached over the last decade because the live in more remote areas, have lower incomes, and are more likely to live in areas affected by fragility, conflict, and violence.

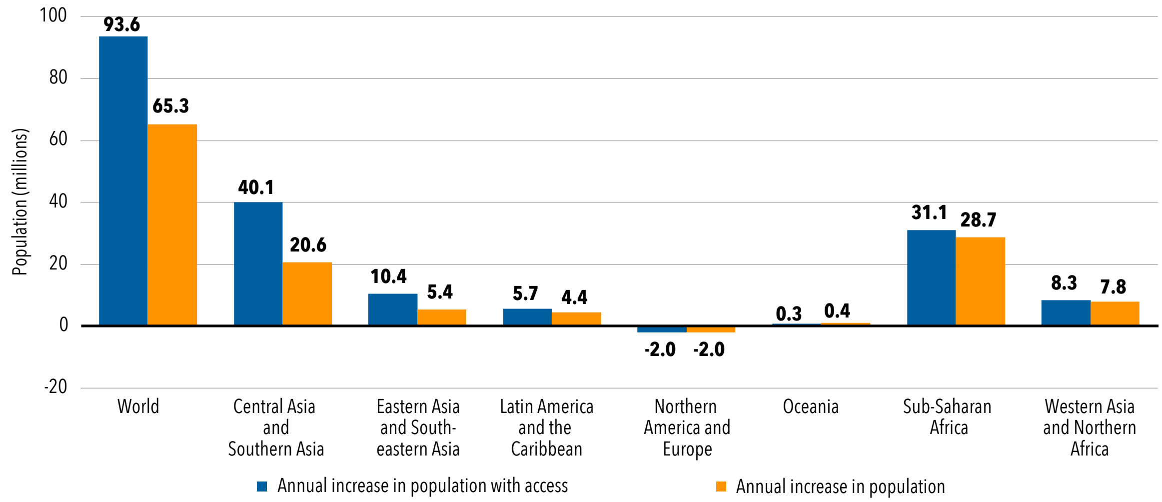
FIGURE 1.4 • GAINS IN GLOBAL ELECTRICITY ACCESS AND POPULATION GROWTH, 2010–22



Source: World Bank 2024b.

On average, an additional 94 million people gained a connection to electricity each year between 2020 and 2022, outpacing average population growth of a little over 65 million during the period—and this despite the reversal of the access trend observed in 2022. The largest growth in access could be seen in Central and Southern Asia, where connections increased by an average of 40.1 million people per year—nearly double the population growth rate of around 21 million. The vast majority of these connections can be traced to India, where the deficit dropped from about 49 million people lacking access in 2020 to just over 11 million in 2022; and to a lesser extent to Bangladesh, where the access deficit dropped from 6.4 million to 1.1 million over the same period. In contrast, the average annual increase of around 31 million in Sub-Saharan Africa was only slightly higher than population growth of around 29 million in the period (figure 1.5).

FIGURE 1.5 • ANNUAL INCREASES IN ELECTRIFICATION AND POPULATION, BY REGION, 2020–22

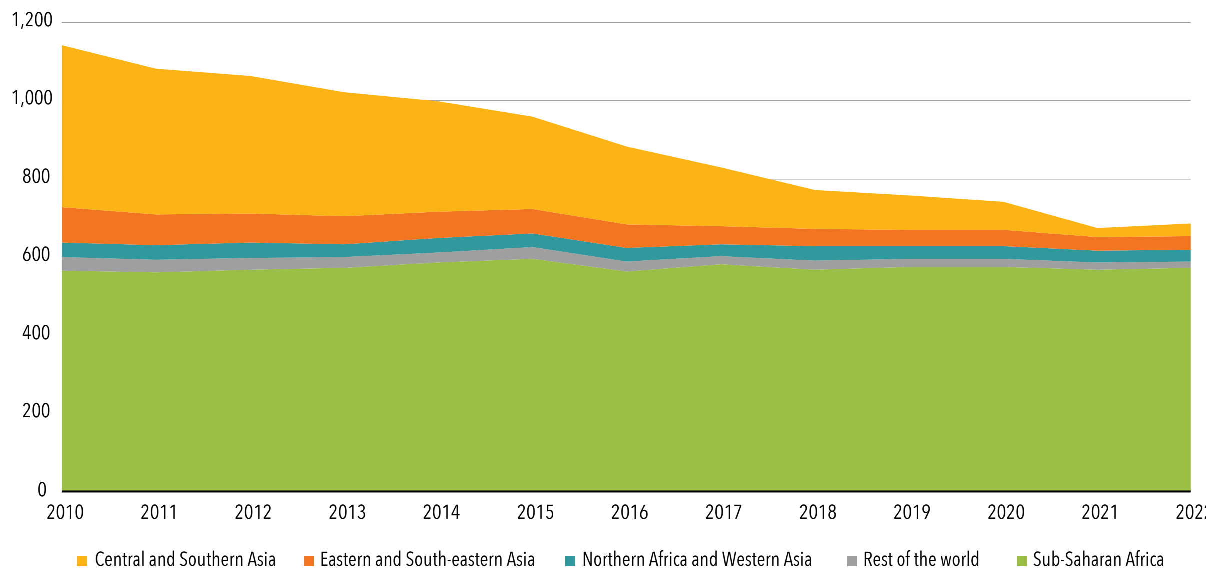


Source: World Bank 2024b.

ACCESS DEFICITS

While hundreds of millions of people have gained access to electricity since 2010, progress has been uneven. Vast regional disparities in access rates persist and continue to widen. While Central and Southern Asia accounted for 36.8 percent of the access deficit in 2010, immense progress in electrification in the region shrank its share of the global unconnected population to 4.8 percent in 2022. Meanwhile, Sub-Saharan Africa's share of the global deficit ballooned from 49.6 percent in 2010 to 83.3 percent in 2022, with a slight increase in the number of unconnected people in 2022 (figure 1.6).

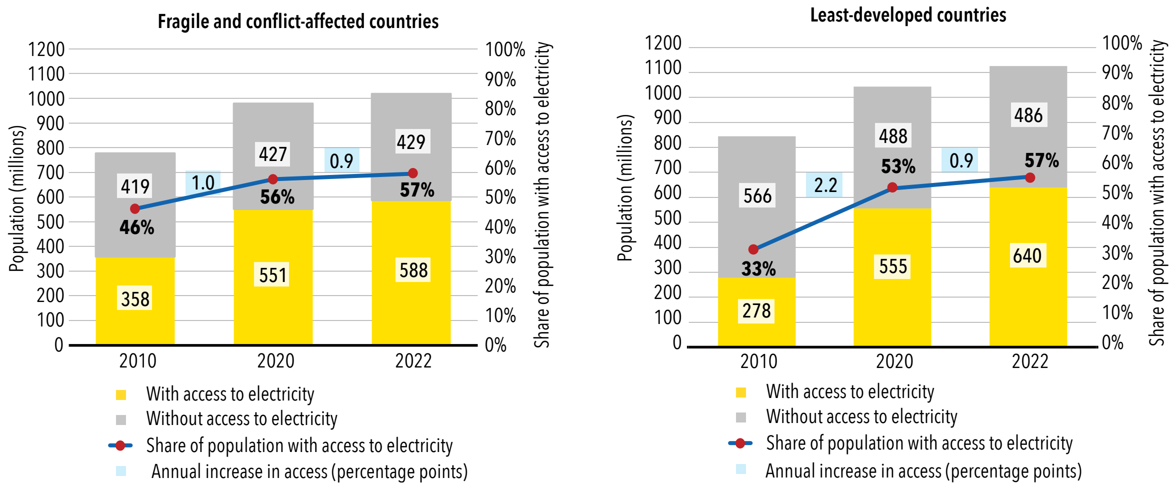
FIGURE 1.6 • POPULATION WITHOUT ACCESS TO ELECTRICITY, BY REGION, 2010–22



Source: World Bank 2024b.

The rate of Increases in energy access were rapid between 2010 and 2020, rising from 33 percent to 55 percent in least-developed countries and from 46 percent to 58 percent in countries affected by fragility, conflict, and violence (FCV). However, between 2020 and 2022 progress slowed. The absolute number of people living without electricity was nearly stagnant between 2020 and 2022, dropping from 488 million to about 486 million people in the least-developed countries, while rising from 427 to just over 429 million in FCV countries (figure 1.7).

FIGURE 1.7 • INCREASES IN GLOBAL ACCESS TO ELECTRICITY IN LEAST-DEVELOPED COUNTRIES AND COUNTRIES AFFECTED BY FRAGILITY, CONFLICT, AND VIOLENCE, 2010, 2020, AND 2022

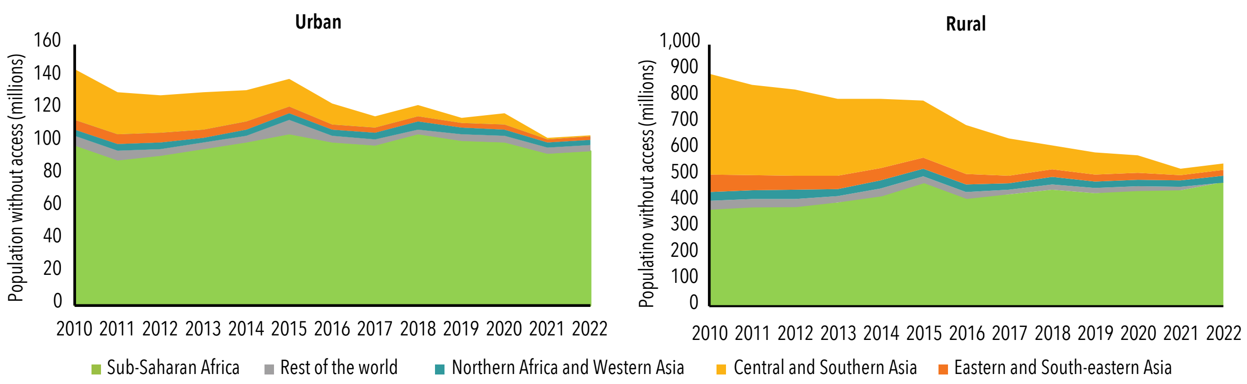


Source: World Bank 2024b.

THE URBAN-RURAL DIVIDE

Electricity access deficits in rural areas shrunk from 886 million globally in 2010 to 562 million in 2022. The steepest decline was seen in Central and Southern Asia (from 383 million to just 24 million), whereas the deficit grew in rural areas in Sub-Saharan Africa (from 376 million to 473 million). The improvements in access rates in urban areas, by contrast, were significantly slower, but also started from a much higher access level, with the deficit decreasing from 145 million in 2010 to 104 million in 2022. Progress was uneven and driven primarily by improved access in Central and Southern Asia, where the urban access gap declined from 30 million in 2010 to 1 million in 2022 (figure 1.8).

