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Electrifying Africa's Economic Transformation

What Reforms Should Governments Pursue?

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Abstract

This paper examines the challenges that African governments are grappling with as part of a renewed international effort to expand electricity access. It shows how the crux of the challenge is twofold: one, to enable poor people to make productive use of electricity to raise their incomes and grow out of poverty; and two, to build the legitimacy of tariffs and taxes as incomes rise, to finance electricity infrastructure sustainably. Africa needs to transition from a situation where incomes are too low to cover the costs of accessing electricity to one where electricity is universally and reliably available to fuel modern economic activities. This means that Africa needs to borrow from future growth in incomes to cover the costs of investing in electricity today. Concomitantly, investments in electricity today need to raise incomes and the willingness to pay tariffs and taxes in the future as incomes rise. The paper offers ideas for a mix of reforms that may strategically complement one another to accomplish this transition. Evaluating these ideas, through a "learning by doing" approach, would help address the fundamental fiscal and institutional challenges to electrifying Africa.

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Electrifying Africa's Economic Transformation:

What Reforms Should Governments Pursue?

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1. Introduction

The economic problem of how to expand access to electricity in low-income countries, where households and communities cannot cover the costs of access, remains one of the major challenges of international development (World Bank, 2021; International Energy Agency (IEA), 2017; Lee et al, 2020a). Nowhere is the challenge more acute than in Sub-Saharan Africa (SSA) where an estimated 43 percent of the current population lacks access to electricity (IEA, 2022). As populations grow, the International Energy Agency (IEA) estimates that 90 million people need to be connected each year between 2022 and 2030 to achieve the goals of universal access to electricity (IEA, 2022). These goals are unlikely to be achieved under current economic and market conditions without active public policies. This paper examines the challenges facing African policy makers to enable electrification not only for its intrinsic value in global development, as enshrined in SDG 7, but also for its instrumental value in bringing about economic transformation. It shows how these challenges are fundamentally fiscal, institutional and political, driving the ability of governments to support the technical and engineering solutions currently on the table. The paper offers forward-looking ideas for a mix of fiscal and institutional reforms that may strategically complement one another to achieve the objectives of access and economic transformation.

The World Bank's Mission 300,[2] the Energy Compacts of African governments,[3] and a report by the Council of Engineers for the Energy Transition to the United Nations Secretary General[4] offer a look at the technical solutions to the problem of electrifying Africa. These solutions leverage engineering advances in the generation of utility-scale renewable energy to bring down costs, and the potential of mini-grids and off-grid solutions to reach far-flung rural areas. They are being incorporated into national electrification strategies, using geo-spatial modeling tools to plan for least-cost, high-return ways of complementing grid expansion with the entry of private firms to supply off-grid solutions. Further, governments are pursuing regional market integration, sharing pools of generation of renewable energy from diversified sources and seeking to attract capital for large-scale investments in trans-boundary transmission and distribution networks.

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[2] https://www.worldbank.org/en/programs/energizing-africa.

[3] https://www.worldbank.org/en/programs/energizing-africa/summit.

[4] Vega (2022).

The paper shows how pursuing and implementing technical strategies for electrification depends upon fiscal and political institutions which shape the ability of countries to attract global capital and raise domestic investments and public revenues. It shows how current fiscal and political institutions are not conducive to supporting the technical strategies on the policy table, albeit with wide variation across countries and real-time changes in promising directions. The paper uses economics research on institutions to show how current forces of positive change—namely, the demand from citizens for good governance—could be applied to the electricity sector to overcome the fiscal and political challenges to implementing technical solutions. This application yields forward-looking ideas for a mix of reforms to enable countries to achieve electrification and economic transformation.

The paper is organized as follows:

Section 2 reviews the trajectory of countries in SSA on the path of expanding access to electricity, compared to that of other regions in the world. The patterns in the data suggest that deep-rooted poverty, which is higher and more persistent in SSA than any other region of the world, may be at the heart of why the SSA region remains in the dark even as universal access is, by now, common in the rest of the world. This section posits that the East Asian experience, which purposefully linked electrification to local economic growth, may be an aspirational example for Africa, while the South Asian experience warns of pitfalls on a path of relying on price subsidies to expand access.

Section 3 examines the scope for demand-side policies related to making electricity access and consumption affordable for households. First, it highlights evidence of the sheer size of the affordability gap between what households are reasonably able to pay for electricity and the cost of providing that electricity. Second, it shows how a crucial part of demand-side policies to close the affordability gap is to enable people to use electricity to grow incomes.

Section 4 examines the scope for supply-side policies related to infrastructure investments and the performance of electricity utilities in providing low-cost, reliable electricity. Lowering costs of reliable electricity is the other piece of the equation to close the affordability gap (complementing the role of demand-side policies). Technical engineering solutions to lower costs suggest a prominent role for creating regional energy markets to expand generation capacity, especially by using lower-cost technologies; attracting private capital to invest in generation from diversified sources of utility-scale renewable energy; and building trans-boundary transmission lines. Implementing these technical solutions on the supply-side requires access to capital. However, weak institutions to control corruption and underpin legal frameworks for long-term contracts impede the flow of capital for these cost- and risk-reducing investments. Furthermore, there are substantial knowledge gaps on how to strengthen incentives of utilities to reduce large losses in transmission and distribution and improve reliability.

Section 5 takes a public economics approach to the problem of designing policies to achieve objectives of electrification. It reviews various documents to distill the policy instruments currently on the table and provides a critical view of the challenges and gaps. It then offers ideas for how a mix of fiscal and institutional reforms might enable governments to cut the Gordian knot of economic viability and affordability: building the credibility of tariff and regulatory policies to attract private capital for infrastructure investments, which lower the costs of providing reliable electricity, while supporting people to use electricity and complementary inputs to grow their incomes. The crux of the matter is whether these policies help governments build legitimacy of (affordable) tariffs and taxes as incomes rise over time, which would be necessary for sustainably financing electrification.

Section 6 concludes by calling for integrating into policy dialog, and electrification projects, new data collection, evidence generation, policy experimentation and impact evaluation to help electrification succeed, rapidly and sustainably. By integrating knowledge products into project design and implementation, projects do not have to "wait" for research but can instead proceed rapidly with implementation in a "learning by doing" approach. This approach would address the large knowledge gaps facing governments that want to implement their "Energy Compacts". International development practice needs to step up to partner with the region not only to finance but also to furnish the knowledge needed to electrify Africa's economic transformation.

2. How Africa compares with others on the path of electrification

This section examines trajectories of developing countries in different regions of the world on the path of electrification and shows how SSA is an outlier. To ensure consistency in cross-country comparisons the analysis uses IEA data for electricity access and the World Development Indicators for income per capita and poverty rates.[5]

Figure 1 shows that the vast majority of people in Africa live in countries where the access rate is below 75 percent, with several large countries below 50 and even 25 percent, in 2022, a time by which most countries in the rest of the world had close to 100 percent access (according to the IEA data).[6] Most analyses of electricity start with the observation that too many people in Africa lack what the rest of the world uses as a basic, general purpose technology, essential for modern economic activity (Burlig and Preonas, 2024; Meeks and Mahadevan, 2025). But there is no clear explanation offered in the literature for *why* Africa has lagged by such a substantial margin. From Figure 1, one part of the answer appears to be that the countries in the SSA region have lower per capita income than others. Generating, transmitting and distributing electricity is costly and requires financing of infrastructure and electricity consumption. If Sub-Saharan African countries are starting out with much lower incomes than it takes to finance the infrastructure and electricity consumption, that might explain why they are lagging in access.

Figure 2 plots the trajectory of countries on the path of increasing electrification and incomes between 2010 and 2022.[7] It shows several examples of countries, like India, Nepal and Bangladesh, which started in 2010 with lower per capita income than several African countries, like Nigeria, Kenya, and Zambia, but end in 2022 with substantially higher rates of electrification and somewhat higher per capita income. East Asian countries, like Viet Nam, Indonesia and the Philippines, do even better than South Asian countries, and China is a striking outlier in the direction of rising incomes and a sustained electricity access rate of 100 percent.[8] Nigeria and South Africa, on the other hand, are outliers for their zig-zagging trajectory, ending

[5] The IEA compiles annual data on electricity access rates (percentage of a country's population with access to electricity), since 1990 to the present (2022 is currently the most recent year in the IEA database). We recognize that using the IEA's basic indicator of electricity access is missing a lot of the complexity of measuring actual access and use of reliable electricity. Min et al (2024) use satellite imagery data of night lights to argue that actual use of electricity is worse than what the IEA data on connectivity suggests.

[6] The only countries from other regions where access rates are low are island nations, or countries in conflict situations (Papua New Guinea, Vanuatu, Micronesia, Solomon Islands, Haiti, Libya, the Republic of Yemen, Myanmar, Afghanistan).

[7] This analysis is inspired and informed by Tariq and Moss, 2024.

[8] Others have analyzed how East Asian countries started out further back in time with much lower incomes than African countries, and achieved dramatic rates of electrification in the 1990s (Aklin et al, 2018).

with stagnant electrification and income despite starting out with higher per capita income than the East Asian countries. Figure 2 thus suggests that lower per capita income is not likely to be the main reason why African countries have lagged so substantially on electricity access.

Figure 3 brings poverty rates rather than income per capita into the picture. It shows that no other region, not even South Asia, suffers from widespread and deep poverty the way Africa does. Figure 4 shows how countries (those for which data on poverty are available from the WDI[9]) have moved between 2015 and 2022 on the path of expanding access and lowering poverty. There is wide variation across African countries on this trajectory, with Kenya and Zambia standing out as examples where increasing electrification has not gone hand-in-hand with reducing poverty (instead, poverty has increased over this time period). Across the handful of African countries where data is available from the same source (the WDI), the trajectories are either quite flat (large reductions in poverty despite little gains in electrification) or quite steep (large increases in electrification but little poverty reduction).[10] These trajectories in African countries contrast sharply with the trajectories of countries in other regions where poverty steadily declines over the same time period (and electricity access rates remain high or increasing).

High and persistent poverty in Sub-Saharan Africa thus emerges as a driving explanation for why the region lags in access to a by-now established general purpose technology available almost universally in the rest of the world. The variation in the paths of countries within the Sub-Saharan Africa region in Figures 2 and 4 suggests that further regional generalizations might be problematic, other than the shared fact that all countries start with much higher poverty, and lower rates of electrification, than the rest of the world. Some countries, like Ethiopia and Benin, show high rates of progress on both increasing electricity access and increasing incomes or reducing poverty, even as the levels of electrification remain low, while others, like Nigeria,

[9] To increase the number of countries for which data are available from the same source, the WDI, we change the initial year from 2010 (in Figure 2) to 2015.

[10] Benin appears to be an exception, standing out as doubling the rate of electrification over the time period along with substantial reduction in measured poverty.

Kenya and Zambia show concerning patterns of stagnant income and rising poverty, even as electrification rates are increasing.[11]

From these patterns in the data, from the experiences of different regions over time, we conclude:

- Widespread and deep-rooted poverty in Africa is a fundamental constraint to electrification.
- It is possible for countries to climb up the electrification path *without* bringing down poverty and growing incomes.[12]
- Extending current trend-lines, or noting their zig-zagging over time in several Sub-Saharan African countries, suggests that unless structural economic problems, which prevent people and firms from using electricity to grow out of poverty and raise employment and incomes, are tackled simultaneously with electrification efforts, the region would likely be dependent on external aid to achieve electricity access goals.

