CHAPTER 1
ACCESS TO ELECTRICITY

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Main messages

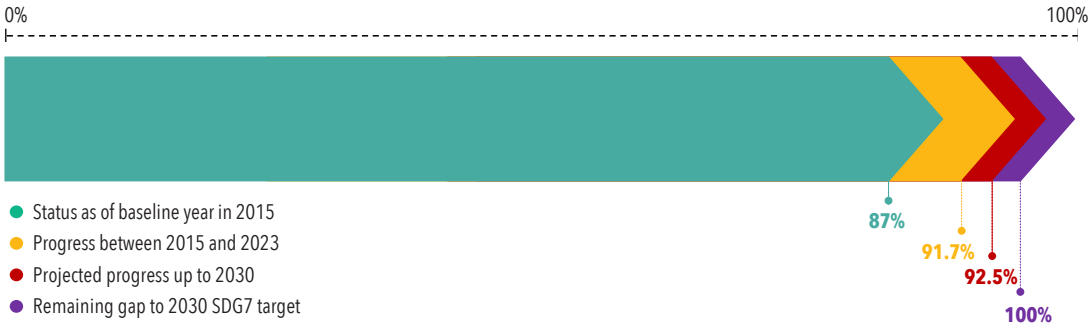
- **Global trend.** Progress toward the goal of improving access to electricity has recovered from its 2022 slump. In 2023, new connections outpaced population growth, raising global access to 92 percent and reducing the number of people without electricity to 666 million—19 million fewer than in the previous year. While this marks a return to a positive trend, the growth rate remains far short of what is needed to reach universal access by 2030. The remaining unconnected population is more likely to live in remote areas, have lower incomes, and face challenges of fragility, conflict, and violence (FCV), than those connected to date. This population would be best served through a combination of grid, mini-grid, and off-grid solutions.
- **Regional highlights.** Central and Southern Asia have made significant strides toward universal access, narrowing their electricity access gap from 414 million in 2010 to just 27 million in 2023. However, closing the gap in Sub-Saharan Africa has been more challenging. While 35 million new people in Sub-Saharan Africa gained access to electricity in 2023, the gap shrank by only 5 million net of population growth—from 570 million in 2022 to 565 million in 2023. As a result, Sub-Saharan Africa now accounts for 85 percent of the global population without electricity—up from 50 percent in 2010. Thus, to reach the target of universal access to electricity, electrification rates in Sub-Saharan Africa must accelerate dramatically.
- **Top 20 access-deficit countries.** Eighteen of the 20 countries with the largest electricity access deficits in 2023 were in Sub-Saharan Africa. As in the previous year, the deficits in Nigeria (86.6 million), the Democratic Republic of Congo (79.6 million), and Ethiopia (56.4 million) accounted for more than one-third of the globe's population without electricity. To advance progress toward Sustainable Development Goal (SDG) 7.1.1, targeted efforts are required to accelerate access in countries with the largest deficits. Responding to this need, the Mission 300 initiative led by the World Bank and African Development Bank (AfDB) seeks to accelerate electrification efforts in Sub-Saharan Africa and targets aims to facilitate access to 300 million people by 2030—more than half the estimated 2023 electricity deficit. Mission 300 will spur other initiatives in the region and targets raising over USD 90 billion in funding to reach its electrification targets.
- **The urban-rural divide.** The electricity access challenge is greatest in rural areas, where 84 percent of the world's people without electricity live. While overall progress in rural electrification was greater than that in urban areas, the gain was largely driven by advancements in Central and Southern Asia, where the number of rural people without access was cut from 383 million in 2010 to just under 25 million in 2023. By contrast, in Sub-Saharan Africa, rural population growth outstripped electrification efforts, leaving 451 million people in rural areas without electricity in 2023. To close the access gap in the most inclusive manner, a better understanding of end consumers will be required: their needs, demographics, affordability thresholds, and decision-making criteria. To gain that understanding, governments must emphasize quality data collection and capacity building at the level of national statistical organizations and other agencies. Definitions of access should also be harmonized within countries and across regions.

- **Decentralized renewable energy (DRE).** Expanding access through grid expansion is complicated by the fact that populations without electricity tend to live in remote locations (many of which are beset by conflict) and to consume only small amounts of energy. Advances in DRE technologies and business models offer good options for reaching these market segments, enabling cash-strapped governments to engage the private sector, development partners, and consumer finance experts in efforts to design cost-effective DRE-based solutions such as those that benefited an estimated 561 million people worldwide in 2023, as well as more than half of the new connections in Sub-Saharan Africa between 2020 to 2022 (ESMAP 2024). The DRE sector has proven resilient to macroeconomic challenges, with more than 50 million off-grid solar products being sold in both 2022 and 2023. (This includes products sold to households for use as a primary electricity source, as well as products intended for use as an additional source, complementing an intermittent grid connection.) Looking ahead to 2030, off-grid solar is the most cost-effective solution for 41 percent of people without access to electricity. An especially promising path forward is to combine household electricity access with technologies (e.g., solar water pumps, cold storage) that enable micro, small, and medium enterprises to generate income from the electricity available to them. Thus, the USD 1.2 billion invested in the off-grid solar sector in 2022–23, largely through debt financing (ESMAP 2024), must sharply increase to meet the SDG 7 goal of universal access by 2030.
- **Building on the gender-energy nexus.** Challenges persist in addressing the interlinkages between electricity access and gender. World Bank data shows that households headed by women in Africa and South Asia are less likely to enjoy off-grid access than in other regions, with affordability being a key barrier. Women also remain underrepresented across the energy sector. Better access will allow women to increase their incomes, thereby facilitating their economic empowerment. Wider access will also make it easier to gather vital information on women's health, education, and well-being. These issues are explored in box 1.3, which closes the chapter.

Are we on track?

In 2023, just under 92 percent of the global population had access to electricity (figure 1.1), leaving 666 million people without access. In 2023, 565 million without access were in Sub-Saharan Africa, where access rates must accelerate, particularly for low-income households in remote areas, if targets are to be met. Following current trends, 645 million people will still lack electricity in 2030. Responding to this need, the Mission 300 initiative led by the World Bank and African Development Bank (AfDB) will tackle these challenges head-on, facilitating access to 300 million people in the region over the next five years. However, the path to achieving universal access by 2030 will be difficult unless other partners step in with ambitious initiatives to close the gap.

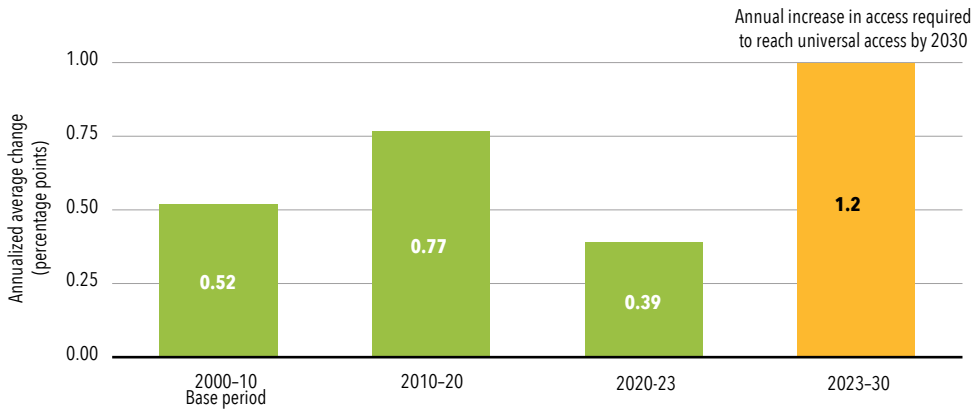
FIGURE 1.1 • PERCENTAGE OF POPULATION WITH ACCESS TO ELECTRICITY



Source: World Bank 2025.