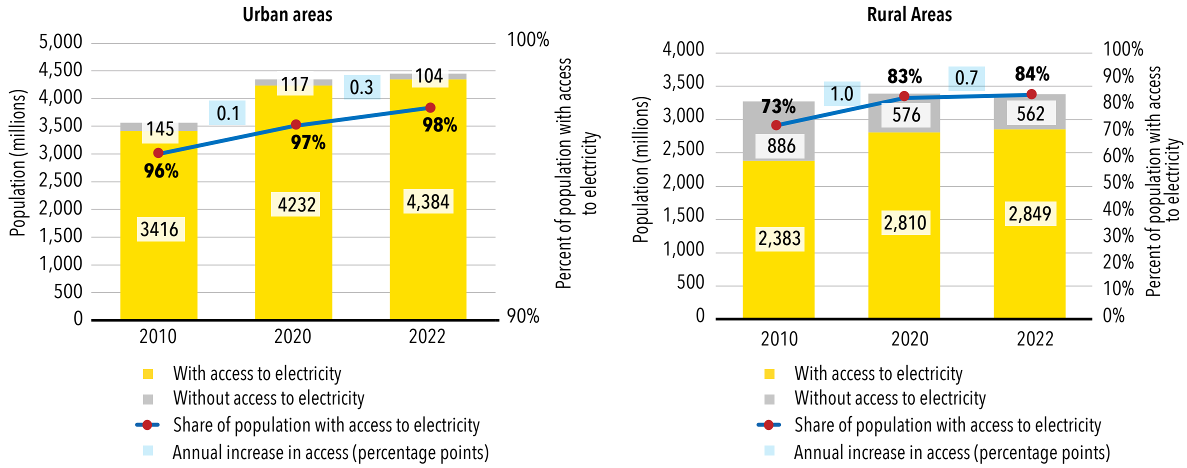
FIGURE 1.8 • ACCESS DEFICITS IN URBAN AND RURAL AREAS IN SELECTED REGIONS, 2010–22



Source: World Bank 2024b.

Overall, electricity access in urban areas increased slightly from 96 percent in 2010 to 98 percent in 2022, while electricity access in rural areas grew rapidly from 73 percent to 84 percent (figure 1.9).

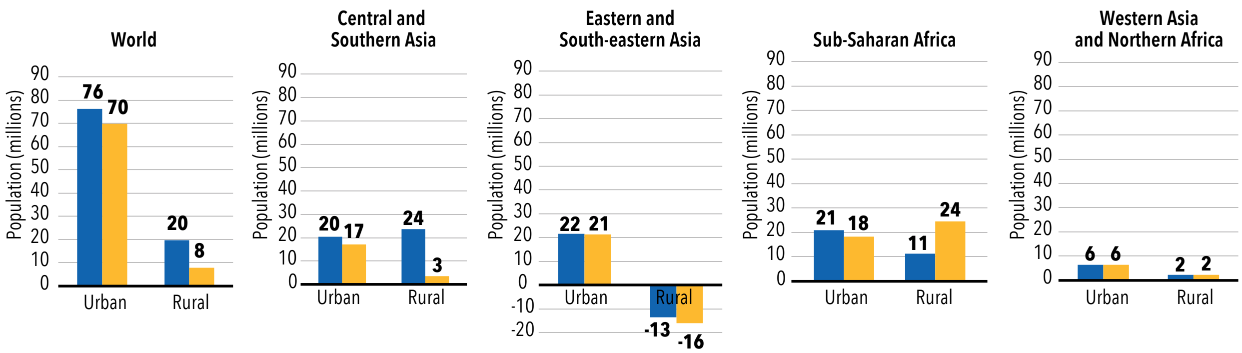
FIGURE 1.9 • INCREASES IN GLOBAL ACCESS TO ELECTRICITY IN URBAN AND RURAL AREAS, 2010, 2020, AND 2022



Source: World Bank 2024b.

The trend continued between 2020 and 2022. It was driven by Central and Southern Asia, where an additional 23.7 million people gained access in rural areas each year, while the rural population increased by only 3.5 million (figure 1.10). In Sub-Saharan Africa, by contrast, an average of 11.2 million people in rural areas gained access each year, far less than average annual rural population growth of 24.5 million people. Eastern and Southeastern Asia saw a significant decline in rural population in parallel with improving rural electricity access rates.

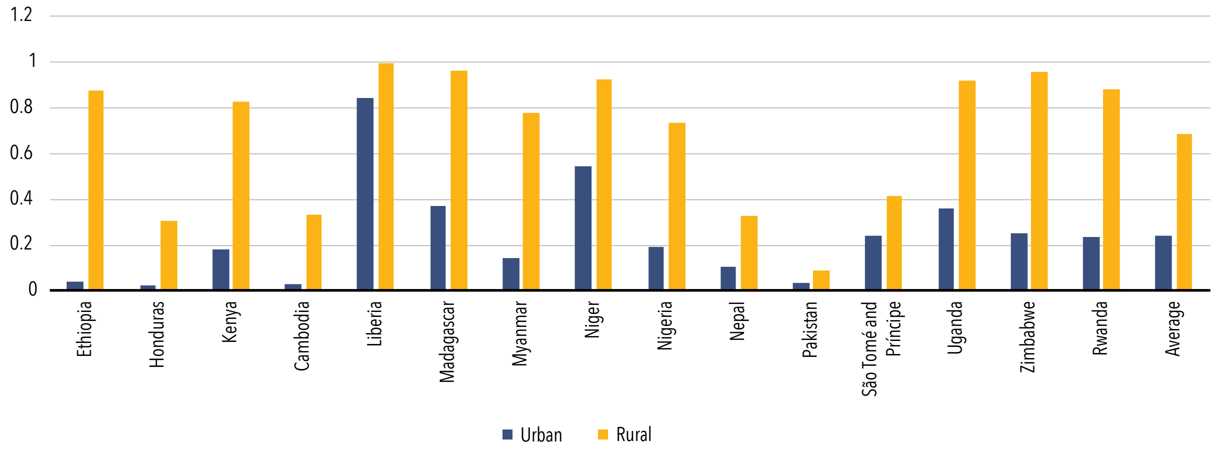
FIGURE 1.10 • ANNUAL GROWTH IN ELECTRICITY ACCESS AND POPULATION IN URBAN AND RURAL AREAS BY REGION, 2020–22



Source: World Bank 2024b.

The urban-rural divide is particularly notable in access to grid power. Figure 1.11 illustrates the stark contrasts in a selection of countries. For example, while just 4 percent of people in urban areas lack grid access in Ethiopia, this gap rises to 87 percent in rural areas (figure 1.11).

FIGURE 1.11 • PROPORTION OF HOUSEHOLDS LACKING GRID ACCESS IN URBAN AND RURAL AREAS



Source: ESMAP 2022c.

THE GENDER AND ENERGY NEXUS

SGD 5, which aims to achieve gender equality by ending all forms of discrimination, violence, and other harmful practices against women and girls has deep linkages with SDG 7. Energy access improves quality of life and the enabling environment for services, jobs, and markets.

Women and girls are disproportionately affected by energy poverty because of gender norms and traditions, which hinder access to modern energy services. At the household level, men and women have different energy needs and capacities when it comes to accessing energy services and appliances (ENERGIA n.d.). In addition, the imposed social and gender responsibilities, such as cooking and fuel collection, affect women and girls' health and safety by the exposing them to heavy work loads, indoor pollution, and violence. Thus, improvements in access to modern energy services bring women more opportunities, allowing them to enjoy greater rights and freedoms.

Policies on infrastructure investments, subsidies, tariffs, and reforms, often overlook gender considerations, yet they hold the potential to mitigate gender disparities. It is crucial to factor in aspects such as forced displacement, unequal land and property rights, employment in technical fields, and gender-based violence that may arise from new projects. These considerations are essential in the design and execution of initiatives aimed at enhancing access to reliable, modern electricity services.

Moreover, female-headed households, which are disproportionately poorer, may face greater challenges and hardships from sudden increases in tariffs compared to male-headed households. Given that men typically control household finances and decision-making under prevailing gender and social norms, it is critical for authorities and stakeholders to incorporate both women's and men's perspectives and suggestions during consultation processes.

Additionally, there is a noticeable gap in women's awareness and access to information about new technologies that can foster skill development and economic opportunities. The energy sector can bridge this divide by collaborating with various stakeholders in the public and private sectors to amplify women's participation and influence in decision-making processes. Employing gender-transformative strategies that challenge and reshape societal and gender norms through behavioral change programs can further this cause.[4]

Women's participation in the electricity access workforce as professionals and decision makers also remains limited. For example, only 27 percent of employees at off-grid solar companies companies are women, compared with women's 48 percent participation in the global labor force (GOGLA n.d.). Most household electricity access surveys are gender blind and therefore unable to shed light on inequality or inform gender-inclusive policy or program development. Few electrification plans specifically address the needs of female-headed households, with no region scoring more than 29/100 in this area, according to the World Bank's Regulatory Indicators for Sustainable Energy (RISE) framework (ESMAP 2022a). Viable paths to SDG 7.1 should include gender equality in energy; and policies and investments must do the same.

On a positive note, recent research by Duke University using survey data from the Multi-Tier Framework found a positive association between a women's empowerment index and energy access at household level in most countries (IOPscience 2023). Research in the stand-alone off-grid solar sector has found that inclusion of women as consumers, employees and entrepreneurs improves service delivery, enhances financial performance, supports employee retention,, and promotes innovation (ESMAP 2022b). Inclusion of vulnerable groups and gender sensitivity considerations in approved electrification plans also improved slightly from 2019 to 2021, with rapid improvement in Latin America and the Caribbean and some improvement in Sub-Saharan Africa, thanks in large part to Nigeria's consideration of gender in electrification expansion planning, according to RISE data (ESMAP 2022a).

There remains an urgent need to collect sex-disaggregated data to inform policies and programs; address inequity in asset ownership; improve women's access to markets, and technical skills for employability; strengthen participation in the electricity access workforce; and enhance access to finance and support for female-led businesses. Governments and development partners must design gender-inclusive programs that use public funding, capacity building, standards and other incentives to reach more women, maximize the benefit of electricity access to women, and enhance the participation of women in the sector at all levels (ESMAP 2022b).

4 Information on the Multi-Tier Framework for Energy Access, a joint project of the World Bank, the Energy Sector Management Assistance Program, and Climate Investment Funds, can be found at ESMAP (2022c; 2024a).

