Electricity grids provide the bedrock of today’s and tomorrow’s power systems – key for the security of the electricity supply, for ensuring access, and for a widespread integration of renewables.\(^1\) In the context of the global energy transition, as well as the push for progress on the Sustainable Development Goals (SDGs) in the so-called ‘Decade of Action’ – particularly SDGs 7 and 9 – electricity infrastructure is more important than ever. On a continent such as Africa with low levels of electricity access and low quality of service, dedicating time and effort to addressing the challenges and exploiting opportunities associated with electricity grids is essential.

Despite their crucial role, transmission and distribution networks in Africa have received little attention so far. Indeed, the majority of Africans still do not have access to, or have an unreliable supply of, electricity. On the generation side, these issues are beginning to be addressed with the help of increasing, albeit limited, private sector participation, however, this is not matched by efforts on the transmission and distribution side. In the absence of grid development, future gains in renewable generation may also be undermined by a grid network unable to cope with increasingly complex electricity flows. Consequently, overcoming the barriers in Africa’s electricity sectors requires consistent and parallel efforts in generation, transmission, and distribution.

This is why RES4Africa Foundation is introducing a new focus area: Grids4Africa. The Foundation’s work since its inception has been focused on the power generation segment of the electricity value chain. With this initiative, however, RES4Africa will broaden its reach to include a focus on grid networks. Through the lens of grids as the key enablers of the energy transition, the Foundation will begin a series of activities dedicated to smoothing out the bottlenecks in electricity networks racing to increase renewable generation and supporting the development of an affordable and reliable electricity provision system in Africa.

1. **Grids and access to electricity**

Electricity access is vital for development and the improvement of quality of life. Studies have shown that access to electricity has a large impact on income, education and productivity indicators.\(^2\) Additionally, electricity consumption per capita is found to be positively correlated with a range of well-being measures, including individual indicators such as life expectancy and infant mortality, as well as composite indices like the Human Development Index (HDI) developed by the United Nations, which considers nations’ life expectancy, education, and gross national income per capita.\(^3\) Electricity consumption and HDI display a logarithmic relationship, signifying that at the lower end of consumption, where sub-Saharan countries are currently located, each additional unit of electricity consumed is correlated with a significant increase in the HDI.
Electricity grids – whether national, mini, or micro – are indispensable for providing access to the nearly 600 million people without it in sub-Saharan Africa. Between now and 2040, on-grid electricity supply will dominate in urban and peri-urban areas, as well as rural communities close to transmission lines, and will account for the majority of electricity consumption in sub-Saharan Africa (see Figure 1). Indeed, in the long-term, national grids will provide access to and serve the vast majority of Africa’s population. As an example, while Ethiopia’s National Electrification Plan considers the provision of universal access by 2025 with 65% on-grid and 35% off-grid, in the long-term, the plan foresees the connection of 95% of the population to the main grid, leaving only 5% with alternative solutions.

Two reasons for the importance of on-grid provision of electricity going forward are Africa’s demographic and urbanisation trends in the next decades. The region is already home to the fastest-growing population in the world and is witnessing unprecedented rates of urbanisation. By 2050, Africa’s urban population is expected to almost triple, to 1.26 billion people, representing 22% of the world’s total urban population. This presents a challenge for expanding and maintaining urban electricity access.

Because urban areas tend to be close to the grid and urban electricity access is consistently higher, there is a misconception that electrification is problematic mainly in rural areas. However, urban access is not without its challenges. Surveys have shown that there are over 110 million Africans who live right
under a grid but lack access to power due to prohibitively high connection costs. Additionally, maintaining the urban access rate is more difficult than improving rural access from its low base, therefore, urbanisation trends could lead to larger populations without access in urban areas. As such, gaining a better understanding of on-grid access is key to shaping effective electrification strategies, with urban and peri-urban households providing an opportunity for quick gains in access without requiring large investments in grid expansion.

Unfortunately, the COVID-19 pandemic has significantly affected progress on electricity access in Africa, with the number of people without access increasing in 2020 for the first time since 2013. Not only have governments had to shift their focus to emergency measures, private companies providing decentralised solutions have also faced challenges, adversely impacting electrification efforts.

2. Grids and quality of service

Grid connection in and of itself means little if the provision of service is unreliable, which is often the case in sub-Saharan countries. A recent survey has shown that fewer than half (43%) of Africans enjoy a reliable supply of electricity, although there are large regional variations in both access and reliability (see Figure 4). Mauritius (98%) and Morocco (91%) boast very high levels of reliable access, meanwhile, Burkina Faso (19%) and Uganda (20%) have the lowest levels of grid connections, yet it is Guinea (7%) and Malawi (5%) where the lowest proportion of the population has access to reliable electricity. South Africa, Nigeria and Cameroon all have above average levels of grid connection, but for a large share of customers in these countries the connection only works about half the time or less. Indeed, South Africa provides an illustrative example: despite being one of the most advanced economies in the sub-Saharan region, the country has been implementing rotational power cuts for years, reaching record highs in 2019 (530 hours of load shedding).
This unreliability, manifesting through frequent outages, is largely the result of the ageing electricity infrastructure combined with inadequate maintenance and low levels of investment. In some countries, insufficient generation capacity further exacerbates the issue. In addition to outages, African networks also display very high losses. Average electricity losses across the continent were 16% in 2019, significantly higher than the average 9% representative of other developing economies. Again, there are large regional variations, with losses ranging from as high as 23% in Ethiopia to as low as 9% in South Africa (see Figure 4).