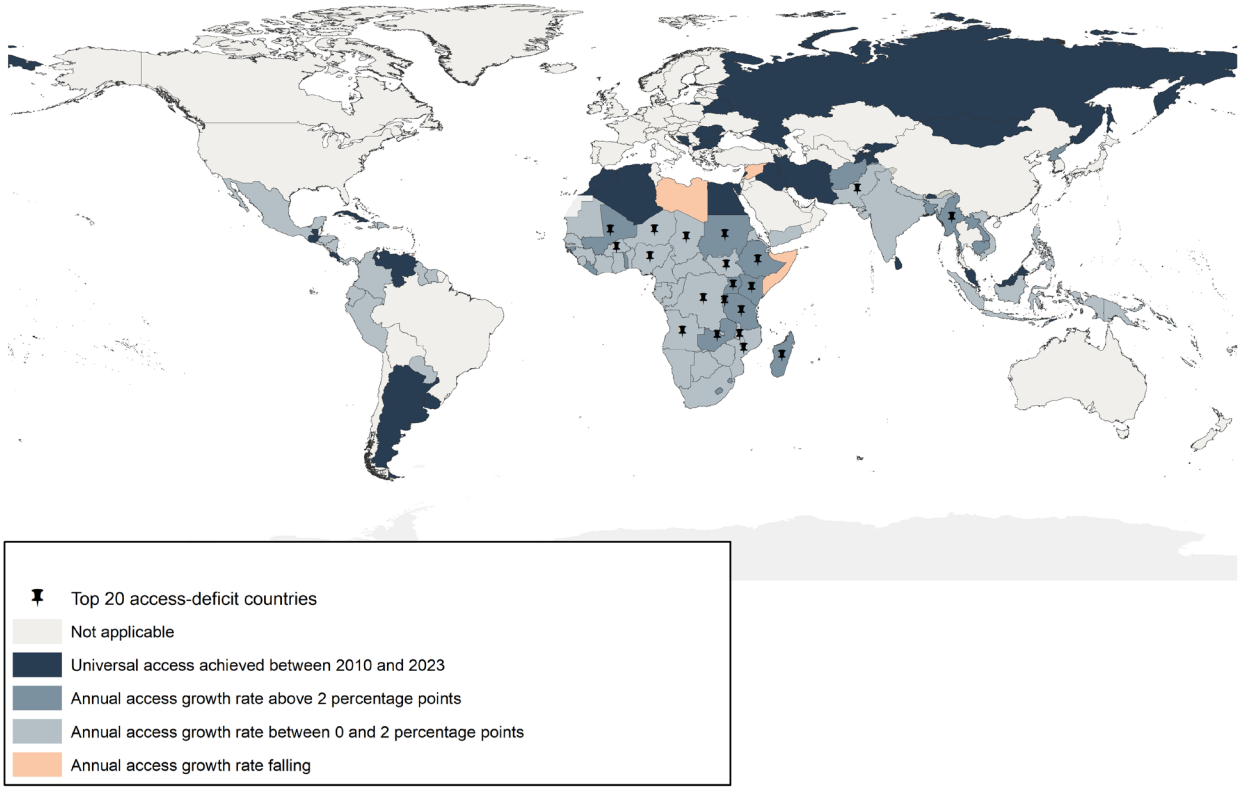
Significant progress was made between 2010 and 2020, when access to electricity grew by an average of 0.77 percentage point per year (figure 1.2). However, growth slowed to an average of 0.39 percentage point between 2020 and 2023, putting increased pressure on future efforts to achieve SDG 7. Achieving universal access by 2030 will now require an annual increase of 1.2 percent—a doubling of the recent pace of progress, even as the remaining unconnected population becomes harder to reach and increasingly unable to afford electricity (figure 1.3).

FIGURE 1.2 • AVERAGE ANNUAL INCREASE IN ACCESS TO ELECTRICITY, 2000–23



Source: World Bank 2025.

FIGURE 1.3 • ANNUAL CHANGE IN ELECTRICITY ACCESS RATES IN ACCESS-DEFICIT COUNTRIES, 2010–23



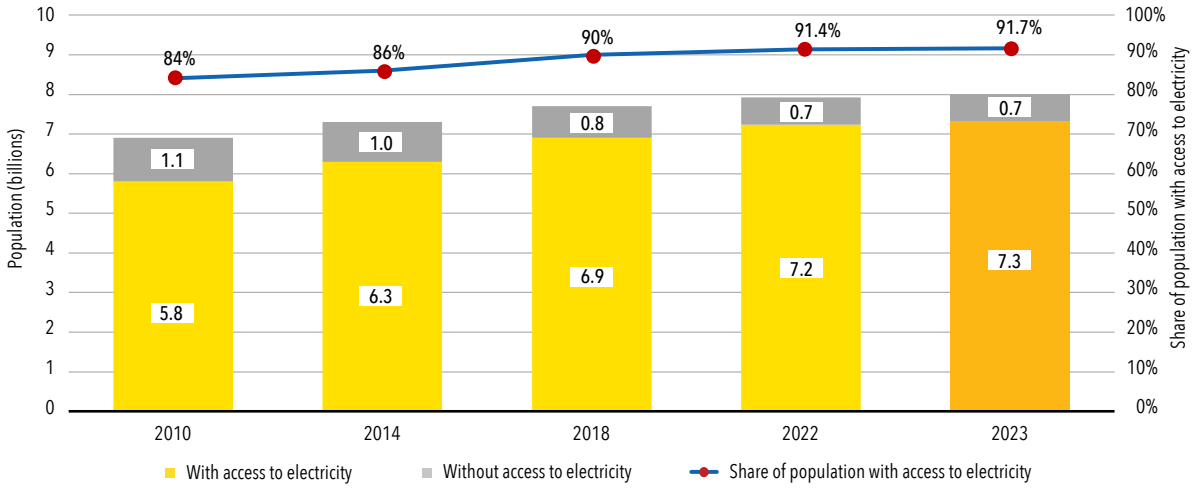
Source: World Bank 2025.

Looking beyond the main indicators

Access deficits and population growth

Global electricity access rose from 84 percent in 2010 to 91.7 percent in 2023 (figure 1.4), despite the setback suffered in 2022. Post-COVID supply chain disruptions eased in 2023, but high inflation, coupled with currency devaluation in many countries, made electricity less affordable for many consumers while straining the finances of private companies, utilities, and governments (ESMAP 2024). The result has been a slowing of progress over the past five years. Expanding access in remote, low-income areas (where grid expansion is typically not the least-cost option) will require a strong focus on decentralized solutions, such as off-grid and mini-grid systems.

FIGURE 1.4 • GAINS IN GLOBAL ELECTRICITY ACCESS AND POPULATION GROWTH, 2010–23

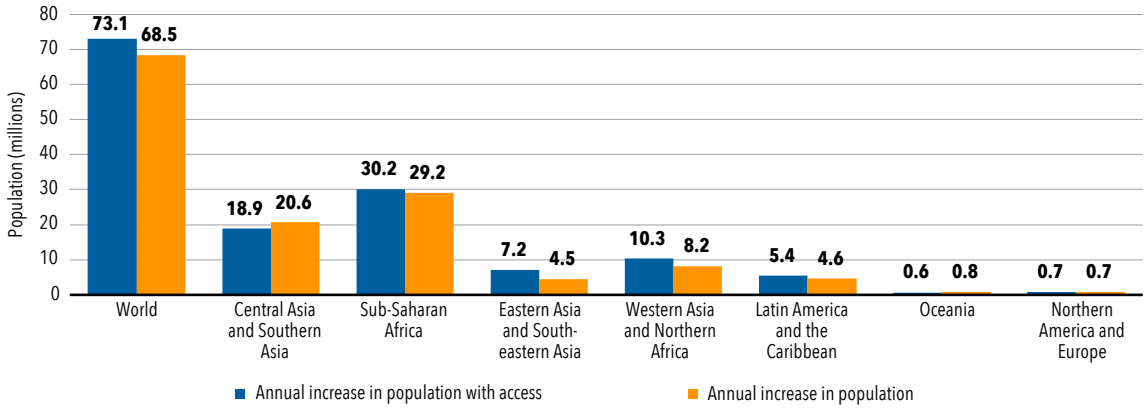


Source: World Bank 2025.

In absolute numbers, access to electricity is increasing globally (figure 1.5), with 73.1 million people gaining access annually between 2021 and 2023, slightly outpacing annual population growth (68.5 million) during the period. However, regional disparities persist. Eastern Asia, Western Asia, and Latin America have progressed steadily. Central and Southern Asia, which accounted for 36 percent of the global access deficit in 2010, made remarkable progress, reducing the region's share to just 4 percent by 2023. Meanwhile economic progress in South Asia has raised income levels, driving higher consumer demand for electricity and allowing governments to scale up grid expansion and integrated electricity markets (Chen 2022).

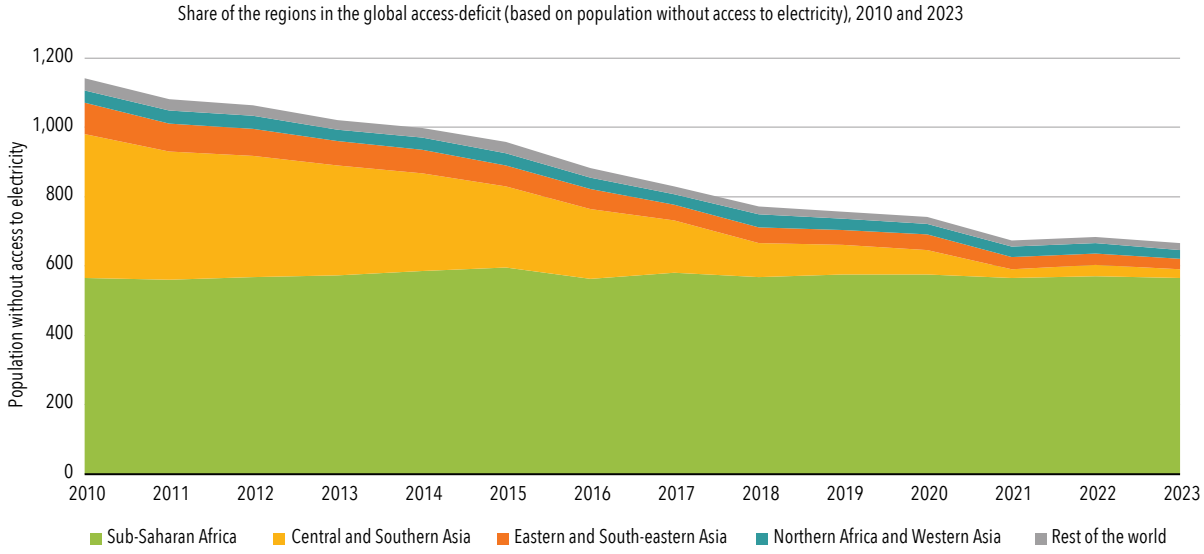
Sub-Saharan Africa continues to have the largest access gap (figure 1.6), a gap increasingly concentrated in countries and regions suffering from fragility, conflict, and violence. These conditions hamper economic progress, limit government capacity for implementing grid expansion, and constrain consumer demand. Annual electrification gains in Sub-Saharan Africa, at 30.2 million/year over 2021–23, barely outpaced population growth during the period (29.2 million/year).