Closing the access gap with decentralized renewable energy

The high cost of extending electricity grids into rural areas with low population density and low demand for electricity explains why decentralized solutions are playing an ever-greater role in rural electrification They offer a lower-cost alternative to grid expansion, because they can be rapidly deployed to meet lower levels of demand. In urban areas, by contrast, grid densification is needed to respond to rising demand from expanding populations. Here, the challenge is not only to raise access but to improve the quality of grid electricity supply. Overall, however, there is no viable path to SDG target 7.1 without a significant role for decentralized renewable energy solutions.

The level of service provided by stand-alone solar solutions, mini-grids, and grid electricity is typically measured using the Multi-Tier Framework (box 1.1). This measures energy access based on seven "attributes" across six tiers (figure B1.1.1). Solar lights and home systems typically provide partial Tier 1, Tier and Tier 2 access, while mini grids and grid electricity typically provide a Tier 3, 4, or 5 level of service.

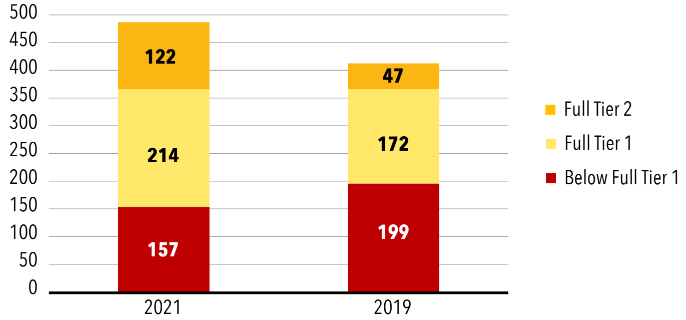
In 2022, the World Bank estimated that approximately 48 million people were connected to 21,500 mini-grids, with approximately half of installed mini grids are solar or solar hybrid, followed by those powered only by hydro (35 percent), fossil fuels (10 percent), and other generation technologies such as wind or fuel cells (5 percent).[5] A further 29,400 mini-grids were planned, 99 percent of them solar or hybrid. The latest "third generation" mini-grids—characterized by new technologies, business models, companies, partnerships, and tools, as well as tailored policy and regulatory systems—offer Tier 4–5 electricity access available 99 percent of the time (ESMAP 2022b). The number of off-grid customers worldwide enjoying Tier 1 and Tier 2 access rose substantially between 2019 and 2021 (figure 1.12).

Off-grid solar solutions contributed greatly to increasing the electricity access rate between 2016 and 2019, before disruptions linked to the COVID-19 pandemic led to a drop in sales in 2020. Sales have rebounded since, and off-grid solar is back on a path to accelerate electricity access, especially in rural areas. Sales and impact data from the Global Off-Grid Lighting Association (GOGLA), data covering only quality-verified products and sales reported by GOGLA members, show a return to growth from 2021 onward (GOGLA 2023a). Stand-alone off-grid solar solutions as a whole—including non-quality-verified systems—were estimated to be serving 490 million people at the end of 2021, up from 420 million in 2019, with a greater proportion achieving Tier 1 or Tier 2 levels of electricity access. IRENA estimates that 158 of the 490 million had access to solar lights and home systems meeting international quality standards (IRENA 2023).[6]

5 This is higher than IRENA's more conservative estimate that solar and hydropower mini-grids serve approximately 13.3 million people (IRENA 2023).

6 This figure encompasses Asia (excluding China), Africa, Central America and the Caribbean, the Middle East, Oceania, and South America. The main quality standard used for off-grid solar lights and home systems up to 350 W is IEC Technical Standard 62257-9-8:2020, with other standards covering specific components. For more information, see IEC (2024).

FIGURE 1.12 • OFF-GRID SOLAR USERS BY TIER OF ELECTRICITY ACCESS



Source: GOGLA and others 2022.

Box 1.1 • Measuring electricity access using the Multi-Tier Framework

The World Bank has sought to move away from a binary definition of electrification to a more nuanced approach, using the Multi-Tier Framework. In this approach, electricity access is measured based on seven attributes across six tiers of access with minimum requirements for each tier. Solar lights and home systems typically provide partial Tier 1 and Tier 2 access, whereas mini-grids and grid electricity typically provide a Tier 3, 4, or 5 level of service. Each attribute is assessed separately, and the overall tier for the household's access to electricity is calculated by applying the lowest tier obtained in any of the attributes.[a]

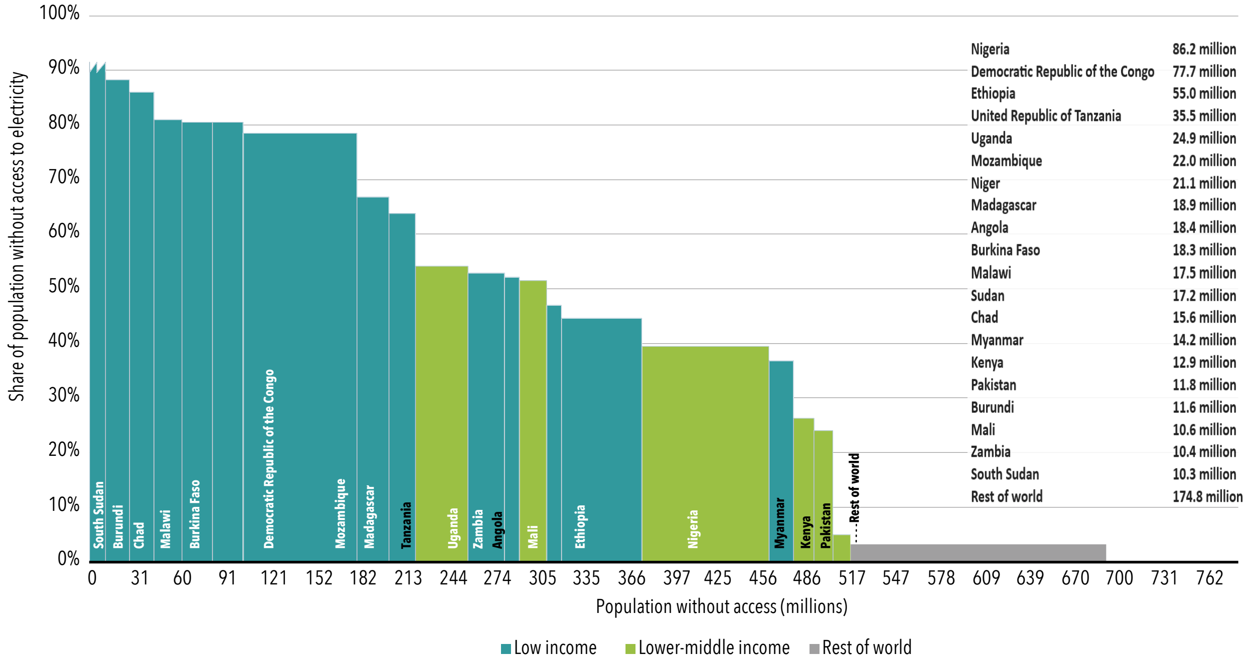
ATTRIBUTE		TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Capacity	Power capacity ratings (In W or daily Wh)	Less than 3W	Min 3 W	At least 50 W	At least 200 W	At least 800 W	At least 2 kW
		Less than 12 Wh	At least 12 Wh	At least 200 Wh	At least 200 Wh	At least 3.4 kWh	At least 8.2 kWh
	OR Services		Lighting of 1,000 lmhr per day	Electrical lighting, air circulation, television and phone charging are possible			
	Electricity Source						
Availability	Daily availability	Less than 4 hours	At least 4 hours		At least 8 hours	At least 16 hours	At least 23 hours
	Evening availability	Less than 1 hour	At least 1 hour	At least 2 hours	At least 3 hours	At least 4 hours	
Reliability		-More than 14 disruptions per week			At most 14 disruptions per week or at most 3 disruptions per week with total duration of more than 2 hours	>3 to 14 disruptions/ week) or ≤ 3 disruptions/week with> 2 hours of outage	At most 3 disruptions per week of total duration less than 2 hours
Quality		Household experiences voltage problems that damage appliances				Voltage problems do not affect the use of desired appliances	
Affordability		Cost of standard consumption package of 365kWh per year			Cost of a standard consumption package of 365kWh per year less than 5% of household income		
Formality		No bill payments made for the use of electricity				Bill is paid to the utility prepaid card seller, or authorized representative	
Health & Safety		Serious or fatal accidents due to electricity connection				Absence of past accidents and perception of high risk in the future	

Source: Bhatia and Angelou 2015.
Note: Color signifies tier categorization. lmhr = lumen hours; W = watts; Wh = watt hours; kWh = kilowatt hours.
a. Previously referred to as "Duration," this MTF attribute is now referred to as "Availability," examining access to electricity through levels of "Duration" (day and evening). Aggregate tier is based on lowest tier value across all attributes.

Country trends

In 2022, the 20 countries identified as having the largest number of people living without electricity accounted for nearly 75 percent of the global access deficit (figure 1.13).[7] Eighteen of these countries are in Sub-Saharan Africa, and 17 are among the least-developed countries. The same three countries as in the previous two editions of this report again topped the list: Nigeria (86.2 million), the Democratic Republic of Congo (77.7 million), and Ethiopia (55 million). Together the three accounted for roughly a third of the entire global deficit. Progress in Nigeria and the Democratic Republic of Congo remains slow, with average annual increases in access rates of just 1 percent and 0.7 percent, respectively, between 2010 and 2022. Ethiopia made more rapid progress, with a 2.5 percent average annual increase in the period.

FIGURE 1.13 SHARE AND ABSOLUTE SIZE OF POPULATION WITHOUT ACCESS TO ELECTRICITY IN THE TOP 20 ACCESS-DEFICIT COUNTRIES, 2022

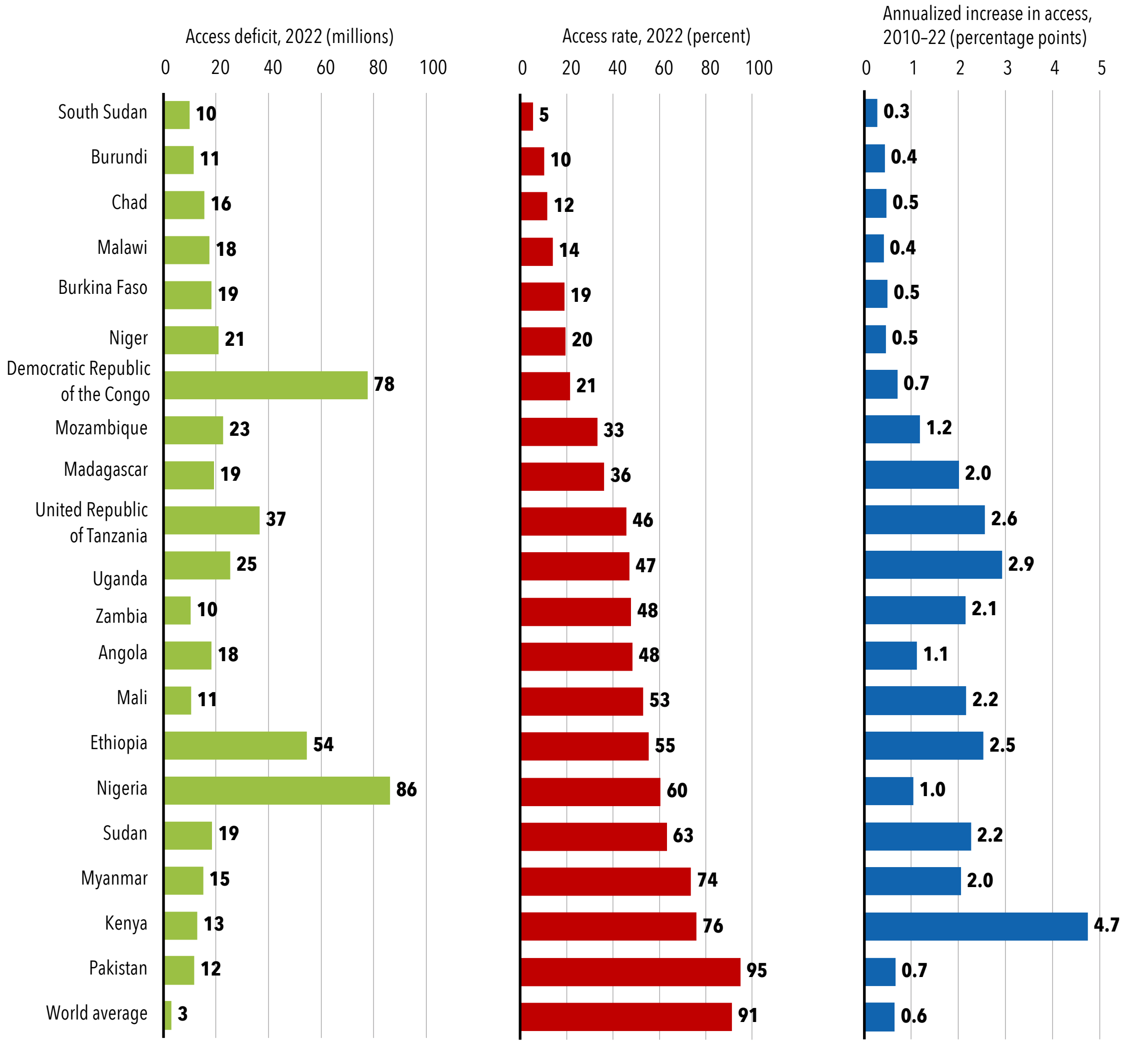


Source: World Bank 2024b.

The lowest national access rates in 2022 were observed in South Sudan (5.4 percent) and Burundi (10 percent), both of which showed only slight increases over the years since 2010 (figure 1.14). Madagascar and Tanzania, on the other hand, saw average annual growth of more 2 percentage points annually since 2010, despite starting from a low baseline. Aside from Nigeria, Pakistan, and Kenya, the countries with the lowest rates of electrification in 2022 were in the group of least-developed countries.

7 The top 20 countries are the countries with the largest populations lacking access for which reliable data are available.

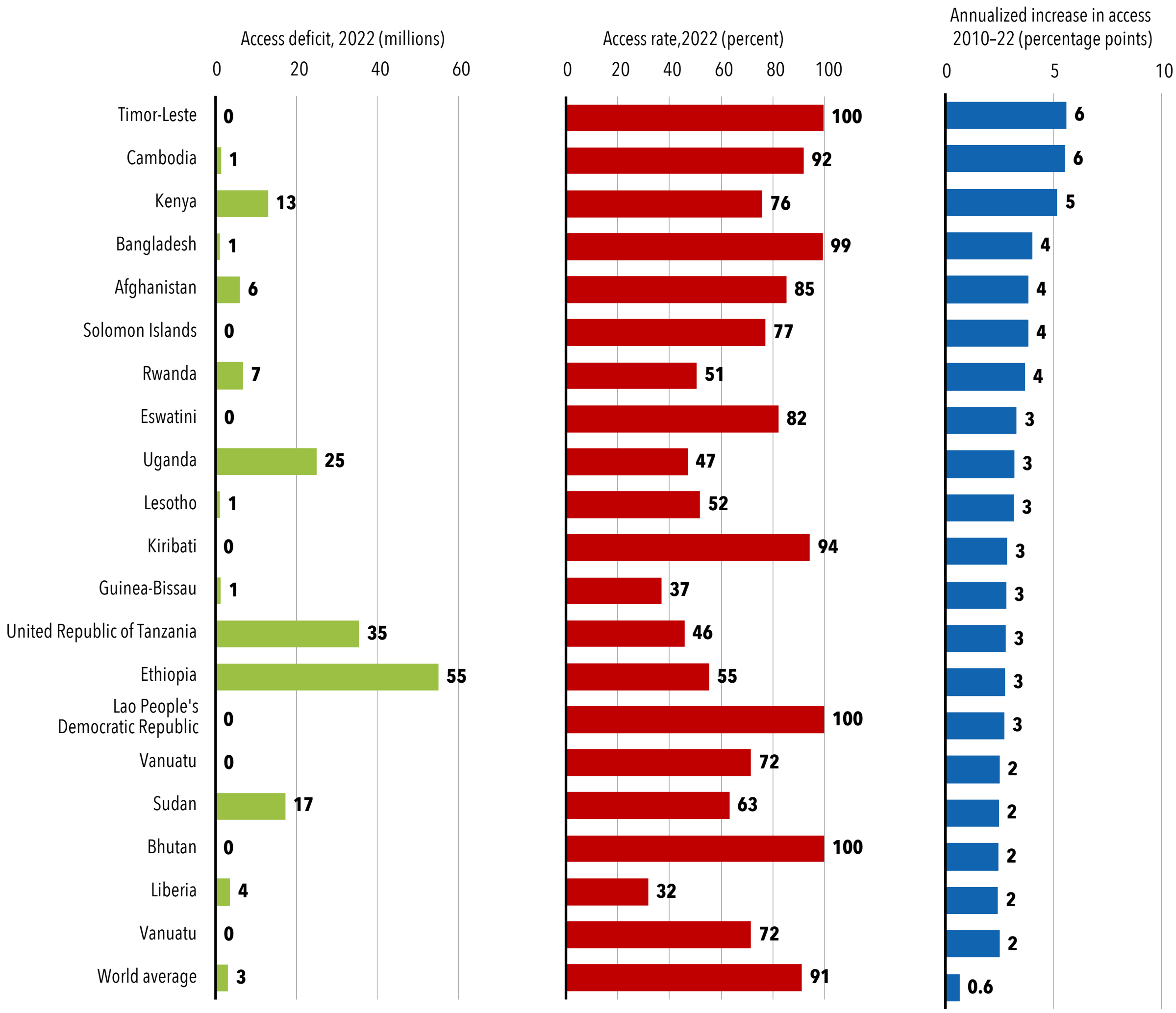
FIGURE 1.14 • ACCESS TO ELECTRICITY IN COUNTRIES WITH THE LOWEST RATES OF ELECTRIFICATION, 2022



Source: World Bank 2024b.

Kenya showed an impressive annual growth rate of 4.8 percent to reach 76 percent access by 2022, putting it both in the list of countries with the lowest rates of electrification and among the fastest electrifying countries (figure 1.15). Timor-Leste, the Lao People's Democratic Republic, and Bhutan also raised their access rates dramatically between 2010 to 2022, achieving universal electrification from very low starting points. Bangladesh very nearly closed the remaining access gap, reaching 99 percent access with an average annual growth rate of 4 percent.

FIGURE 1.15 • ACCESS TO ELECTRICITY IN THE 20 FASTEST ELECTRIFYING COUNTRIES, 2010–22

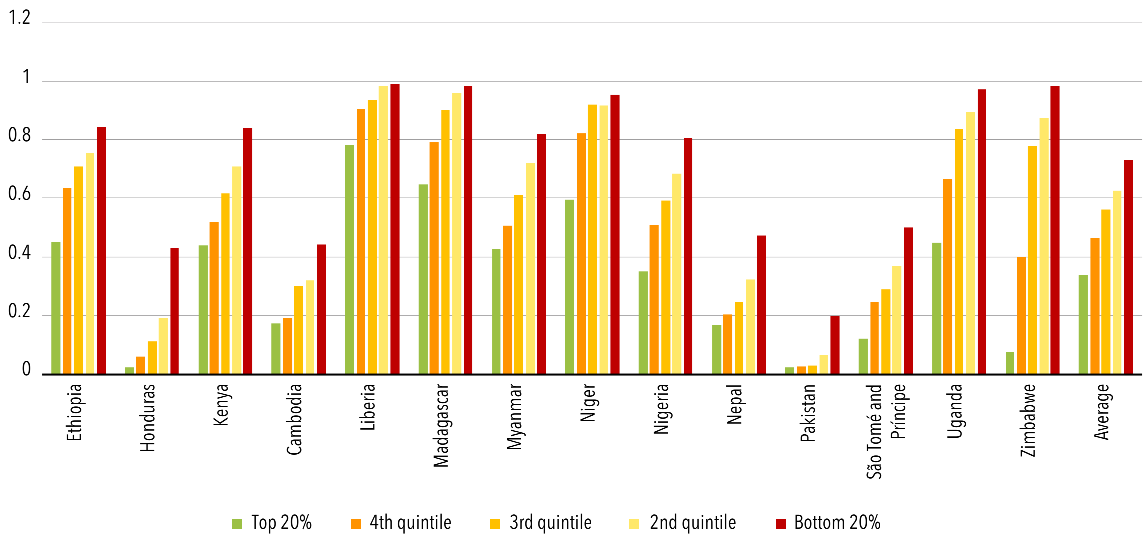


Source: World Bank 2024b.

Reaching the unserved population

As previously noted, the remaining population lacking electricity access has lower incomes and lives in more remote areas than those who have been newly connected over the past decade. Multi-Tier Framework (MTF) surveys that have gathered in-depth information on energy access in 14 countries over the past 9 years yield valuable insights regarding the population still to be reached.[8] According to data from the surveys, grid access is highly correlated with household incomes, with lower-income households less likely to be connected to the grid. For example, while 35 percent of households in the top income quintile in Nigeria lack grid access, the deficit rises to 81 percent for the lowest income quintile (figure 1.16).