![Figure 4: Average electricity losses in selected African power systems. Based on IEA (2019).](image)

It is paradoxical that the countries with the highest unmet demand for electricity are also the ones losing the highest share of the power they generate. Considering a total electricity production across Africa of 839.4 TWh and average losses of 16%, the amount of electricity lost on the continent in 2018 corresponds to roughly 134.3 TWh – over 14 times the total consumption of the entirety of Kenya in the same year. With yearly average per capita power consumption at 0.6 MWh, this amount alone could have served about 223.8 million Africans for the entire year.

Unreliability and losses result in significant economic damages. World Bank Enterprise Survey data shows that 41.7% of sub-Saharan firms surveyed cite electricity as a major constraint, and outages can cost countries up to 2% of their annual GDP. In South Africa alone, power cuts in 2019 were associated with a cost of approximately R60-120 billion, or US$4.1-8.2 billion. High losses represent substantial costs for utilities, and signify that countries only get to use a smaller proportion of the total electricity generated. It follows that in order to increase the amount of electricity available for use (to meet increasing demand), generation must increase proportionally more.
3. Grids and the energy transition

Power grids are one of the most important pillars of the energy transition, crucial to reducing CO₂ emissions, guaranteeing affordable, reliable, sustainable and modern energy to all, and creating resilient, digital and sustainable infrastructure and cities. For this reason, extending, upgrading, reinforcing and digitalising networks is crucial to ensuring a smooth energy transformation.

The widespread deployment of renewables is introducing more complexity into electricity systems, and there is an increasing need for flexibility to account for intermittent and distributed generation. In order to facilitate this, grids must successfully incorporate the wide range of sources of flexibility, including storage solutions and demand response, and capitalise on digital technologies available today.

Africa in particular is in a unique position to create a modern and sustainable electricity system from early on, avoiding decades of high emissions from the use of fossil fuels. Studies have shown that as nations develop, they climb an energy ladder, switching from primarily using biomass, to burning fossil fuels, to increasingly using electricity, derived from nuclear power and modern renewables (see Figure 5). This shift towards cleaner, more efficient, more cost-effective energy need not be linear: developing countries have the opportunity to leapfrog directly to low-carbon energy sources at the top of the ladder, bypassing some of the fossil fuel stages. Leapfrogging to electricity would also open up the possibility of benefitting from new types of services previously based on fossil fuels, such as electric vehicles and heating systems. This would transform grids from a simple link between producers and consumers to a platform enabling a wide range of services. Facilitating this transformation requires that grids be prepared to incorporate higher shares of intermittent renewable generation, as well as new electricity services.

4. Investment in grids

Extending and improving grids imply large investments. The IEA estimates that in order for sub-Saharan countries to meet their stated policy goals, power sector investment will need to more than double relative to 2018, with cumulative investment needs between 2019-2040 reaching over US$ 1 trillion. Ensuring universal access to clean energy (SDG7) and meeting the targets of the African Union’s Agenda 2063 would require investments to multiply fivefold, resulting in a cumulative investment over
US$ 2 trillion. In both cases, over half of the funds would go towards grid expansion, reinforcement and maintenance.

Public utilities, however, are not in a position to make the necessary investments. Although funding for power infrastructure has traditionally come from public sources (national governments, state-owned utilities, development finance institutions, etc.), public utilities and governments in Africa have limited fiscal space and cannot unilaterally provide the financing necessary to meet their national policy goals, much less the SDGs and Agenda 2063.

A review of utility companies in 39 sub-Saharan countries showed that only two, Seychelles and Uganda, are able to fully recover their operational and capital costs, an additional 19 are able to cover operational but not capital costs, while 18 countries are unable to cover even operational costs. This is further exacerbated by low uptake of grid connection and low consumption, preventing utilities from increasing their income and leaving them unable to invest in infrastructure expansion and service quality improvement.

5. The role of the private sector in supporting grids

There is a substantial role for the private sector in reducing the aforementioned investment gap. Private investments have been concentrated in the generation segment, while investments in electricity networks have remained primarily public, as these are often subject to national monopolies and strict regulation. Regulation is a crucial determinant, as 34 out of 43 sub-Saharan African nations do not allow private sector participation in transmission and distribution (see Figure 6).

![Figure 6: Private sector participation in electricity supply in sub-Saharan Africa. Based on IEA (2019).](image)

Yet evidence from around the world, particularly Latin America, shows that private participation – whether in the form of service contracts, transmission or distribution concessions, or full privatisation – in these segments can greatly improve efficiency and quality of service. Following large-scale power sector reforms in the 1990s, by 2010, private participation across 18 Latin American countries stood at 25% in transmission and 42% in distribution. Several empirical analyses have highlighted the advantages associated with this. In their review of the performance of 250 public and private
distribution utilities between 1995 and 2005, Andres et al. found that private utilities performed better in terms of distribution losses, quality of service, and labour productivity.\textsuperscript{18} Similarly, an analysis of the period 1971-2010 found robust statistical associations between private participation and a reduction in losses and increase in generation capacity.\textsuperscript{17}

Notwithstanding these results, it is worth noting, that the key determinant of electricity coverage and end-user-prices was found to be regulatory quality.\textsuperscript{17} This illustrates that an efficient and well-designed institutional and regulatory setting is fundamental for the sound performance of the electricity industry.

In conclusion, the extension, reinforcement and modernisation of electricity grids is indispensable for the expansion of access to electricity, the improvement of service quality, and a successful energy transition in Africa. Grids4Africa will support the achievement of these goals by conducting extensive dialogue with relevant stakeholders, publishing strategic analyses relating to electricity infrastructure, raising awareness about existing issues, organising training activities to transfer knowledge, and identifying solutions to stimulate action.
Endnotes:


