CHAPTER 11

Just Energy Transition: Challenges and Low-Carbon Pathways for Africa

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Introduction

Transitioning to renewable energy is a critical part of addressing climate change and ensuring sustainable development. However, if this transition does not consider the social, economic, and financial implications for African countries, it cannot be considered a "just" transition for Africa. At the social level, the transition to low-carbon pathways, such as renewable energy sources, will create new employment opportunities. However, poor countries and marginalized populations may face disproportionate challenges during this transition if they are excluded from decision-making processes or do not benefit from these new job prospects. It is therefore essential to ensure that low-carbon pathways help reduce social inequalities and improve livelihoods for people in these countries and communities. At the economic and financial levels, transitioning to low-carbon pathways will require significant funding to develop national or regional value chains, invest in research and development, and build capacity. International financial support will be crucial for developing countries, especially in Africa, to ensure a just transition.

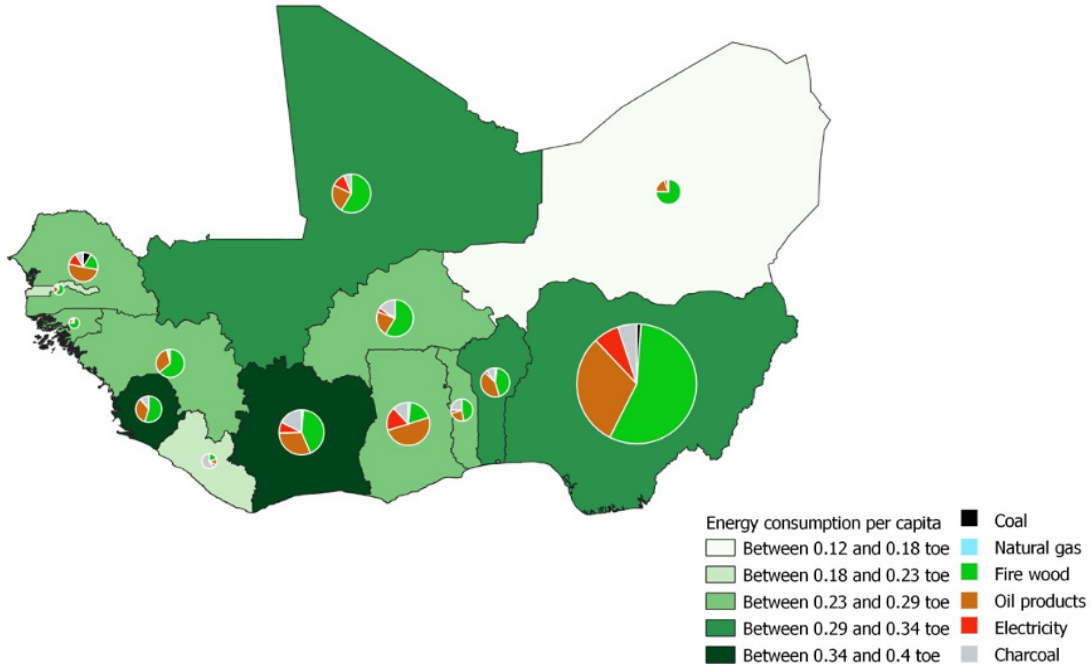
A just transition in Africa's energy sector is not just a matter of shifting from fossil fuels to renewables or low-carbon pathways; this transition must also promote social justice, economic development, and environmental sustainability, and strengthen Africa's place in the international division of labor and influence in global governance. In the global division of labor, African countries frequently act as suppliers of raw materials and low-value-added products, while wealthier nations or regions specialize in manufacturing and high-value-added sectors (Faizel 2021). This imbalance perpetuates economic dependency and limits the growth potential of African economies. To break this cycle, it is crucial to shift toward a more equitable low-carbon system that encourages industrialization, technology transfer, and capacity building within Africa.

The objective of this chapter is to review the existing evidence and debates on a just energy transition and low-carbon pathways in Africa, with the purpose of prompting discussions among researchers, policymakers, and practitioners.

Africa's Diversity: Common Challenges and Opportunities

The vast array of ecosystems across Africa—from the arid deserts of the Sahara to the lush rainforests of the Congo Basin—as well as unequal access to clean and efficient fuels and social disparities require tailored approaches to development and a just energy transition. Each region faces distinct challenges, such as varying levels of economic development and access to natural resources. For instance, North Africa, with its abundant solar energy potential, differs greatly

FIGURE 11.1—MAPPING FINAL ENERGY CONSUMPTION IN THE ECOWAS REGION IN 2021 (TOE/CAPITA)



Source: Khennas, Chitou, Kemausour, and Ramde (2024).
Note: toe = ton oil equivalent.

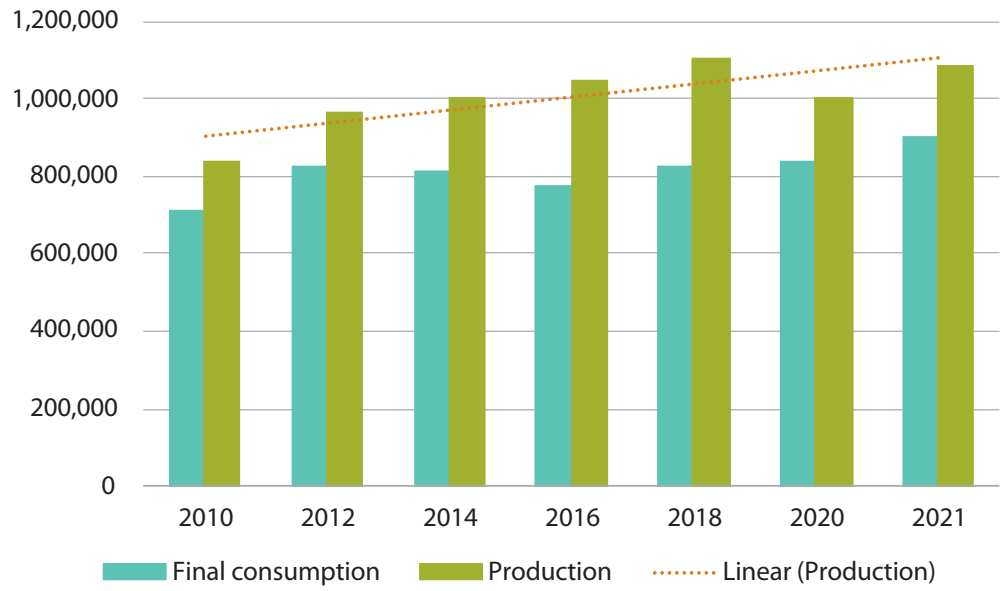
from the hydro-rich regions of Central Africa, the high potential for wind energy in some West African countries, or the geothermal resources of East Africa.

Moreover, socioeconomic development is a key determinant in shaping sustainable and equitable pathways to the energy transition toward cleaner renewable energy sources. Countries and regions have different levels of energy infrastructure and decision-making processes, which determine how they are impacted by the transition from fossil fuels to low-carbon economies. Countries such as South Africa and, to some extent, those in North Africa have more developed economies and infrastructure compared to many others in Africa, which significantly influences their capacity to implement energy transitions. Similarly, levels of technological adoption, governance structures, and public awareness vary widely across the continent, affecting the speed and nature of development initiatives.

Despite these differences, several key commonalities across Africa's regions unite the continent's approach to development and its energy transition. A significant portion of the African population relies on traditional biomass for cooking and heating, which poses severe health and environmental challenges. Indeed, most countries south of the Sahara still rely heavily on traditional and inefficient biomass fuels to meet their domestic energy needs for cooking and some productive activities. A recent study carried out by the Economic Community of West African States (ECOWAS) shows that in 2021, final energy consumption was dominated by biomass fuels (accounting for 60 percent), which included 51 percent for fuelwood and other biomass energy and 9 percent for charcoal (Khennas, Chitou, Kemausour, and Ramde 2024). Electricity accounted for only 7 percent of final energy consumption and petroleum products for 31 percent, indicating limited access to clean and renewable forms of energy.

Biomass (mainly fuelwood and charcoal) is the primary source of energy in most ECOWAS member states. Only Cabo Verde, Ghana, and Senegal have final energy consumption dominated by petroleum products. Moreover, Africa is the only continent experiencing a growth in firewood and charcoal production and consumption (Figure 11.2).

FIGURE 11.2—AFRICA'S BIOFUELS (FIREWOOD AND CHARCOAL) PRODUCTION AND FINAL CONSUMPTION, 2010–2021 (KILO TONS)



Source: Authors' calculations based on AFREC (2024).

The continent also faces a substantial gap in access to energy, with more than 600 million people lacking access to electricity, particularly in rural areas (IEA 2022). This creates a shared urgency to develop sustainable, affordable, and accessible energy solutions.

Another commonality is the continent's vulnerability to climate change, which exacerbates existing socioeconomic challenges. The impacts of climate change, such as extreme weather events, droughts, and floods, are felt across the continent, underscoring the need for a resilient and adaptive approach to development and an energy transition.

Toward a Just Energy Transition

Addressing these shared challenges requires a just energy transition that accounts for Africa's diversity while leveraging its communal strengths. A just energy transition in Africa must prioritize equitable access to energy, ensuring that poor

countries and marginalized communities are not left behind. This involves not only expanding access to renewable energy but also creating economic opportunities through the development of value chains, such as manufacturing, in strategic fields, including critical minerals.

Regional and continental cooperation is crucial. Africa's diversity can be harnessed through shared initiatives, such as the African Continental Free Trade Area (AfCFTA), which aims to promote economic integration and collective growth. AfCFTA should provide a strategic platform for African countries to collaborate on large-scale energy projects, such as the Grand Inga Dam in the Democratic Republic of Congo, which could provide renewable energy to multiple countries. Through AfCFTA, African nations can present a united front in global discussions on climate change and energy, advocating for more favorable terms of trade, technology transfer, and financing to support a just energy transition. According to the World Bank (2020), trade will grow substantially within the continent by 2035. The volume of total exports is expected to increase by almost 29 percent by 2035 (relative to the 2020 baseline) and intracontinental exports by more than 81 percent, while exports to non-African countries will increase by 19 percent. The biggest expansion in exports to regional partners is expected in manufacturing. Cross-border energy projects, such as the West African Power Pool, demonstrate how regional cooperation can help optimize resources and improve energy access across multiple countries.

Convergence and Equity

The transition to a sustainable energy economy should serve as a catalyst for economic growth and social development. This will involve making use of the opportunities presented by emerging green industries, such as renewable energy, energy efficiency, and value chain development in key sectors including agriculture. The transition should create new economic opportunities, particularly in regions that are dependent on traditional energy sources, particularly in Africa south of the Sahara, where access to clean and modern energy remains very low, despite deployment of so-called sustainable initiatives and programs since the 1990s.

A just transition is fundamentally about ensuring that the shift toward sustainable energy systems is inclusive, fair, and equitable. The principles of convergence and equity are deeply interconnected in the context of a just energy transition. Achieving convergence without equity would likely exacerbate existing inequalities, leaving vulnerable populations and nations behind. Conversely, pursuing equity without convergence might result in fragmented efforts, undermining the global and systemic changes needed to effectively combat climate change.

Historical Responsibility

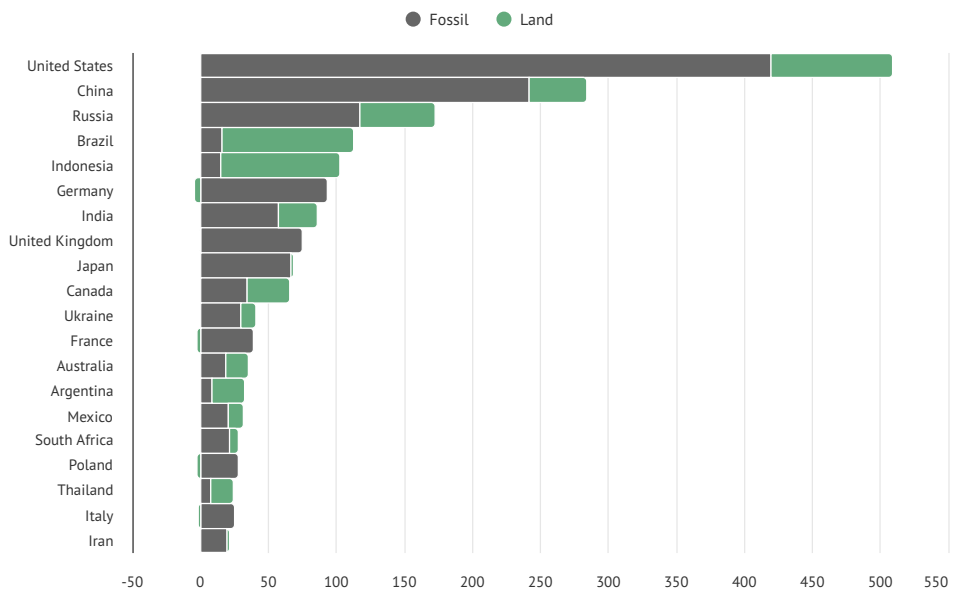
Developed countries have a significant responsibility to support a just energy transition globally, and particularly in Africa, given their historical contribution to greenhouse gas emissions and their relative wealth and technological advancement. Cumulative CO2 matters because there is a direct linear relationship between the total amount of CO2 released by human activity and the level of warming at the Earth's surface (Allen et al. 2009).

Wealthier nations and industries that have historically benefited from fossil fuels bear a greater responsibility to lead the transition to sustainable energy. This includes providing financial and technical support to developing countries, which are often more vulnerable to the impacts of climate change and less equipped to manage the transition. Historical responsibility also involves recognizing and addressing the injustices that have been perpetuated by the existing energy system, such as the exploitation of natural resources in developing countries and the displacement of Indigenous communities. A just transition requires that those who have contributed the most to environmental degradation take the lead in rectifying these harms and supporting a global shift toward sustainability.

Since the industrial revolution, approximately 2,500 Gt CO2 have been released, contributing to the 1.2°C rise in global temperatures. This leaves fewer than 500 billion tonnes of CO2 left to stay below a 1.5°C increase. By the end of 2021, the world used up 86–89 percent of this carbon budget. The United States is identified as the largest historical emitter, responsible for more than 509 billion tonnes, or 20 percent of the global total. China ranks second, contributing 11.4 percent of cumulative CO2 emissions and approximately 0.1°C of global warming (Figure 11.3). Although China has consistently had significant land-related emissions, its current position is largely due to its rapid, coal-driven economic expansion since 2000 (Evans 2021).

The global shift toward cleaner renewable energy sources carries significant implications for emerging oil and gas producers in Africa south of the Sahara, including in countries such as Mozambique, Niger, and Senegal. Having recently

FIGURE 11.3—COUNTRIES WITH THE LARGEST CUMULATIVE EMISSIONS, 1850–2021



Source: Evans (2021).

discovered sizable hydrocarbon reserves, these countries are in the early stages of developing their oil and gas industries. However, the energy transition poses challenges to the long-term profitability of their resources, as global demand for fossil fuels is projected to decline in the coming decades. This could result in lower-than-anticipated revenues from their reserves. Economic diversification is becoming increasingly important. To reduce the risks linked to declining demand for fossil fuels, it is essential to focus on investing in sectors such as agriculture, manufacturing, and renewable energy. Such a strategy will contribute to reducing countries' dependence on volatile oil and gas revenues and foster more resilient, sustainable economies.

Additionally, during the transition phase, the development of oil and gas industries in these African countries can result in the establishment of essential infrastructure such as pipelines, refineries, and power plants, which can also benefit other sectors of the economy. For instance, industries such as steel, chemicals, and plastics heavily depend on refined products. Access to reliable, affordable energy enables industries to reduce operational costs and enhance productivity. The availability of energy encourages investment from other sectors, such as heavy industry and manufacturing, since energy-intensive processes can therefore be supported. The energy sector drives innovation in areas such as renewable energy, more efficient processing technologies, and energy storage. This will contribute to strengthening energy security and help mitigate the persistent energy shortages faced by many of these countries, thereby promoting industrialization and economic growth.

Transitioning to Low-Carbon Pathways: What is at Stake for African Countries

In the transition to green energy and sustainable low-carbon pathways, several critical issues must be addressed by African countries and their regional organizations, such as the Economic Communities.

Exacerbation of global inequities and geopolitics: Wealthier countries and regions may be better positioned to invest in and benefit from renewable energy technologies, while poorer countries may struggle to make the transition. This can exacerbate existing global inequalities and create new forms of energy imperialism, where rich nations dominate renewable energy production and control critical resources. The shift to renewables can also lead to new geopolitical tensions, particularly around the control of critical minerals and technologies essential for renewable energy and other key strategic sectors.

Concentration of ownership and profits: The benefits of renewable energy projects can be concentrated among large corporations from developed countries or, to some extent, emerging countries. For instance, apart from sourcing the key components for building renewable energy projects, large-scale solar or wind farms might be owned by multinational companies, with few dividends for African countries.

Unequal distribution of wealth: While renewable energy sectors do create jobs, these jobs may not be in the same locations or require the same skills as those in fossil fuel industries. Without targeted retraining programs and regional economic development, communities dependent on fossil fuel industries may be left behind.

Social and Environmental Concerns and Equity

Large-scale renewable energy projects, such as wind farms, solar panels, and hydroelectric dams, can require significant land use, which may lead to the displacement of communities or disruption of local ecosystems. Indigenous peoples and rural communities may be disproportionately affected if they are not adequately consulted or compensated.

The renewable energy sector relies on materials such as lithium, cobalt, and rare earth elements, which are often mined in conditions that raise serious human rights and environmental concerns. This can perpetuate cycles of exploitation and environmental degradation, particularly in resource-rich but economically vulnerable countries.

The Way Forward

Renewable energy is already cost-competitive compared to gas or other fossil fuels in many places. IRENA (2021) found that 62 percent of new renewables added in 2020 had lower costs than the cheapest new fossil fuel option. It also noted that two thirds of newly installed renewable power in 2021 had lower costs than the cheapest fossil-fuel fired option in the G20. Recent research by Way and colleagues (2022) concluded that "compared to continuing with a fossil fuel-based system, a rapid green energy transition will likely result in overall net savings of many trillions of dollars—even without accounting for climate damages or co-benefits of climate policy" (2057).

Africa's economy has historically been reliant on the export of raw materials with little value addition, which limits its benefits from global trade. According to the African Development Bank, the continent is at the bottom of the global value chain, with its share of global manufacturing at around only 1.9 percent (AfDB 2017). By investing in industrialization, Africa can shift toward processing and manufacturing its raw materials, thereby increasing the value of its exports.

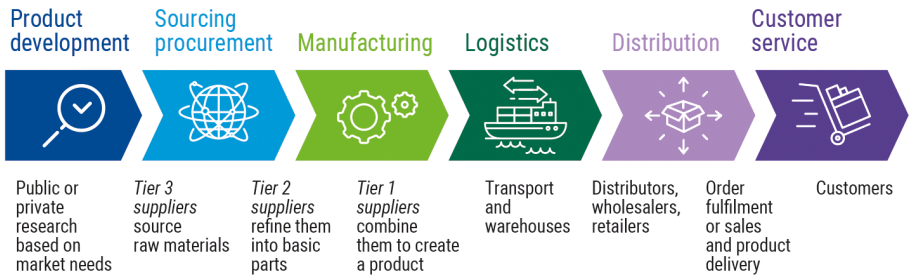
Potential For Capturing High-Value Supply Chains

To increase Africa's added value in the green energy sector, the continent needs to focus on attracting significant investment in renewable energy development, building local manufacturing capabilities for green technologies, creating supportive policy frameworks, fostering partnerships with international institutions, and leveraging its abundant natural resources, such as solar, wind, and hydropower, to generate clean energy for domestic use and export markets, while also developing skills and expertise within the sector to create sustainable jobs. South Africa and a limited number of other countries, particularly in North Africa, have made significant strides in manufacturing green energy equipment locally, reducing dependence on imports and creating jobs.

Strengthening regional value chains within Africa will enhance the continent's integration into global supply chains. The AfCFTA can play a critical role in this by facilitating intra-African trade, harmonizing regulations, and reducing tariffs. Although some segments of the green energy value chain are already controlled by China and a limited number of developed countries, there is potential to manufacture many components of the supply chain locally. For instance, the assembly of a solar field must be performed on site, offering significant potential for local manufacturing. As many component inputs, such as ball joints, bearings, and cables, are used by other industries, these parts offer opportunities for already established companies to achieve lateral diversification of customers (UNCTAD 2023).

Promotion of small and medium-sized enterprises (SMEs): SMEs are the backbone of many economies and play a vital role in creating jobs and fostering innovation. Supporting SMEs through access to finance, capacity building, and market access can enhance Africa's economic resilience and global

FIGURE 11.4—SUPPLY CHAIN COMPONENTS

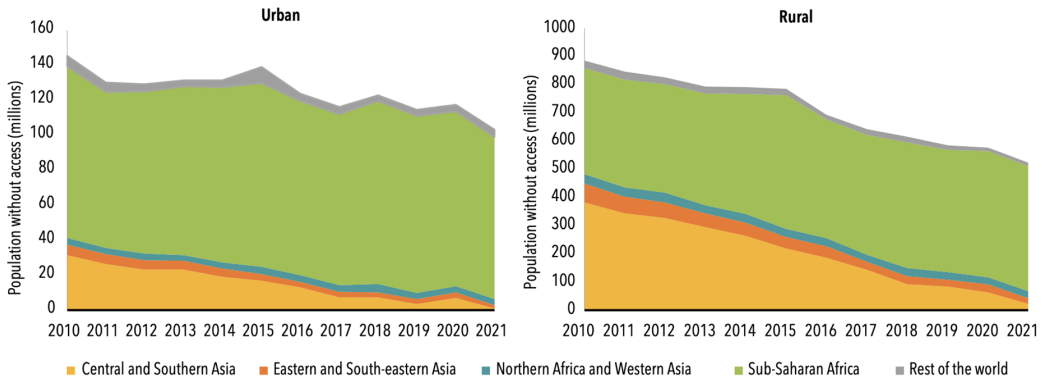


Source: UNCTAD (2023).

competitiveness. In Africa, SMEs provide an estimated 80 percent of jobs across the continent, representing an important driver of economic growth. Africa south of the Sahara alone has 44 million SMEs, almost all of which are micro enterprises (Runde, Savoy, and Staguhn 2021).

By contrast with the conventional approach to electrification—often referred to as "grid electrification" because it occurs primarily through extending the existing high- and medium-voltage grid—off-grid electrification, or "decentralized distributed generation," offers opportunities for SMEs to be involved in most segments of the off-grid electrification value chain.

FIGURE 11.5—DEFICITS IN ELECTRICITY ACCESS ACROSS URBAN AND RURAL AREAS, GLOBALLY AND IN SELECTED AFRICAN REGIONS



Source: IEA, IRENA, UNSD, World Bank, and WHO (2023).

Africa's Energy Systems and Opportunities for Off-Grid Deployment

In this chapter, off-grid electrification refers to renewable energy systems not connected to the centralized power grid. These systems can be standalone, serving a single or a few households, or part of a mini-grid supplying small communities or villages.

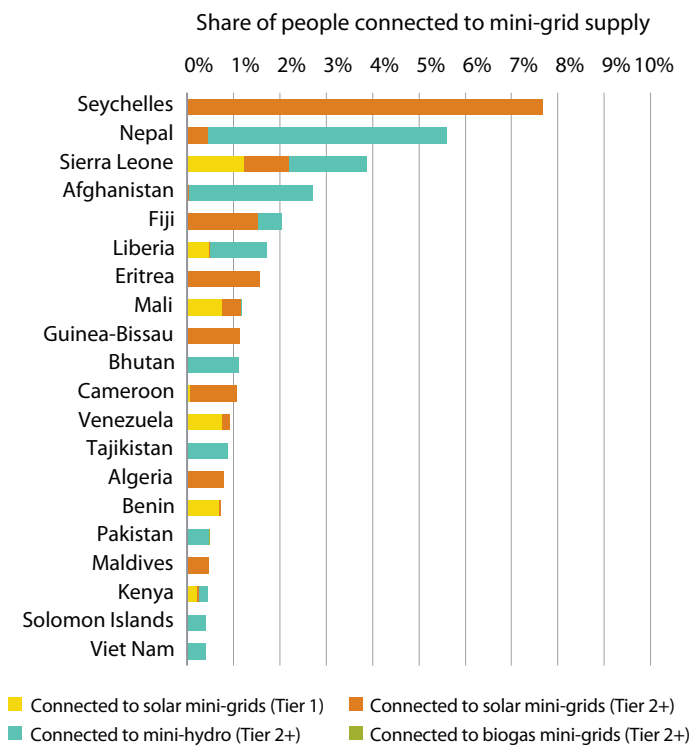
Energy system transitions require time and capital, particularly when energy infrastructure is either nonexistent (such as liquefied petroleum gas infrastructure or electricity distribution networks) or underdeveloped. A low- to zero-carbon energy development strategy will therefore require not only financial transfers but also, above all, a thriving manufacturing industry for energy to increase economic integration and a sustainable energy future for Africa's population. Almost all the literature on energy access in Africa highlights the lack of electricity access and the urban-rural divide. Indeed, this region still has the world's lowest rate of electrification and the highest population without access (Figure 11.5).

Figure 11.5 highlights the unequal access to electricity in Africa and the sharp rural-urban divide in Africa south of the Sahara. In many countries in this region, electricity access is below 46 percent and, in some cases, below 15 percent. According to the report by IEA and others (2023), the countries with the largest number of people without access in 2022 included Nigeria (86 million), the Democratic Republic of the Congo (76 million), and Ethiopia (55 million). Off-grid electrification offers opportunities to lower the costs of rural access to electricity, bridge the rural-urban gap, and provide opportunities for local manufacturers and service providers. Of the top 20 countries with extensive access to mini-grid electricity, nearly half are located in Africa south of the Sahara.

The current electrification system in Africa has been largely shaped by the classical traditional centralized power grid model, which is comprised of generation, transmission, and distribution. Large parts of rural and peri-urban Africa remain non-electrified, and current generation capacity is often unable to meet the demand from a rapidly growing population and proliferating micro, small, and medium enterprises. The supply-oriented approach characterizing the electrification system can hardly provide options and/or opportunities for widening electricity access to all populations in Africa south of the Sahara in the foreseeable future, if ever. Dependence on such a centralized power paradigm requires heavy investments and high operational costs. The shortcomings of such systems can hardly be handled by poor economies with limited capacities. Hence, Africa needs a new model.

Mini-grids already play a crucial role in helping countries achieve universal electricity access, particularly in regions that the national grid is unlikely to reach in the near future. Furthermore, mini-grids can be quickly deployed, creating local jobs and thus contributing to bridging the urban-rural divide.

FIGURE 11.6—SHARE OF POPULATION CONNECTED TO MINI-GRID SUPPLY



Source: IRENA (2022); IEA, IRENA, UNSD, World Bank, and WHO (2023).

Advances in technology and growing policy support further enhance their viability. In the countries where they operate, mini-grids outperform national utilities with respect to service metrics, including uptime, power quality, reliable connections, and downstream job creation. They have consistently high service uptime, on average above 99 percent, whereas national grids experience significantly more outages (SEforALL 2024).

The large-scale deployment of mini-grids has already drawn significant interest from African investors across the entire value chain. A notable example is the Africa Mini-grid Developers Association (AMDA), established by private mini-grid developers, operators, development partners, and investors to improve the political and financial landscape. Currently, AMDA represents more than 44 companies operating mini-grids in 22 countries across five regions of the continent (AMDA 2024). To accelerate mini-grid expansion and achieve universal access goals, AMDA has been working with policymakers to address key challenges, particularly regulation and the need for independently operated mini-grids to connect to the main grid. This would allow mini-grids to continue functioning by either selling power to or buying power from the main grid.

Unlocking financing for mini-grids in Africa is critical. The World Bank estimates that the 29,400 mini-grid projects currently planned—95 percent of which are in Africa and Southeast Asia—will require US$9 billion in funding (World Bank and ESMAP 2022). The two main financing models available are inadequate: larger deals with complex structures take too long to finalize, while smaller deals face high transaction costs. In this sector, there is a pressing need for concessional capital to de-risk financing to the level necessary to attract commercial investors.

Implementing Historical Responsibility

Developed countries have contributed disproportionately to global warming and are responsible for a significant portion of cumulative carbon emissions. To address the climate crisis, these countries must take responsibility for their contributions by playing a key role in driving global mitigation and adaptation pathways. This includes providing financial assistance, enhancing technology transfer, increasing ambition in emissions reductions, and compensating less developed countries for loss and damage. At the 15th session of the Conference of Parties (COP15) to the United Nations Framework Convention on Climate Change in Copenhagen in 2009, wealthy countries pledged to provide $100 billion per year in climate finance by 2020 to help developing countries mitigate and adapt to climate change.

Held in Paris in 2015, COP21 was a landmark in international cooperation, with developed countries agreeing to take the lead in reducing emissions and providing financial and technological support to developing countries. The Paris Agreement (UNFCC 2015), which resulted from COP21, also emphasized the need for technology transfer and capacity-building support from developed to developing countries. Wealthy countries are expected to share low-carbon technologies to help developing nations quickly advance to sustainable and

low-carbon energy systems. At COP24 in Katowice in 2018, the Katowice Rulebook was adopted to operationalize the Paris Agreement, with a strong focus on technology transfer mechanisms. However, implementation has been slow, and many developing countries continue to call for greater access to climate-friendly technologies.

A key outcome of recent COPs, especially COP27 in 2022, was the landmark decision to establish a Loss and Damage Fund. This followed earlier milestones, including the creation of the Warsaw International Mechanism for Loss and Damage at COP19 (Warsaw, 2013), which was the first formal recognition of loss and damage within the UNFCCC. At COP26 (Glasgow, 2021), discussions on funding for loss and damage gained momentum, though no definitive financial mechanisms were agreed upon. However, at COP27 (Sharm El-Sheikh, 2022), a formal agreement to create the fund marked a breakthrough and was widely regarded as a historic achievement in global climate negotiations. The fund is intended to provide financial aid to vulnerable nations most severely impacted by the climate crisis, underscoring growing pressure on developed countries to acknowledge their historical responsibility and support those disproportionately affected by climate change. However, the structure and scale of the fund are still being negotiated.

Conclusion

Decentralized energy solutions such as mini-grids offer vital technical pathways for achieving a just energy transition, particularly in remote and underserved regions. These solutions are critical for providing sustainable modern clean energy, such as reliable electricity, in places where traditional grid extension is not cost-effective. However, the successful implementation and scalability of these solutions depend heavily on support from the international community and strong policy backing.

Moreover, regional integration across Africa plays a crucial role in maximizing the benefits of these decentralized energy solutions. By fostering cross-border energy cooperation, African nations can share resources, technical expertise, and infrastructure, which not only enhances energy security but also reduces costs. Integrated energy markets can help bridge the gap between energy supply and demand, ensuring that even poor countries and remote areas can benefit from reliable and affordable energy. This collaborative approach is essential for driving the continent toward a sustainable and inclusive energy future.