FIGURE 1.5 • ANNUAL INCREASES IN ELECTRIFICATION AND POPULATION, BY REGION, 2021–23



Source: World Bank 2025.

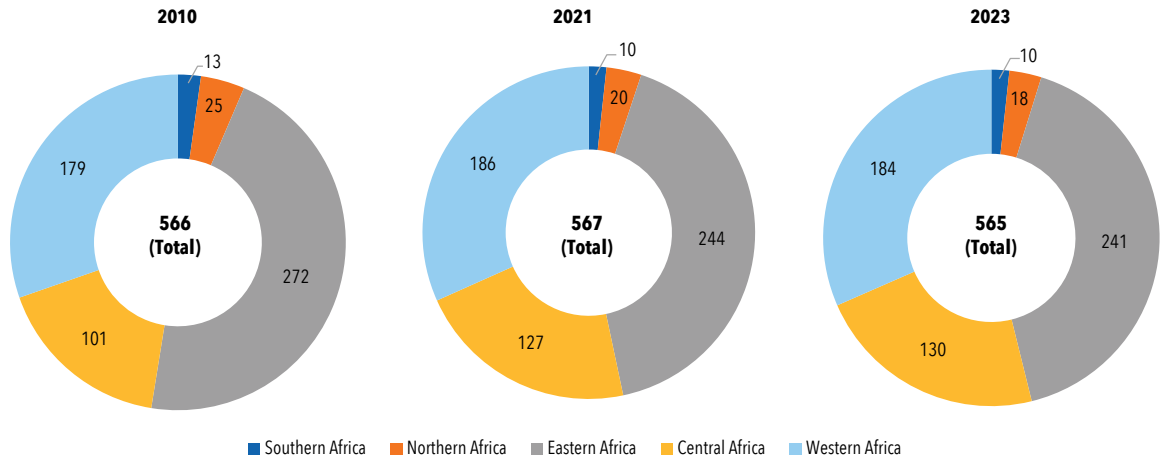
FIGURE 1.6 • NUMBER OF PEOPLE WITHOUT ACCESS TO ELECTRICITY, IN SELECTED REGIONS, 2010–23



Source: World Bank 2025.

From 2010 to 2023, progress on closing the electricity access deficit in Africa has been far from uniform, as shown in figure 1.7. Southern Africa's deficit declined from 13 million in 2010 to 10 million in 2021, remaining stable through 2023. Northern Africa steadily reduced its deficit from 25 million in 2010 to 20 million in 2021 and 18 million in 2023, driven by significant gains in Algeria, Morocco, and Tunisia. Eastern Africa also saw progress, reducing its deficit from 272 million in 2010 to 244 million in 2021 and 241 million in 2023. However, Central Africa's deficit increased, growing from 101 million in 2010 to 127 million in 2021 and 130 million in 2023. Western Africa had mixed results, with the access gap increasing from 179 million in 2010 to 186 million in 2021 before dropping slightly to 184 million in 2023.

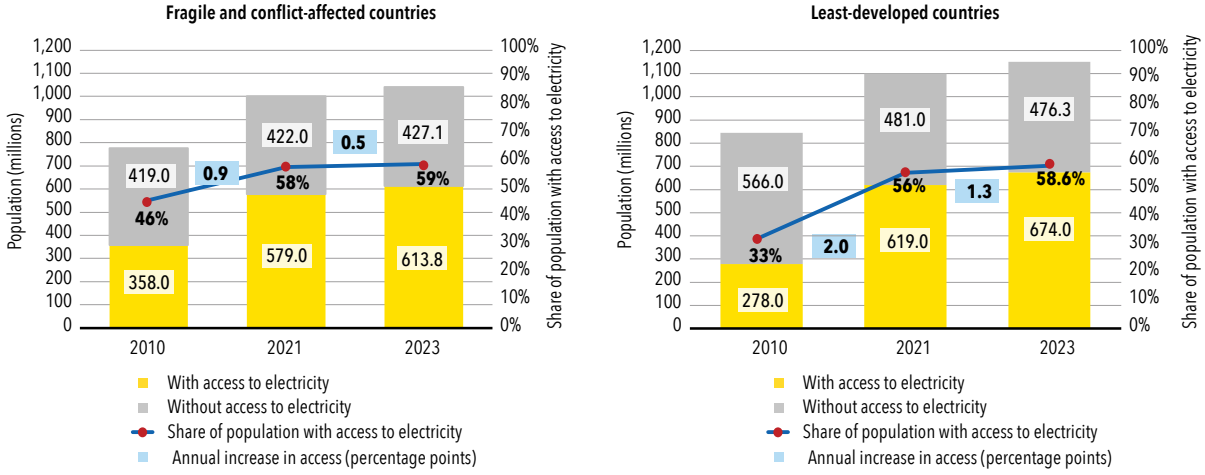
FIGURE 1.7 • SUBREGIONAL ACCESS DEFICITS IN AFRICA (IN MILLIONS OF PEOPLE WITHOUT ACCESS), 2010, 2021, 2023



Source: World Bank 2025.

Of the globe's 44 least-developed countries (LDCs), 32 are in Sub-Saharan Africa. Similarly, of the 15 countries facing situations of fragility, conflict, and violence, only two (Haiti and Afghanistan) lie outside Sub-Saharan Africa. As shown in figure 1.8, after a period of significant progress between 2010 and 2021, the number of people without access to electricity in LDCs decreased slightly from 481 million in 2021 to 476.3 million in 2023. Over the same period, for FCV-affected countries, the access gap increased from 422 million to 427 million. In LDCs, low incomes and capacity levels pose challenges in implementation. These challenges are exacerbated in FCV situations, curbing incomes and imposing higher costs and risks of servicing customers (ESMAP 2024).

FIGURE 1.8 • INCREASES IN GLOBAL ACCESS TO ELECTRICITY IN LDCs AND FCV-AFFECTED AREAS, 2010, 2021, 2023

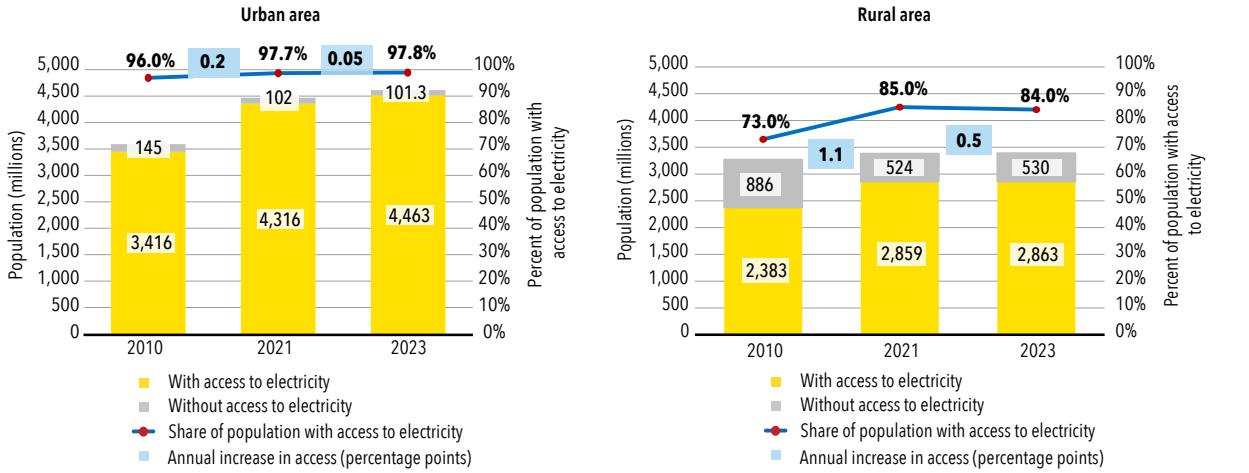


Source: World Bank 2025.