FIGURE 1.16 • PROPORTION OF HOUSEHOLDS LACKING GRID ACCESS BY WEALTH QUINTILE



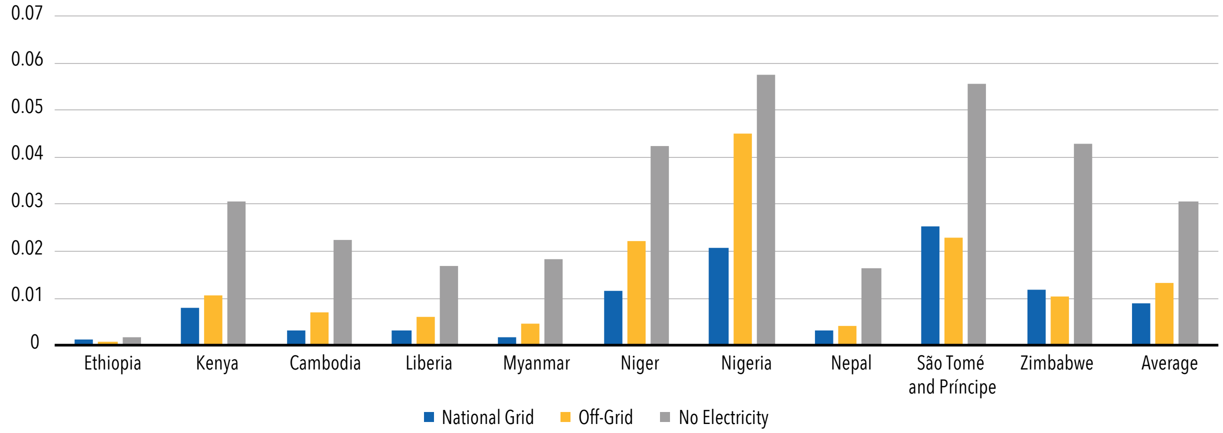
Source: ESMAP 2022c.

Thus, the access gap is increasingly concentrated in rural areas, which, again, are more remote and harder to reach. Moreover, in rural settings, where the load is smaller and more widely distributed, it is harder to justify the costs of grid expansion. The difference between urban and rural grid electrification rates is therefore stark, as seen in figure 1.11.

Households that lack access to electricity—whether from the grid or from off-grid solutions—allocate a substantial share of their monthly income to the purchase of inefficient and polluting energy sources such as kerosene, candles, and dry-cell batteries for lighting. Even after access is obtained, households may still need these inefficient lighting sources for outdoor cooking, walking in poorly lit neighborhoods, or access to places in the house where there is no electric lighting. However, the proportion of expenses on such non-electric lighting sources is lower for electrified households. For households that reported using such lighting solutions across 10 countries, people with no electricity access spend more than 3 percent of their household income on inefficient energy for lighting. Households with off-grid solutions spent only 1.34 percent on inefficient lighting, a rate that drops to 0.90 percent for those with grid access (figure 1.17).

8 The averages shown in figure 1.15 cover only the countries and locations surveyed and are not weighted according to sample size; nonetheless they offer a sense of overall correlations in the data. MTF surveys have been done by the World Bank's Energy Sector Management Assistance Program (ESMAP) and others since 2015. For more information, see ESMAP (2022c; 2024a).

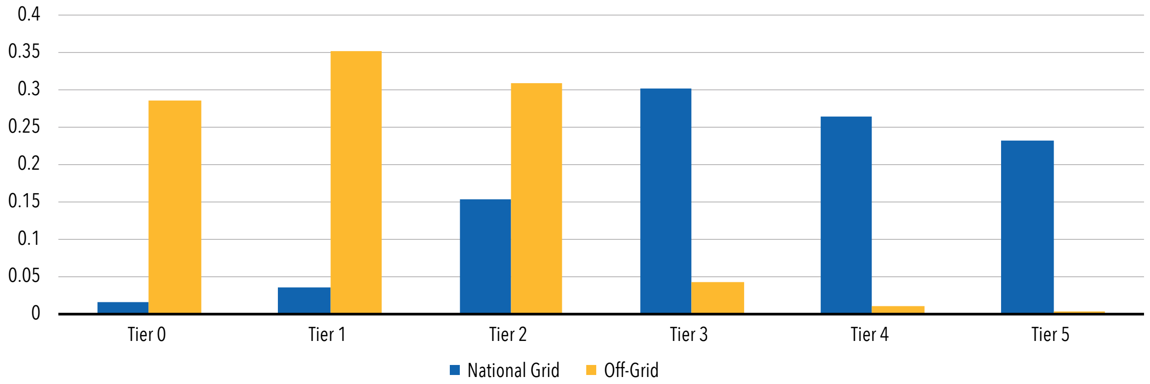
FIGURE 1.17 • SHARE OF MONTHLY HOUSEHOLD SPENDING ON INEFFICIENT ENERGY FOR LIGHTING



Source: ESMAP 2022c.

MTF data from 15 countries indicate that an average of 71 percent of households using any off-grid solution are gaining access to a Tier 1 level of electricity service or above, while 36 percent enjoy Tier 2 or above. The most commonly used off-grid solution is a solar lantern (50 percent), followed by solar home systems (17 percent), mini-grids (13 percent), generators (12 percent), and rechargeable batteries (10 percent). The percentage of grid-connected and off-grid households reaching each tier of access shows off-grid solutions providing most of the Tier 1 and 2 connections, with grid electricity providing most of the Tier 3–5 connections (figure 1.18).

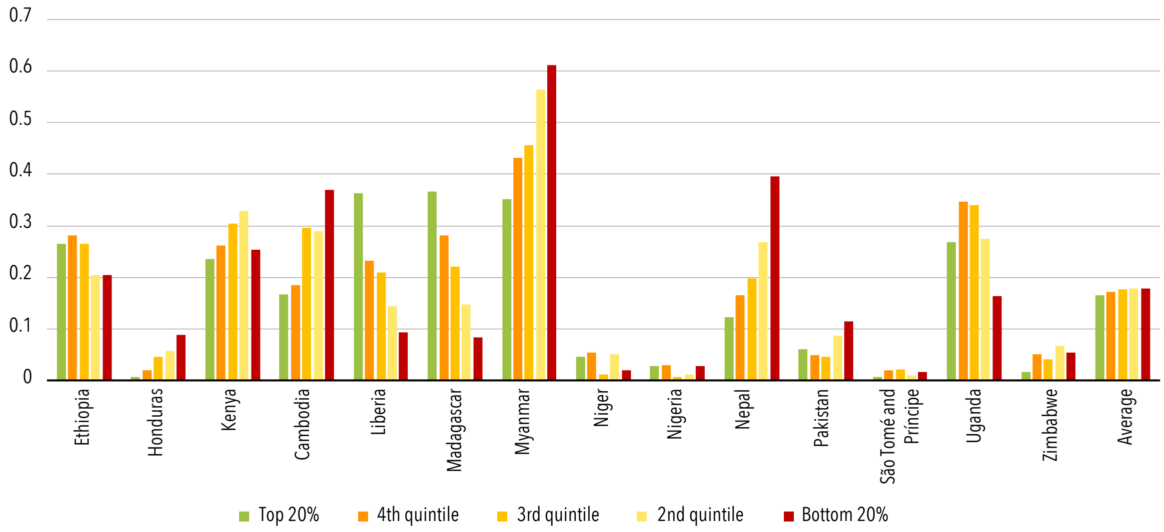
FIGURE 1.18 • PERCENTAGE OF GRID AND OFF-GRID HOUSEHOLDS REACHING EACH TIER



Source: ESMAP 2022c.

Across 15 countries, the penetration of off-grid solutions is typically higher in rural areas (the average is 20 percent) compared to urban areas (7 percent). The relationship between household income and the use of off-grid solutions varies, however. In countries such as Myanmar and Nepal, off-grid solutions are more likely to be used by lower-income households, perhaps because higher-income households are more likely to have access to a grid connection (figure 1.19). There is also likely to be a correlation between income and location, with higher-income households more likely to live in urban areas and lower-income households more likely to live in remote, rural areas where grid electricity is not available. In other countries, such as Liberia and Madagascar, higher-income households are more likely to use off-grid solutions, either because of limited grid access or because, where there is access, the quality of service is poor. In some cases, off-grid solutions can serve as a backup, particularly for more affluent households.

FIGURE 1.19 • PROPORTION OF OFF-GRID ENERGY SOLUTIONS BY WEALTH QUINTILE (PERCENT)



Source: ESMAP 2022c.

Modelling estimates of least-cost options for electricity access

Least-cost approaches to achieving universal electricity access under a range of demand scenarios are modeled in this section using the Global Electrification Platform (GEP n.d.). GEP is an open access, interactive online platform that models future electrification scenarios for countries with high access deficits. The scenarios present pathways for achieving universal electricity access, split into intermediate strategies from 2022 to 2025 and full electrification from 2020 to 2030. The tool, which uses data for 58 countries, was used to model pathways for achieving universal electricity access in the 20 countries with the largest access deficits.[9]

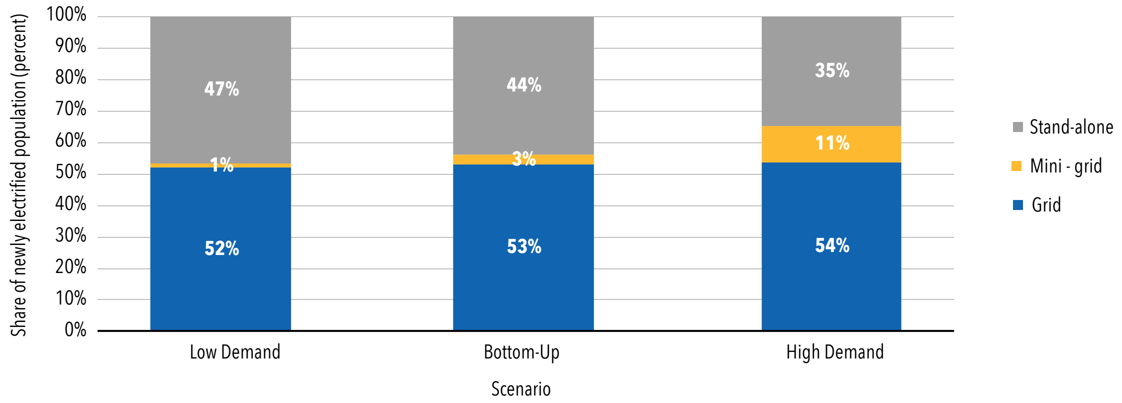
Residential electricity demand scenarios are modeled using projected population growth rates, combined with a target tier of electricity access and the associated electricity consumption level:

- In the "Bottom-Up" scenario, which is the base case, a unique demand target is set for each settlement, based on data on GDP and income levels.
- In the "Low Demand" scenario, urban demand is estimated based on 2020 levels of electricity consumption in electrified parts of the country, translated into the nearest equivalent access tier. Rural demand is set to Tier 1.
- In the "High Demand" scenario, the urban demand target is set one tier higher than 2020 levels of electricity consumption in electrified parts of the country (unless already Tier 5), while rural demand is set to Tier 2.

9 The top 20 access deficit countries are Burundi, Chad, Malawi, Burkina Faso, Niger, Democratic Republic of Congo, Madagascar, Uganda, Tanzania, Mozambique, Sudan, Zambia, Ethiopia, Angola, Mali, Kenya, Nigeria, Myanmar, Pakistan, and South Sudan.

In the Bottom-Up scenario, out of a total of 826 million new connections from 2022 to 2030, 439 million are made to the grid (53 percent), 363 million (44 percent) to stand-alone PV, and a further 24 million (3 percent) to mini-grids. By 2030, this results in 71 percent of the total population being reached by the grid, with a further 27 percent reached with stand-alone solar solutions and 2 percent served by mini-grids. In the Low Demand scenario, stand-alone PV plays a more prominent role; in the High Demand scenario, which envisages a Tier 2 level of household electricity access in rural areas, mini-grids provide 11 percent of new connections. In this latter scenario, there would also be greater productive use of electricity in commercial settings (figure 1.20).

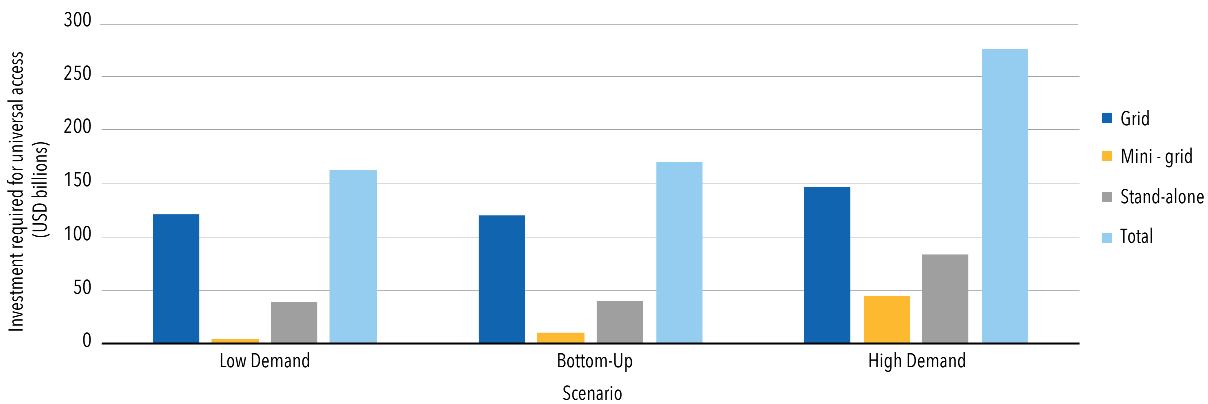
FIGURE 1.20 • NEWLY ELECTRIFIED POPULATION, BY SCENARIO, 2022–30



Source: World Bank 2024b.

The Bottom-Up scenario requires a total investment of USD 170 billion, with USD 120 billion invested in the grid, USD 40 billion in stand-alone PV, and a further USD 10 billion in mini-grids. The Low Demand scenario requires only slightly less investment (USD 163 billion), whereas the High Demand scenario requires a significantly greater total investment (USD 275 billion) (figure 1.21). These calculations are based on estimated up-front capital costs of each electrification solution and do not include ongoing operation and maintenance costs.[10] The GEP methodology is explained in box 1.2.

FIGURE 1.21 • GLOBAL INVESTMENT REQUIRED FOR UNIVERSAL ELECTRICITY ACCESS, BY SCENARIO (BILLIONS OF DOLLARS)



Source: World Bank 2024b.

10 For more information on OnSSET cost assumptions for each technology, see Korkovelos and others (2019).

Box 1.2 • Methodology of the Global Electrification Platform

To estimate demand, GEP uses population density maps to identify settlements. Geospatial information such as distance to the closest electricity grid, population density, and brightness at night (using satellite imagery) is used to determine the size and current electrification status of each settlement.

Commercial electricity demand is added as a multiplier of residential demand (30–60 percent), estimated using an economic index measuring GDP and accessibility (e.g., travel time to major cities). The location and size of education and health institutions are gathered from national data sets and OpenStreetMap, with electricity demand estimated based on the size of the institutions.

Least-cost technologies for each settlement are identified based on the levelized cost of electricity, taking into account the costs of transmission, distribution, and generation as applicable for each technology type and including both up-front capital costs and ongoing operation and maintenance costs.[a] The model assumes linear progress toward a final electrification rate of 100 percent by 2030. Based on a review of the rate of progress in a range of countries, it also assumes that the grid can at most double its generation capacity and connect an additional 2.5 percent of the population per year until 2025. Between 2025 and 2030, no such limitations are applied. The model indicates the technology mix, capacity, and investment requirements for achieving universal access in the modeled countries.[b]

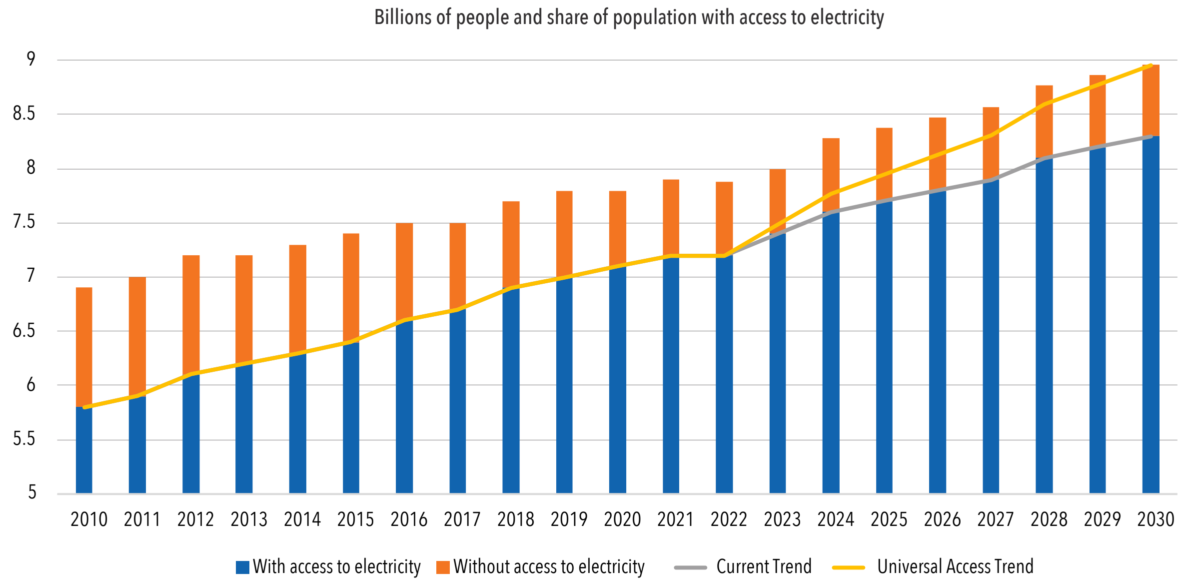
a. For more information on how the levelized cost of electricity can be calculated, see World Bank (2020).

b. For more information about the Open Source Spatial Electrification Tool (OnSSET) methodology that underpins the Global Electrification Platform, see Sahlberg and others (2020).

Looking ahead to 2030

Experience from several countries reveals the feasibility of accelerating the pace of electricity access, as pledged by the Global Roadmap for Accelerated SDG 7 Action in Support of the 2030 Agenda for Sustainable Development and in pursuit of the Paris Agreement on Climate Change (UN 2021). Attainment of the goal is particularly feasible through the promotion of off-grid solutions such as stand-alone PV and mini-grids. For example, Kenya moved from 36 percent access in 2011 to 75 percent in 2018 (Dubey and others 2019), while Rwanda has gone from an 11 percent access rate in 2011 to over 60 percent today (World Bank n.d.). Stand-alone off-grid solar solutions have made a significant contribution to progress in electricity access in both countries, providing Tier 1 and Tier 2 solutions. In Rwanda's case, notable success factors included government ownership, leadership, and commitment; an accountable and dedicated promotional structure; institutional strengthening; availability of funding; private sector involvement; and policy reforms (World Bank 2024a). These growth rates are even steeper than those achieved by past electrification champions, such as Vietnam, Thailand, and China. Figure 1.22 shows progress from 2010 to 2022, the current trend, and the trend required to achieve universal access.

FIGURE 1.22 • PROGRESS IN ELECTRICITY ACCESS FROM 2010 TO 2030



Source: IEA and World Bank 2024b.

But if mini-grid and stand-alone PV solutions are to fulfill their potential, a significant increase in the level of investment will be required—along with enabling policy and regulatory reforms, institutional strengthening, and capacity building. The stand-alone PV sector is projected to raise only USD 7.8 billion in investment between 2022 and 2030, and while data on mini-grid investment trends and projections are limited, this sector is also likely to be off-track (GOGLA and others 2022).

Scaling up the productive use of renewable electricity is critical to boosting incomes and resilience, while finding sustainable models for the electrification of public institutions will be essential for the reliable provision of health, education, and other social services. The total amount of funding for productive uses increased from USD 25 million in 2021 to USD 65 million in 2023 (GOGLA 2023b). Governments have steadily scaled up investments in electrification of public facilities through World Bank–funded projects since 2019; other major players include the UN Development Programme, GAVI, UNICEF, Power Africa, the SELCO Foundation, and the World Health Organization (SEforALL 2024).

The next two sections summarize recent developments in productive uses of electricity and the sustainable electrification of public institutions, before outlining what is needed for each sector to scale up.

PROMOTING THE PRODUCTIVE USE OF RENEWABLE ELECTRICITY

The productive use of electricity in rural communities contributes to socioeconomic development and improves quality of life. Productive use technologies such as solar water pumps, refrigerators, agri-processing machinery, and a wide range of equipment and tools for vocational, service, and other microenterprises increase incomes and raise productivity, contributing to job creation, the emergence of new enterprises, and economic growth. Much off-grid productive use to date has focused on improving agrifood systems, for example by improving the availability of water with irrigation and extending the shelf-life of food with refrigeration, which not only increases incomes but also enhances climate resilience and food security (World Bank 2023a).

A new generation of more affordable, high-performing tools and technologies for the productive use of renewable energy is emerging, promising a positive impact on incomes and quality of life for end users. In 2023, GOGLA reported continued growth of stand-alone solar appliances for productive uses, such as water pumps and refrigerators, with cumulative sales exceeding USD 1 million for the first time (GOGLA 2023a). A recent longitudinal study found that after four years, 86 percent of solar water pump users reported increased yields, and 70 percent found that their quality of life had very much improved. For refrigerator owners, 96 percent reported their businesses had gained more customers, logged more hours of operation, and increased inventory and supplies (Efficiency for Access and 60 Decibels 2023).

By increasing demand for electricity in grid- and mini-grid-connected settings, productive use technologies make an important contribution to the financial viability of rural electrification projects and businesses (World Bank 2023a). Research by the CrossBoundary Innovation Lab (2022) finds that average consumption per user was 48 percent higher in sites where appliance financing was made available (compared to control sites), with the top 20 percent of appliance financing customers consuming 16 times more than their peers. High-consuming customers ran equipment or machinery that met specific community needs, such as sewing, weaving, ice-making, and carpentry. An assessment of productive use programs implemented by Mlinda, India's leading mini-grid developer, found that microenterprises increased revenues by 28 percent.

Despite the growth in sales of productive use tools and technologies, adoption has been slow. This is due to challenges typical of emerging technologies and markets, such as low consumer awareness, product reliability, and affordability, as well as access to finance and capacity constraints at both the end-user and company levels (GDC 2022). There is a need for collaboration across the energy, water, and agriculture sectors to address these challenges, and for an enabling policy environment to accelerate adoption (WRI 2024).

According to a World Bank report, Accelerating the Productive Use of Electricity (2023a), five key building blocks are needed to accelerate access to productive use technology:

- **Planning.** Productive use needs to be integrated into rural electrification plans, both to maximize the development impact of energy access and to enhance the financial viability of rural electrification business models. GIS-linked data and analysis tools, as well as rural appraisals, can help to identify high-potential opportunities.

- **Technology and innovation.** Continued investment is needed to enhance the performance of productive use equipment while reducing its cost, alongside quality-assurance measures to mitigate technology risks. There is also a need to invest in innovative business models and digitalization, workforce skills, and stronger capacity among end users and companies. In particular innovations should focus on local needs and capacities to absorb and adapt technologies and business models to archive rapid replication and scale-up.
- **Access to finance.** End-user finance, essential to overcoming affordability constraints, could be provided either through suppliers of productive use technology, microfinance institutions, or local banks. Financial instruments such as up-front grants, results-based financing, credit lines, and guarantees can help to attract private debt and equity into the sector, enabling suppliers of productive use equipment to scale up.
- **Market and business development.** Raising awareness and marketing productive use technologies to local leaders, small businesses, and savings and cooperative groups, among others, is essential to accelerating adoption. Once small businesses have adopted productive use technologies, it is crucial that they be able to find buyers for their products and services. Collaboration across the energy, water, and agriculture sectors is essential to ensure that businesses have clear value propositions, ample access to technical and promotional information, adequate support to develop their businesses, and access to markets for their products.
- **Policy and regulation.** Tax exemptions or subsidies are needed to accelerate growth of the market in productive uses of renewable energy. Standards covering both productive use technologies and the services provided by the companies making use of those technologies are vital to protect consumers. Those standards must extend into areas such as consumer financing, repair, and e-waste management. Geospatial mapping exercises, household surveys, agricultural surveys, and market intelligence studies undertaken by governments can all help to inform data-driven decision-making by private sector, governments, and investors.

ELECTRIFICATION OF PUBLIC INSTITUTIONS

Affordable, reliable, and modern electricity services are key to improving nutrition, health care, education, jobs, and skills—all of which contribute to human capital development. Close to 1 billion people in low- and lower-middle-income countries are served by health-care facilities without reliable electricity access or with no electricity access at all. Approximately 12 percent of health-care facilities in South Asia, and 15 percent in Sub-Saharan Africa, have no access to electricity (WHO 2023). About 186 million children go to primary schools without any access to electricity (UNICEF 2023). Access to reliable electricity facilitates education by powering schools, enabling students to study after dark, and providing resources like computers and internet access. It supports health-care systems by allowing for the operation of medical equipment and refrigeration of vaccines.

Most unelectrified public institutions are in remote, hard-to-reach areas where grid electricity is not available—and not likely to become available in the near term, given the high cost and slow pace of grid extension. In these cases, the most cost-effective solution to electrifying such facilities is typically via stand-alone solar systems and storage solutions. The conventional approach is through engineering, procurement, and construction (EPC) contracts. In this model, once systems are installed, ownership is transferred to the relevant ministries, which often lack the capacity and funding required to cover operation and maintenance. Despite efforts to ensure longer-term operation and maintenance, EPC approaches have not passed the test of time.

To reverse this trend, the World Bank and other development partners—including SEforALL, the UN Development Programme, and Power Africa—are deploying new strategies to ensure sustainable electricity service provision to health centers and schools, such as the “energy as a service” model. The EaaS model leverages the expertise and capital of the private sector to deliver electricity services to public institutions, while ensuring that financing and incentives are structured over the long term, usually 10 to 15 years (SEforALL and ESMAP 2021). Electricity service companies (ESCOs) are responsible for installation, operation, and maintenance. Asset ownership is typically retained by the ESCO during the payment period and transferred at the end of the contract. Remote monitoring platforms are used to track performance, with payments made to ESCOs based on availability of service. Capital grants may be offered to cover part of the up-front system cost in order to ensure that payments made over time are affordable for the public sector, while also ensuring bankability for the private sector. Derisking mechanisms such as guarantees are used to cover cases of nonpayment by health facilities or schools.

The EaaS model is being implemented in several countries, with the World Bank's Uganda Electricity Access Scale-Up Project representing the largest application so far, initially targeting 700 facilities (World Bank 2022a). Further pilots are being undertaken in Nigeria and Benin within the World Bank's Regional Off-Grid Electricity Access Project (World Bank 2019). Through the Distributed Access through Renewable Energy Scale-Up Platform (DARES) the World Bank, International Finance Corporation, and Multilateral Investment Guarantee Agency have committed to work together to electrify 100,000 public institutions using the DARES model (World Bank 2022b). As a first step, the Accelerating Sustainable and Clean Energy Access Transformation program was launched in 2023; ASCENT targets 50,000 schools and health centers in East and Southern Africa (World Bank 2023b). To support these projects, tools and resources have been developed by the World Bank, the Energy Sector Management Assistance Program, and SEforALL, including quality-assurance frameworks, bid-specification templates, design templates, and market assessments.[11]

The World Bank, SEforALL, the UN Development Programme, Power Africa, and other development partners are assembling the building blocks needed to implement EaaS and other private sector–led models. Such building blocks include a conducive enabling environment that encompasses coordination among energy and education stakeholders; fiscal reforms to increase the health and education sector's ability to pay for ongoing electricity services; data resources to ensure demand-driven design; capacity building; and financial risk mitigation mechanisms to support both service providers and public sector agencies.

The World Bank's and SEforALL's report, From Procurement to Performance (SEforALL and ESMAP 2021), makes the following recommendations to scale up modern, affordable, sustainable, and reliable electricity services for public institutions via EaaS in low- and lower-middle-income countries:

- **Invest in data.** Data are needed on the location and electrification status of public institutions, as well as their level of demand and ability to pay for electricity services.
- **Support demonstration.** Donors and development finance institutions should support experimentation and the demonstration of service-based models through pilots. Their support should also help identify and address risks faced by different stakeholders, including government, donors, companies, and investors. Grants and loans will be needed to scale up, including concessional financing and derisking mechanisms, as well as technical assistance and capacity building.
- **Foster dialogue and knowledge exchange.** For this model to be successful, stakeholders need to come together to exchange best practices and to identify remaining barriers. A platform needs to be in place—especially at the national level—to allow the process to be inclusive of public and private sector actors, as well as stakeholders in energy, education, and health.
- **Rally the sector behind sustainable delivery models.** To be truly viable and scalable, service-based models will eventually require greater buy-in, support, and coordination among a range of stakeholders, including governments, development finance institutions, service providers, and investors.

11 For more information, see ESMAP (2024b) and SEforALL (2024).

ACHIEVING SDG TARGET 7.1

SDG target 7.1 can be met by 2030 only through a combination of grid, mini-grid, and stand-alone solutions. Distributed solutions that can leverage a much larger set of stakeholders, including consumers themselves, can lead to faster deployment speeds and thus help close the access gap quickly. There is a parallel need to improve the performance, condition, and financial viability of the grid so that government funds are used efficiently, thereby freeing up resources to help close the access gap. The 2022 edition of this report highlighted the need to reinforce policy and regulatory frameworks; enhance the socio-economic inclusiveness of energy access; align the costs, reliability, quality, and affordability of energy services; and catalyze, harness, and redirect financing for energy access (IEA, IRENA, UNSD, World Bank, WHO 2022). The 2023 edition made further policy recommendations about how to strengthen linkages with other SDGs (IEA, IRENA, UNSD, World Bank, WHO 2023).

These recommendations can be implemented through national and regional electrification programs that use public funding to unlock private co-investment. The World Bank has partnered with the African Development Bank Group on an ambitious effort to provide at least 300 million people in Africa with electricity access by 2030 (World Bank 2024c). It has also launched ASCENT, a USD 5 billion program designed to attract an additional USD 10 billion in investment for the purpose of exponentially accelerating sustainable and clean energy access and providing life-transforming opportunities for 100 million people in up to 20 countries across Eastern and Southern Africa over the next seven years. With 365 million people without electricity and 558 million without clean cooking, the region accounts for more than half of the world's unelectrified population and nearly a quarter of people without access to clean cooking fuels. As described in this chapter, the lack of access hinders the region's economic recovery, resilience, and progress toward poverty reduction.

ASCENT, one of the world's largest energy access programs to date, is organized into three pillars. The first focuses on the development of regional and national platforms to enable economies of scale and cost-reduction strategies. The second pillar provides investment and technical assistance for grid densification and expansion; grid connections, reinforcement, and upgrading; and investments in integration of variable renewable energy. The third pillar finances investments in distributed renewable energy and clean cooking to expand energy access for households, enterprises, farmers, schools, health clinics, and other institutions. ASCENT leverages digital technologies for remote monitoring of solar home systems and mini-grids, verification of results, planning, and reporting. The program will begin in four countries (Rwanda, São Tomé and Príncipe, Somalia, and Tanzania) before expanding to up to 20 countries in the region over the next seven years (World Bank 2023b).

Conclusion

There is much to celebrate as we take stock of global progress in efforts to expand access to electricity. From the baseline year of 2000, when 78 percent of the world's population enjoyed access to electricity, we have now reached an access rate of 91 percent. This has been achieved despite significant population growth and global disruptions such as COVID-19 and the conflict in Ukraine.

Even as we recognize this success, however, we must remember that 685 million people were still living without electricity in 2022—the vast majority in Sub-Saharan Africa. They represent some of the world's most vulnerable people, located in remote areas with limited institutional capacities, often in areas beset by conflict and poverty. All of this makes them more difficult to serve than most of those already reached. Since 2000, the highest rate of increase achieved in electricity access was 0.77 percent per year over the period 2010–20, but over the next six years we must reach an increase of at least 1.08 percent each year to meet our target of universal access by 2030.

While daunting, this challenge is not insurmountable. But it will require thinking outside the box, strong commitments, deep partnerships, increased investments, and collaboration to meet the common goal of universal access. Some suggestions along these lines are outlined below:

- Sub-Saharan Africa, which accounts for 83 percent of the remaining access deficit, must remain a key focus of electrification activities. A particular focus on those countries with the largest populations lacking access—the Democratic Republic of Congo, Nigeria, and Ethiopia—will be critical.
- Even as we accelerate efforts to expand the grid, attention and investment must focus on off-grid and mini-grid options that can be deployed rapidly and affordably through combined public-private efforts.
- In parallel, modern tools must be deployed to improve the performance of the grid and off-grid infrastructure, as well as to gather more accurate information to track access and inform data-driven decision-making, all for the purpose of squeezing efficiencies and freeing up resources in a constrained fiscal space.
- Scarce public funding must be targeted toward those with lower affordability thresholds, requiring a deeper understanding of consumers so that funds can be directed to have the greatest impact. Public funds must also be used to catalyze private investment, in order to maximize total investments in the achievement of access goals.
- Productive uses of renewable energy and the electrification of public facilities in off-grid settings can be promoted through cross-sectoral approaches involving energy stakeholders collaborating with counterparts in agriculture, water, education, health, and other sectors.
- Building capacity in planning, management, data gathering, and monitoring is crucial. Improving the quality and frequency of data collection on energy access—while ensuring that data are disaggregated by gender—will be essential in building a just and inclusive energy sector. By scaling up household surveys and using new tools for outreach and analysis, the pace and efficacy of implementation can be accelerated.
- Access efforts must move beyond a focus on connections toward one of ensuring sustainable service over time, factoring in reliability, social impact, resilience, and social justice.

The exercises just described should encourage South-South learning, particularly in view of the successes achieved in Latin America, East Asia, and most recently in Central and South Asia between 2010 and 2022.

We hope that this edition of the SDG 7 Tracking Report will highlight the need to accelerate efforts through deeper partnerships and increased investments, particularly toward decentralized solutions, to enable universal access to electricity by 2030.

ANNEX 1.
METHODOLOGICAL NOTES

Chapter 1. Access to electricity

THE WORLD BANK'S GLOBAL ELECTRIFICATION DATABASE

The World Bank's Global Electrification Database compiles nationally representative household survey data and census data for the period 1990–2022. It incorporates data from the Socio-Economic Database for Latin America and the Caribbean, the Middle East and North Africa Poverty Database, and the Europe and Central Asia Poverty Database, all of which are based on similar surveys. The database relies on the Bank's Multi-Tier Framework, which classifies access along a tiered spectrum, from Tier 0 (no access) to Tier 5 (the highest level of access). At the time of this analysis, the database contained 1,404 surveys from 149 countries in 1990–2022.

A multilevel, nonparametric model is applied to extrapolate data for missing years (described below). The modelling approach originally developed by the World Health Organization (WHO) to estimate clean fuel usage was adapted to project electricity access and fill in missing data points.[1] Where data were available, access estimates were weighted by population. Multilevel, nonparametric modelling considers the hierarchical structure of data (country and regional levels), using the regional classification of the United Nations.

The model was applied in all countries with at least one data point. To use as much real data as possible, results based on survey data were reported in their original form for all years available. The statistical model was used to fill in data for years in which data were missing and to conduct global and regional analyses. In the absence of survey data for a given year, information from regional trends was used. The difference between real data points and estimated values is clearly identified in the database. Countries classified as high-income are assumed to have electrification rates of 100 percent for the years the countries belong to the category.

For 1990–2010, the statistical model was based on insufficient data points or outdated household surveys. To avoid having electrification trends in this period overshadow efforts since 2010, the model was run twice, once with survey data and assumptions for 1990–2022 (for model estimates for 1990–2022) and once with survey data and assumptions for 2010–22 (for model estimates for 2010–22). The first run extrapolates electrification trends for 1990–2022, given the available data points. The second considers only real data collected since 2010 and estimates the historical evolution in the most recent years. The outputs from the two model runs were then combined to generate a final value for access to electricity. If survey data were available, the original observation remained in the final database. Otherwise, the larger value generated by the model runs was chosen as the final data point.

Under the WHO methodology adapted for the purpose of assessing access, regional trends affect the estimation of yearly values in countries with missing data points in certain years. Depending on the regional trend and how many years have passed since the last available year of data for a certain country, the model can interpolate unrealistic access rates of 100 percent. To avoid reporting unrealistic rates, the country's latest survey data are extended. In this version of the report, this was done Nepal, and Nigeria.

1 The model draws on the modelling of solid fuel use for household cooking presented in Bonjour and others (2013).

COMPARISON BETWEEN DEMAND-SIDE DATA AND SUPPLY-SIDE DATA

While the World Bank's Global Electrification Database collects data mainly from household surveys and censuses, the IEA's Energy Access Database draws from government reports of household electrification (usually based on connections reported by utilities). IEA considers a household to have access if it receives enough electricity to power a basic bundle of energy services.

The two approaches sometimes yield different estimates. Estimates based on household surveys are moderately higher than estimates based on energy sector data because they capture a wider range of phenomena, including off grid access, "informal" connections (connections not made by or known to the utility), and self-supply systems.

Comparison of the two datasets in the previous edition of this report (updated in this edition) highlights their respective strengths. Household surveys, which are typically conducted by national statistical agencies, offer two advantages for measuring electrification. First, thanks to efforts to harmonize questionnaire designs, electrification questions are largely standardized across country surveys. Although not all surveys reveal detailed information on the forms of access, questionnaire designs capture emerging phenomena, such as off-grid solar access. Second, data from surveys convey user-centric perspectives on electrification. Survey data capture all forms of electricity access, painting a more complete picture of access than may be possible from data supplied by service providers. But greater investment in data collection and capacity building is needed to generate a comprehensive and accurate survey-based understanding of electricity access.

Government data on electrification reported by national ministries of energy are supply-side data on utility connections. They offer two principal advantages over national surveys. First, administrative data are often available on an annual basis and may therefore be more up to date than surveys, which are conducted every two to three years. (Moreover, since 2010, only about 20 percent of countries have published or updated their electricity data at intervals of two to three years in time for global data collection.) Second, administrative data are not subject to the challenges that can arise when conducting field surveys. Household surveys (particularly those implemented in remote and rural areas) may suffer from sampling errors that may lead to underestimation of the access deficit.

MEASURING ACCESS TO ELECTRICITY PROVIDED THROUGH OFF-GRID SOLAR SOURCES

The rates and levels of access to off-grid solar energy shared in this chapter are based on data shared by affiliates in the bi-annual data collection undertaken by GOGLA, Lighting Global, and Efficiency for Access.

Eligible off-grid solar lighting products included in the affiliate data collection are defined as systems that include a solar panel, a battery, and at least one light point. Every six months, affiliate companies fill out a questionnaire on their product sales by country, system type/size, and business model; they also share product specifications and capacities. Although companies are ultimately responsible for the accuracy of the self-reported data submitted, the data are checked for quality by an independent consultancy (Berenschot), as well as by GOGLA, Lighting Global, and the Energy Savings Trust.

Manufacturers and distributors of off-grid solar products report their sales, but the results shared in public reports cover only products sold by manufacturers of off-grid solar products. This is to avoid double counting sales reported by both manufacturers and distributors. The product sales reported by manufacturers include both business-to-business transactions (e.g., sales to distributors, governments, and nongovernmental organizations) as well direct business sales to customers. The latest Off-Grid Solar Market Trends Report (GOGLA and others 2022) estimates that sales of

GOGLA affiliate companies represent 28 percent of the total off-grid solar market, although estimates of percentages by country, as well as by system size and business model, vary significantly.

In addition to using standardized impact metrics[2] created by the GOGLA Impact Working Group, additional steps are taken to calculate tiers of energy access:

Tier 1. To estimate Tier 1 energy access, a "SEforALL factor" is applied to the sales numbers.[3] That factor estimates the service-level impact of smaller technologies. This tool reviews the system size and capacity of each product and estimates whether it has helped to unlock either partial or full Tier 1 access. It then calculates the total number of people who have achieved either partial or full Tier 1 access.

Tier 2. Products that have a capacity of more than 50 watts peak, or that are more than 20 watts peak and come packaged with a television, are deemed to provide Tier 2 energy access. This approach is designed to align product specifications or energy service with the requirements for Tier 2 access of the Multi-Tier Framework. Products that have enabled a household to achieve Tier 2 access are not included in the final Tier 1 estimates.

MEASURING ACCESS TO ELECTRICITY PROVIDED THROUGH MINI-GRID SOURCES

IRENA collects off-grid capacity and generation data from a variety of sources. These include IRENA questionnaires; national and international databases; and unofficial sources, such as project reports, news articles, academic studies, and websites. For some countries, IRENA also estimates off-grid solar PV capacity, based on solar panel import statistics obtained from the United Nations' COMTRADE Database.

The agency's 2022 decentralized energy database contains global data on off-grid renewable energy in Africa, Asia, South America, Central America and the Caribbean, and Oceania. Its database covers off-grid renewable power capacity (in megawatts), biogas production (in cubic meters), and energy access (in numbers of inhabitants). This chapter uses energy access data estimated for people with access to hydropower, solar mini grids (Tiers 1 and 2), and biogas.

IRENA publishes off-grid statistics by the end of December each year. Details on the methodology used in this report are set forth in IRENA (2018).

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2 The Global Impact Metrics are available online here: https://www.gogla.org/impact/gogla-impact-metrics.

3 Where a product provides partial Tier 1 access a methodology devised by SEforALL can be applied to calculate how several products can be combined to reach Tier 1 equivalency. The methodology was designed to account for "energy stacking" and so to prevent Tier 1 access from being underrepresented in calculations.

ANNEX 2.
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