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CHAPTER 1
ACCESS TO ELECTRICITY

Main Messages

- **Global trend.** Globally, access to electricity grew every year between 2010 and 2021, rising from 84 percent of the world's population to 91 percent, raising the number of people with access by more than a billion. The number without electricity dropped by almost half, from about 1.1 billion in 2010 to 675 million in 2021. The pace of annual growth in access has slowed since 2019, however. Several factors may account for the slowdown, including the COVID-19 pandemic. The current pace is not fast enough to reach the last mile.
- **Target for 2030.** To reach universal access by 2030, the world will have to drastically increase efforts toward the target by scaling up investments and policy support. To bridge the gap, the annual rate of growth in access must be 1 percentage point per year from 2021 onward—almost twice the current pace of 0.6 percentage points in 2019–21. If no additional measures are taken, about 660 million people will still be unserved in 2030 (IEA 2022). Some 75 million people were estimated to have lost the ability to pay for extended electricity services because of the pandemic and the energy crisis associated with the conflict in Ukraine (IEA 2022).
- **Regional highlights.** Access to electricity remains a major barrier to socioeconomic development in Sub-Saharan Africa, where more than 80 percent of the global population lacking access to electricity lived in 2021. Despite steady progress in the access rate over the past decade, the number of people without access in the region remained stagnant because of population growth, leaving 567 million without access in 2021. In contrast, Central and Southern Asia, Latin America and the Caribbean, and Eastern and South-eastern Asia are on track to universal access, with access rates of more than 98 percent. Of these, Central and Southern Asia made the fastest progress in electrification between 2019 and 2021. Northern Africa and Western Asia showed consistent progress—94 percent of the population in the region enjoyed access in 2021. The access rate in Oceania has remained at around 81 percent since 2010.
- **Urban-rural divide.** Electrification grew more rapidly in rural areas, where the bulk of the population without access lives, than in urban areas. But because the access rate in rural areas improved from a very low level, the gap between rural and urban areas remains large. In 2021, roughly 8 of every 10 people without access were living in rural communities, most of them in Sub-Saharan Africa. To narrow the access gap between urban and rural areas, a better understanding of electricity end uses and a greater mobilization of public financing are needed to address affordability challenges and make electricity infrastructure more resilient. Moreover, both grid and off-grid electrification options should be deployed to ensure a rapid expansion of service to rural areas. Geographic information systems (GIS) should be considered to identify areas in dire need of policy support and investment.
- **Top 20 access-deficit countries.** As of 2021, the 20 countries with the largest access deficits accounted for 75 percent of the global population without access. The countries with the largest number of people without access were Nigeria (86 million), the Democratic Republic of the Congo (76 million), and Ethiopia (55 million). In 2019–21, electrification progress in the Democratic Republic of the Congo trailed population growth; as a result, the number of unserved people in the country increased. On the contrary, the progress of electrification outpaced population growth in Nigeria and Ethiopia. Among access-deficit countries, Kenya and Ethiopia showed the most rapid improvement, extending electrification by more than 3 percentage points each year between 2019 and 2021.

- **Decentralized renewable energy.** The number of people served by renewable mini-grids powered by solar, hydro, and biogas technologies was 11 million globally in 2021 (IRENA 2022).[17] Solar mini-grids, a viable option for last-mile communities, accounted for one-third of connections in 2021. Around 101 million people had access to stand-alone off-grid solar solutions in 2021, a decrease from 107 million in 2019 owing to a significant drop in sales during the COVID-19 pandemic (GOGLA 2022).[18] Off-grid renewable energy solutions continue to play a key role in expanding electricity access in many countries in Sub-Saharan Africa.
- **Interlinkages with other Sustainable Development Goals (SDGs).** Universal access to electricity is not a stand-alone target. Particularly in low-income countries, electrification can help increase educational attainment, improve healthcare, increase food security, and create business opportunities and jobs. It is therefore imperative, when planning measures to accelerate electricity access, to consider interlinkages with other SDGs, notably SDG 1 (poverty), SDG 3 (health), SDG 4 (education), SDG 5 (gender equality), and SDG 17 (climate action). To maximize the chances of success, policy makers should work to build a legal and institutional environment that is conducive to strong utilities, that attracts new mini-grid and off-grid business models (to help close the affordability gap), that mobilizes adequate amounts public and private sector financing, and that focuses on poor and fragile regions where progress has been slow.

17 According to ESMAP (2022b), 48 million people were connected to about 21,500 mini-grids in 2021, mostly first- and second-generation systems. Approximately half of installed mini-grids are powered by solar photovoltaic (PV), followed by hydro and fossil fuels. Meanwhile, the IRENA figure includes access under Tier 1 (access through a small PV mini-grid) or Tier 2 or better (access through a large PV mini-grid or non-PV mini-grid).

18 The data are a subset of the market—that is, a proxy for higher-quality products that are quality-certified and/or associated with GOGLA members. The number of off-grid users is probably much larger. For example, OGS Market Trend Reports (Lighting Global/ESMAP et al. 2022) estimates nearly half a billion. This topic is explored in more detail in the chapter.

Are We on Track?

In 2021, 91 percent of the global population enjoyed access to electricity (figure 1.1).[19] Over the past decade, access improved steadily, reducing the number of unelectrified people from 1.1 billion in 2010 to 675 million in 2021, despite a growing population. But the COVID-19 pandemic and associated energy crisis are estimated to have caused 75 million people to have lost the ability to pay for an extended bundle of electricity services (IEA 2022).[20] Against the backdrop of challenging macroeconomic conditions induced by the COVID-19 pandemic and geopolitical developments, and absent urgent action by national governments and the international community, the share of the global population projected to have access to electricity by 2030 will be 92 percent, leaving some 660 million people unserved, of whom approximately 85 percent will be in Sub-Saharan Africa.[21]

Figure 1.1 • Percentage of population with access to electricity

Source: World Bank 2023; IEA 2022.

The pace of growth in electricity access has been slow in recent years, the main result being to leave the poorest and hardest-to-reach people without access. In 2019–21, the number of people with access increased by 114 million per year, fewer than the 129 million per year observed between 2010 and 2019. Overall, access grew 0.7 percentage points per year between 2010 and 2019, declining to 0.6 percentage points a year between 2019 and 2021 (figure 1.2).[22] To reach universal access by 2030, the annual rate of growth in electricity access will have to be 1 percentage point per year from 2021 onward. The acceleration must be concentrated in Sub-Saharan Africa, with progress of more than 5 percentage points a year on average over the next nine years. Given the continued impacts of COVID-19 on the global and national economies, which have been compounded by the war in Ukraine and the related energy crisis, urgent actions must be taken to maintain energy access as a key priority and prevent setbacks.

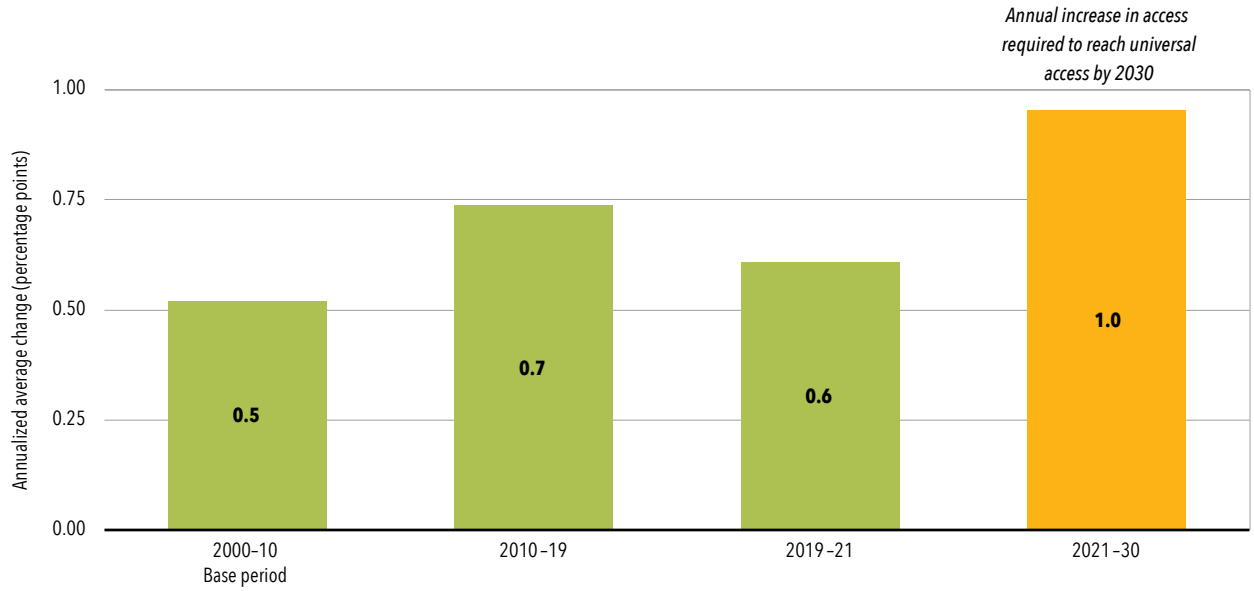
19 The rate of access to electricity generally means either having or not having an electricity connection.

20 An extended bundle of electricity services includes four lightbulbs operating for four hours per day, a fan for six hours per day, a radio or television for four hours per day, and a refrigerator.

21 The projected access rate of 92 percent in 2030 was calculated based on UN population data and IEA (2022).

22 The annual change in access is calculated as the difference between the access rate in year 2 and the rate in year 1, divided by the number of years: (Access Rate Year 2 – Access Rate Year 1)/(Year 2 – Year 1)

Figure 1.2 • Average annual increase in access to electricity, 2000–21

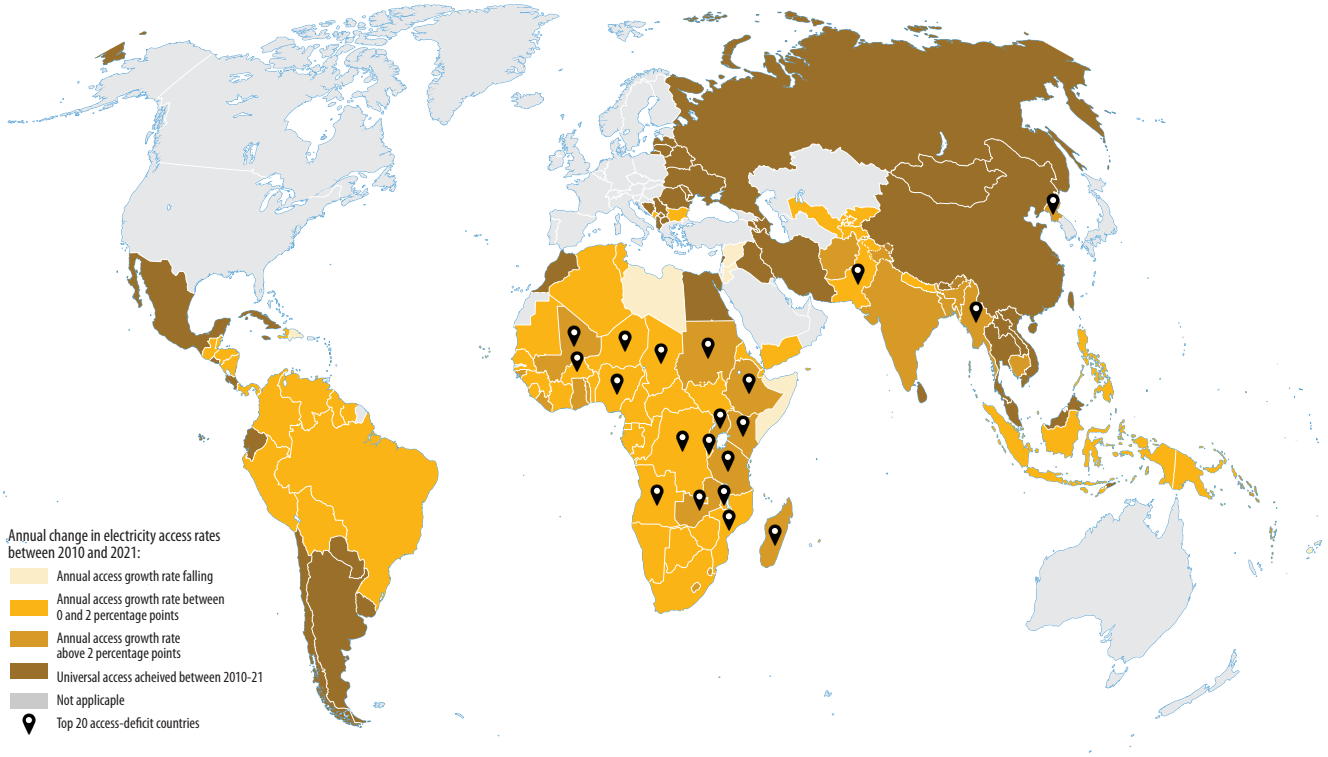


Source: World Bank 2023.

Since 2010, 51 countries have achieved universal access, 17 of them in Latin America and the Caribbean (figure 1.3). Another 95 countries, concentrated in Sub-Saharan Africa, were still short of the target in 2021. About one-quarter of these countries—which includes half of the 20 countries with the largest access deficits[23]—advanced their electrification access by more than 2 percentage points each year, whereas declining annual access growth appeared in some of the remaining three-quarters of the countries. To reverse these trends, governments and international organizations should prioritize information-based electrification planning, mobilize capital, and deploy implementation programs, focusing particularly on countries and areas with very low access rates and those that have made only limited progress in recent years.

23 In this chapter, the access deficit is defined as the population lacking access to electricity.

Figure 1.3 • Annual change in electricity access rates in access-deficit countries, 2010–21



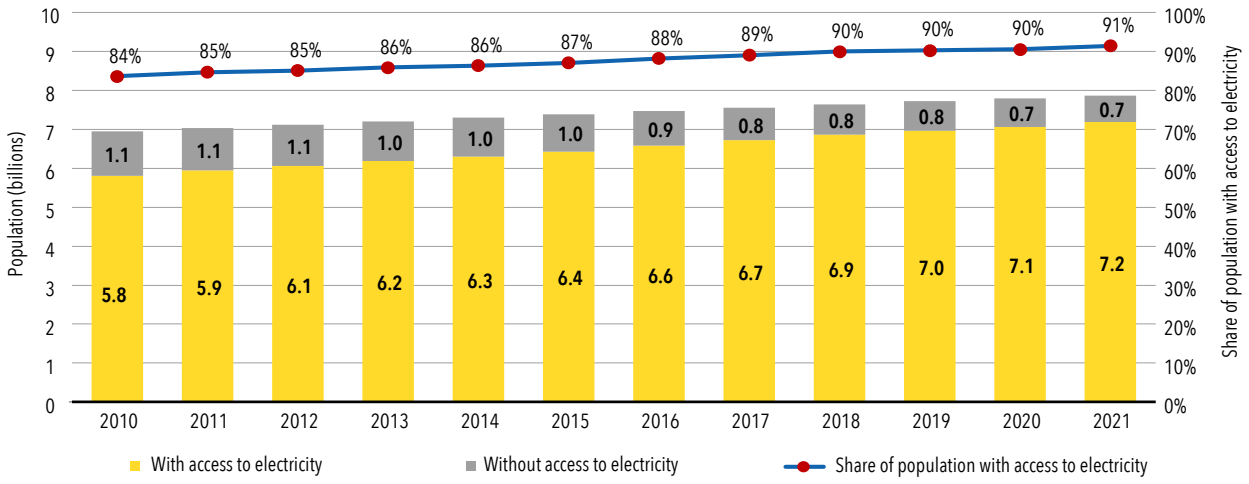
Source: World Bank 2023.
Disclaimer: This map was produced by the Geospatial Operations Support Team of the World Bank based on the Cartography Unit of the World Bank. The boundaries, colors, denominations, and other information shown do not imply any judgment on the part of the custodian agencies concerning the legal status of or sovereignty over any territory or the endorsement or acceptance of such boundaries.

Looking Beyond the Main Indicators

ELECTRICITY ACCESS AND POPULATION GROWTH

Between 2010 and 2021, the global rate of access to electricity increased from 84 percent to 91 percent (figure 1.4). Over the past decade, the increase in the number of people with access to electricity outpaced population growth. However, compared with the annual growth of 0.7 percentage points seen between 2010 and 2021, progress dipped to 0.6 percentage points in 2019–21. The dip is not surprising: the home stretch usually involves connecting people living in the most remote and poorest areas.

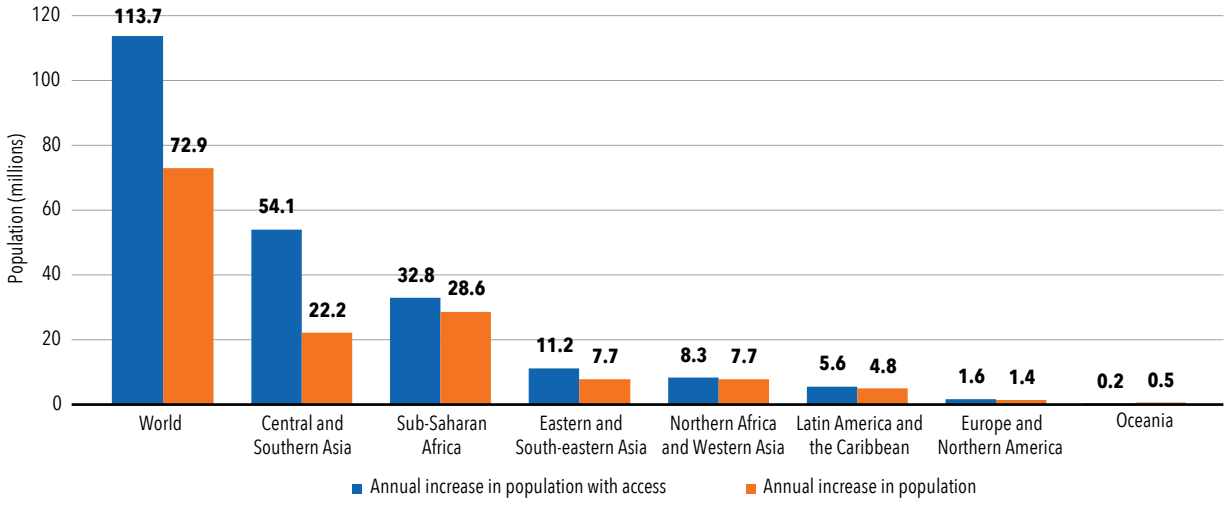
Figure 1.4 • Global electricity access and population growth, 2010–21



Source: World Bank 2023.

In 2019–21, the population with access to electricity increased by 114 million a year on average, while the world's population grew by 73 million, helping to close the electrification gap (figure 1.5). Electrification efforts in most regions outperformed or kept pace with population growth. Most of the annual increase in access came from Central and Southern Asia, where 54 million people a year gained access between 2019 and 2021, outstripping the population increase of 22 million. Southern Asia showed the fast growth in electricity access thanks to growing economies and urbanization. In Sub-Saharan Africa, electrification largely kept up with population growth in 2019–21. However, although the trend resulted in a marginal decrease in the number of people without access, the region still has the largest access deficits in the world. Because small national power systems predominate in the region, regional cooperation among national electricity companies and regional electricity markets are important to manage prices and ensure security of electricity supply (ESMAP 2022a).

Figure 1.5 • Annual increase in total population and in population with access to electricity between 2019 and 2021

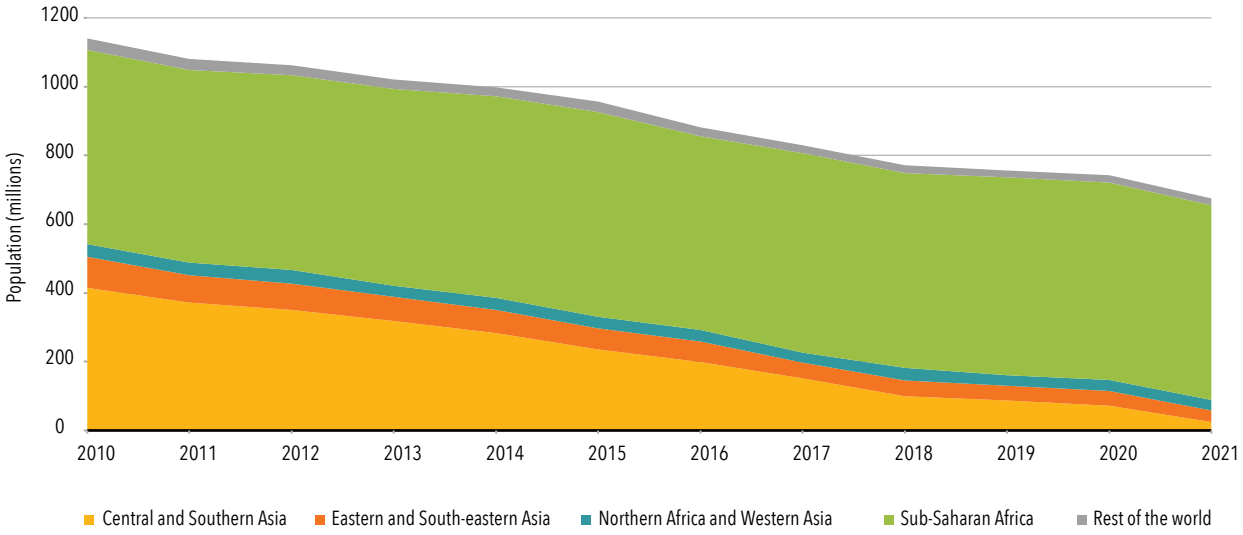


Source: World Bank 2023.

THE ACCESS DEFICITS ACROSS REGIONS AND MORE

Globally, the number of unserved people fell every year between 2010 and 2021 (figure 1.6). However, the trend is different across regions. Most of the decline came in Asia, while the pace was sluggish in Sub-Saharan Africa, where the number of people without access in 2021 was roughly the same as in 2010. The number of people without access plummeted in Central and Southern Asia, falling from 414 million in 2010 to 24 million in 2021, largely due to a decline in the number of the unserved in populous countries, such as Bangladesh and India in Southern Asia. The number of people without access to electricity in Eastern and South-eastern Asia declined from 90 million to 35 million from 2010 to 2021. In Northern Africa and Western Asia, the access deficit decreased slowly: from 37 million in 2010 to 30 million in 2021.

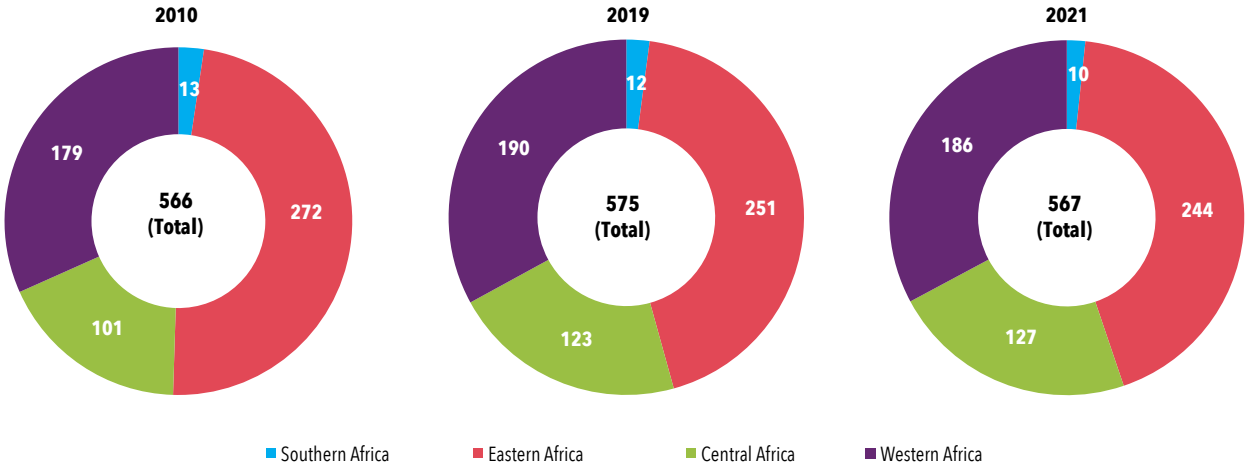
Figure 1.6 • Number of people without access to electricity, in selected regions, 2010–21 (millions of people)



Source: World Bank 2023.