The urban-rural divide

Globally, electricity access in urban areas rose slightly from 96 percent in 2010 to 97.8 percent in 2023, while electricity access in rural areas grew from 73 percent to 84 percent (figure 1.9). During the period, the urban population with access swelled by 1 billion, while the rural population with access expanded by 480 million. The contrast between percentage gains and absolute numbers reflects the fact that adding grid connections in more densely populated urban areas expands access at scale, while in rural settings a new connection reaches fewer people. Fortunately, decentralized solutions have become increasingly feasible for dispersed populations, though granular, case-specific geographic analyses are needed to accurately assess potential impact of any contemplated expansion plan.

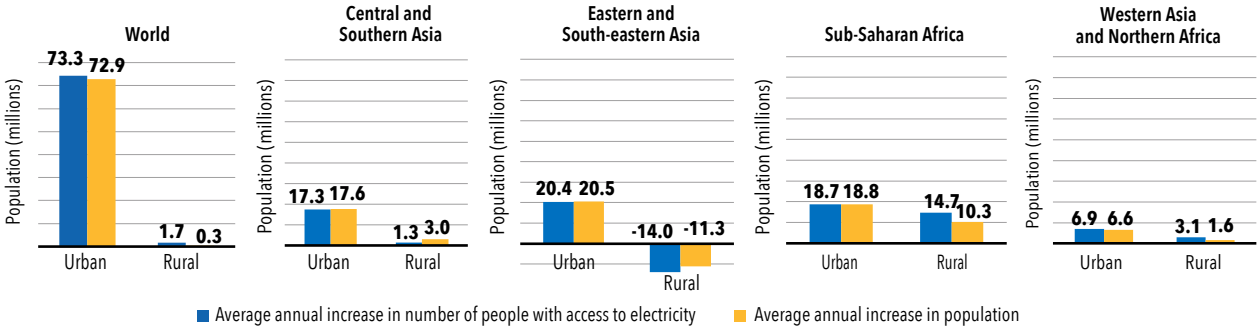
FIGURE 1.9 • INCREASES IN GLOBAL ACCESS TO ELECTRICITY IN URBAN AND RURAL AREAS, 2010, 2021, 2023



Source: World Bank 2025.

Between 2021 and 2023, the net gain in global electricity access in rural areas (~4 million) was much smaller than the gain in urban electricity access (147 million). The imbalance is broken down regionally in figure 1.10. Over the period in Central and Southern Asia, the annual access increase in rural areas was 1.3 million people, while in Sub-Saharan Africa an average of 14.7 million new connections were added each year. However, in Eastern and South-eastern Asia, there was a decrease in rural connections to the tune of 14 million/year. The data may indicate a greater deployment of off-grid and mini-grid technologies in Sub-Saharan Africa, but more data and analysis are needed to determine the pace at which these technologies can be deployed in countries with the greatest access deficit in Sub-Saharan Africa. It is also important to note that the figures reflect the starting points and patterns of urbanization in each region.

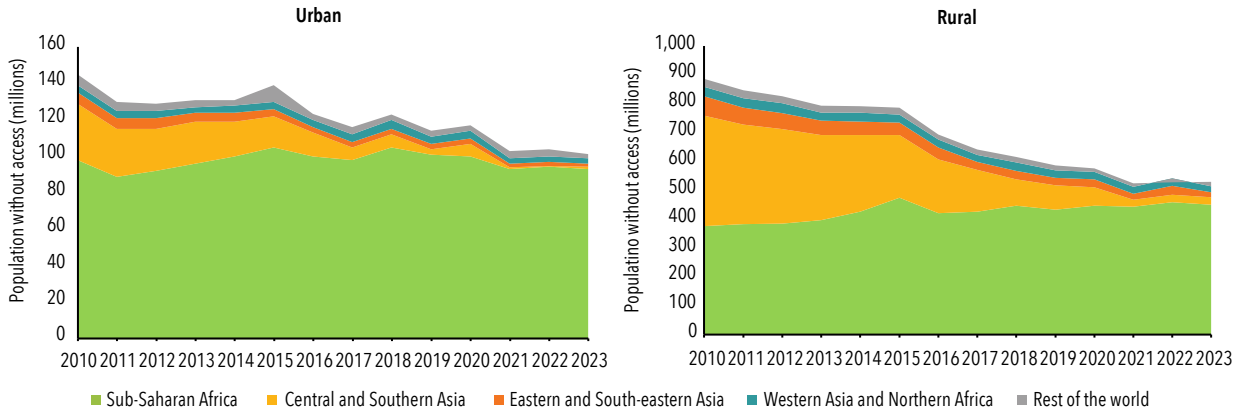
FIGURE 1.10 • ANNUAL GROWTH IN ELECTRICITY ACCESS AND POPULATION IN URBAN AND RURAL AREAS, BY REGION, 2021–23



Source: World Bank 2025.

Between 2010 and 2023, access deficits in rural areas shrank from 886 million to 530 million (figure 1.11). The steepest decline was seen in Central and Southern Asia (from 383 million to just 25.6 million). In contrast, Sub-Saharan Africa's rural deficit grew from 376 million to 451.1 million, though there was a slight decrease between 2022 and 2023 (from 459 million to 451 million). Globally, urban access gaps narrowed, starting from a much lower deficit number of 145 million in 2010 and falling to 101 million in 2023. As with rural areas, progress was uneven, driven primarily by Central and Southern Asia, where the urban deficit moved from 31 million in 2010 to 1 million in 2023.

FIGURE 1.11 • ACCESS DEFICITS IN URBAN AND RURAL AREAS, IN SELECTED REGIONS, 2010 AND 2023



Source: World Bank 2025.

Access to energy services through decentralized renewable energy

The off-grid solar (OGS) sector served 561 million people in 2023, of whom 385 million (~69 percent) were served by Tier 1 or higher products (Tier 1+ beneficiaries) (ESMAP 2024), as defined by the Multi-Tier Framework (MTF). OGS contributed 55 percent of new connections in Sub-Saharan Africa from 2020 to 2022.

The use of the MTF framework for target setting, alongside demand and affordability assessments, has enabled governments to pursue least-cost electrification strategies that combine grid, mini-grid, and off-grid solutions to accelerate progress.

The MTF bases access on seven attributes and six service tiers. Solar home systems typically provide partial Tier 1, Tier 1, or Tier 2 access, whereas mini-grids and grid electricity generally offer Tiers 3, 4, or 5 levels of service. Previous editions of this report have considered Tier 1 as the minimum level of service to constitute "electricity access," aligned with the International Energy Agency's (IEA's) "basic bundle" threshold, and the standard used by most governments in countries with access deficits (IEA 2023).[1]

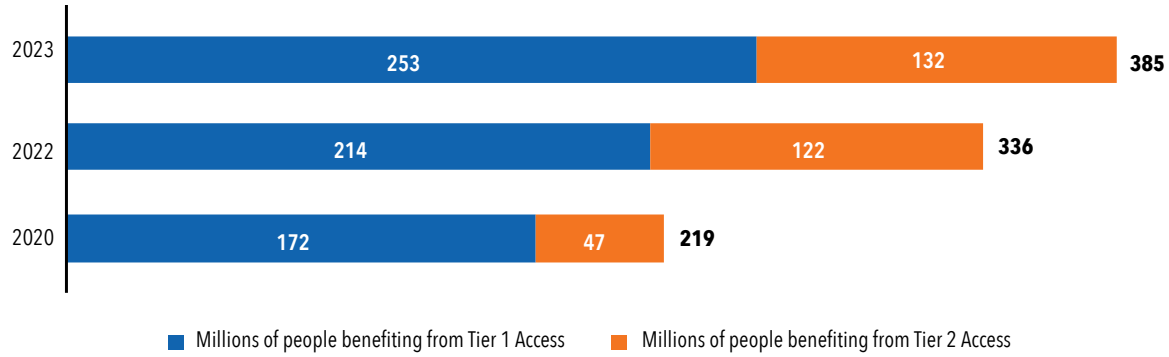
Tier 1 provides at least four hours of daily electricity (including one hour in the evening) with a system capable of generating 12 watt-hours per day. This level supports basic devices like lights and phone chargers, offering an entry point for remote or low- income households through OGS solutions.[2] For low-income households in off-grid areas, Tier 1's 50–100 kilowatt-hours (kWh) of electricity per year often meets their basic needs.

1 The MTF methodology is described at https://mtfenergyaccess.esmap.org/methodology/electricity.

2 Product lifespans are conservatively assumed to be 1.5 times the warranty period, at 18 months for solar lanterns and three years for solar home systems. For more information, see ESMAP (2024).

The number of Tier 1+ beneficiaries in off-grid households grew steadily from 219 million in 2020, to 385 million in 2023 (figure 1.12). In 2023, Tier 1 beneficiaries represented 65.9 percent of off-grid households; while Tier 2 made up 34.4 percent—and a growing share. The steady increase in Tier 2 customers indicates that Tier 2 access is increasingly meeting the affordability and level-of-service requirements. Tier 3+ beneficiaries were negligible. Thus, almost all households using off-grid systems (>200-watt [W] capacity) were receiving fewer than 8 hours of electricity per day for basic lighting and entertainment purposes.[3] More analysis of this point is needed in the context of Sub-Saharan Africa and the implementation of Mission 300.

FIGURE 1.12 • NUMBER OF PEOPLE BENEFITING GLOBALLY FROM OFF-GRID SOLAR ENERGY KITS BY TIER OF ELECTRICITY ACCESS, 2020–23 (MILLIONS)



Source: ESMAP 2024.
SHS = solar home system.

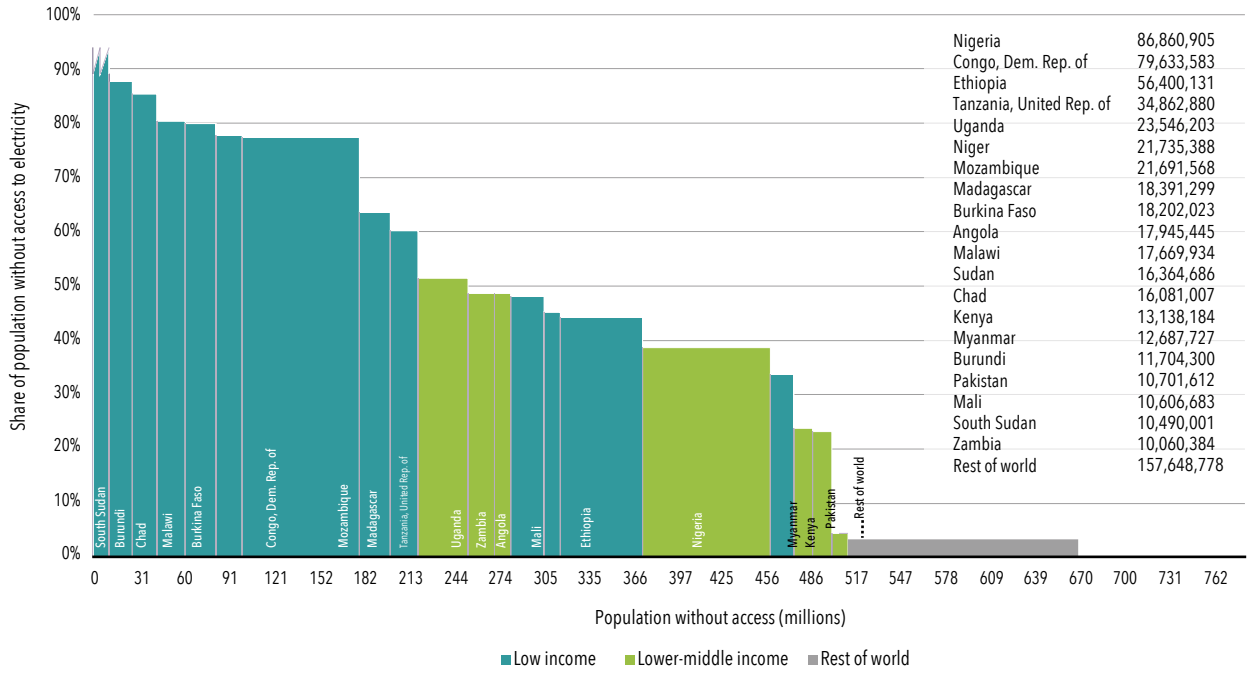
Figure 1.12 indicates the near zero market penetration of Tier 3+ service levels. Thus almost all households using off-grid systems (>200W capacity) were receiving less than 8 hours of electricity per day for basic lighting and entertainment. Only households with Tier 3+ service levels (>800W capacity) have access to 8–16 hours of electricity per day. These higher tiers would support energy services such as air conditioning, refrigeration, and space heating, which are not getting much traction currently. More investments in off-grid renewable energy solutions are required to improve the level of access and lessen the inequality in standard of living for first-time off-grid households (Tier 1) while keeping the goal of universal access in sight.

3 Only households with Tier 3+ service levels (>800 W capacity) have access to 8 to 16 hours of electricity per day. These higher tiers would indicate energy services such as air-conditioning, refrigeration, and space heating. More investments in off-grid renewable energy solutions would be required to improve the level of access and bridge the inequality in the standard of living for first-time off-grid households (Tier 1) while keeping the goal of universal access in sight.

Country trends

In 2022, the 20 countries with the largest electricity access deficits accounted for 76 percent of the global total, up from 75 percent in 2022.[4] Once again, 18 of these countries are in Sub-Saharan Africa. For the third consecutive edition of this report, Nigeria (86.8 million), the Democratic Republic of Congo (79.6 million), and Ethiopia (56.4 million) topped the list, together accounting for roughly a third of the entire global access deficit (figure 1.13). The lowest national access rates were observed in South Sudan (5 percent) followed by Chad and Burundi (12 percent), all three of which have shown low annualized increases in access since 2010 (figure 1.14).

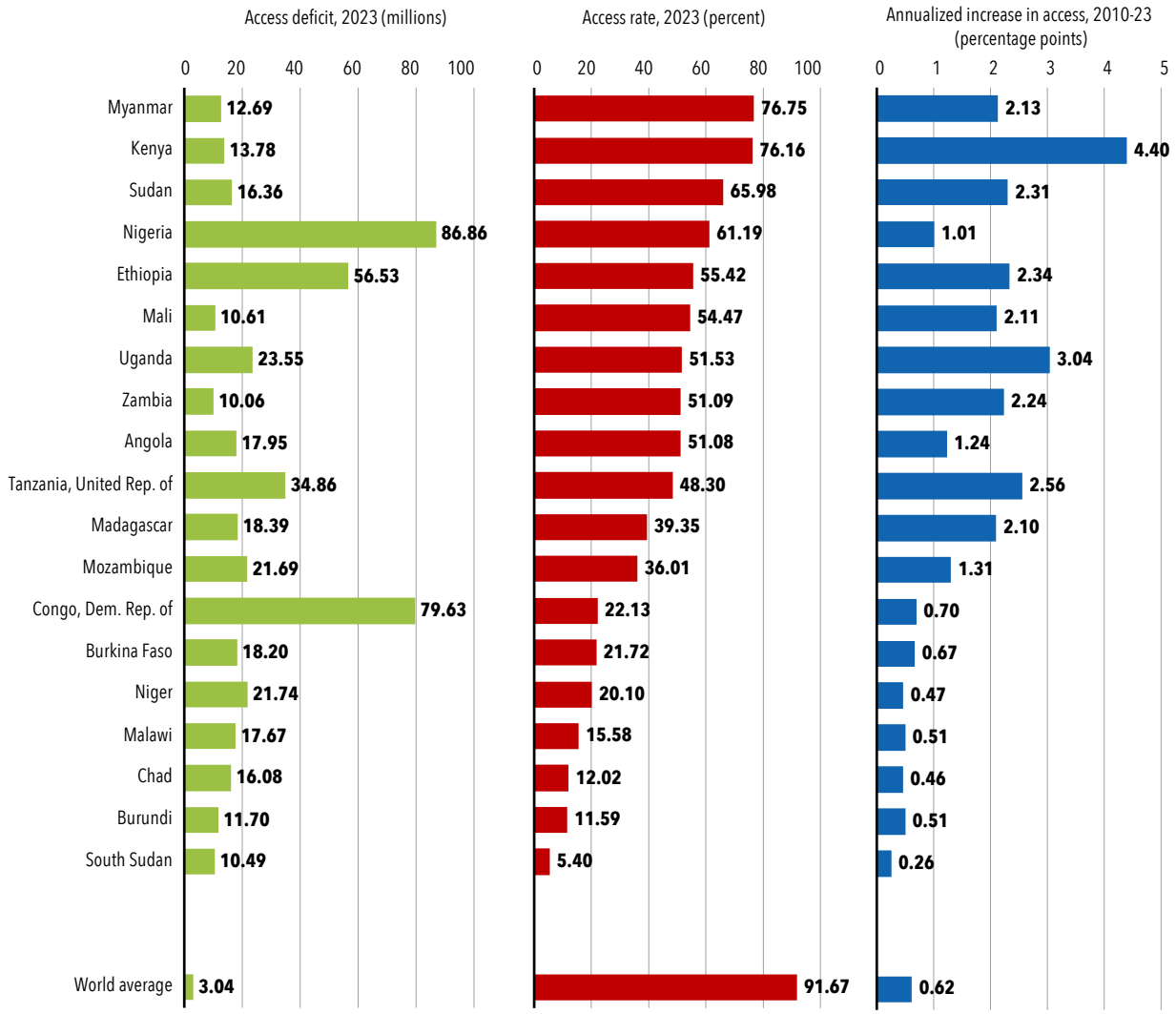
FIGURE 1.13 • SHARE AND ABSOLUTE SIZE OF POPULATION WITHOUT ACCESS TO ELECTRICITY IN THE TOP 20 ACCESS-DEFICIT COUNTRIES, 2023



Source: World Bank 2025.

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

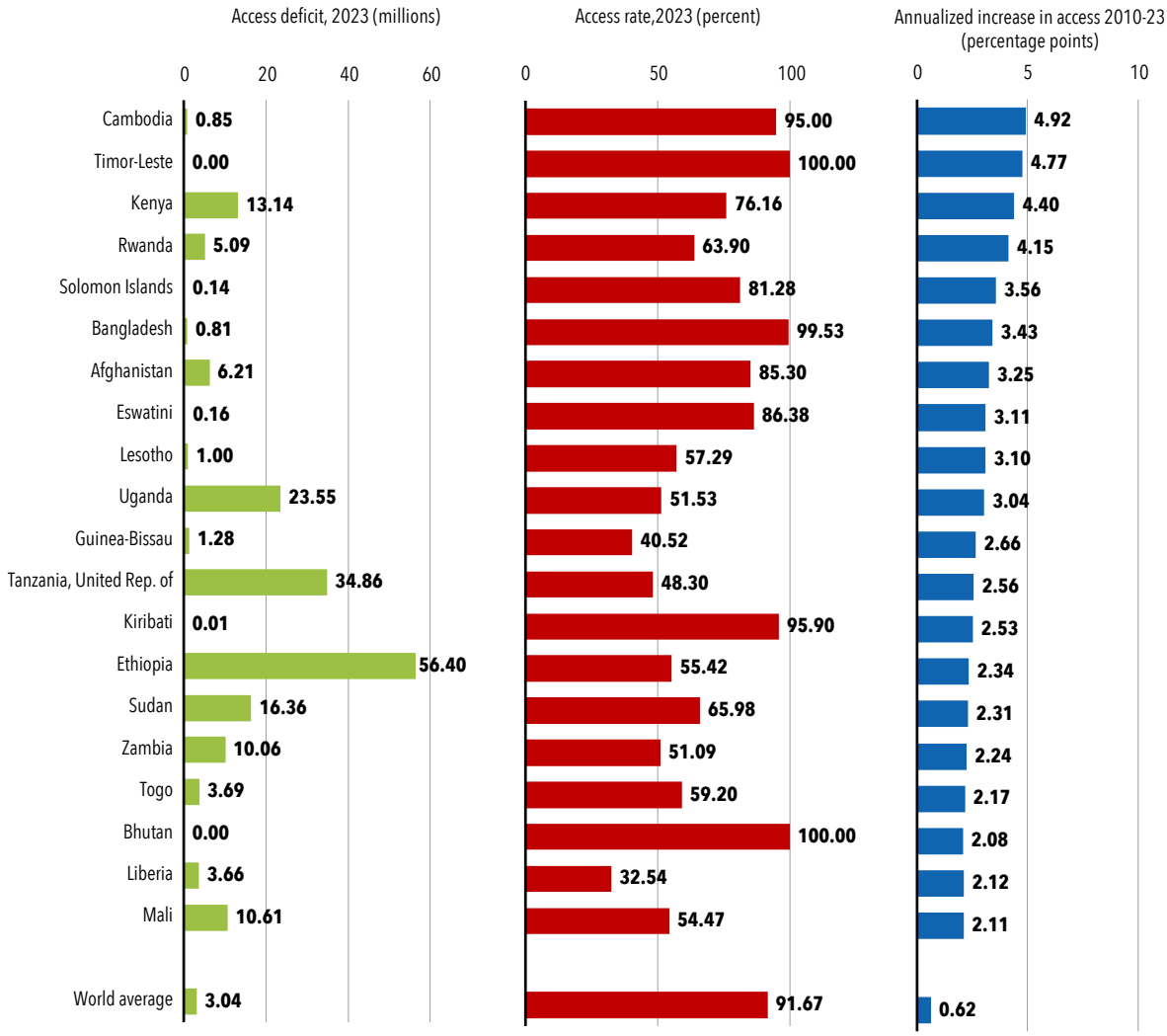
FIGURE 1.14 • ACCESS TO ELECTRICITY IN COUNTRIES WITH THE LOWEST RATES OF ELECTRIFICATION, 2023



Source: World Bank 2025.

Multiple countries were able to increase their access rates between 2010 to 2023, the most notable being Timor Leste and Bhutan, both of which achieved universal electrification starting from low levels. Kenya was among the fastest-electrifying countries, showing an impressive annual growth rate of 4.4 percent to reach 76 percent access by 2023 (figure 1.15). Rwanda also made impressive progress between 2021 and 2023 (from 48.7 to 63.9 percent), driven by aggressive grid expansion, increased investment in off-grid solutions, and strong government commitment to electrification targets. Bangladesh nearly closed its remaining access gap, reaching 99.5 percent access, with an annual growth rate of 3.4 percent.

FIGURE 1.15 • ACCESS TO ELECTRICITY IN THE 20 FASTEST-ELECTRIFYING COUNTRIES, 2010–23



Source: World Bank 2025.

Policy insights

Harmonizing definitions of access and moving beyond households

SDG 7 does not define "electricity access," and no single internationally accepted or adopted definition exists. However, since 2015, a growing number of governments have used the Multi-Tier Framework (MTF) to define levels of electricity access, set targets, and measure progress (ESMAP n.d.).

A key limitation of the current MTF approach is its exclusive focus on household electricity, omitting businesses, public institutions, and other settings. According to the IEA, only 26 percent of global electricity consumption is residential. Hence, it is important to consider electricity use in industry, agriculture, commerce, and other sectors. In the past decade, there has been growing interest in promoting the productive use of electricity by farmers, in particular. According to estimates from the Food and Agriculture Organization, about 30 percent of the world's total end-use energy is consumed by the agrifood sector.

Box 1.1 presents a new method for estimating the least-cost path to universal residential access to electricity.

BOX 1.1 • REFINING ESTIMATES OF ELECTRICITY ACCESS

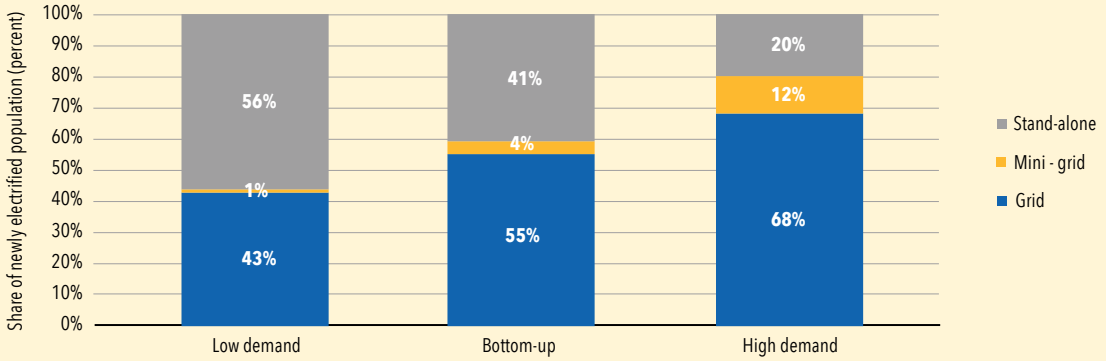
An updated least-cost electrification analysis based on the Global Electrification Platform—an open access, interactive, online platform—makes it possible to estimate the most cost-efficient path to universal access by 2030 in the top access-deficit countries under three demand scenarios. The model runs reported below used data from 58 countries. Residential electricity demand scenarios are based on projected population growth rates, a target tier of electricity access, and the associated electricity consumption level.

- *"Bottom-up" scenario.* A unique demand target is set for each settlement, based on the local poverty rate and the level of gross domestic product in the country.
- *"Low-demand" scenario.* Urban demand is estimated based on 2020 levels of electricity consumption in electrified parts of the country, translated to the nearest equivalent access tier. Rural demand is set to Tier 1.
- *"High-demand" scenario.* Urban demand targets are raised by one tier above 2020 consumption (unless already Tier 5), while rural demand is set to Tier 3.

In the bottom-up scenario, out of a total of 956 million people provided with new access to electricity from 2025 to 2030, 526 million are projected to be served by the grid (55 percent), 389 million (41 percent) by stand-alone photovoltaic (PV) power, and a further 40 million (4 percent) by mini-grids. In the low-demand scenario, stand-alone PV plays a more prominent role (56 percent); in the high-demand scenario, mini-grids provide 12 percent of new connections. In this latter scenario, there would also be greater productive use of electricity in commercial settings (figure B1.1.1).

BOX 1.1 • REFINING ESTIMATES OF ELECTRICITY ACCESS *(cont.)*

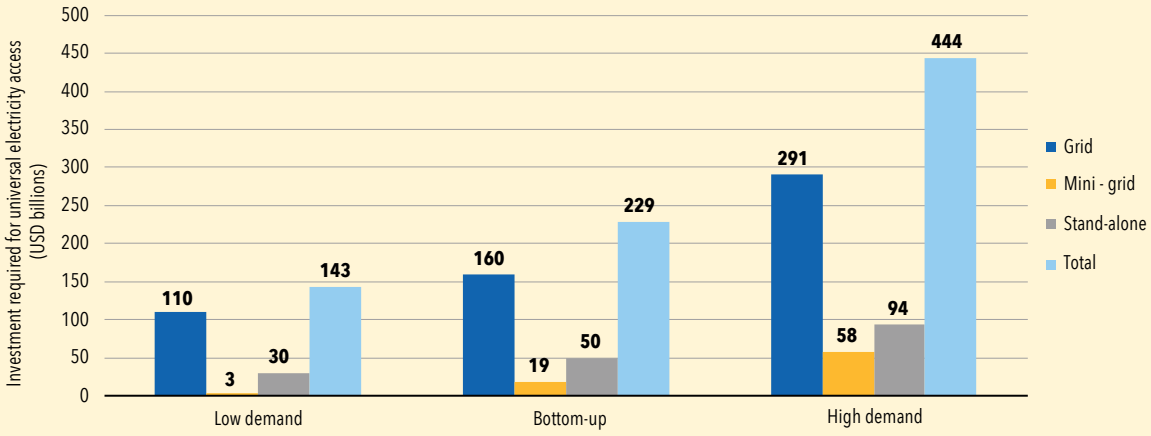
FIGURE B1.1.1 • NEWLY ELECTRIFIED POPULATION, BY SCENARIO, 2025–30



Source: World Bank 2025.

The bottom-up scenario would require a total investment of USD 235 billion, with USD 164 billion invested in the grid, USD 51 billion in stand-alone PV, and a further USD 19 billion in mini-grids. The low-demand scenario would need about two-thirds as much (USD 147 billion), whereas the high-demand scenario would require a significantly higher total investment (USD 455 billion) (figure B1.1.2). These calculations are based on estimated up-front capital costs of each electrification solution and do not include ongoing operation and maintenance costs.

FIGURE B1.1.2 • GLOBAL INVESTMENT REQUIRED FOR UNIVERSAL ELECTRICITY ACCESS, BY SCENARIO (USD, BILLIONS)



Source: World Bank 2025.

Data and customer awareness needs for implementing distributed renewable energy options

Mission 300 recognizes the crucial role of DRE solutions, which are transforming the energy landscape in Africa's poorest and most isolated regions. These technologies provide reliable, clean, and affordable power, offering faster deployment and supporting local economic development. For instance, Nigeria's mini-grid projects have connected nearly 6 million people through more than 170 mini-grids and almost 1.2 million stand-alone solar systems. Box 1.2 probes the use of DRE to advance rural electrification in Sub-Saharan Africa.

Improving data quality, frequent monitoring of progress, and a willingness to revisit priorities are crucial to successful DRE implementation, particularly as the access gap shrinks and implementation efforts move to more remote and difficult-to-reach demographic groups. The Global Electrification Database, ESMAP's MTF surveys, and Night-Time Light Satellite Imagery are some of the sources currently used. However, challenges persist in data consistency, collection frequency, and accuracy, particularly in remote areas.

Data and analytics are also needed to discover what drives consumer decisions. A newly announced partnership between the Energy Sector Management Assistance Program (ESMAP) and the Living Standards Measurement Study to conduct surveys in 15 countries over five years is driven by a focus on improving data quality and understanding consumers' needs and preferences—as well as their knowledge about the options available to them. Increasing consumer awareness of DRE technologies can fuel the growth of a self-help culture, encouraging consumers to become drivers and active participants in the electrification process.

BOX 1.2 • SUCCESS STORIES FROM SUB-SAHARAN AFRICA: KENYA, RWANDA, AND UGANDA

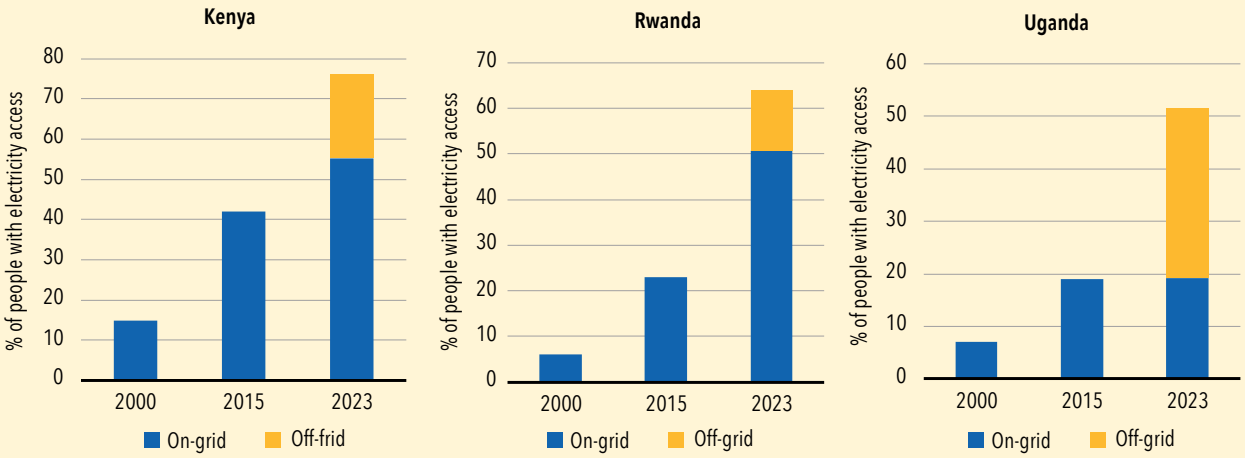
While grid extension is needed in more than a few countries of the region, budgetary and capacity constraints limit rapid extension, especially where per capita load is low and locations are remote. Here solutions based on decentralized renewable energy (DRE) are the fastest and most cost-effective way to expand electricity access. Over the past decade, DRE has been used for nearly 20 percent of all new electricity connections, nearly half of which were realized in East Africa alone.

In contexts characterized by fragility, conflict, and violence, where centralized grid expansion is even more challenging, DRE may frequently be the only option. Beyond household electrification, DRE is increasingly delivering targeted services that power productive uses for farmers and small businesses, as well as providing reliable electricity to health facilities, schools, and other essential public institutions.

Countries making significant strides in electrification—among them Kenya, Rwanda, and Uganda, are adopting a mix of grid and DRE options in their energy access strategies (figure B1.2.1). While grid extension has a more traditional path, scaling of DRE systems requires innovative customer outreach and financing mechanisms that foster consumer finance, entrepreneurship in the sector, and private sector financial flows.

BOX 1.2 • SUCCESS STORIES FROM SUB-SAHARAN AFRICA: KENYA, RWANDA, AND UGANDA *(cont.)*

FIGURE B1.2.1 • FAST PROGRESS IN ELECTRIFICATION ASSISTED BY DRE IN THREE COUNTRIES, 2000–20



Source: World Bank 2023. For Uganda, the grid-off-grid proportion is from "Energy Policy for Uganda 2023."

Off-grid solar: An example of a consumer-driven process

OGS is a cost-effective, rapidly scalable solution to meet electricity demand, especially in remote, low-income areas where demand is low and grid or mini-grid connections are impractical, as in areas beset by conflict or violence. In 2022 and 2023, over 50 million OGS products were sold, surpassing pre-COVID levels. Market turnover reached an estimated USD 3.9 billion in 2022 and USD 3.8 billion in 2023, surpassing the previous record of USD 3.3 billion in 2019. Pay-as-you-go (PAYG) models, which allow customers to pay in small instalments, accounted for 39 percent of sales in 2023, up from 24 percent in 2018.

Unelectrified households in such areas, especially those caught in FCV situations, have limited purchasing power and few opportunities to generate income, making subsidies or other forms of support a key ingredient in attaining market penetration. Only 22 percent of unelectrified households can afford a Tier 1 solar energy kit even on PAYG terms, while 49 percent might be able to afford it at a stretch. (Productive use appliances on PAYG terms remain largely out of reach.) Affordability is further exacerbated by logistical challenges in remote areas, especially in FCV situations. Extending services to remote or conflict-affected areas raises Tier 1 PAYG system prices by ~57 percent, affecting 82 percent of those lacking electricity (ESMAP 2024).

Fortunately, public and private investments in OGS are growing, reaching USD 1.2 billion during the 2022–23 period, up from USD 773 million in 2020–21. Since 2017, OGS funding has grown at an average annual rate of 6 percent, largely driven by debt financing. Of the USD 425 million invested in 2023 (excluding results-based financing), USD 285 million came in the form of debt (66 percent), USD 128 million as equity (30 percent), and USD 16 million as grants (4 percent). Large international and vertically integrated companies captured 70–80 percent of the total amount invested, broadly in line with their market share.

Public funding is also expanding, with the World Bank lending a record USD 660 million to governments in fiscal 2024 to scale up proven off-grid solar solutions, alongside active involvement from a range of development partners. Results-based financing, too, has gained traction, with USD 350 million disbursed since 2018 and USD 733 million committed under newly approved projects to be implemented over the next five years. Finally, the Mission 300 initiative led by the World Bank and African Development Bank (AfDB) should enable governments to secure financing from multilateral development banks for new programs investing in off-grid solar solutions.

All told, an estimated USD 21 billion is needed to electrify the 398 million people who would be most efficiently connected through OGS by 2030.[5] An additional USD 2.4 billion would electrify more than a million schools and health-care facilities. USD 74 billion would be needed to address the total market for solar water pumps, cold storage solutions, and Tier 2+ OGS products for micro, small, and medium-sized enterprises. Governments would only need to cover 30–40 percent of the cost to unlock an additional 60–70 percent in public and private co-investment (ESMAP 2024).

The case for governments to invest in OGS is profound—with such investments delivering significant social and economic returns. Achieving universal Tier 1 access for households could save USD 15.5–16.7 billion annually, or USD 142 per household, by reducing inefficient lighting costs and boosting incomes. Replacing diesel generators with OGS for businesses could save USD 6.3–12.5 billion in fuel costs and eliminate 8.3–16.6 million metric tons of carbon dioxide (CO2) emissions per year. Electrifying social infrastructure could reduce fuel generator costs by USD 10,000 per school and USD 30,000 per health center annually, while avoiding 0.9 million metric tons of CO2 equivalent globally each year. Finally, expanding the OGS sector generates tax revenue and reduces fossil fuel subsidies, in some cases enabling governments to make a net profit from OGS programs (ESMAP 2024).

The unexploited potential of mini-grids

Mini-grids—electric power generation and distribution systems that can supply electricity to households, businesses, and social institutions in a discrete area—come in various sizes and serve remote communities that lack access to electricity from the main grid. The overall value proposition of mini-grids as an electrification strategy is that they can be deployed faster than main grid extensions, often at a lower cost per connection; they tend to provide better-quality electricity and customer service than utility companies; they can support more productive uses at lower cost than solar home systems; and they can attract both private and public sector finance.

While electrification programs have traditionally focused on extending the national grid, recent experience in high-deficit countries in Sub-Saharan Africa shows that grid supply is often unreliable and grid extension costs prohibitive for areas with dispersed or remote populations. Compared to off-grid solar systems that can also serve these populations, mini-grids can offer 24/7 electricity and support larger productive loads. Additionally, distribution infrastructure built for the mini-grid can still be utilized if and when the main grid arrives. Therefore, in denser, larger communities with productive loads located away from the main grid, mini-grids will often be the least-cost, best electrification solution and can accelerate the provision of affordable access to high-quality electricity to millions of people.

Over the past decade, mini-grid installations have surged globally, with numbers now more than six times higher than in 2018. Growth has been especially prominent in Sub-Saharan Africa (SEforALL 2024). Mini-grids already serve 48 million people connected to 21,500 mini-grids, half of which are solar PV mini-grids. Another 29,400 mini-grids are currently planned, 95 percent of them in Africa and South Asia. Ninety-nine percent of these planned mini-grids use solar PV technology and are estimated to connect more than 35 million people at an investment cost of USD 9 billion.

5 The GEP bottom-up demand scenario estimates that the total cost of connecting all households for which off-grid solar is the least-cost option is USD 50 billion, based on assigned tiers corresponding to the relative affluence of households. In contrast, the USD 21 billion estimate assumes Tier 1 access for all. For more information, see Annex 6 of ESMAP (2024).

The Africa Mini Grid Developers Association has highlighted six key trends and opportunities in the sector (AMDA 2025).

- Mini-grids are growing in size and gravitating toward markets with an enabling financial and regulatory framework. The average number of connections per mini-grid has grown from 244 per site reported in 2022 to 458 in 2024. During this same period, mini-grid developers have flocked to markets with enabling ecosystems for mini-gid development, especially Nigeria.
- Mini-grids are significant contributors to job creation in Africa. Just 27 mini-grid developers surveyed created more than 6,000 jobs over the past four years, with the majority of them in the communities where the mini-grids are located.
- While mini-grid costs have decreased globally, capital expenditure for deployment in Sub-Saharan Africa remains stubbornly high compared to other regions. This regional discrepancy reflects factors like high logistics costs and low population density, but improved supply chain efficiency, economies of scale, and more favorable tax treatment can help reduce costs.
- Although more than USD 9 billion of concessional capital has been committed to the sector over the past five years, disbursement of donor funds has been slow, adversely affecting the rollout of mini-grids. The sector needs fewer, larger financing windows with harmonized reporting requirements to enable swifter disbursements.
- Gaining traction are new financing mechanisms, such as blended finance, escrowed grant payments to derisk commercial lending, and monetization of environmental benefits to attract corporate and institutional investors.
- The slow pace of regulatory approvals threatens to delay or halt the scale-up of mini-grid deployment, and streamlining regulatory processes and addressing bureaucratic bottlenecks will be critical to timely deployment.

Although mini-grids are estimated to be the least-cost electrification solution for 40 million people under a uniform bottom-up scenario for all countries considered in the analysis of the Global Electrification Platform (GEP) presented in box 1.1—and for 115 million people under the high-demand scenario—there is ample reason to expect that the addressable market for mini-grids is significantly larger. In fact, an earlier World Bank analysis found that, when adjusting the parameters in the GEP study on a country-by-country basis to reflect conditions favorable for mini-grid development, mini-grids could be the least-cost option for connecting up to 430 million people (ESMAP 2022).[6]

While mini-grids are not a new phenomenon—all existing centralized power grid systems started as small, isolated power systems and mini-grids that eventually interconnected—generation technologies, ownership models, and other attributes have evolved over time. The mini-grids being deployed today usually rely on modular technologies, especially solar PV and batteries, combined with sophisticated digital solutions like smart metering and remote monitoring. They are often developed and operated by private companies (with support from the public sector).

A geospatial assessment for the GEP study determined that 291,000 communities across Sub-Saharan Africa have the profile, in terms of settlement size and population density, that favors the deployment of solar mini-grids. Many of these communities, particularly those located closer to existing grid infrastructure, may be candidates for least-cost electrification via grid extension. However, most utilities in Sub-Saharan Africa face constraints that limit their capacity to raise financing, invest in infrastructure, improve service, and generate adequate revenue. Thus, counting on expansion of the main grid to connect 526 million people at least-cost would be unrealistic in the near to medium term. A good part of the population will have to be served instead by more agile, tech-enabled mini-grid operators, unburdened by the legacy obligations of distribution utilities.

6 Given the acceleration in the technology learning curve observed for mini-grid systems and components—especially for PV panels, battery storage, energy management systems, geospatial planning tools, and advanced metering solutions—along with operational efficiencies achieved from scale, least-cost assessments will probably point to a growing role for mini-grids.

BOX 1.3 • ACCESS EMPOWERS: THE GENDER-ENERGY NEXUS

Access to electricity empowers women and girls (Vidart 2014; Dutta, Koojiman, and Ceceleski 2017). Time saved from traditional energy tasks allows women to focus on income-generating activities and human capital development. The long-term benefits of access to electricity on girls' education and future employment are well documented. Moreover, access to electricity serves as a gateway to vital information, empowering women and girls to make informed decisions about health, education, and overall well-being.

Despite the benefits of energy access for women and girls, challenges persist in addressing the gender-energy nexus—whether approached from a lens of vulnerability or opportunity. Data from the MTF surveys show that households headed by women in Africa and South Asia are less likely to have off-grid access, with affordability being among the top constraints. Closing this gap requires increasing incomes or improving affordability, as exemplified by the Yemen Emergency Electricity Access Project supported by the World Bank (World Bank 2022, 2023). The project expanded electricity access for women in rural and peri-urban areas and promoted financial inclusion. Targeting women through microfinance institutions, the project helped increase sales to women from 5 to more than 20 percent, with 44 percent of total credit sales going to women, 16 percent of whom were first-time borrowers.

Employment opportunities for women in the energy sector remain limited, with women representing only 16 percent of the global energy workforce, compared to 40 percent economywide (IEA 2022). Senior leadership roles are even rarer, with women filling only about 17 percent of leadership slots. Although the clean energy sector is more promising, challenges remain. The International Renewable Energy Agency estimates that while women represent about a third of the renewable workforce, most are found in administrative and clerical positions. Additionally, only 7 percent of climate venture capital goes to women founders (Tech Crunch 2023).

To fulfill the promise of the Beijing Declaration and Platform for Action, policy makers must implement policies and regulations that foster women's participation and leadership in the energy sector. Investments should prioritize gender equity by directing financial resources toward initiatives that equip women with financial tools, such as access to financing, and business support services for women-led energy projects. Additionally, markets must be more inclusive by promoting women's involvement at all levels of the value chain, from design and production to distribution and decision-making. Projects should also address structural barriers and offer skills development while fostering cultural shifts toward gender equality. Finally, improving gender data in the sector is an opportunity to better identify the gaps that disadvantage women and to design solutions that can better support their ability to benefit fully from electricity access across the value chain.

By working together, governments, private sector players, civil society, and international organizations can pave the way for a just and equitable energy transition.