In contrast, the access deficit has remained large in Sub-Saharan Africa, where about half of the regional population still lacked access in 2021. As a result, more than 80 percent of the world's unserved lived in Sub-Saharan Africa in 2021. The pattern of the access deficits in the region is far from uniform. In Central and Western Africa, population growth outpaced improvements in electrification in 2010–21, increasing the access deficit (figure 1.7). Meanwhile, the access deficit has fallen steadily in Eastern and Southern Africa. But poor reliability of electricity services is as serious a problem in Africa as low rates of access and per capita consumption. Few utilities measures service quality. Therefore, there is an urgent need for meaningful monitoring and reporting of reliability statistics at the end-user level.

Figure 1.7 • Number of people in Sub-Saharan Africa without access to electricity, by subregion, 2010, 2019, and 2021 (millions of people)

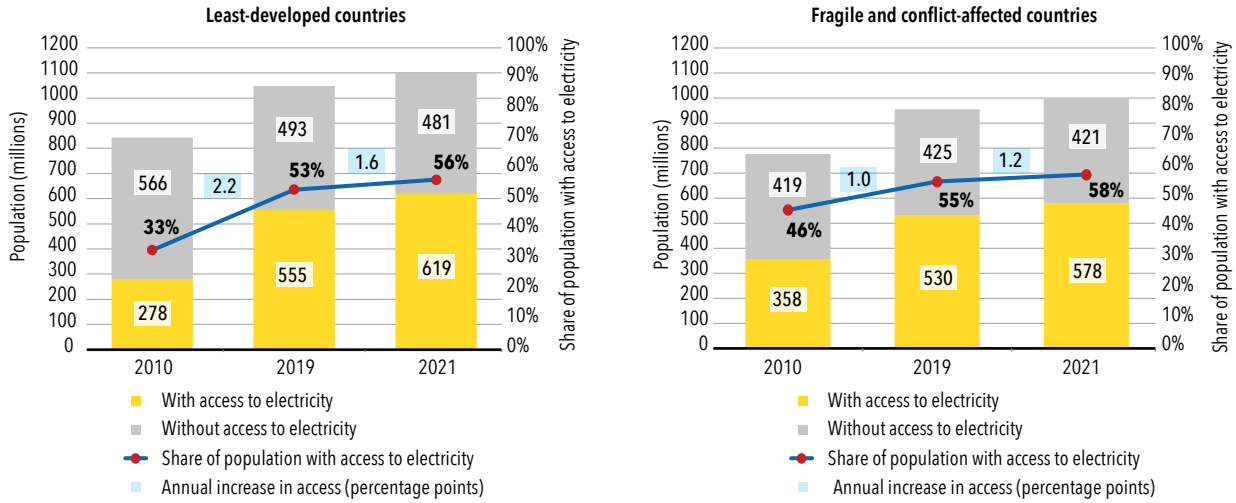


Source: World Bank 2023.

Compared with the global average, LDCs saw a relatively rapid increase in electrification, connecting about 32 million people a year in 2019–21 and bringing the rate of access up 3 percentage points, from 53 percent in 2019 to 56 percent in 2021 (figure 1.8). Nevertheless, a wide gap of more than 30 percentage points in access rates between LDCs and the global average persists, leaving 481 million LDC residents without access. In countries marked by fragility, conflict, and violence (FCV), access increased from 55 percent to 58 percent, leaving 421 million people still unserved in 2021.[24] At the current pace of electrification, most people without electricity access by 2030 will live in LDCs and FCVs. Dedicated financial and regulatory support should be strengthened to increase electrification in these settings.

24 The list of countries affected by violent conflict is based on the World Bank classification. The list is updated annually. This report refers to the list published in July 2022: https://thedocs.worldbank.org/en/doc/69b1d088e3c48ebe2cdf451e30284f04-0090082022/original/FCSList-FY23.pdf

Figure 1.8 • Increases in global access to electricity in least-developed and conflict-affected countries, 2010, 2019, and 2021

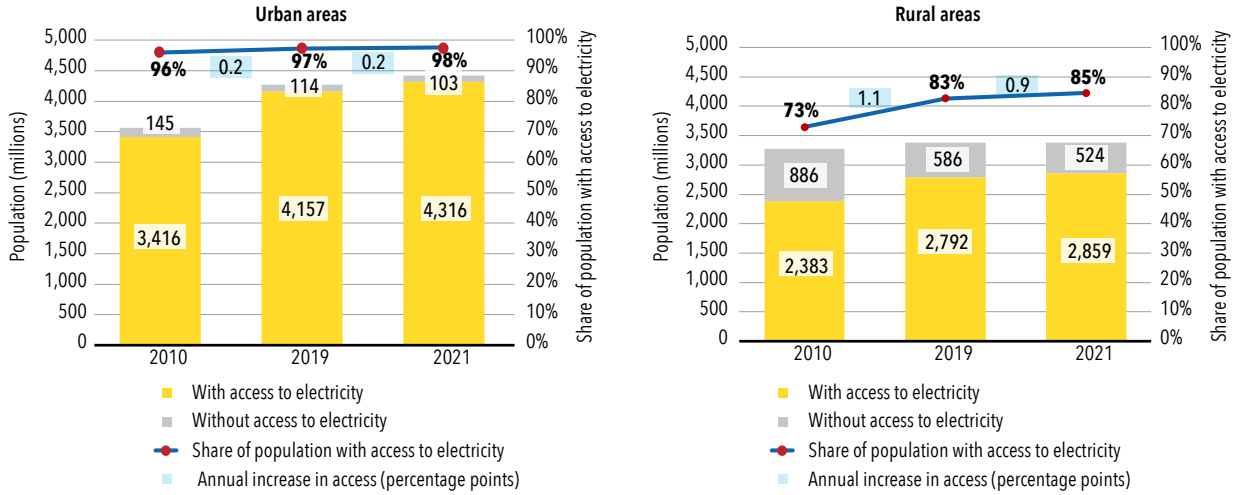


Source: World Bank 2023.

THE URBAN-RURAL DIVIDE

The discrepancy between access rates in urban and rural areas has been narrowing. In 2019–21, the pace of electrification was rapid in rural areas, outpacing population growth. In urban areas, by contrast, it flattened, partly because most urban areas had already achieved higher access. Also, rapid urbanization coupled with population growth has increased energy consumption and offset access gains. Even so, electrification rates in rural areas still trail far behind those in urban areas. In 2021, the share of the world's population with access to electricity was 85 percent in rural areas and 98 percent in urban areas (figure 1.9). Narrowing the gap between rural and urban access requires a better understanding of electricity end uses and greater mobilization of public and private financing to make electricity more affordable and electricity infrastructure more resilient. Grid and off-grid electrification options should be deployed to ensure a rapid expansion of service in rural areas. In addition, GIS techniques must be more widely applied to identify rural areas in dire need of policy support and investment.

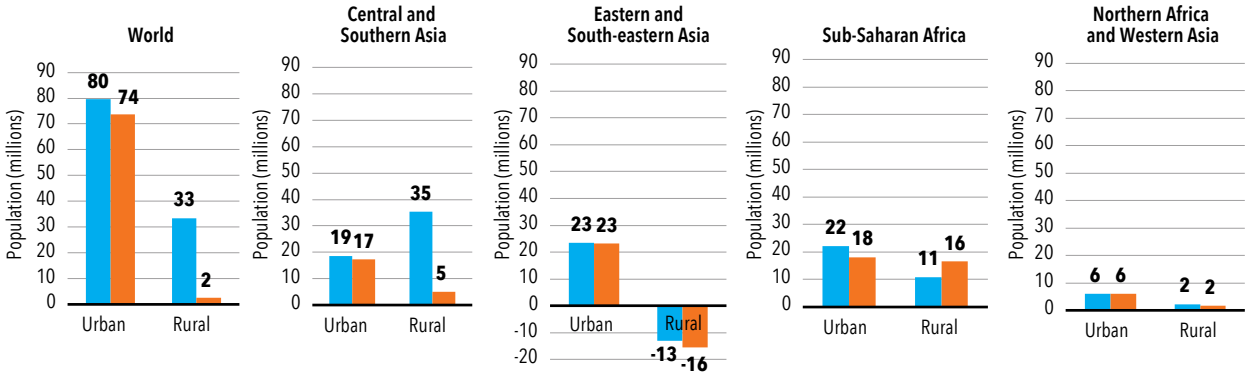
Figure 1.9 • Increases in global access to electricity in urban and rural areas, 2010, 2019, and 2021



Source: World Bank 2023.

During this period, the number of people with access to electricity grew by 33 million a year in rural areas, significantly outpacing population growth (figure 1.10). This trend was driven by Central and Southern Asia. In contrast, rural electrification progress lagged behind population growth in Sub-Saharan Africa. More than 80 percent of the 524 million rural dwellers without access in 2021 were in Sub-Saharan Africa. In the same period, annual growth in the number of rural residents served slowed in Eastern and South-eastern Asia, as the rural population shrank. In Northern Africa and Western Asia, electrification progress in rural areas kept pace with population growth. In urban areas, 80 million people a year gained access to electricity over the period. Owing to rapid urbanization and population growth, however, more than half of Sub-Saharan Africa's urban population lived in informal settlements, where reliable access to electricity is much lower than in other urban areas (UN 2022).[25]

Figure 1.10 • Annual increase in total population and population with access to electricity in urban and rural areas, globally and by region, 2019–21

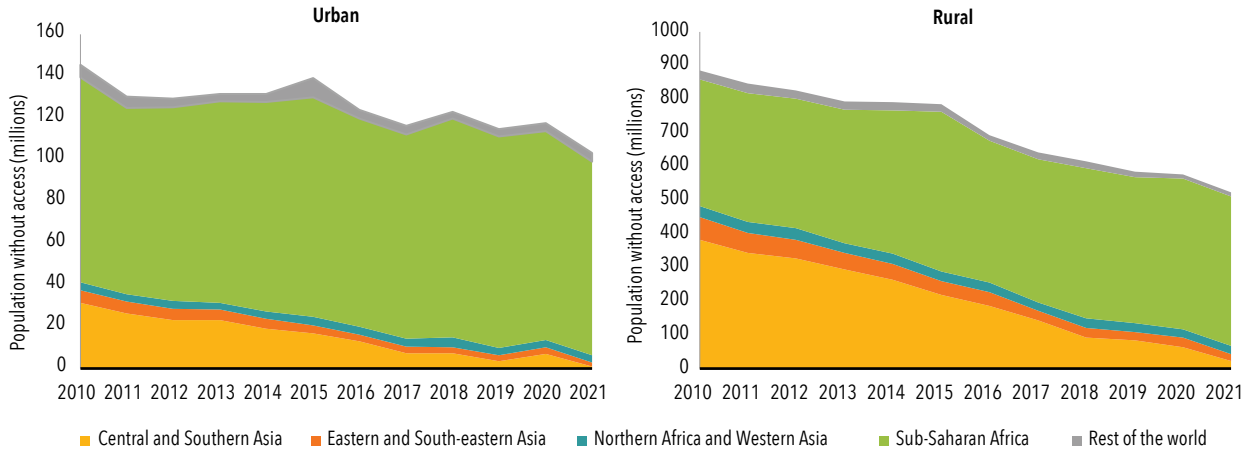


Source: World Bank 2023.

Between 2010 and 2021, the number of unserved people in Central and Southern Asia plunged from 31 million to about 1 million people in urban areas and from 383 million to 23 million in rural areas. In Eastern and South-eastern Asia, the number of people without access in urban and rural areas dropped to a third of the access deficits in 2010, falling to 2 million and 21 million, respectively. In Northern Africa and Western Asia, the urban access deficit remained almost the same, while the number of rural population without access decreased from 33 million to 25 million. In Sub-Saharan Africa, the access deficit declined to 93 million in urban settings but increased to 444 million in rural areas, with an annual increase of 6 million (figure 1.11). Central Africa, in particular, led the substantial increase in the region's rural access deficit over the period. Eastern Africa accounted for about half of the rural population without access in Sub-Saharan Africa in 2021.

25 According to the metadata for SDG indicator 11.1.1 ("proportion of urban living in slums, informal settlements or inadequate housing") informal settlements are recognized as synonymous with slums, with a particular focus on the formal status of land, structure, and services. They are defined by three main criteria, including (1) inhabitants whose claim to land or housing is insecure, (2) neighborhoods that lack (or are cut off from) formal basic services; and (3) housing that does not comply with current planning and building regulations.

Figure 1.11 • Access deficits in urban and rural areas, globally and in selected regions, 2010–21



Source: World Bank 2023.

ELECTRIFICATION USING DECENTRALIZED RENEWABLE ENERGY

Tracking progress in access to electricity produced using decentralized renewables depends on a complex mix of elements, of which market structure and the multiplicity of players in value chains are two. This section reviews trends in mini-grids and stand-alone off-grid solar solutions reported by the International Renewable Energy Agency (IRENA) and the Global Off-Grid Lighting Association (GOGLA) respectively.[26]

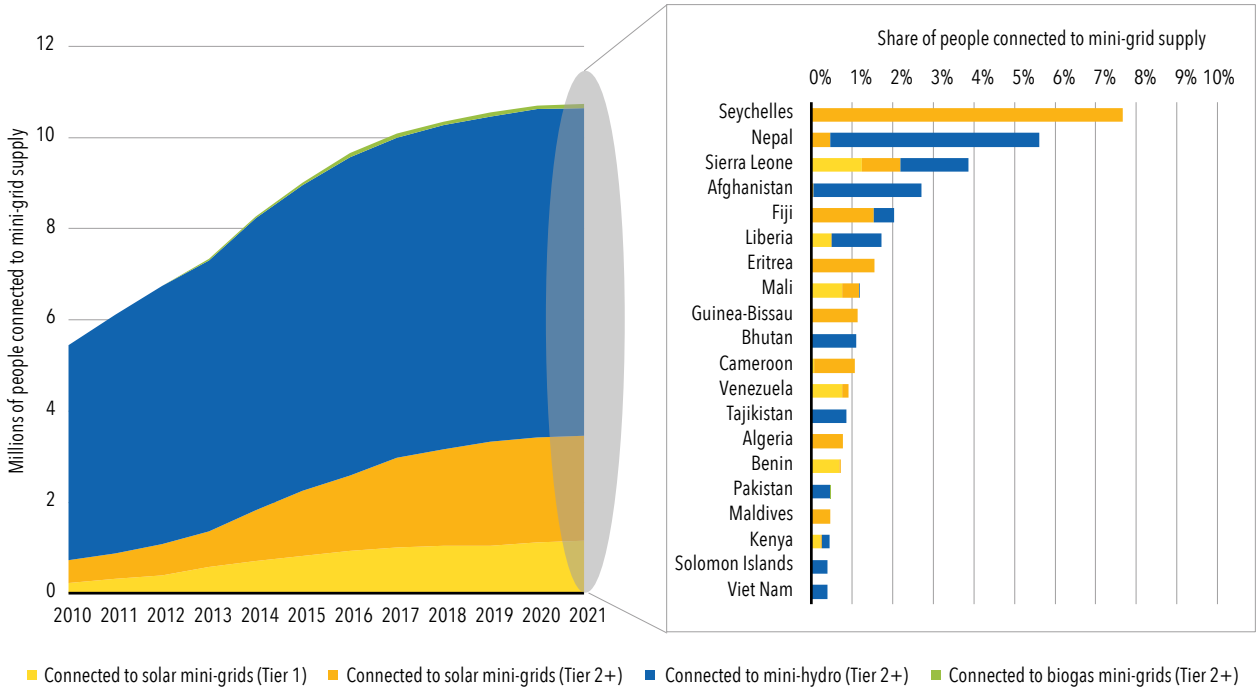
Stand-alone off-grid solutions are promising for closing the access gap in remote and rural areas of Sub-Saharan Africa, where weak utility creditworthiness and other challenges (such as the absence of infrastructure and low population densities) have impeded progress in grid electrification in rural and remote areas (ESMAP 2022a). However, to close the access gap by 2030, off-grid renewable electrification should be rapidly scaled up through dedicated policies and strong public and private financial schemes.

In the context of the challenges of the COVID-19 pandemic, mini-grid supply continued to expand access between 2019 and 2021 through support from policy makers, private investors, and end users (IRENA 2022). The number of people connected to mini-grids powered by solar, hydro, and biogas technologies reached 11 million in 2021 (figure 1.12).[27] In particular, solar Tier 2+ mini-grids have shown fast growth in recent years. Solar mini-grids served about a third of the connected and have become the least-cost way of bringing reliable electricity to communities living far from the grid or experiencing regular power outages (ESMAP 2022b). Among the 20 countries with the highest rates of access to mini-grid supply, about half were in Sub-Saharan Africa. Seychelles and Nepal served more than 5 percent of their population through mini-grids.

26 IRENA assesses Tier 1 (small PV mini-grid access) and Tier 2 access or better (large PV mini-grid access and non-PV mini-grids). GOGLA assesses access to electricity from off-grid solar products, including portable lanterns, multi-light systems, and solar home systems.

27 According to the ESMAP's market outlook and handbook "2022 mini grids for half a billion people", 48 million people were connected to about 21,500 mini grids. Most of these systems are first- and second-generation mini-grids, and approximately half of installed mini-grids are powered by solar, with hydro and fossil fuels.

Figure 1.12 • Increase in number of people with access to mini-grid supply (Tier 1+) in 2010–21 and 20 countries with the highest rates of access to mini-grid supply in 2021



Source: IRENA 2022.

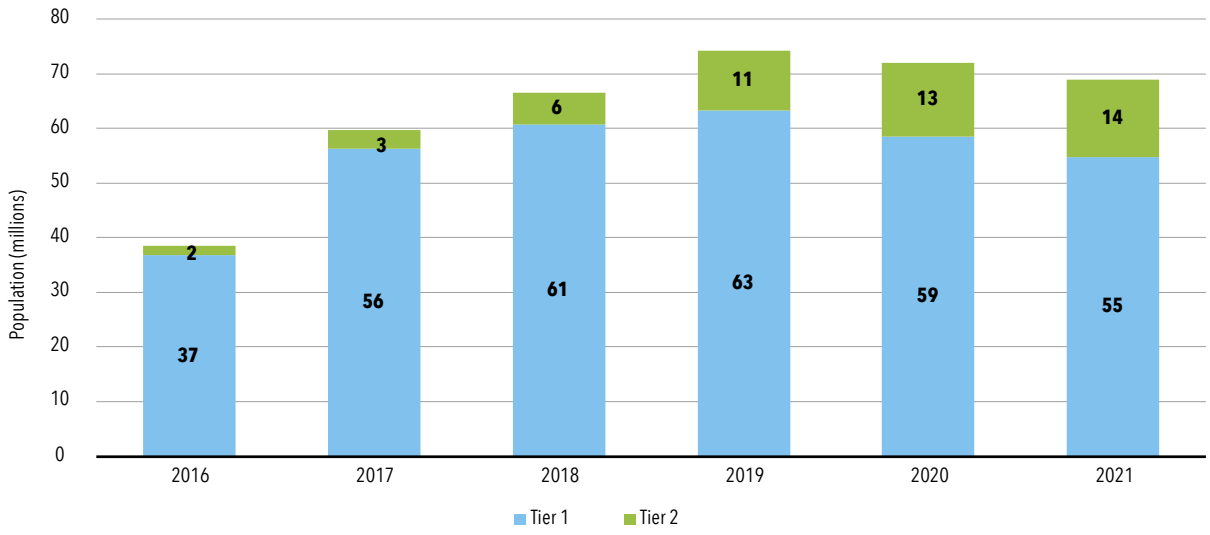
Note: More information on the Tier classification can be found in the last section of this chapter.

The number of people with access to stand-alone off-grid solar solutions dropped from 107 million in 2019 to 101 million in 2021, as the sector was hit by the COVID-19 pandemic (GOGLA 2022).[28] The decrease in sales in 2020 was significant compared with 2019 sales, which represented a peak. The countries with the largest number of people connected to off-grid solar products were Kenya (23 million), India (15 million), and Ethiopia (7 million). Between 2019 and 2021, access to Tier 2 solutions grew consistently from 11 million to 14 million, whereas Tier 1 access decreased from 63 million to 55 million (figure 1.13).[29] Since 2021, the sector has begun to recover from the COVID crisis, with a 10 percent increase in sales of solar energy kits and a 7 percent increase in market turnover. Still, significant efforts are required to recover the pre-COVID level and reach universal access by 2030 (box 1.1).

28 The figure of 101 million is calculated based on sales by GOGLA and its affiliates, which include GOGLA members, companies with Verasol-certified products, and companies working with the Low Energy Inclusive Appliances (LEIA) program. For these reasons, the impact figure captures only a percentage of the customers reached with off-grid solar technologies. ESMAP reports 490 million off-grid solar users (Lighting Global/ESMAP et al. 2022), but the quality of many of the systems is unknown.

29 Tier 1 and Tier 2 do not add up exactly to the total of 101 million people with access to quality-verified off-grid solar products because calculation of the total reflects the "partial" or "full" household aspects of Tier 1 based on the estimator created by SEforALL. For example, when some products, such as solar lanterns or multi-light kits, do not create full Tier 1 access, stacking of several products is considered in the current total of people with access.

Figure 1.13 • People connected to off-grid solar products by access tier, 2016–21



Source: GOGLA 2022.
Note: Tier classification is defined as Tier 1 (partial Tier 1 or full Tier 1 based on the system size and capacity of each product) and Tier 2 and above (at least 20 Wp, coupled with high-efficiency appliances or above 50 Wp even using conventional appliances). More information can be found in the Methodology section of this chapter.

Box 1.1 • Energy access beyond the pandemic: Findings from the Off-Grid Solar Market Trends Report

The 2022 Off-Grid Solar Market Trends Report was produced by Lighting Global/ESMAP, GOGLA, Efficiency for Access, and Open Capital Advisors. This box explores the key findings from the report.

In a trajectory to achieve universal access to electricity by 2030, the recent findings of the report indicate that off-grid solar technologies are expected to be the most cost-effective and feasible solution for 55 percent of new household connections over the next five years. While the economic disruptions induced by the COVID-19 pandemic led to a decline of 22 percent in the sales of off-grid solar products during 2019–20, the sector has since demonstrated resilience and nascent recovery, though sales remain below pre-COVID levels. The number of people accessing solar energy kits grew from 420 million people in 2019 to more than 490 million by the end of 2021, with more people gaining the higher Tier 2 level of access.[a]

Pay As You Go (PAYG), a business model that allows customers to pay for their system in smaller increments over several months, can help by lowering the up-front cost of owning a solar home system, but this may be insufficient to close the affordability gap. According to the report, even if PAYG were universally available, an estimated 177–277 million people currently without access would be unable to afford a Tier 1 system because of higher prices and lower income, in part as a result of the economic repercussions of the current energy crisis in the wake of the pandemic.

Businesses in the sector create hundreds of thousands of jobs, more than half of which are created in rural areas within the off-grid solar industry, boosting incomes in regions with relatively few employment opportunities. Many jobs are filled by members of the burgeoning youth population, whose opportunities are particularly limited.

Governments, investors, and development partners are increasingly recognizing the potential of off-grid solar solutions to power public institutions, including rural schools and health clinics. In addition, off-grid solar lighting systems and packages designed to encourage productive uses of electricity are powering more than 10 million micro- and small enterprises around the world. There is also a substantial opportunity to leverage solar energy for productive uses in the agriculture sector. Expanding access to technologies like solar water pumping or solar-powered cold storage holds the promise to quickly improve the livelihoods of some 22 million smallholder farmers across Sub-Saharan Africa and India.

According to the report, in order to achieve SDG 7, 1.1 billion people around the world will have to be served with off-grid solar products at Tier 1 and above by 2030. This would include (i) 186 million customers of weak grids who will need off-grid solar systems as a backup; (ii) 493 million current off-grid solar users who are expected to continue replacing and upgrading their systems; and (iii) 464 million people connecting to off-grid solar for the first time.

To achieve this goal, an estimated USD 23.3 billion in public and private funding will be required. Based on historical sales and investment trends, however, the off-grid sector is projected to raise only USD 7.8 billion in investments between now and 2030. Moreover, current funding is highly concentrated in mature markets; only a fraction of private investment is directed toward nascent and emerging markets, where the vast majority of unconnected households are located. To unlock the sector's full potential, bridge the affordability gap, and make products accessible to households in hard-to-reach areas, increases in both public and private funding will be needed.

Source: Lighting Global/ESMAP and others (2022).

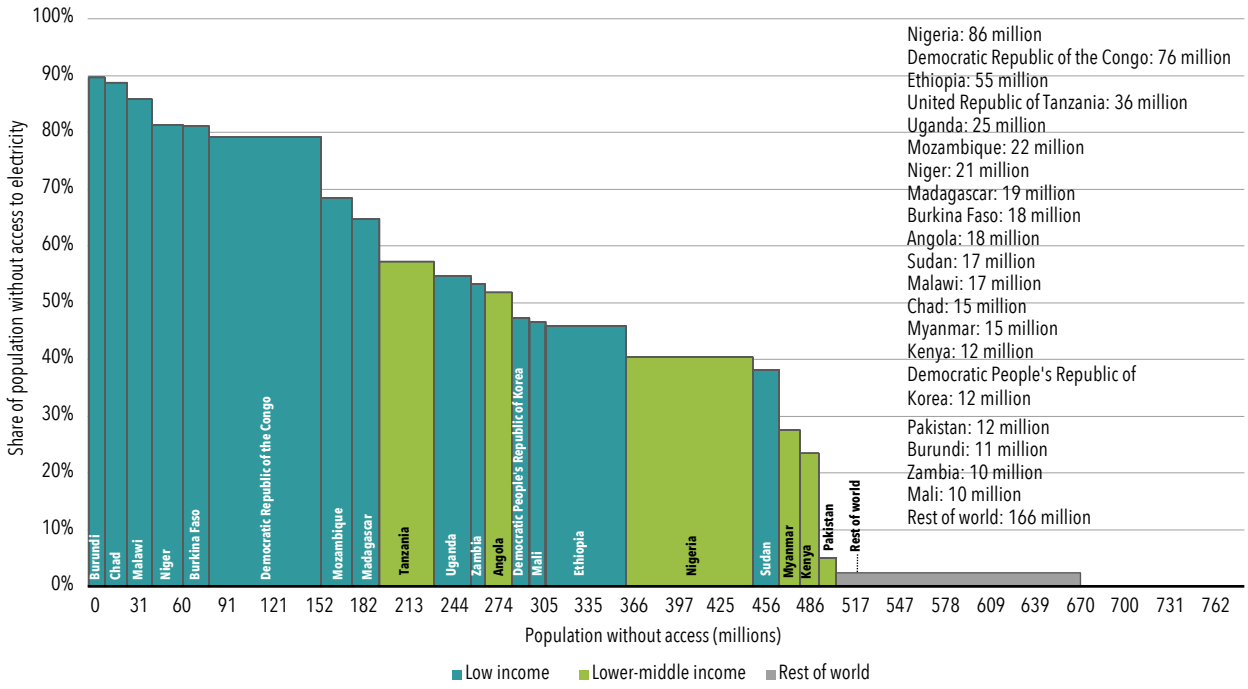
a The estimate of 490 million with access is based on sales of the broader industry, not just sales of GOGLA affiliates. The estimate includes sales of component-based solutions.

COUNTRY TRENDS

In 2021, the 20 countries with the largest access deficits accounted for 75 percent of the world's people lacking access to electricity. The countries with the largest numbers without access were Nigeria (86 million), the Democratic Republic of the Congo (76 million), and Ethiopia (55 million) (figure 1.14). In 2021, the top three countries were the same as in the previous edition of this report. India and South Sudan dropped out of the top 20, and Zambia and Mali joined it.

Increases in electrification did not keep up with population growth in the Democratic Republic of the Congo between 2019 and 2021. As a result, the access deficit increased by about 2 million people annually. In contrast, the number of people without access in Nigeria and Ethiopia fell by 2 million each year between 2019 and 2021, although those countries are still among the top 3 in terms of unserved population. During the same period, Kenya and Ethiopia increased their access rates by more than 3 percentage points. Consequently, as in Ethiopia, the number of unserved people declined by about 2 million a year in Kenya in 2019–21.

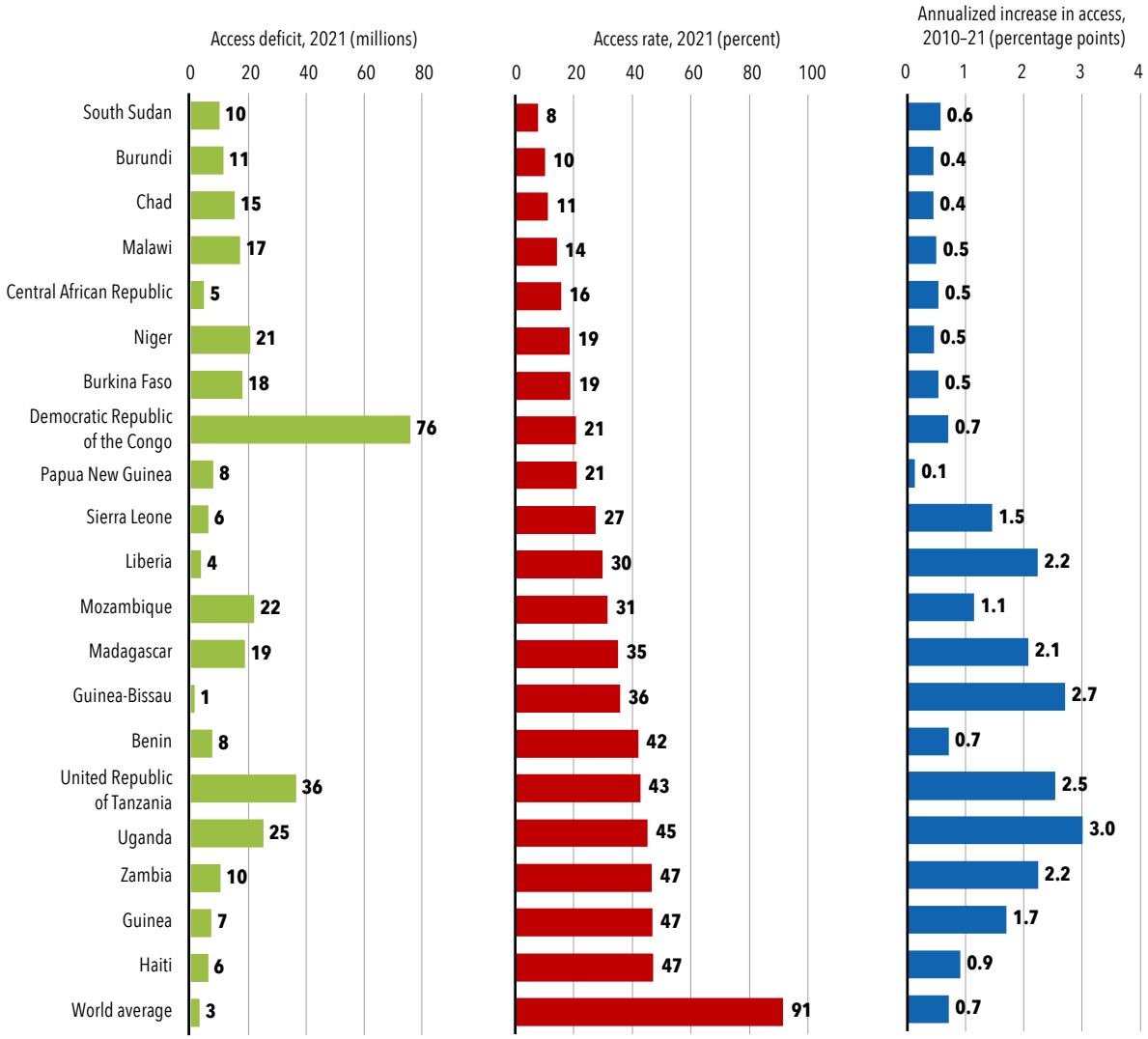
Figure 1.14 • Share and absolute size of population without access to electricity in the top 20 access-deficit countries and the rest of the world, 2021



Source: World Bank 2023.

The lowest access rates were in Burundi (10 percent) and South Sudan (8 percent) (figure 1.15), where the pace of electrification was slow over the past decade. The electricity infrastructure in South Sudan has been underdeveloped due to decades of conflict and insecurity. Burundi had the large access gap between urban (63 percent) and rural areas (2 percent); thus, the country should prioritize rural electrification to help the poor and the most vulnerable communities improve their livelihoods. In contrast, Guinea-Bissau, Tanzania, and Uganda expanded electrification by approximately 3 percentage points a year between 2010 and 2021, although overall access rates remained low.

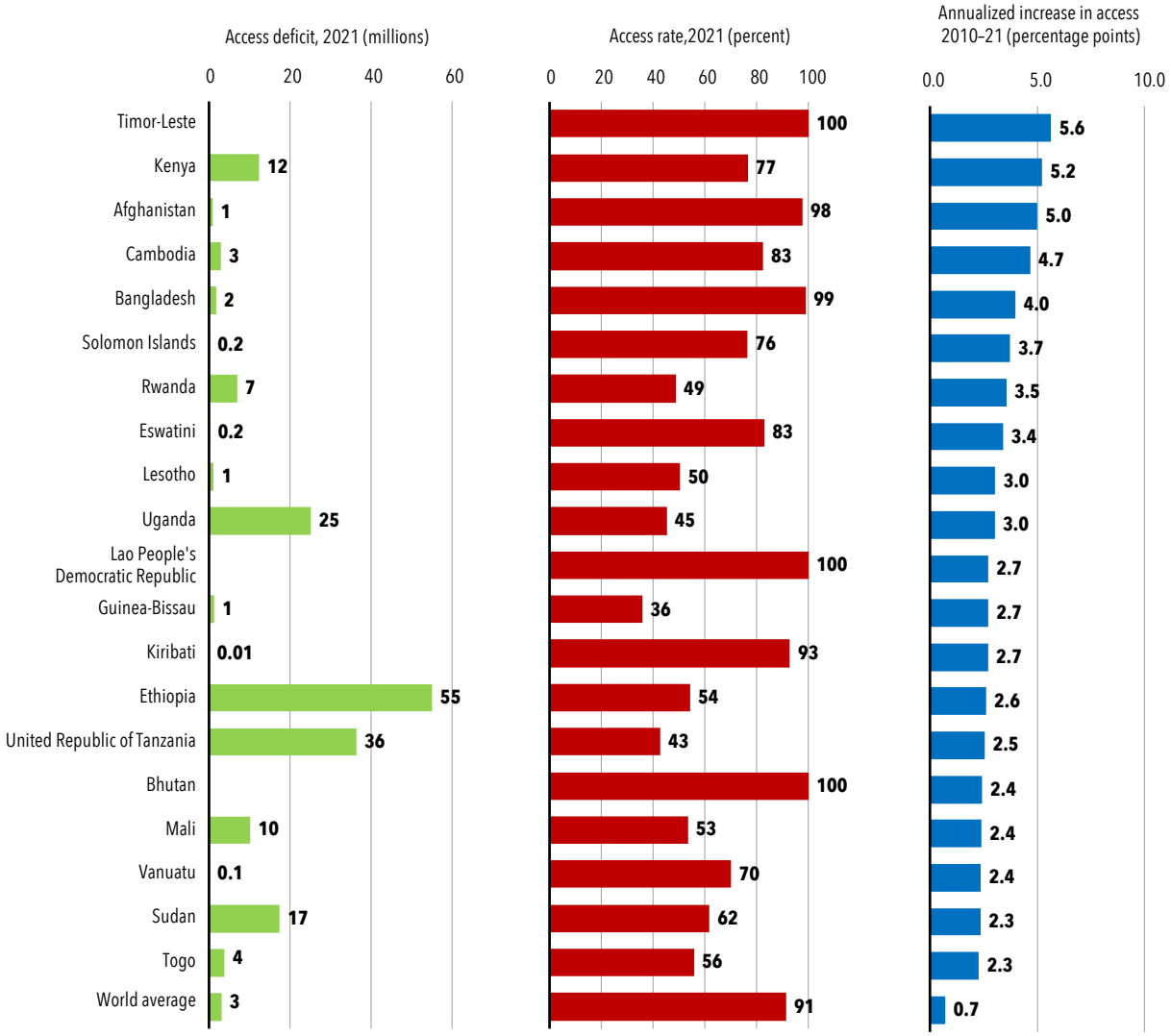
Figure 1.15 • Access to electricity in countries with the lowest rates of electrification, 2021



Source: World Bank 2023.

Timor-Leste and Kenya increased their access rates fast—by around 5 percentage points a year since 2010—thanks to notable improvements in rural electrification. These countries have built strong access strategies tailored to their country contexts (figure 1.16). For example, Kenya developed regulatory and policy frameworks for grid and off-grid solar expansion and extended them into several underserved countries in partnership with the private sector (ESMAP 2022a). Despite the fast-growing trends, the countries should continuously take action to address a concerning challenge of improving the reliability and quality of electricity access.

Figure 1.16 • Access to electricity in countries with the largest increases in access, 2010–21



Source: World Bank 2023.

Policy Insights: The Interlinkages Between SDG 7 and Other SDGs

Policies for energy access should demonstrate political commitment and maximize the socioeconomic benefits of access, keeping the most vulnerable populations at the forefront of efforts to close the access gap. Annual investment of USD 30 billion is required to achieve universal access to electricity by 2030, according to IEA's Net Zero by 2050 Scenario (IEA 2022). Expanding blended finance and establishing partnerships of humanitarian, development, government, and private actors through impact investing and risk-mitigation instruments can attract new capital, increase funding from existing investors, and improve the terms of both equity and debt financing (Prasad and others 2022; Gibson and others 2022).

Governments should strive to improve the legal and institutional environment so as to improve the financial viability of utilities to expand on-grid access and attract private sector investments in clean energy generation. A supportive climate and the right policies would also serve to expand mini-grid and off-grid electrification to meet energy access goals. In the early stages of electrification, for example, PAYG energy service providers that provide lease-to-own, usage-based payment services have benefited in some countries from low-cost public financing. Arranging public-private partnerships and project finance with long repayment periods and flexible payment schedules, especially when interest rates are high, would provide a major boost to utilities, mini-grid operators, off-grid companies, and other energy service providers (ESMAP 2022b).

Coordination efforts should focus on strengthening and supporting partnerships between local and regional stakeholders, the goal being to improve local conditions and lead to more sustainable and robust regional effects. Collaboration among regulators, utilities, mini-grid operators, off-grid companies, community leaders, and nongovernmental organizations allows stakeholders to share experiences; pool resources, knowledge, and capacity building; and set shared standards. Such collaboration can improve the security of supply, the broader diffusion of technological innovation, and the sustainability of new business models, ultimately leading to harmonization of standards and practices and more affordable energy services (African Development Bank 2022).

Affordable, reliable, modern energy is a prerequisite for the attainment of other SDGs. At the same time, it competes for attention with other SDGs. This section explores how energy access is interlinked with several SDGs, notably SDG 1 (zero poverty); SDG 3 (good health and well-being); SDG 4 (high-quality education); SDG 5 (gender equality); SDG 8 (decent work and economic growth); SDG 9 (industry, innovation, and infrastructure), and SDG 13 (climate action). Improvements to energy access take place within the framework of the 2015 Paris Agreement on climate change, which commits the world to holding the long-term mean global temperature to no more than 2°C above pre-industrial levels and reaching net-zero emissions by 2050.

INCREASING ACCESS TO CLIMATE-RESILIENT ENERGY: INTERLINKAGES BETWEEN SDG 7 AND SDG 13 (CLIMATE ACTION)

Expanding access to affordable, clean energy and meeting climate change obligations are interdependent. Achieving these two goals is challenging, however, especially for the least-developed countries, which must build cleaner and more resilient energy systems as a prerequisite to meet international climate change pledges. To manage the trade-offs, policy makers must develop practical climate adaptation strategies and plans for energy infrastructure that are connected to diverse climate justice considerations. The participation of public and private investors will be needed to support initiatives in pursuit of both goals.

Electricity expansion through mini-grids or stand-alone systems could help developing countries to address electricity access challenges in a climate-friendly manner and sustain livelihoods. Like other types of infrastructure, however, modern electrical capacity (grid, off-grid, and mini-grid) is vulnerable to climate change to varying extents (IEA 2021). These vulnerabilities imperil the gains in access to affordable, reliable, modern energy achieved over the past decades (WMO 2022). Adapting to climate change can also increase demand for energy (Ruijven, de Cian, and Wing 2019). Satisfying that demand with renewable energy will require tight integration of renewables in the adaptation agenda (IRENA 2021).

In the quest for affordable and clean energy access, therefore, integrated-least cost planning is important to meet consumers' needs for reliable and efficient energy services. Governments can and should build an enabling environment to attract and manage private capital into clean on-grid electrification, while simultaneously leveraging public funds to encourage private sector investment in decentralized electricity access. Integrating climate change considerations into national access policies, strategies, and planning supports the concurrent goal of strengthening resilience and adaptive capacity to climate-related hazards and natural disasters. Accounting for the detrimental effects of climate change on energy access—by, for instance, making infrastructure more resilient, diversifying energy sources, and developing adequate insurance mechanisms—can help communities, utilities, and countries enable adaptation action (United Nations Climate Change Secretariat 2017).

Acquiring high-resolution climate, energy system, and socioeconomic data remains a challenge, especially in Africa, as does developing the capacity of private and public stakeholders to apply the data to energy access and business planning, financing, and related policy making (UN 2021a). Local, national, and regional stakeholders must improve their ability to acquire data, manage it (including by addressing data privacy, ownership and sharing between entities), and to use it to expand climate-resilient energy access.

INCREASING ACCESS TO ENERGY AT SCHOOLS AND HEALTH FACILITIES: INTERLINKAGES BETWEEN SDG 7 AND SDGS 4 (HIGH-QUALITY EDUCATION) AND 3 (GOOD HEALTH AND WELL-BEING)

Increasing access to high-quality education is crucial for reducing poverty. Access to energy facilitates lighting, heating, cooling, cooking, and access to informational and communication technologies, all of which can improve learning (UN 2019, 2021). Modern and dependable access to energy in schools can attract new teachers and increase teacher retention, facilitate school administration, and increase access to teaching resources and classroom materials. Access to electricity at home can free students of the time-consuming task of collecting fuel; improve health and education outcomes; and allow students to study after dark, thereby increasing attendance, performance, literacy, and school completion rates.

The COVID-19 pandemic exposed the shortcomings of a lack of energy and internet in schools and homes, which prevented millions of children from continuing or accessing education, adversely affecting their learning and putting them at risk of not returning (UNESCO 2020). In 2020, only 47 percent of lower-secondary schools in Sub-Saharan Africa had access to electricity; globally, less than half the population had access to the internet (UNESCO 2022). In 2021, rates of electricity access in primary schools were as low as 4 percent in Chad, 9 percent in Nepal, and 10 percent in Niger (UNESCO 2022).

Technology should be harnessed to address educational challenges through out-of-the-box programs, as some countries are already doing. In Sierra Leone, for example, SMS Dictionary allows students with access to electricity but not the internet to charge their phones and learn new words (Sengeh 2022). Radio instruction—first rolled out during the 2014 Ebola crisis—helped keep children in schools during the COVID-19 pandemic (Behsudi 2021). Sierra Leone is also using tablets—which can be charged with the same mini-grid and off-grid solutions that provide power to cell-phones—to track budgets, grades, and other administrative priorities (Ministry of Basic and Secondary Education of Sierra Leone 2022).

Accelerating financing for affordable mini-grid and stand-alone systems, including battery storage technologies, is an important step toward providing education that has implications for many other SDGs. Using innovative solutions to increase energy access in schools should be part of an integrated strategy to make education accessible and inclusive for all, including previously marginalized groups, such as pregnant students, rural students, and persons with disabilities. In turn, investment in education will be needed to equip the next generation of tech leaders with the necessary skills to perform this work. Green skills and other facets of energy education are important in preparing a generation of young people to complete the energy transition.

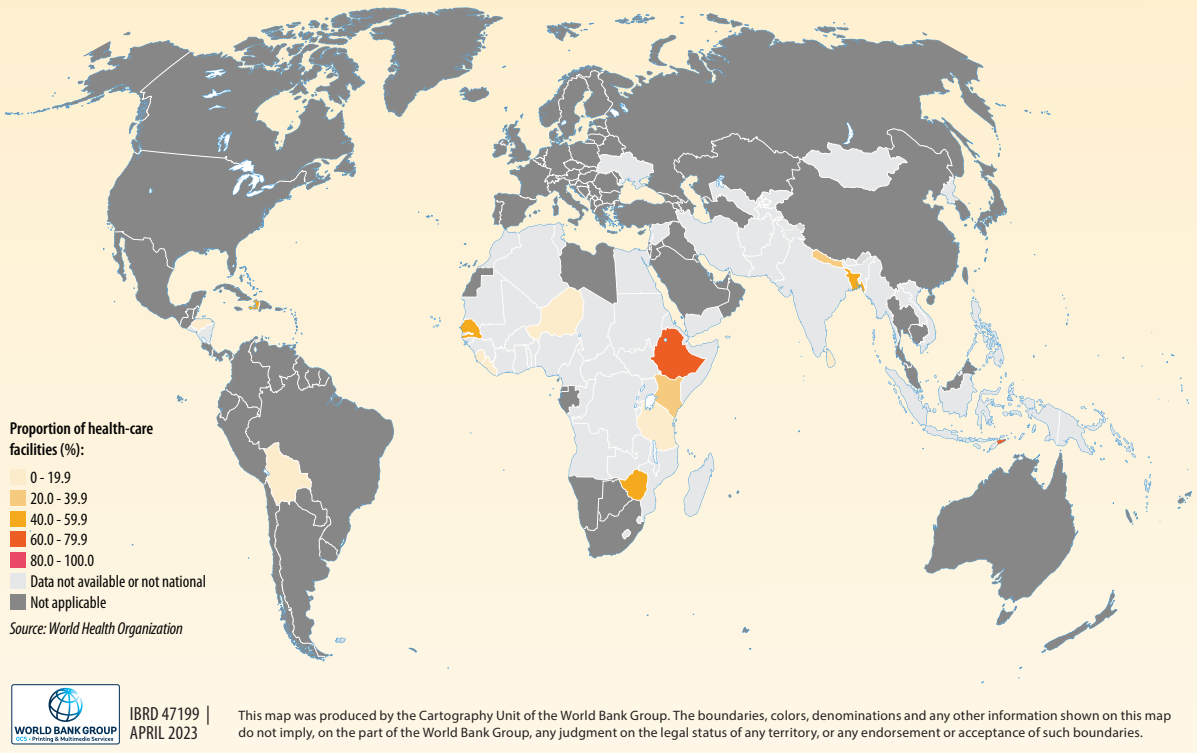
Reliable electricity is also needed to power life-saving medical and emergency operations. Unreliable supplies compromise medical equipment and instruments, water for sanitization, cold chain immunization systems, and other fundamental amenities. A recent study presented data on electrification of health care facilities and key priority actions for governments and development partners (box 1.2).

Box 1.2 • Accelerating access to electricity by health-care facilities

Reliable electricity access is crucial for effective delivery of health care. In 2023, the World Health Organization, the World Bank, the International Renewable Energy Agency, and Sustainable Energy for All published Energizing Health: Accelerating Electricity Access in Health-Care Facilities. The report discusses the overlaps between these two crucial SDGs, as summarized here.

Electricity access is essential to powering basic services in health-care facilities—among them lighting, clean water supply, childbirth and neo-natal care, immunization, storage, and power for medical equipment. Unfortunately, this aspect of health infrastructure is often neglected, leading to inadequate access to electricity, especially in low- and lower-middle-income countries (figure B1.2.1).

Figure B1.2.1 • Percentage of health-care facilities reporting unreliable electricity access in national surveys, 2015–22



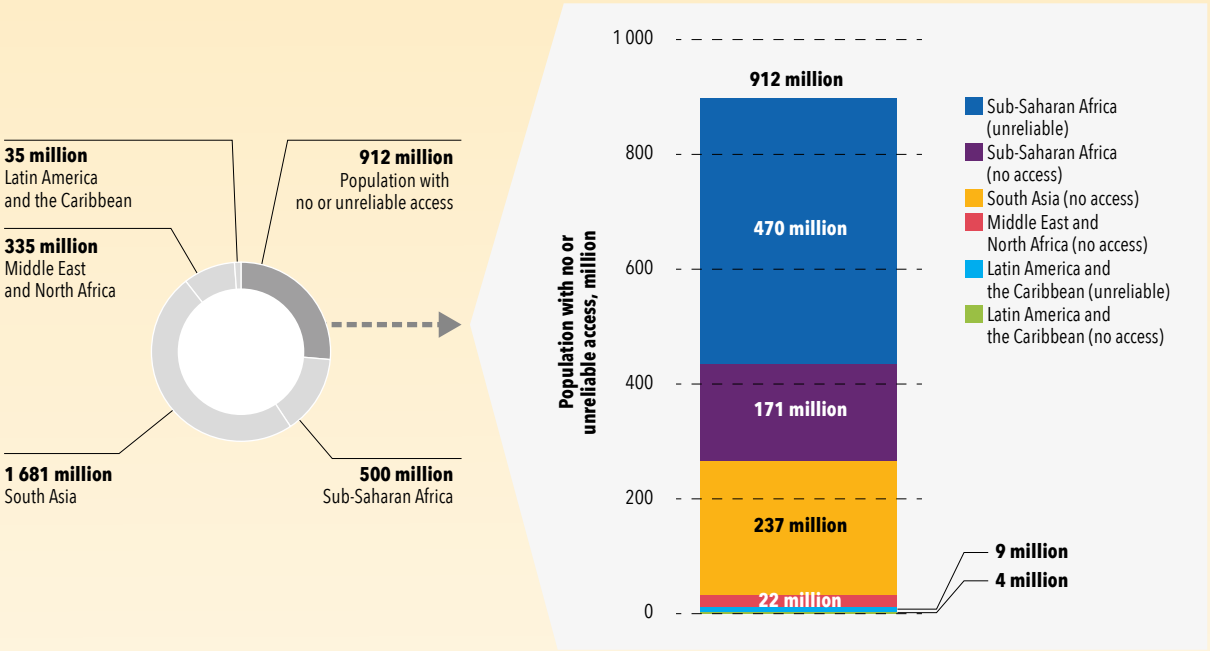
Source: World Health Organization 2023.

Note: This figure is extracted from the report Energizing Health: Accelerating Electricity Access in Health-Care Facilities.

In low- and lower-middle-income countries of South Asia and Sub-Saharan Africa, approximately 12 percent and 15 percent of health-care facilities, respectively, have no access to electricity. Only half of Sub-Saharan Africa's hospitals have reliable access. These data translate to some 25,000 health facilities with no power and 68,000 with unreliable power. Overall, it is estimated that the health-care facilities of nearly 1 billion people in low- and lower-middle-income countries lack reliable access to electricity (figure B1.2.2). The urban-rural divide is sharp. For example, less than 5 percent of rural facilities in Senegal have reliable access, compared with almost 55 percent of urban facilities.

The World Bank's analysis shows that 64 percent of health-care facilities in 63 low- and middle-income countries require immediate intervention, and USD 4.9 billion is urgently needed to bring these facilities up to a minimal level of reliable electrification. Further comprehensive energy needs assessments in health services are crucially needed.

Figure B1.2.2 • Estimated population served by health-care facilities with no electricity access or with unreliable electricity, disaggregated by region



Source: World Health Organization 2023.
Note: This figure is extracted from the report Energizing Health: Accelerating Electricity Access in Health-Care Facilities.

Decentralized renewable energy solutions, such as solar photovoltaics, are cost-effective, clean, and rapidly deployable, making them a good solution for electrifying health-care facilities without waiting for arrival of the grid. Powering health-care facilities through renewables also helps build climate resilience.

Building the capacity of local stakeholders, local skills, and local markets around the needs of energy in health is essential. The "install and forget" approach to electrification must be transformed into "install and maintain," with accountability mechanisms and long-term operation and maintenance, waste management, and replacement of batteries and spare parts all included in budget planning.

Both the lack of electricity and unreliable supply are major barriers to wider health-care coverage. Reliable electrification must be considered a priority because health is a public good and a human right. To make good on that right, technical assistance, development financing, and investments from governments, donors, and development partners must be increased through cooperation that avoids duplicate efforts and integrates specialized health knowledge, medical devices and appliances, and energy systems at the country level.

Source: WHO 2023.

INCREASING ACCESS TO ENERGY WHILE LEAVING NO ONE BEHIND: INTERLINKAGES BETWEEN SDG 7, SDG 5 (GENDER EQUALITY), AND FRAGILITY, CONFLICT, AND VIOLENCE

Access to electricity is strongly associated with women's economic empowerment and gender equality, just as gender-sensitive electrification policies and regulations are more likely to succeed. A gender-sensitive approach to electrification, with women involved in policy making, could help increase women's participation in business activities in the energy sector, despite social and other barriers, while also driving more inclusive solutions for electricity access. In Sub-Saharan Africa, several countries have adopted gender-responsive energy policy frameworks for electrification expansion (ESMAP 2022a). Because gender-disaggregated data and information are limited, strengthening gender-inclusive energy policies and promoting women's entrepreneurship will depend on stronger efforts by policy makers and practitioners to develop gender statistics.

Fragility and energy poverty are closely interlinked. Instability and conflict inhibit the development of infrastructure and investment for electrification, and the electricity access gap exacerbates existing vulnerabilities. People living in FCV settings or along the "last mile" face special barriers to energy supply and higher access costs.[30] Forcibly displaced persons often experience minimal access to electricity, and when they do, they must often use sources of electricity that are costly, inefficient, unsafe, and harmful to the environment. Logistical and technical challenges make it difficult to provide energy access in displacement settings, increasing project risks and diminishing potential returns (World Bank 2022).

Camps and settlements for forcibly displaced persons are among the areas that are hardest to reach with electricity because their residents are poor, the settings are often remote, and the high upfront capital costs of energy are typically hard to justify for settlements that are intended to be temporary. As a result, most water systems, health-care facilities, and schools serving forcibly displaced persons and their host communities lack access to reliable and modern energy. Solarization efforts are ongoing in 46 percent of water pumping stations in displacement settings, 37 percent of health-care facilities, and 13 percent of schools; most of the remainder still depend on unreliable, fossil fuel–powered energy, or have no power at all (UNHCR 2022). Investing in solar and other renewable solutions in these areas is paramount to advancing progress on SDG 7.

To sustainably address the vulnerabilities of forcibly displaced persons and their impacts on local communities, energy access projects in displacement settings typically need to be addressed differently from standard development initiatives (World Bank 2022). Evidenced-based least-cost programs—including programs supporting the deployment of mini-grid and off-grid technologies—should recognize vulnerable populations, rather than emergency aid programs, as the primary agents of decision-making, keeping people at the center of attention. Improvements might include linking energy access to program incentives, integrating vulnerable populations in funding windows, and supporting technologies and skill development that address the particular access challenges of vulnerable populations.

Focusing energy access efforts and financing on people suffering from fragility, conflict, and violence (before or after displacement) and on women and girls has been shown to have multiplier effects on poverty reduction, educational attainment, inequality, and the attainment of other SDGs (UNHCR 2020). National access and infrastructure plans, regulatory frameworks, and efforts to strengthen the enabling environment around access should integrate these populations into the broader energy access strategy in an inclusive, effective, and sustainable manner (UNHCR n.d.).

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30 A staggering 90 percent of displaced people lack access to sustainable, reliable, affordable energy. This lack of access affects all areas of life in refugee camps, including education, health care, hygiene, and safety (UNHCR 2022). This figure reflects only displaced people living in camps, rather than other settings.

INCREASING ACCESS TO ENERGY BY STIMULATING MARKETS AND IMPROVING REGULATORY FRAMEWORKS: INTERLINKAGES BETWEEN SDG 7 AND SDG 8 (DECENT WORK AND ECONOMIC GROWTH) AND SDG 9 (INDUSTRY, INNOVATION, AND INFRASTRUCTURE)

COVID-19 brought new challenges to the advancement of all SDGs; it also created opportunities to recalibrate spending, re-focused attention on new priorities, and highlighted possible connections among the goals (Shulla 2021). In September 2021, for the first time in 40 years, the UN secretary-general convened the High-Level Dialogue on Energy, this time with the objective of promoting an accelerated implementation of SDG 7, other targets of the 2030 Agenda for Sustainable Development, and the Paris Agreement (UN 2021). The Dialogue issued recommendations to make universal access to electricity a political, economic, and environmental priority, aligned with an inclusive COVID-19 recovery, by (i) reinforcing enabling policy and regulatory frameworks and (ii) catalyzing, harnessing, and redirecting energy-access financing as needed to deliver universal energy access by 2030 (UN n.d).

Many developing economies are hobbled by scarce financing, inadequate risk mitigation resources, financially nonviable utilities, low capacity in critical agencies, and the absence of local financial institutions with access-related expertise—all of which compromise the bankability of access projects. Specific policies to expand infrastructure, upgrade technology, and achieve modern and sustainable energy service targets under a given regulatory framework are country dependent, but all countries need to establish conditions that support new and innovative ways to promote transparency, ensure accountability, and de-risk investments. The vitality of small and medium-size enterprises, in particular, depends on closing the gap between commitments and disbursements, reducing inefficient subsidies, and identifying predictable, practicable methods of leveraging public resources.

Regulatory and policy frameworks for electricity access should be designed to support innovations in energy technology and to leverage financing—both for the ultimate purpose of providing affordable and reliable electricity and maximizing economic growth. The World Bank's Regulatory Indicators for Sustainable Energy (RISE) measure the policy and regulatory environment for public and private investment in the realm of sustainable energy. The most recent RISE survey results (ESMAP 2022a) provide performance scores on access to electricity in the aftermath of the COVID-19 pandemic (box 1.3).

Good regulatory and policy frameworks will encourage productive uses of electricity, which generate income and employment in local communities and thus help fight poverty. Integrated access planning, with special attention to the expansion of mini-grid and off-grid systems, is a precondition for such frameworks. In addition to promoting productive uses at the local level, regulatory and policy frameworks informed by integrated planning can meet the energy demands of industry (especially small and medium-sized enterprises), attract private investment in the energy sector, and multiply the effects of the sector on the rest of the economy. For example, an ongoing effort to mainstream mini-grid tariff settlement tools and methodologies across African regulators could broaden deployment of mini-grids across the region, buoying economic activities that depend on access to modern and reliable energy (African Forum for Utility Regulators 2021). To exploit the interlinkages with SDGs 8 and 9 the policy and regulatory environment for energy access must integrate incentives for cross-sectoral collaboration.

Supporting technological innovation and digitalization could reduce costs, provide efficiencies across the value chain, and improve collection and accountability, encouraging investments that widen opportunities to close the energy access gap while having large cross-sectoral effects. Two examples: Technology platforms that connect developers with investors and suppliers in large-scale mini-grid tenders can bring mini-grid projects to fruition (ESMAP 2022b). And using machine learning and artificial intelligence for load management, planning, and upkeep can minimize costs and free resources to expand and improve grid and other energy services. Governments should consider the deployment of digital technologies and the interoperability of components when strengthening and updating national institutional networks and legal frameworks that guide standards and regulations for energy products and services.

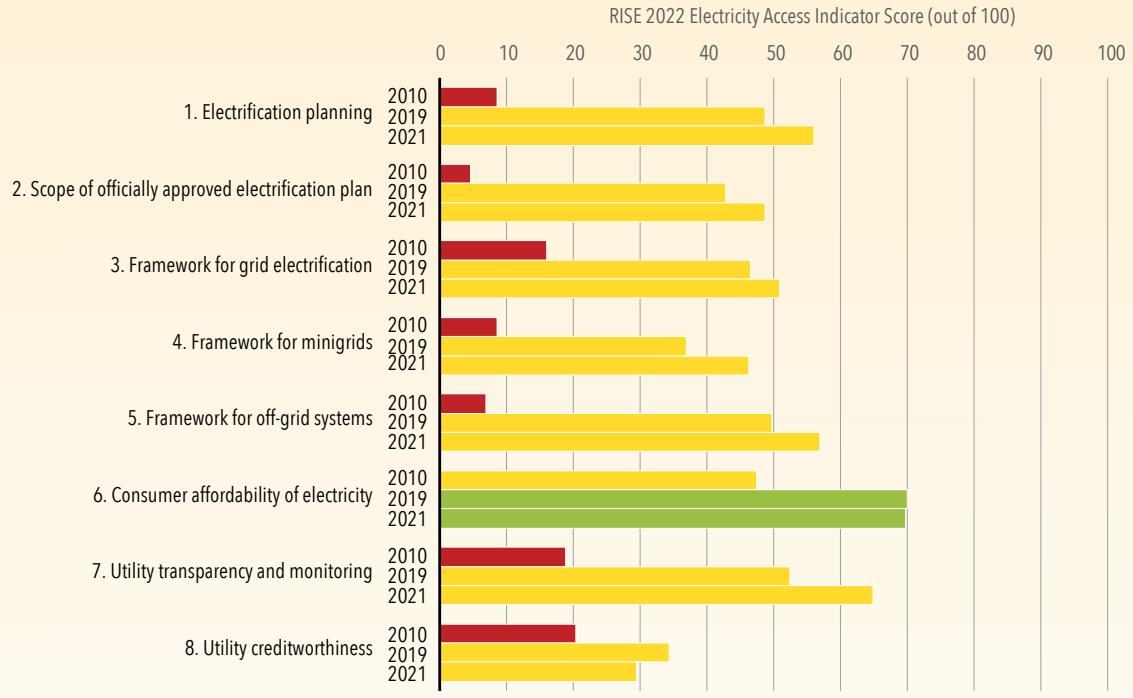
Box 1.3 • Progress on the energy access pillar of the Regulatory Indicators for Sustainable Energy (RISE) 2022

The Regulatory Indicators for Sustainable Energy (RISE), compiled by the Energy Sector Management Assistance Program (ESMAP), tracks electricity access policies across 54 access-deficit countries. RISE uses "traffic light" colors to represent the lower, middle, and upper third of access scores, normalized to a theoretical minimum of 0 and a maximum of 100.

The latest RISE results (ESMAP 2022a) show that although the global economy slowed in 2019–21, many governments continued to advance in their access-related regulations. In 2021, a quarter of the access-deficit countries entered the green zone in their overall access scores, and about half were in the yellow zone. The results are based on eight indicators that capture a comprehensive picture of regulatory incentives for mini-grids and off-grid systems, including approaches to targeting low-income households (figure B1.3.1). The steady overall improvement was primarily due to changes in the following indicators: electrification planning, frameworks for mini-grids and off-grid systems, and utility transparency and monitoring (Indicators 1, 4, 5, and 7). Nigeria and Ethiopia, two of the largest access-deficit countries (along with the Democratic Republic of the Congo), made notable progress in policy and regulatory measures and reached the green zone in their overall electricity access scores.

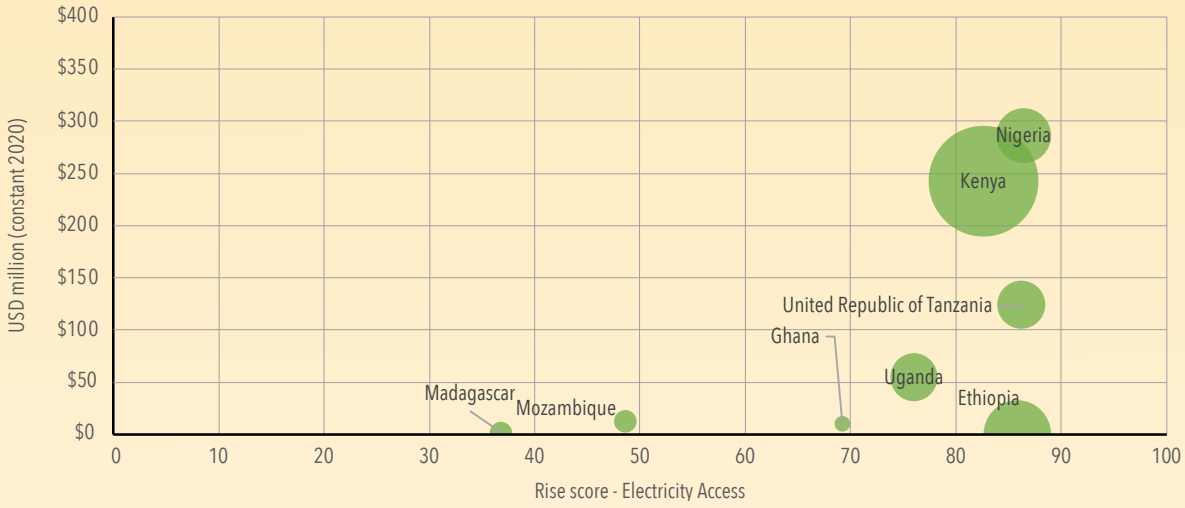
Further analysis illustrates the strong correlation between RISE scores and investment mobilization at the national level (IRENA 2023) (figure B1.3.2).

Figure B1.3.1 • Electricity access: Progress by RISE indicators, 2010, 2019, and 2021



Source: ESMAP 2022a.
Note: Among the indicators, utility creditworthiness (Indicator 8) reflects only results calculated from the financial statements of distribution utilities, whereas the consumer affordability score (Indicator 6) considers both quantitative findings and policies. The other indicators measure only policy frameworks or plans.

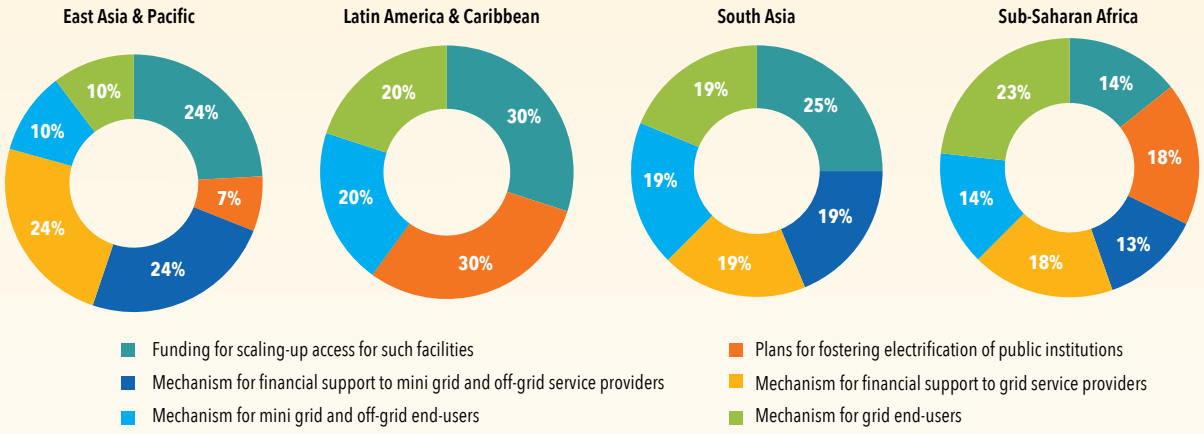
Figure B1.3.2 • Investment with respect to RISE scores and populations served by off-grid renewables in access-deficit countries in Sub-Saharan Africa, 2010–21



Source: IRENA 2023.
Note: Bubble size represents the population (households) served by off-grid renewable energy. Most off-grid renewable investment in Nigeria is for commercial and industrial purposes; that investment is not reflected in the graph.

The 2022 edition of the RISE indicators includes a stand-alone "COVID-19 module" that monitors electricity access policies and mechanisms for end users, suppliers, and public institutions during the pandemic. Financial support for electricity consumption through grid, mini-grid, and off-grid systems was observed across all regions, but Sub-Saharan Africa experienced the strongest support response (figure B1.3.3). Additionally, although the pandemic left some in Sub-Saharan Africa unable to pay for basic electricity services, consumer affordability increased at the regional level in 2021 according to the consumer affordability indicator of the RISE survey. Latin America and the Caribbean experienced the same change (ESMAP 2022a).

Figure B1.3.3 • The RISE COVID-19 module: Share of countries with supportive mechanisms, plans, and funding for access to electricity after the outbreak of the pandemic



Source: ESMAP 2022a.

Methodological Notes

The subsections that follow expand on several methodological matters raised or implied in the text.

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 1990–2021. 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 1,375 surveys from 149 countries in 1990–2021.

A multilevel, nonparametric model is applied to extrapolate data for missing years (described below). The modeling 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.[31] Where data were available, access estimates were weighted by population. Multilevel, nonparametric modeling takes into account 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. In order 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 generally 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 1990–2021 (for model estimates for 1990–2021) and once with survey data and assumptions for 2010–21 (for model estimates for 2010–21). The first run extrapolates electrification trends for 1990–2021, 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 in Afghanistan, Nepal, and Nigeria.

31 The model draws on the modeling 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 Market Trends Report (Lighting Global/ESMAP 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[32] 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.[33] 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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32 The Global Impact Metrics are available online here: https://www.gogla.org/impact/gogla-impact-metrics.

33 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.

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