In tackling these challenges, what can Africa learn from the experience of other regions? South Asia, particularly some of the poorest states of India which also have deep-rooted poverty and have lagged other states within the same country, is perhaps the closest comparator. Figure 2 shows that while South Asian countries have climbed the electrification and income ladder more than Africa, they remain below the experience of East Asian countries. The striking feature of public policies on electrification in India that has been highlighted in the literature is its reliance on price subsidies, ostensibly to expand access to poor households who otherwise would not be able to afford to use electricity. But these subsidy policy regimes, or how they function in practice, appear to result in utilities periodically shutting off power (so-called "load-shedding"), leading to *lack of* reliable electricity (Zhang, 2018; Burgess et al, 2020; Ryan and Sudarshan, 2022). Unreliable electricity in turn can have substantial negative economic consequences in

[11] The "macro" view in these graphs should not be interpreted as evidence of the (low) impact of electrification. Micro-empirical methodologies are suited to estimating the impact of electrification. The section below examines this micro evidence of the impact of electrification on incomes.

[12] Even if the Moss and Kincer (2023) argument that no country has grown without electricity can be true, it may also be true that countries can increase electrification without sufficient increases in income/reduction in poverty to afford universal electrification.

general equilibrium, of weak firm dynamism and job creation (Fried and Lagakos, 2023; Mensah, 2024).

Despite evidence of inefficiencies of electricity subsidy policies in India, reform has been politically difficult because politicians use electricity as a tool of clientelist targeting to win votes from their supporters (Min and Golden, 2014; Min, 2015; Baskaran et al, 2015; Mahadevan, 2024). Political capture of electricity subsidy policies, as has been found in the case of India, is likely to be a risk for Africa because the region similarly experiences clientelism and vote buying in politics (Wantchekon, 2003; Vicente and Wantchekon, 2009; Collier and Vicente, 2012; Khemani, 2015). India's experience shows that despite substantial evidence of the inefficiencies of electricity subsidy policies, ineffectiveness in achieving equity objections, political capture by clientelist politicians, and demand for public goods from voters, leaders with the will to reform are unable to overcome political challenges (Burgess et al, 2020; Khemani, 2025). A strand of research on designing institutional reforms to overcome these political challenges is focusing on the role of deliberation and political contestation at the "first mile" where citizens participate as voters and contenders for local political leadership (Fujiwara and Wantchekon, 2013; Casey, 2015; World Bank, 2016; Blimpo et al, 2022; Faguet and Pal, 2024; Devarajan and Khemani, 2022; Myerson, 2022, 2025).

Lessons might also be gleaned from China's experience expanding rural electrification in the 1970s-1990s, starting out with lower per capita income and larger numbers of households in poverty than many African countries (Aklin et al, 2018; Bhattacharyya and Ohiare, 2012). Available accounts argue that China purposefully linked rural electrification to local economic growth. It relied on local governments (counties, towns, and villages) to develop integrated plans for local economic growth and spearhead productive use of electricity through Township and Village Enterprises, which in turn mobilized demand for energy (Bhattacharyya and Ohiare, 2012). This account is strikingly similar to the experience of rural electrification in the United States in the 1930s, despite vastly different economic and institutional contexts. Federal agencies like the Rural Electrification Authority and the Tennessee Valley Authority worked with local farmer cooperatives, providing loans at concessional rates and empowering the cooperatives to manage the electricity connections of farms, wiring of homes, and negotiation of prices with utilities. China in the 1970s-1990s and the US in the 1930s suggest a role for significant decentralization of resources, empowering local agencies to devise strategies tailored to local conditions and needs for electrification to lead to income growth.[13]

3. The scope of demand-side policies

This section documents a substantial affordability gap: the difference between current costs or market prices of delivering basic electricity to households and the ability of households to pay for those services out of their current incomes. Policy instruments to close this affordability gap cover a range from public spending on subsidies to reduce the price households pay, to addressing market failures and institutional constraints which prevent households from using electricity to grow their incomes.

Evidence on the affordability gap. Electrification involves two steps: connecting to electricity and using electricity. Each step carries costs for the utility that the utility passes on to consumers depending on the regulated prices it is allowed to charge. For simplicity, we will refer to the upfront price of connecting as the adoption price and the price for ongoing use of electricity as the use price.

Consumers jointly consider the adoption price and the use price when deciding whether to connect to electricity. For instance, Lang (2025) shows that reducing the use price significantly increases adoption of solar home systems in Togo even when the adoption price remains unchanged. However, since few studies can speak to both margins simultaneously, we first focus on willingness to pay for connections before turning to willingness to pay for use.

Studies of willingness to pay outright for solar home systems provide a useful starting point because use prices are zero after purchasing the system. Grimm et al (2020) estimate willingness to pay for three goods: solar lanterns, a basic system with two lights and charging ports, and a slightly larger system with four lights and six charging ports. They focus on rural consumers in Rwanda who live in areas not anticipated to be served by the grid in the medium term. Although the average affordability gap is largest in absolute terms for the largest system, at USD 86, in proportional terms the affordability gap is declining in system size. Willingness to pay is 39% of

[13] These decentralized policies for linking electrification to local income growth were complemented in each case by large supply-side investments in the generation of electricity and overall support by federal/national agencies. We will take up this point of complementarity across different policies—national scale supply-side investments and local government's role to address "last-mile" issues—in Section 5.

the market price for a solar lantern, 46% of the market price for a basic system, and 52% of the market price for the larger system. These patterns suggest that even though consumers highly value energy services and are willing to pay increasing shares of their income for better services, prevailing low levels of income make even lower-cost off-grid solutions far from affordable.

Sievert and Steinbuks (2020) find somewhat lower estimates in Senegal and Burkina Faso for a basic solar home system despite their estimates being only for non-incentivized stated preferences. As with Grimm et al (2020), Sievert and Steinbuks (2020) study a sample of households without access to the grid. They find an average willingness to pay for a basic system of USD 7.13 in Burkina Faso and USD 9.02 in Senegal. Their estimate of USD 15.32 in Rwanda is strikingly close to that in Grimm et al (2020). However, they point out that estimates in all three contexts comprise 10%-15% of household expenditures, again highlighting that households have a relatively high willingness to pay for improved energy services in terms of the proportion of their income they would be willing to allocate.

Empirical evidence from Kenya and Tanzania suggests that willingness to pay for grid connections is higher in absolute terms than that for solar, but proportionally higher prices for grid connections leave massive affordability gaps. In rural Kenya, Lee et al (2020) find that the average willingness to pay for a grid connection is USD 147 while the average cost to the utility is USD 739, implying a USD 593 affordability gap. Given the low average valuation for a grid connection relative to costs, offering partial subsidies for connections yields limited benefits. Results from subsidized connections in both rural and urban/peri-urban Tanzania suggest that these findings are not driven by the relatively high adoption price as in the Kenyan context. Lowering the adoption price to around USD 11 from USD 95 only increases connection rates from 18% to 31% (Chaplin et al 2017). Both studies suggest that demand for electricity connections is highly elastic among the unconnected consumers who are the target of energy access initiatives. Though based on stated preferences, results from Sievert and Steinbuks (2020) in Burkina Faso, Senegal, and Rwanda closely align with those from Tanzania. They find that only around 20% of households in their sample would connect to the grid at a price of USD 25. On average, households in their sample in Burkina Faso are willing to pay USD 9.64 for a grid connection, those in Senegal USD 11.90, and those in Rwanda USD 22.32. Although low in absolute terms, these amounts range from 16% to 23% of total monthly household expenditures.

Figure 5 summarizes the results from these four studies. Although all align in showing generally low willingness to pay for electricity relative to market prices, three features are notable. First, the demand curve for solar home systems in rural Rwanda is generally flatter (more elastic) than those for grid connections in Kenya and Tanzania, particularly in the region of the curve from 20% - 100% connection rates. This is partially driven by a lower maximum willingness to pay for a solar home system than a grid connection among consumers with the highest willingness to pay, as solar home systems provide more limited energy services than a grid connection. However, over 80% of consumers would be willing to pay around USD 75 for a solar home system, substantially above what is implied by the results from Tanzania though in line with those from Kenya. Second, there is substantial variation across contexts, potentially pointing to the importance of income levels in determining willingness to pay. Finally, achieving 90% - 100% electrification requires that electrification is almost free in most contexts, underscoring the extremely limited ability to pay for the most marginalized households.

In addition to high connection costs, households must make a range of costly investments to safely access and use electricity, including wiring their dwelling for electricity and purchasing electrical appliances. Figure 6 plots the distribution of internal wiring costs across seven low-income countries. Apart from Ethiopia and Nigeria, costs are high with large variability between reports from different households. Notably, the median estimated internal wiring costs in Kenya are around 50% of the willingness to pay for a grid connection estimated in Lee et al. (2020). Low-income households thus face multiple major costs when first attempting to access electricity, potentially contributing to limited willingness to pay for the connection.

After becoming connected, households must pay to use electricity to derive any benefits from electrification. Decisions about how much electricity to use are continuous rather than binary, so the idea of a single affordability gap does not translate directly. Instead, it is useful to consider usage levels and price elasticities to understand how much electricity households and firms are currently using and how demand for electricity would change at different price points.

The challenges of achieving universal access to electricity have placed much less emphasis on demand for electricity on the use margin, leading to less evidence. Jack and Smith (2020) study the effects of switching from postpaid to prepaid meters in Cape Town, South Africa, which increases the salience of marginal prices for electricity consumers. Their estimates indicate that households with the lowest use levels have relatively inelastic demand at around -0.12. Such estimates align with those reviewed by Klug et al. (2022), which document residential electricity price elasticities from studies in South Africa, Tunisia, Ethiopia, and Nigeria. However, such studies necessarily focused on connected households. As electricity access expands to increasingly economically marginal households, price elasticities may change.

Though somewhat less rigorous, a matching exercise among rural mini grid customers in Tanzania estimates much more elastic demand for use, with estimates ranging from -2.7 to -0.6 for all but the lowest demand customers, who have even more elastic demand (Crossboundary, 2022). Such striking differences in elasticities of demand for use are likely due to a combination of factors such as differences between rural and urban consumers, differences in income, and varying quality of service between on-grid and mini grids in Tanzania, to name only a few. Nevertheless, the results underscore the importance of understanding intensive-margin price elasticities for the full range of consumers being targeted by energy access initiatives.

Multiple studies have examined responsiveness to use prices among commercial and industrial enterprises. Those included in the review by Klug et al. (2022) document generally inelastic demand across sectors in South Africa, Tunisia, and Kenya, as well as aggregate inelastic demand for electricity across South Africa, Tunisia, Namibia, and Lesotho. However, it is important to note that many countries have subsidized electricity for specific sectors and industries, potentially leading to lower price elasticities than would be observed were tariffs cost reflective. It is not clear how tariff reforms would affect industrial and commercial customers (Klug et al. 2022).

The scarcity of evidence on the use margin is a critical gap that needs to be filled to design energy policies that are fiscally sustainable and generate economic growth. The high elasticities observed in rural Tanzania indicate that rural households are highly sensitive to price. This suggests that raising prices to cost-covering levels will reduce energy consumption and investments in energy-dependent technologies. At the same time, using subsidies to cover the large gap between costs and affordability has substantial fiscal implications for the state, transferring the problem of household affordability to government affordability or state fiscal capacity. The following section examines the scope for complementary policies that address market frictions and failures that may lessen the fiscal burden of subsidies on the state.

Closing the affordability gap by addressing market imperfections. To what extent are large affordability gaps for electricity connections and highly elastic demand for electricity use due to underlying market imperfections? This section considers evidence on whether lack of access to credit and liquidity and low service quality/reliability may be shaping demand for electricity and, if so, to what extent fixing these issues could narrow the affordability gap.

Evidence from both Kenya and Rwanda suggests that credit constraints are somewhat limiting demand for connections (or purchases of solar home systems). In Rwanda, Grimm et al (2020) find that a contract spreading payments for solar home systems over 6 weeks would increase willingness to pay by 4%-6%, and a 5-month payment plan would increase willingness to pay by 8%-11%. Lee et al (2020) find much larger increases in stated willingness to pay for more expensive grid connections when consumers considered 2- or 3-year financing, with amounts more than tripling. They also document that stated demand for connections would nearly double if payments did not have to be made with any time constraints. Although only based on stated preferences, their work suggests that credit constraints are significantly limiting demand for expensive grid connections. Despite evidence that credit constraints are lowering willingness to pay for electricity connections, it is not clear how much credit could close the affordability gap. Credit appears to be capable of closing the affordability gap in the Kenyan context, but the authors point out that the stated willingness to pay with hypothetical access to credit seems implausible. In Rwanda, credit makes meaningful progress in narrowing the affordability gap but does not close it.

On the use margin, liquidity constraints may limit demand for electricity if households have difficulty aligning income streams with their need for electricity. For instance, Jack and Smith (2015) show that households with low property values make a large proportion of electricity payments on Fridays, when people are typically paid. However, Lang (2025) experimentally varies access to liquidity among pay-as-you-go solar consumers in rural Rwanda and finds no change in overall demand for electricity, suggesting that increasing liquidity would not meaningfully change electricity use.

The quality of electricity service also affects willingness to pay. Cisse (2025) shows that a 40% reduction in outages increases household willingness to pay for electricity by 10% in Senegal. Small firms increase willingness to pay by 28% and large firms by 25%, indicating that better quality service leads to higher demand on the use margin. His results are in line with stated preference results from Deutschmann et al (2021) in Senegal. It is less clear how service quality affects willingness to pay for connections. Lee et al (2020) state that 19% of the transformers in their study had long-term outages, but they find no significant interactions between the faulty transformers and demand for connections. They also note that the average time to get connected is 188 days, so low demand for connections may reflect overall expectations for poor service quality from the utility.

Policies to finance access without borrowing. Although fixing credit market failures and improving service quality will increase willingness to pay for electricity, existing evidence suggests that an affordability gap will remain. Can policy makers address the remaining affordability gap without borrowing?

At one extreme, policy makers could simply rely on income growth to close the affordability gap over time, taking no direct policy action to close the gap. Dabalen et al (2024) show that positive coffee price shocks in Rwanda can account for around 4% of the increases in electrification seen by Rwanda from 2000 – 2019, suggesting that income growth alone may increase electrification rates slowly. This is in line with evidence from Lee et al (2020), who find only small positive effects when they interact subsidies for grid connections with baseline income levels in Kenya, and Chaplin et al (2017), who find no differential effects by income levels. Across countries, the World Bank's Multi-Tier Framework (MTF) survey shows that electricity use does increase with income, although the slope of the relationship changes markedly with the price of electricity. For instance, in Ethiopia, small increases in total monthly expenditures are associated with large changes in electricity consumption. The opposite is true in Rwanda: large increases in total monthly expenditures are associated with only small changes in electricity consumption (Figure 7).

If policy makers choose to directly tackle the affordability gap, one fiscally attractive solution is cross-subsidizing between consumers with high versus low demand for electricity. Although appealing in theory, existing evidence indicates that an extremely low proportion of consumers have a willingness to pay that meets market prices, much less exceeds them (Grimm et al 2020, Lee et al 2020, Chaplin et al 2017). Given the size of the affordability gap and the number of households with low willingness to pay, it is unlikely that cross-subsidization could generate enough revenue to achieve universal access. Another alternative could be cross-subsidizing between firms and residential consumers, as firms tend to have higher demand for electricity than households. However, this clearly creates perverse incentives for firms that may slow investment in productivity-enhancing electronic technologies, ultimately slowing the economic returns from electrification.

Cross-subsidizing between different domestic consumers appears unlikely to resolve the affordability gap, but there may be scope to finance access initiatives through international markets for carbon. If countries can demonstrate that there are meaningful reductions in emissions that result from expansions in electricity access, they may be able to trade these benefits in international carbon markets. However, participating in credible emissions markets requires its own set of investments, as countries need to collect the necessary data to demonstrate additionality. It is also unclear whether expanding basic electrification will yield meaningful reductions in emissions: basic electrification often does not electrify cooking, the primary source of emissions in rural, low-income settings. As such, international carbon financing is likely to only provide a partial solution for financing access initiatives.

The available evidence suggests that it will be difficult for governments to meet energy access objectives without borrowing to finance them. It follows that governments must find ways to invest in access that will generate the future revenue required to repay loans. We therefore consider evidence on how governments can promote the productive use of electricity.

Policies to promote productive use of electricity. How can access to electricity be productively used to grow incomes? A starting point is to examine evidence of the impact of expanding access on incomes and employment, to assess how far countries can go simply with policies like price subsidies to expand access. Economics research has focused on identifying the impact of electricity access, with less attention paid to factors that shape both where electricity expands and how electrification impacts the socio-economic outcomes of interest. Several recent reviews of the accumulating evidence take the view that the results are mixed (Foster et al., forthcoming; Meeks and Mahadevan, 2025; Meeks and Pokhrel, 2024; Lee et al, 2020a; Moore et al, 2020; Bayer et al, 2020).

While estimated economic impacts of expanding access are generally positive, the size of the impacts varies greatly across different contexts. Burlig and Preonas (2024) use evidence of heterogeneous impacts within India, ranging from negative net surplus (meaning, the costs of electrification exceed the benefits) in small villages, to an estimated 33 percent internal rate of return in larger villages, to reconcile the mixed evidence. Their reading of the available evidence is that estimates of large economic impacts have tended to come from electrifying large populations (e.g., entire counties in Brazil in Lipscomb et al, 2013), while studies of variation in electrification at the village level tend to estimate modest economic benefits which are less than the costs of electrification (e.g. Lee et al 2020b for Kenya).[14]

Demand for electricity and willingness to pay for it appears to vary by potential for productive use. Blimpo et al (2020) provide qualitative evidence that farmers are willing to invest in electrifying their farms to pump water for farming rather than lighting their homes. More generally, Blimpo et al (2020) argue that households and communities value electricity primarily for its use in income-generating activities rather than for consumption of lights. Consistent with this argument, Figueiredo-Walter and Moneke (2024) find that take-up of grid electricity in under-grid villages is higher where there are pre-existing facilities for the productive use of electricity, such as grain mills.

The available pattern of evidence thus suggests that expanding electricity access (through both supply-side infrastructure investments and price subsidies to encourage take-up) to small villages in Sub-Saharan Africa may need to be complemented with other policies to enable the people living in these villages to make productive use of electricity. That is, current market or economic conditions in small villages in rural Africa do not seem to be sufficient for economic activity to take off after electrification, in the absence of other public policies to address failures in institutions (e.g. property rights; contract enforcement), infrastructure (e.g., roads, irrigation, digital technology), and markets (e.g., credit constraints; factor market frictions) to using electricity to grow incomes (Blimpo and Cosgrove-Davies, 2019; Jones et al, 2022; Acampora et al, 2025). The constraints in rural economies also matter for the success of supply-side energy policies such as opening-up energy markets for decentralized mini-grid solutions which are

[14] The reviews of available evidence also tend to conclude that much more evidence is needed in Africa of the impact and cost-effectiveness of electrification (Jimenez, 2017; Bayer et al, 2020; Berha, 2025). While encouraging findings are available from Ghana (Akpandjar and Kitchens, 2017), Ethiopia (Fried and Lagakos, 2021) and South Africa (Dinkelman, 2011), there is little micro-evidence to understand what is behind the disappointing trajectories of countries like Kenya, Nigeria and Zambia examined in Section 1. The diversity of experiences in the region demands much more research coverage across different country contexts.

deemed more cost-effective than grid extension. Peters, Sievert, and Toman (2019) assessed the market viability for mini-grids and found that low demand and high payment default rates are significant barriers.

The problem of productive use of electricity to grow incomes may be inextricable from the general problem of economic development and poverty. As such, it remains an open question whether solutions can come from current energy-sector interventions, such as providing households with energy-using appliances, which ignore the broader economic environment in which poor people live. The functioning of local economies, opportunities for people engaged in subsistence agriculture to increase their productivity or transition out into more productive small businesses and jobs, will likely drive whether they take-up electricity to make these transitions. Without electricity, we may safely say that they will be stuck in traditional modes of agriculture and economic activity. In that sense, electricity is a crucial and necessary part of local income growth. But, the evidence suggests, providing electricity alone does not automatically lead to sufficient demand and productive use, if the general local economic environment is not conducive.

There is less (but growing) research on what might be key complementary policies to alleviate rural economic constraints and enable productive use of electricity. Recent evidence from Brazil and multiple countries in SSA suggests that roads complement electricity, leading to significantly larger effects than either would produce in isolation (Selod et al, 2024; Abbasi et al, 2022). There is strong interest in the potential for electricity to jumpstart structural transformation by increasing agricultural productivity and allowing less productive farmers to move into other sectors of the economy, particularly given that Africa lags far behind the rest of the world in the adoption of productivity-enhancing agricultural technologies such as irrigation (Srivastava et al 2024, Suri and Udry 2022).

Fried and Lagakos (2021) document substantial increases in agricultural productivity and non-agricultural business activity in Ethiopian villages that received electricity relative to those that did not, but provide limited evidence on what complementary investments or policies may have contributed to such large economic impacts from electrification in that context relative to others on the continent. Evidence from reducing frictions in land and labor markets suggests that policies to address such factor market frictions are likely key complements to boost agriculture productivity and increase take-up of transformative technologies, though the interaction of such policies with electrification has not been tested (Jones et al, 2022; Acampora et al, 2025). In a similar vein, alleviating credit market imperfections is likely a critical complement as evidence suggests credit can enable small businesses to grow, productive farmers to stay in agriculture, and others to migrate for jobs in urbanizing areas (Diop, 2025; Lagakos et al, 2023).[15]

Urban-rural linkages appear to matter across all these areas of complementary policies to enable productive use of electricity—smaller villages are more likely to productively use electricity if they can access markets in urban areas; larger villages are more likely to productively use electricity if there are opportunities for small firms to develop and grow. The heterogeneous results in the available literature on the economic impact of electricity access, such as larger impact in larger villages (Burlig and Preonas, 2024), further supports a role for considering agglomeration economics in demand-side policies to expand access.

On the one hand, a focus on electrification of small, remote villages through demand-side subsidy policies may be an unsustainable strategy to achieve electrification goals because of lack of economic returns and weak state fiscal capacity to fund those subsidies. On the other hand, the potentially good news is that demographic patterns of urbanization in Africa have resulted in a majority of the unelectrified being located within or close to urban agglomeration centers. Kersey et al (2025) report that 57% of the unelectrified live within one hour travel time of an urban agglomeration, and another 28% of the unelectrified live in or around cities of 100,000-250,000 people. This suggests that policy makers could achieve electrification goals by targeting these peri-urban areas where a majority of the unelectrified populations live, and where complementary investments could enable firms and people to use electricity productively.

One approach to consider would be a Chinese-style focus on strengthening incentives of local governments, across the rural and rapidly urbanizing spectrum, to leverage their information about local economic conditions and tailor the provision of complementary inputs accordingly (Bhattacharya and Ohiare, 2012; Dai et al, 2019; Munshi, 2024). Many African governments have been experimenting with allocating grants to communities and locally elected governments to address local needs and spur local area development (Devarajan and Khemani,

[15] Agglomeration benefits are argued to be driving the results of substantial returns from electrifying large villages in India (Burlig and Preonas, 2024).

2023; Casey, 2015).[16] Electrification strategies may be able to tap into these grants to enlist the participation of local governments in last-mile financing of grid connections and increasing economic demand for off-grid/mini-grid solutions. Local governments could also fund those complementary investments which communities identify as binding constraints to using electricity for local economic growth. The returns to electrification that accrues to local economies could get reflected in local tax bases, such as property values, enabling local governments to contribute to state fiscal capacity for public spending on expanding access and complementary inputs to enable further productive uses of electricity.[17]

4. The scope of supply-side policies

This section examines the role of public policies on the supply-side of generating, transmitting and distributing electricity for consumption by households and firms. State-Owned Enterprises (SOEs) have dominated the provision of electricity in developing countries, and investments in electricity infrastructure have been financed by governments through both public debt and revenue instruments.[18] Reforms to "unbundle" large, vertically integrated public utilities, into generation, transmission and distribution companies, and to privatize competitive segments of the market, have been pursued since the 1990s (Kessides, 2012; Estache, 2016; Foster and Rana, 2019). These reforms are predicated on the argument that private ownership is generally preferable to public ownership because private firms have greater incentives to minimize costs, improve efficiency, and be responsive to consumer demands (Shleifer and Vishny, 1994; Megginson and Netter, 2001). At the same time, the literature has acknowledged that private ownership is not a magic bullet. Its success depends on the surrounding institutional environment such as effective regulatory oversight and public support for privatization (Bacon, 2018; Martimort and Straub, 2009).

Public policies on the supply side thus consist of designing the institutions of electricity markets—where the private sector is invited/allowed to enter, where SOEs operate, and how these

[16] Albeit with start-stop-reverse dynamics, resulting in variation across countries in the extent of effective decentralization (Devarajan and Khemani, 2023).

[17] Lipscomb et al (2013) provide some evidence from electrification in Brazil resulting in rising urban land values and property tax revenues accruing to the state.

[18] General budgetary spending (out of domestic revenues) on building electricity infrastructure; or providing subsidies to loss-making utilities. There are also examples of policies requiring utilities to levy taxes on paying customers and transferring the resultant revenues to a rural electrification fund for subsidized access (for example, in Zambia).

markets, electricity transactions, and prices are regulated. A technical solution to the problem of electrifying Africa while individual countries' economies are too small or too poor to afford electrification is to create regional energy pools and promote greater regional market integration.[19] Electricity market structures and regulatory institutions in turn shape the ability of private firms and public utilities to access financing to invest in electricity infrastructure. The challenge of public policy on the supply side can thus be gauged by the sheer size of the financing requirements to expand electricity infrastructure to achieve access objectives.

The IEA estimates that Sub-Saharan Africa will require USD 22 billion of investments per year, between 2022 and 2030, in electricity connection alone, mainly on distribution networks and off-grid solutions (IEA, 2022, page 124). If the investment on the expansion of electricity transmission grid is also included, the total annual investment would be USD 40 billion per year during the 2026-2030 period (IEA, 2020, page 130). Including all segments of the energy sector (fuel supply, electric power, end-use infrastructures), Africa needs USD 190 billion of investment for the 2026-2030 period (IEA, 2022, page 156). The IEA has estimated that 60% of the cumulative investment on energy infrastructures in the region needs to come from the private sector, presumably because of limited fiscal capacity of governments (IEA, 2022, page 105). The role of private sector participation and financing is even greater in the National Energy Compacts that were presented by twelve governments at the Africa Energy Summit of January 2025.[20]

The overarching challenge facing African policy makers on the supply-side can thus be summarized as the challenge of attracting global private capital to finance investments in energy infrastructure. By some estimates, the potential returns to investments in public infrastructure in developing countries are much higher than alternate investments in the global capital market (Chari et al, 2025[21]). But the problem inhibiting the flow of capital is "appropriability"—or the ability of investors to recoup the required private return to make their investments financially viable (Chari

[19] Regional energy market integration is part of the technical policy dialog under the World Bank's Mission 300. Vega (2024) reports how regional market integration has been identified by the Council of Engineers for the Energy Transition, an independent technical advisory council of the United Nations Secretary General, as necessary for financing Africa's energy transition.
[20] Energy Compacts of governments.
[21] Chari et al (2025a) estimate the social rate of return on investments in public roads. Ongoing work is expected to generate estimates for the returns on energy investments. Other estimates reported in: https://www.ifc.org/en/insights-reports/2025/financial-returns-on-equity-investments-in-infrastructure.

et al, 2025).[22] A large literature examining obstacles to the flow of capital, generally, to developing countries has concluded that institutions—control of corruption and rule of law—are fundamental (Alfaro et al, 2008). Reviewing the evidence specifically for private capital flows to finance the infrastructure gap in developing countries, Fay, Martimort and Straub (2021) conclude that regulatory and legal institutional conditions in the countries with the largest gaps (and therefore the greatest need for financing) are not conducive.

High cost of capital for private investors to enter. The problem of appropriability and other risks of investing in Africa is reflected in high costs of capital. Sachs et al. (2025) argue that developing countries face higher cost of capital, in terms of both debt and equity financing, than developed or high-income countries. UNCTAD (2025) reports that developing regions borrow at rates that are two to four times higher than for the United States. The market interest rates for lending in 2021 reported in World Development Indicators of the World Bank (World Bank, 2025a) show that the rates for SSA countries are higher than the global average. Several SSA countries had market interest rates higher than 15% in 2021 (World Bank, 2025a). Although market interest rates may not necessarily reflect true cost of capital as these rates do not account for inflation and exchange rate fluctuations, the higher market interest rates of SSA countries as compared to the global average implies a higher cost of capital. This high cost of capital is part of the reason why SSA electric utilities find it difficult to attract private sector investment, even if they are willing to pursue privatization reforms.

The domestic private sector also faces difficulties in borrowing from domestic lenders. The World Bank developed a numerical indicator to represent the hurdle in borrowing from financial institutions. The indicator includes (a) time to obtain a loan and (b) obstacles to obtaining loans (World Bank, 2025). Figure 8 compares this indicator between SSA countries and between SSA and other regions for which the indicator is available. All SSA countries except Botswana have lower scores than the global average.

Despite these hurdles for the private sector to enter the SSA region, a number of regional or international initiatives have been started. For example, Africa50, a Pan-African infrastructure

[22] Acharya et al (2025) examine how appropriability is a problem for optimal capital allocation to public infrastructure even in the case of advanced economies like the United States.

investment platform, has created a 12-year private equity fund in 2021 aiming to raise $500 million in commitments.[23] The fund, also known as Infrastructure Acceleration Fund, has gained commitments from 16 African institutional investors, including the African Development Bank and the International Finance Corporation. However, the size of the fund is small compared to the investment demand in the electricity sector (US$20 billion annually accordingly to IEA, 2022).

Inability of the public sector to borrow. Can governments generate long-term financing for long-lived electricity infrastructure assets whose returns are expected to accrue into the future? That is, can governments issue public debt to borrow from their citizens/residents or from international markets? The answer appears to be negative, given the experience in many SSA countries: major infrastructure projects are typically co-financed by international development partners who provide subsidized finance.

Sub-Saharan African countries started issuing sovereign bonds on the international markets in 2000. The size of the sovereign Eurobond issued by African countries reached $29.67 billion in 2018 (UNECA, 2022). However, African countries typically face higher costs on their sovereign bonds in international markets. For example, African countries pay 2 percentage points higher premium on their Eurobond coupon than other developing countries (UNCEA, 2022).

The credit ratings of sovereign bonds issued by SSA countries are not promising, with a few exceptions. Table 1 presents the Standards & Poor's ratings of sovereign bonds issued by SSA countries as of March 2024. According to S&P, a bond is credible if its rating is BBB− or higher. As we can see from Table 1, out of 18 sovereign long-term bonds issued on the international market, only two are credible. This indicates SSA countries' inability to generate funding from the international markets for their infrastructure projects.

Financial performance of existing utilities. Galeazzi, Steinbuks and Anadon (2024) argue using the RISE 2022 data, that "counterparty risk"—indicators of utility financial health and technical (in)efficiency (such as loss rates in transmission and distribution)—are the single most important factors that likely inhibit the flow of international finance to invest in low-cost energy generation in Africa. Timilsina (2025) examines data on 67 electricity utilities in more than 40 countries in the Sub-Saharan Africa (SSA) region, of which (i) 30 utilities provide electricity

[23] https://www.africa50.com/investing-for-growth/investment-vehicles/africa50-infrastructure-acceleration-fund/.

generation, transmission and distribution services and referred as vertically integrated utilities or VIU, (ii) eight utilities own only generation facilities (hereafter, electricity generation utilities or EGU), (iii) seven utilities provide only transmission services (hereafter, electricity transmission utilities or ETU), (iv) 19 utilities provide electricity distribution services (hereafter, electricity distribution utilizes or EDU) and (v) three utilities provides electricity transmission and distribution (T&D) services (hereafter, electricity T&D utilities, or TDU). All VIU are publicly owned except Cameroon's ENEO. ETU and TDU are, by virtue, publicly owned. While all EDUs in Nigeria and an EDU in Uganda are privately owned, the rest of the EDUs in SSA are publicly owned.[24]

The majority of utilities in the SSA region are operating at a loss as their annual revenues are smaller than their operating costs. If the cost of debt service is also accounted for to reflect the cost of capital, more utilities are in loss (see Figure 9). The upper panel of Figure 9 shows that out of 30 VIUs, 16 have their average revenues lower than their average operational costs. If cost of debt is also included, another four VIUs have their revenues lower than operational and debt service costs. In some cases, revenues cover less than half of operational costs.

For other types of utilities (EDU, ETU, EGU, TDU and EGT), the scale of average operational costs and average revenues are smaller than that of VIUs due to fewer functional responsibilities as compared to the VIUs (Figure 9, lower panel).[25] However, several still have revenues that are lower than their operational costs. Only a few EDUs (Ethiopia's EEU, Namibia's ERONGO and CENORED, Nigeria's IKEJA and Uganda's UMEME) have revenues higher than their operational and debt costs.

Timilsina (2025) compares the operational costs of Sub-Saharan African VIUs, with the VIUs from the Middle East & North Africa (MENA) region (Saudi Arabia), South Asia region

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[24] Among the VIU, South Africa's ESKOM is the largest utility in the SSA region, followed by DR Congo's SNEL, Tanzania's TANSCO and Côte d' Ivoire' CIENERGIES. The total assets of EGUs are also higher as they own dams and generation machinery.[24] This is also true for ETU and TDU because they own transmission towers, transmission wires, and switchyards with large transformers. EDUs normally have lower assets because they own distribution transformers and distribution wires only. Employment is also proportional to the size of utilities measured on asset value (World Bank, 2025c).

[25] ETUs have revenues higher than operational costs, as the electricity transmission system has relatively lower operational costs. So does the case of EGU, particularly those with predominant hydropower assets. In the case of Ethiopia's EEP, the cost of debt services is three times higher than its revenue because of large-scale hydropower plants more recently commissioned.

(Nepal) and the East Asia & Pacific region (Viet Nam). The operational costs in Saudi Arabia, Nepal and Viet Nam are respectively, US$42, US$63 and US$72 per MWh, whereas the operational costs of SSA VIUs vary from US$70 to US$671per MWh, with median value of US$183/MWh. In the case of EDUs, operational costs vary from US$34/MWh to US$214/MWh with the median value of US$154/MWh (Timilsina, 2025). Compared to this, the operational costs of EDUs Empresa Distribuidora de Electricidad de Mendoza S.A. (EDEM) of Argentina, Bangalore Electricity Supply Company Limited (BESCL) of India and Metropolitan Electricity Authority (MEA) of Thailand are respectively, US$78, US$103 and US$113 per MWh. The difference in operational costs between SSA utilities and utilities from other regions are more prominent in the case of VIUs than EDUs.

Timilsina (2025) breaks down utilities' financial performance factors into: (i) cost-side factors that have contributed to higher production costs and (ii) revenue-side factors that might have lowered the revenues. The cost- side factors include: (a) higher fuel costs, (b) lower capacity factor and (c) lower capital and labor productivities. The revenue-side factors include higher T&D loss and lower rate of electricity bill collection, while the posted tariffs in Africa are among the highest in the world.

Higher fuel cost is one of the main factors causing higher operational costs in SSA countries, particularly those which predominantly use imported petroleum products (diesel and fuel oil) for power generation. Of the 43 SSA countries, 13 use petroleum products for more than 50% of their electricity generation (EIA, 2025). Petroleum products are expensive in these countries due to import prices and transportation costs from ports to power plants. Moreover, thermal efficiencies of power plants using petroleum products are one of lowest among electricity generation technologies. For example, internal combustion engines that use diesel have thermal efficiency below 30%, meaning that 70% of the heat content of the fuel is lost during electricity production. Higher fuel prices and less efficient technologies make production costs of electricity very high in several SSA countries (e.g., Chad, Cabo Verde, Mali, São Tomé & Príncipe, Senegal). Considering utility-scale solar PVs instead of diesel fired power plants while expanding the power system could be an option to reduce operation costs, as solar plants are getting cheaper and have zero fuel costs. Timilsina (2021) finds that the unit cost of electricity from a solar plant would be US$22/MWh in regions with moderate discount rates (7%) and high solar irradiation (most of SSA region). By contrast, production costs of diesel-fired power plants could be as high as US$682/MWh with 28% thermal efficiency and US$2/liter diesel price on average delivered in SSA region in 2023 (Timilsina, 2025).[26]

The electricity system loss of VIUs in the SSA region vary from 6.2% (Mauritius) to 38% (Cameroon). Existing studies show that T&D loss is one of the primary technical reasons for poor financial performances of utilities (see e.g., Galeazzi et al. 2024; Burgess et al. 2020; Kozima et al. 2016; Trimble et al. 2016). Timilsina (2025) estimates the level of increment in average revenue per unit of electricity sold if electricity T&D losses of SSA VIUs are reduced to the level of South Africa's current T&D loss, which is 11.8%. Doing so would increase the average revenue of utilities by 1% to 36%. Three VIUs out of 15 VIUs, which are suffering with lower revenue than their operational costs, would increase their revenue above the operational costs through T&D loss reduction.

Low collection of electricity bills is another reason for revenue loss. About one-third of VIUs have collection rates below 90% (Timilsina, 2025). Bill collection rates of some VIUs are below 60%. Similarly, out of 26 other utilities (e.g., EGU, TDU, ETU, EDU) for which data are available, more than half have bill collection rates below 90%. Some utilities have bill collection rates below 50%. If the revenue loss due to the poor bill collection is eliminated VIUs would increase their revenues from 1% to 181%. Six VIUs out of 15 which are operating in loss could have more revenues than operational costs if T&D loss is reduced and revenue collection loss were eliminated. The problem on the revenue-side thus appears to be high T&D losses and low collection of bills rather than low tariff rates, as in the case of South Asia (Burgess et al, 2020). In fact, using the available data on tariffs, Timilsina (2025) finds that several African countries have significantly higher tariffs than many OECD countries, reflecting their higher costs of supplying electricity.

Technical performance of the electricity sector. In a macroeconomic study of the electricity sector including not only large-scale energy generation, transmission and distribution by utilities but also self-produced electricity by firms/producers using small generators, Colmer et al (2024) show that Total Factor Productivity (TFP) in the electricity sector is strikingly high in Africa. In

[26] This insight resonates with current policy dialog (Mission 300 and Vega, 2024, cited earlier) to regionally integrate power generation pools in Africa and attract low-cost, utility-scale renewable energy investments. The problem, however, as discussed in the sections above, is barriers to the flow of capital to finance these investments.

their preferred estimates, the authors find the poorest quartile of countries has around 86 percent the TFP level in electricity as the richest ones. This is quite large, compared to differences in aggregate TFP, across poor and rich countries. For example, the authors indicate, the poorest countries have aggregate TFP that are around 36 percent of the richest. That is, in the electricity sector, the production technology does not seem to be a key constraint.[27] Instead, the constraints producers or firms face in Africa is planning the use of their other inputs depending upon when electricity will be available from the system, or the unpredictability of electricity supply by utilities. The World Bank Enterprise Surveys show that unreliable power is one of the biggest obstacles for African firms. On average, African firms face over 50 hours of power outage per month, equivalent to 25 lost days of economic activities per year (Oseni, 2019). Frequent power blackouts, and constraints to insuring against blackouts such as by investing in private generators, can deter firm entry and dynamism, dampening profitability, competitiveness, and job creation (Colmer et al, 2024; Fried & Lagakos, 2023; Mensah, 2024).

Berha and Khemani (2025) use the recently compiled UPBEAT database, which covers most utilities in SSA and an expanding number of utilities in other developing countries (Balabanyan et al, 2021), to examine variation in utility performance. They find robust evidence that utilities in low-income countries, and in countries with weaker institutions (lower control of corruption), perform worse on indicators of reliability. The South Asia region stands out as having the most unreliable services, consistent with the literature cited in Section 1 that price subsidy policies in that region have resulted, in effect, in lack of reliable electricity. Reviewing the literature on what is known about how to improve utility performance, Berha and Khemani (2025) conclude that the fundamental drivers of performance are incentives among utility management and staff, with little rigorous evidence on policy regimes to strengthen these incentives to pursue good performance.

For example, Cisse (2025) shows that investing in a technology to more quickly identify outages significantly increased reliability in Senegal, and that the increase in willingness to pay for more reliable electricity made the internal rate of return on the investment over 30% for the utility. Such high returns suggest that utilities are under-investing in information about reliability

[27] In contrast, in the agriculture sector, TFP is very low in Africa due to lack of mechanization, irrigation and use of latest seeds and production technologies suited to agro-climatic conditions (Suri and Udry, 2022).

and subsequent improvements to reliability, but the cause of under-investment is not clear. One constraint could be lack of information – Cisse (2025) provides the first rigorous, causal evidence that willingness to pay increases meaningfully with marginal improvements in reliability, so it is possible that utilities are systematically under-valuing investments in reliability. More evidence of this kind is needed to inform utilities and enable viable investments in increasing reliability. At the same time, the evidence in Berha and Khemani (2025), that reliability is significantly worse in countries with low control of corruption, suggests that in many contexts the binding constraint might be the incentives of utility managers and staff to become informed and pursue performance improvements.

Utilities may also face incentives that work against improvements in reliability. If utilities have limited budgets and must meet mandates to expand energy access, they face stark trade-offs between increasing access and improving reliability. Put otherwise, even if a profit-maximizing utility would choose to improve reliability, many utilities may be implicitly or explicitly constrained from doing so due to national policies that prioritize access. McRae (2015) provides a model and evidence on how subsidies lead to weak incentives in utilities to deliver reliable electricity.

In summary, the fundamental challenge confronting policies on the supply-side is the problem of weak institutions in poor countries—low control of corruption and weak rule of law which inhibits the flow of capital, weakens utility performance incentives, and ability of governments to borrow to invest in cost-reducing electricity infrastructure. Furthermore, evidence from other regions, such as Latin America (e.g. McRae, 2015) and South Asia (e.g. Mahadevan, 2024), shows that tariff subsidy regimes weaken utility incentives and allow for political interference and capture, leading to both inefficiencies (e.g. power cuts, or lack of reliable electricity) and ineffectiveness in achieving equity objectives.

5. Analyzing the policy makers’ problem

The previous sections on the scope of policies on the demand and supply sides can be summarized as follows:

- Public spending on subsidies to households, utilities, and to private sector firms in the off-grid electricity market, such that households gain access and use electricity.

- Public spending on various other inputs to enable households and firms to make productive use of electricity to grow their incomes.
- Regulatory regimes to encourage adoption of renewable energy, which could be co-financed through carbon credits.
- Public investment spending on electricity infrastructure, to increase supply and lower costs (by investing in generating lower-cost electricity, such as utility-scale renewable energy in regional energy pools).
- Policies to attract private capital at a large scale, to finance between 60-90 percent of the infrastructure plans of governments, with financing needs estimated at USD20 billion each year.
- Policies of transboundary cooperation such as harmonizing tariffs and regulations to develop regional electricity markets.
- Policies to reform utilities to improve technical and financial performance.

With these policy instruments on the table, national governments are pursuing national electrification plans, using geospatial models to plan energy infrastructure investments (grid extension, mini-grids and off-grid solutions) based on a variety of geographic, demographic, economic and cost factors. The previous sections of this paper have shown that implementing these technical plans requires fiscal and institutional capacity to finance the infrastructure investments and attract private firms to be part of the solutions.[28] These fiscal and institutional challenges can be summarized as follows:

- Weak and insufficient state fiscal capacity to spend on subsidies to close a substantial affordability gap.
- Structural economic constraints in poor economies which prevent poor people from using electricity to grow out of poverty.
- High cost of capital and low sovereign credit ratings, inhibiting the financing of infrastructure investments to reduce costs and deliver reliable services.

[28] Institutions likely also matter in shaping the incentives and capacity of the national agencies which develop national electrification plans. Addressing that is outside the scope of this paper. However, the economics literature suggests that incentives in national institutions are likely to be shaped by the functioning of political markets (Acemoglu, 2006; Myerson, 2021; Besley et al, 2022; World Bank, 2016); and this section offers one idea for how to strengthen political incentives across government agencies by improving citizen engagement at the first level at which elections occur.

- Weak institutions (high real or perceived corruption and weak rule of law) as potential root factors underlying why capital does not flow, and governments are unable to borrow.
- Lack of sufficient knowledge on how to strengthen incentives of utility managers and staff to improve performance.

This section uses a public economics approach to examine how governments might pursue a mix of fiscal and institutional policies to overcome the challenges and effectively achieve the objective of access to affordable, reliable, sustainable, and modern electricity for all. The economic framework to examine this question is a constrained optimization problem—maximize access to affordable, reliable, sustainable and modern electricity, subject to a "budget" constraint. This budget constraint for the electrification problem has a public and a private component: the government budget constraint, or state fiscal capacity, to pay for the public financing of electricity infrastructure and for subsidies; and, private households' income, and firms' operating budget constraints to pay for the electricity they would consume. This approach leads to the following insights.

First, the fiscal budget constraint in the constrained optimization problem limits the extent to which subsidies can be used to achieve access objectives. If Africa is going to embark on a path of relying on subsidies, it would be worth examining the experience of South Asia in this regard. State fiscal capacity in Africa is among the lowest in the world,[29] constraining the ability of governments to use subsidies to achieve access objectives.

Second, structural economic constraints in places with deep-rooted poverty can prevent people from using electricity to grow their incomes, and firms from growing their business and creating jobs. Potential lessons from the experience of East Asia, particularly China, in achieving electrification by purposefully linking it to local economic growth strategies, could be explored.

Third, institutions of control of corruption and rule of law may be binding constraints to mobilize finance to invest in energizing Africa. There is a significant trade-off between policies to attract private capital and policies to close the affordability gap through price subsidies (Fay, Martimort and Straub, 2021). Energy sector policies could address this by using available ideas

[29] Forthcoming Policy Research Report on Domestic Revenue Mobilization.

from the accumulating evidence on the economics of institutions[30] to simultaneously create viable economic conditions for the private sector to enter and build state fiscal capacity to address affordability and equity concerns.

Using the lens of institutions as the fundamental binding constraint, the following 5-point mix of reforms that may strategically complement each other are proposed for examination and evaluation in specific country contexts:

1. **Hefty grants to local governments to pursue local economic growth strategies**. This idea draws upon lessons from the Chinese experience and adapts it to Africa's economic and institutional context. These grants can be used for (i) public spending on "last mile" problems of electrification, to directly contribute to electrification; (ii) endowing local governments with the fiscal capacity to serve as markets for private sector mini-grid/off-grid solutions; and (iii) providing the range of public services and institutions needed for local markets to flourish, enabling people to make productive use of electricity. Eventually, if we expect the economic returns from electrification to accrue in rising land values (as evidenced in the case of Brazil, examined by Lipscomb et al, 2013), local governments could contribute to paying for national electrification investments through local property taxation and reduce their reliance on grants.
2. **Interventions to strengthen local institutions of political contestation**. These interventions would be necessary complements to (1), addressing problems of weak political incentives and accountability, to effectively use grants to support local electrification and economic growth.[31] The role of local media, such as community radio in Africa, can be leveraged for public debate and deliberation leading to stronger incentives to deliver public goods (Fujiwara and Wantchekon, 2013; Bidwell et al, 2020; Keefer and Khemani, 2024). In addition to their role in strengthening incentives of local governments, these interventions may also address general problems across government institutions of corruption and lack of trust, which matter directly for financing electricity

[30] Stock-taking of the economics of institutions in World Bank (2016 and 2017) and its application to infrastructure in Estache (2016).

[31] For example, Caselli and Michaels (2013) provide evidence from Brazil that municipalities that received an oil windfall did not allocate the revenues sufficiently well to increase local incomes; they recommend greater attention to accountability interventions, such as audit disclosures using local media (Ferraz and Finan, 2008), to ensure that local revenues are used well.

infrastructure through capital markets and domestic revenue mobilization.[32] Interventions that lead to better delivery of public goods, and lower corruption at the lowest-level where executive governments are elected, and where the state interacts with citizens, could have spillover effects on political incentives up the chain of office (Myerson, 2022), addressing political obstacles to electrification more generally.

3. **Empowering utilities to pursue performance improvements**. Allowing tariffs to reflect costs, and insulating utility management from undue political influence, have been long recognized as a necessary part of improving utility performance. However, these policy goals of improving utility performance can be substantially at odds with the use of subsidies to achieve access goals. Available case studies of utility performance in Africa, and a body of evidence on the political economy of electricity subsidies in India, shows that subsidy policies are prone to political capture (Berha and Khemani, 2025). De-linking tariff and bill collection policies from policies to achieve access objectives may be necessary to effectively diminish political interference and empower utilities to improve performance. Such de-linking matters not only for the performance of publicly owned utilities but also for privatization reforms, as successful privatization depends upon regulatory independence and political credibility to allow private firms to run viable enterprises.
4. **Strengthening independent institutions to regulate the monopoly power of utilities**. The empowerment of utilities to improve performance needs to be complemented with strengthening regulatory institutions to monitor the incentives of utilities to reduce costs, improve efficiency, and deliver services at prices regarded as fair and reasonable.[33] Empowered yet regulated utilities could have the incentives to pursue a variety of innovations and technical solutions to reduce waste and build legitimacy of cost-recovering tariffs through communication to customers.

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[32] As cited earlier, Alfaro et al (2008) find that weak control of corruption explains why capital does not flow to poor countries. Reviewing a large literature on state fiscal capacity, Besley and Dray (2022) argue that governments need to build trust and legitimacy with their citizens in order to mobilize domestic revenues.

[33] If utilities are empowered to set tariffs to cover their costs, an immediate challenge arises of the risk of monopoly pricing by utilities and social protests against tariff hikes. Public suspicion of pricing by monopoly providers applies equally to the ability of states to privatize SOEs. For example, Martimort and Straub (2009) provide an analysis of public backlash against privatization.

5. **Use of grants to local governments to support poor and vulnerable households to access electricity**. This is the last piece of the reform mix to accompany tariff subsidy reforms, replacing tariff policies to achieve access and equity objectives. As tariffs are reformed to reflect costs, two challenges are likely to arise immediately: one, the affordability gap (as Section 3 documents high price elasticity among low-income households); and two, the legitimacy of tariffs, such that people actually comply with posted tariffs rather than taking to the streets in protest, not paying bills, or stealing electricity (low bill collection, high T&D losses). This brings us full circle to the first two areas of policy in this mix—grants to local governments and strengthening of accountability at the first mile of political contestation. Local governments could, potentially, use their grants to support poor and vulnerable households to close the affordability gap[34] and build legitimacy for tariffs and taxes as incomes rise.[35]

The above idea for a five-point mix of complementary reforms raises two questions: why local governments; and how would sufficiently large grants to them be financed to enable them to address the affordability gap, serve as markets for decentralized electrification, and encourage productive use of electricity?

Answers to the first question are to be found in a voluminous literature on the role of local elections in the African context (Casey, 2015; World Bank, 2016; Blimpo et al, 2022; Faguet and Pal, 2024; Devarajan and Khemani, 2022; Myerson, 2022, 2025). This literature documents evidence of widespread participation by citizens in local elections, not only as voters

[34] Basurto et al (2020) provide recent evidence from Malawi on the performance of decentralized spending on subsidies, finding that local leaders are able to allocate subsidies (agricultural inputs and food) in ways that reach the poor and vulnerable, while increasing local productive capacity. These results are obtained despite local leaders' incentives to target friends and family.

[35] The research on legitimacy of taxation (or voluntary compliance with tax policies) and on the legitimacy of tariffs (voluntary compliance with cost-reflective tariffs, rather than protests on the street) is nascent and qualitative but growing. The idea offered here to test and evaluate is whether grants to local governments to support poor households to access and make productive use of electricity helps build legitimacy of future taxation, and withdrawal of state support as incomes grow and people can afford to pay for the electricity they consume. For example, Kyle (2018) finds evidence in Indonesia that fuel subsidy reforms are more likely to be supported in local government areas with lower corruption. McCulloch et al (2021) asked more than 16,000 Nigerians: "In your opinion, do you think it would be a good thing if the government reduced the fuel subsidy (which would increase the fuel price)?" Almost 32 percent answered affirmatively that subsidy reform would be a good thing, even though it would raise prices. The paper indicates that the largest correlate of answering whether reform would be good is the respondent's perception about whether the government would use the savings from subsidy reform to improve public services.

but also as contenders for local political leadership. These forces of political engagement by citizens have the potential to be harnessed at local levels for economic development (World Bank, 2016). Applying this literature to the problem of electrification yields the idea of using local government grants to pursue Chinese-style local electrification and economic growth, adapted to the African institutional context of local politics.

Research and evidence are growing on how Chinese local governments invested in local infrastructure, spurred local entrepreneurship and established Township and Village Enterprises as engines of local growth (Ang, 2018a and 2018b; Dai et al, 2019; Munshi, 2024). The institutions and incentives which made Chinese local governments accountable for delivering infrastructure and growth have been regarded as age-old, developed over centuries, and difficult to transplant or replicate in contexts with completely different histories and socio-political institutions (Tsai, 2007a and 2007b; World Bank, 2016 and 2017; Ang, 2019). The question is whether SSA can successfully pursue a Chinese-style program of local electrification and economic growth in the context of its own institutions.

Unlike China, the institutions which shape incentives and performance of governments, both local and national, in SSA and in many other regions in the developing world are largely electoral (World Bank, 2016; Devarajan and Khemani, 2023). Electoral contestation shapes who gains access to positions of power to make decisions over policies and resource allocation, and their incentives. The afore cited body of research has established evidence that elections incentivize politicians at both local and national levels to provide public services, even in the context of developing countries with poor voters and practices of clientelism. Yet, because of weak institutions to control corruption and enforce laws, electoral institutions have yielded disappointing results (Ferraz and Finan, 2025). Current events of youth taking to the streets across Africa, popularized by the hashtag “end bad governance,” are a reflection of this disappointment and people’s lack of trust in government leaders. Such demonstrated lack of trust, in turn, jeopardizes the credibility of national policy regimes for tariffs and taxation to attract private capital and invest in large-scale electrification needed for economic growth.

One idea to try to break out of a vicious cycle of clientelism and corruption, which fuels distrust and makes reforms difficult, leading to continuing opportunities for clientelism and corruption, is increasing the fiscal and technical capacity of locally elected executive governments to deliver concrete results on local economic growth through electrification. A strand of research on the role of decentralization has highlighted the potential of local government to contribute to building institutions of accountability and overcoming clientelism, because of greater information, scope for citizen engagement, and reputation-building for good performance at local levels (Bardhan and Mookherjee, 2006; Casey, 2015; Faguet and Pal, 2024; Myerson, 2022, 2025). Equipping locally elected governments with meaningful public resources, including access to expert advice on how to leverage scarce resources for maximal impact, such as through electrification, may help build accountability and trust by enabling local leaders to deliver concrete results. Prior evidence suggests that local deliberation over public policies could build trust in government (Fujiwara and Wantchekon, 2013). Greater trust in government, in turn, can build the legitimacy of nation-wide policies of tariffs and taxation for citizens to contribute to government, especially as incomes rise (Besley, 2020; Acemoglu et al, 2020; Besley and Dray, 2022). Legitimacy of raising tax revenues as incomes rise is important for electrification, because without it countries cannot borrow against future income growth to invest in the infrastructure needed to energize that growth.

The rationale for local government reforms is *not* about decentralization of infrastructure provision *per se*. Instead, the rationale is to decentralize *some* public spending to support access by poor and vulnerable households (in lieu of electricity subsidies), promote productive use of electricity which may vary widely by location, and build institutions from the bottom-up (strengthening the control of corruption, ensuring political stability, trust and legitimacy of public policies). National institutions of planning infrastructure systems and structuring power markets[36] would be supported by grants to locally elected governments to address affordability, last mile electrification, productive use of electricity for local economic growth, and legitimacy of tariff and fiscal policies.

Answers to the second question, on fiscal space for grants to local government, are embedded within the proposed five-point mix: fiscal space freed-up from reforming subsidies and improving utility finances, and fiscal capacity built through strengthening local institutions. As reliable electricity becomes more available to spur business and employment growth, the tax

[36] There are also knowledge and data gaps confronting these national institutions of planning energy systems. Examining this has been outside the scope of this paper; but we highlight it in the conclusion section as an important area for future work.

base of the state is expected to expand, both through rise in incomes and through rise in urban land values to support property taxation (Lipscomb et al, 2013, provide some estimates of this in the Brazilian experience). Hidden in Ashraf, Glaeser, and Ponzetto (2016) is a case study of the history of New York City where water and sanitation infrastructure was financed (at least partly) through raising property taxes on landlords. Property taxes may be a crucial part of how governments can capture some of the economic returns from general-purpose infrastructure investments whose benefits are expected to accrue throughout the economy, in order to credibly service their debt and thus access capital markets. Local governments have historically been the jurisdiction with powers of property taxation. Mookherjee (2024) contrasts the experience of China with India, arguing that the ability of Chinese local governments to raise local taxes and access capital markets was key to infrastructure investments that fueled China's economic transformation. Balan et al (2022) provide recent evidence from an African context (the city of Kananga in the DRC) that decentralizing property tax collection to local leaders resulted in higher tax compliance.

Current policy dialog in Mission 300 and the Energy Compacts of African governments are centered on the need for long-term capital market borrowing, and development finance, to invest in developing regional energy pools and in within-country extension of the grid and off-grid solutions. Such financing is essential for long-lived transmission infrastructure within and across country boundaries to support utility-scale generation of low-cost renewable energy, diversifying electricity generation in regional energy pools. Investments in within-country and cross-country transmission grid infrastructure can enable entry of private capital for utility-scale renewable energy (using Africa's vast potential), which could drive down marginal costs, and thereby enable the cost-covering marginal price facing households to be lower (Gonzalez et al, 2023). Access to long-term capital would be supported by the five-point policy package discussed above, as utility and state creditworthiness improves through tariff reforms, fiscal capacity (ability to pay for borrowing by raising taxes from future income growth), and socio-political stability, trust and legitimacy.

While the need for utility reforms to improve technical and financial performance has long been on the table, the new idea offered here is how local government policies could complement utility reforms, make them more likely to succeed, and address other barriers to electrification. Can equipping local governments to play a role in electrification for local economic growth be a missing piece of the policy package to finally tackle electrification in Africa? The potential lies in informational advantages at the local level to provide complementary inputs tailored to conditions of the local economy to enable people to grow their incomes as they gain access to energy; to serve as viable markets for DRE firms to provide off-grid solutions; to raise revenues through local property taxation; and more generally, to address the political constraints to energy reforms and state fiscal capacity through communication and deliberation. Communication is not a soft or easy option; it interacts in complex ways with political institutions to achieve (or fail) the goals of reforms (World Bank, 2016). The idea of combining local government capacity building with communication, to serve the goals of electrifying local economic growth, may build institutions from the bottom up to solve a swath of national-level problems: attracting capital; raising financial viability of projects; raising state fiscal capacity to cover public spending needs and prevent debt crises.

6. Conclusion

A review of available evidence on the challenges facing policy makers in Africa to finance expanded electricity access, and implement their "Energy Compacts", has revealed large knowledge gaps. Using subsidies to expand access runs into the problem of state fiscal capacity to spend on subsidies. Attracting private capital to finance infrastructure investments, to reduce the costs of electricity and increase the reliability of supply, runs into the problem of economic viability of such investments in the context of weak institutions. There are few off-the-shelf solutions to address these fiscal and institutional constraints and build trust and legitimacy in society to implement the technical solutions on the table for Africa's electrification.

The ideas offered in this paper—of delinking subsidies, or public support to poor and vulnerable households, from tariffs; empowering utilities to improve performance and attract private investment; leveraging grants to local governments for last-mile electrification and productive use of electricity; and strengthening incentives of local governments to use their grants well and of utilities to deliver low-cost, reliable electricity—can be examined to address these knowledge gaps.

While this paper took as its point of departure the technical policy solutions already on the table, more data and knowledge are also needed to help governments with devising these technical solutions. For example, how should grid expansion be planned to manage the trade-offs between expanding access to electricity in areas where load density is relatively low (e.g., rural areas) versus strengthening it where there is greater demand? How can off-grid systems ease this trade-off and complement grid access? Planning for complementarities and balancing finance allocation between on-grid and off-grid solutions could make use of the institutional ideas offered in this paper. For example, could grants to local governments cover last-mile electrification for both on- and off-grid solutions by creating a decentralized market for off-grid firms to enter? Information and incentives in decentralized markets could be harnessed by national planners as they seek to build efficient, reliable and sustainable power systems.

Addressing these knowledge gaps does not mean that governments or international development practitioners "wait" for research; rather, that new evidence and data generation, policy experimentation and impact evaluation can be integrated into project design and implementation. The new ideas offered in this paper are geared toward helping technical policies and projects already on the table to be more likely to be successful and impactful, distilling insights from economics research on institutions and structural constraints to development. These ideas could be pursued in a "learning by doing" manner, that is, embedded in policy action, with scope for experimentation and impact evaluation. The evidence from the evaluations would be used to re-design what does not work and scale up what works. Such data and policy knowledge work would help reform leaders overcome the long-standing challenges of electrifying Africa's economic transformation.

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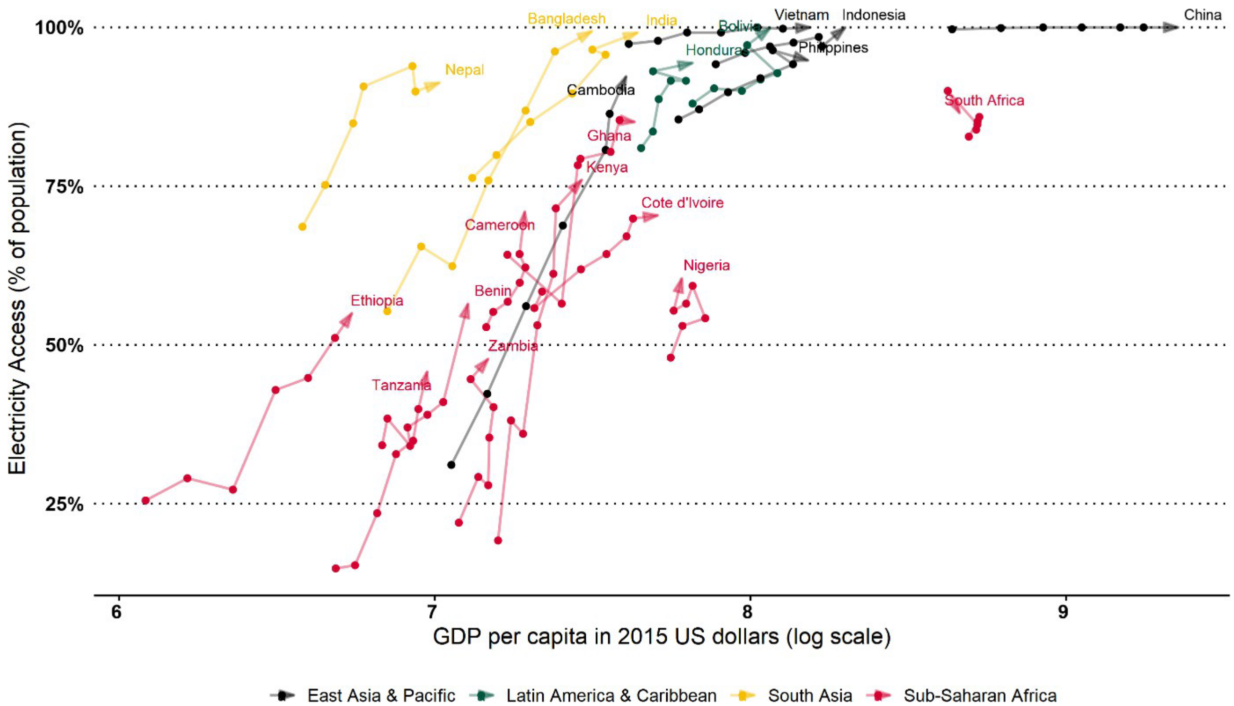
Figure 1: Electricity Access by per capita GDP (2022)

Notes: This figure displays the relationship between electricity access and GDP per capita across countries in year 2022. The bubbles are sized by population, while colors are coded by region. The sample is restricted to countries in four regions: East Asia & Pacific, South Asia, Latin America & Caribbean, and Sub-Saharan Africa. Data Source: International Energy Agency (IEA) and World Bank's World Development Indicators (WDI).

Figure 2: Co-evolution of electricity access and per capita GDP, 2010 → 2022



Notes: This figure displays long-term evolution of electricity access as income grows between 2010 and 2022 for selected countries. Each trajectory connects observations from every two-year interval, with the final arrow pointing to 2022. Lines are color-coded by region and labeled at their 2022 endpoints. The sample is restricted to countries in four regions: East Asia & Pacific, South Asia, Latin America & Caribbean, and Sub-Saharan Africa. Data Source: International Energy Agency (IEA) and World Bank's World Development Indicators (WDI).

Figure 3: Africa is an outlier on both electricity access and poverty, 2022

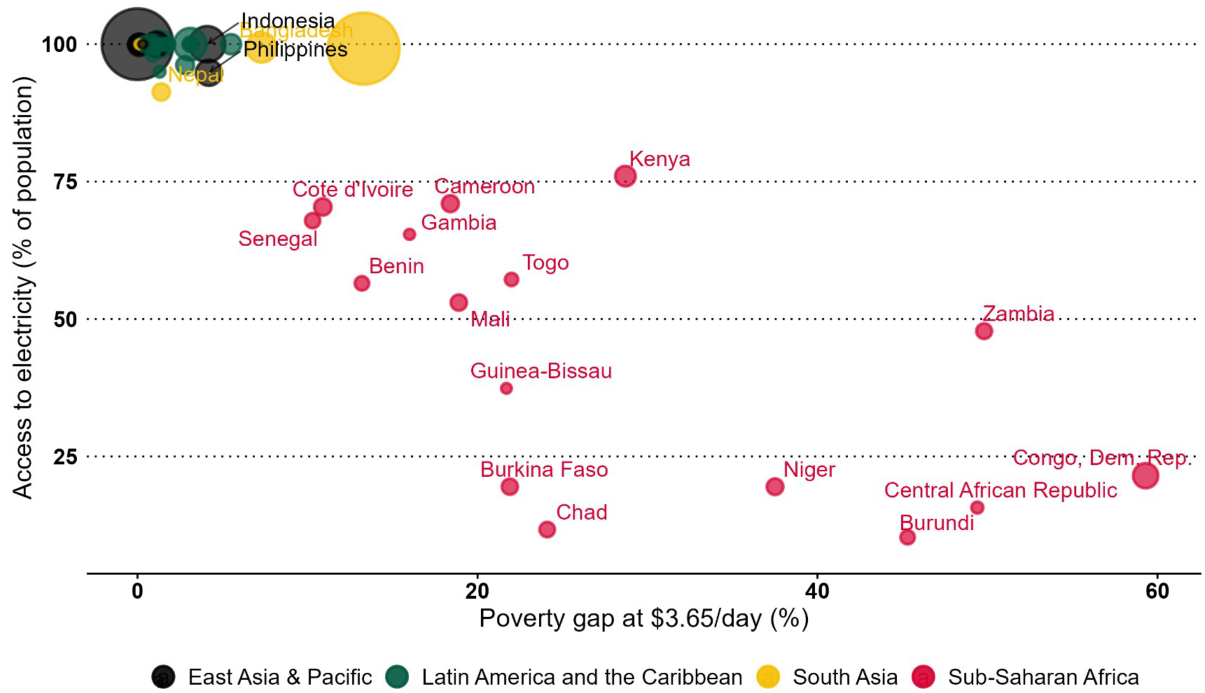
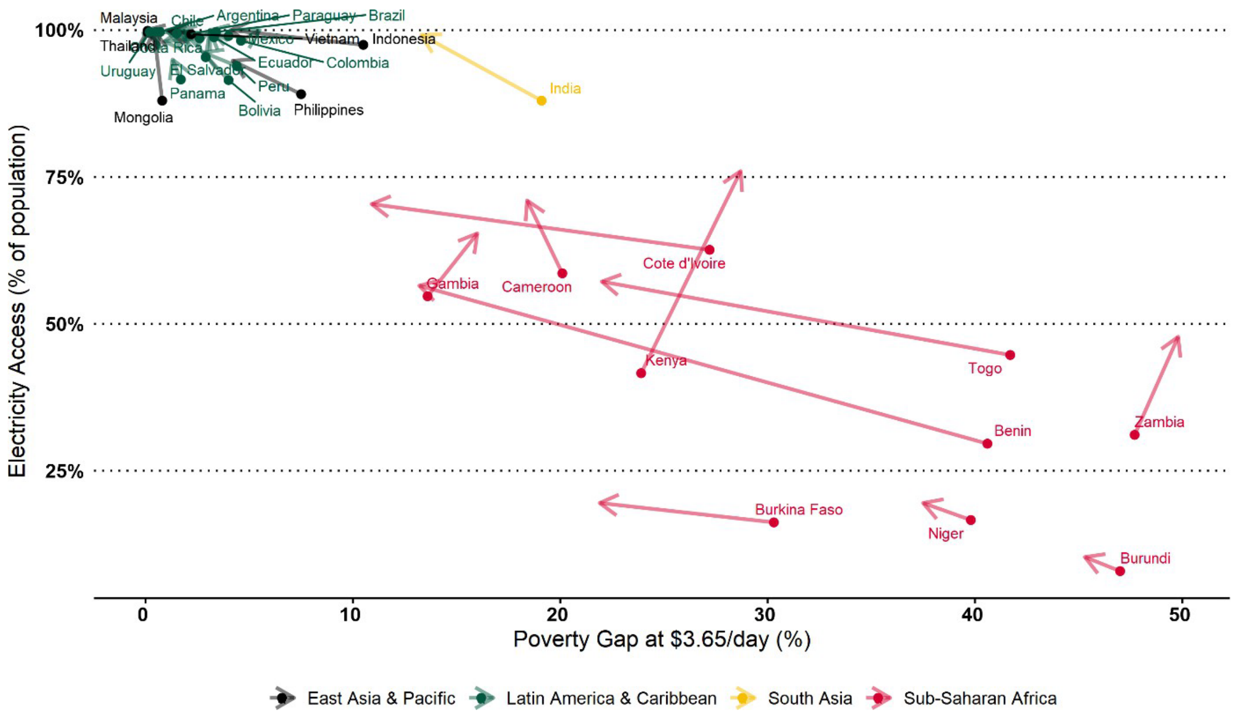
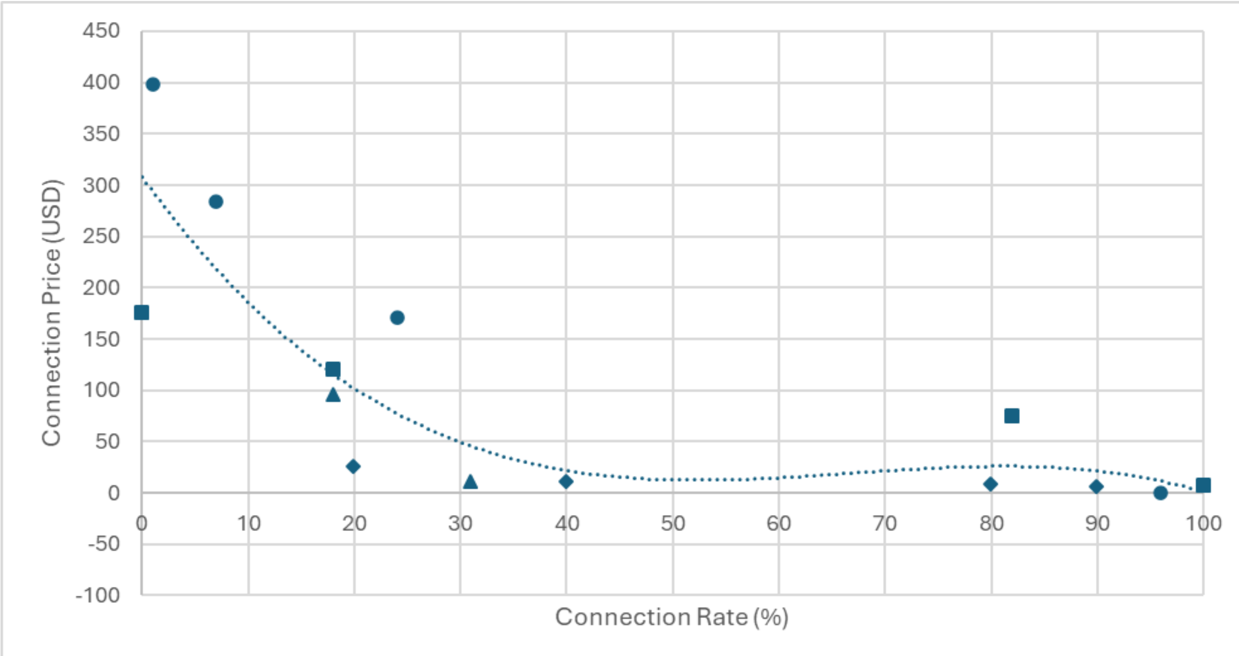


Figure 4: Co-evolution of electricity access and poverty, 2015 → 2022



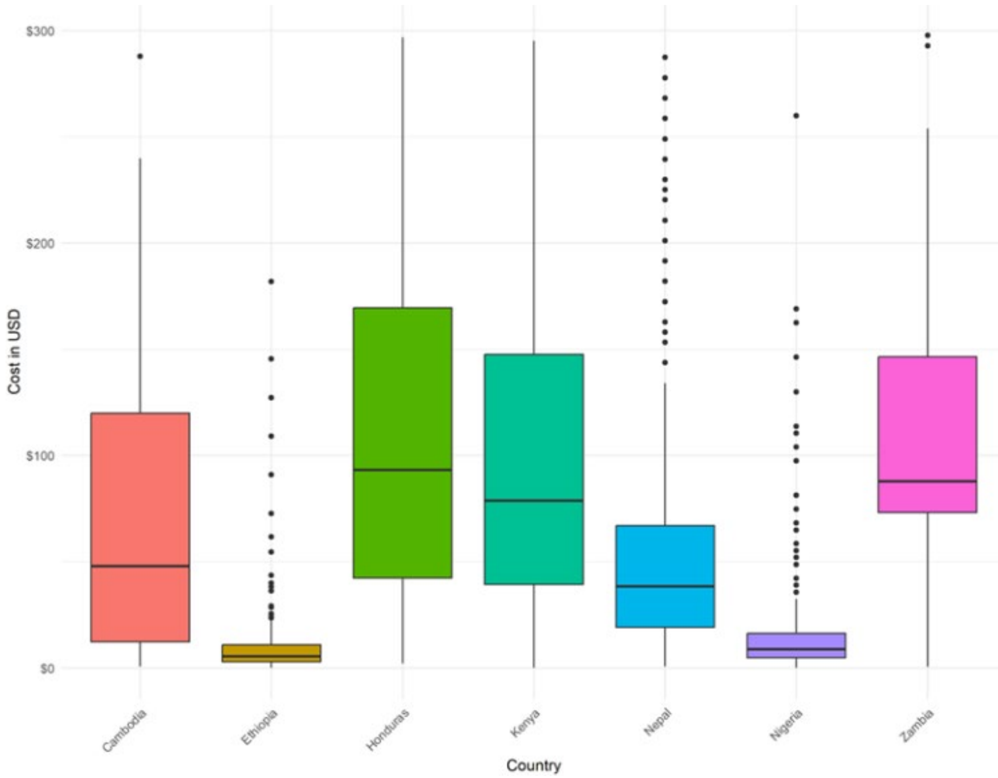
Notes: This figure plots the evolution of electricity access and poverty intensity across countries between 2015 and 2022. Each arrow represents the trajectory of a country, capturing changes in electricity access (vertical axis) and the poverty gap at $3.65 per day per person (2017 PPP) (horizontal axis). A leftward and upward arrow indicates a desirable dual outcome: increased access coupled with reduced poverty gap. The sample is restricted to countries in four regions: East Asia & Pacific, South Asia, Latin America & Caribbean, and Sub-Saharan Africa. Missing values are imputed using observations from preceding two years for both 2015 and 2022. For visual clarity, countries which have 100% electricity access in both period (e.g. China) are dropped. Data Source: International Energy Agency (IEA) and World Bank's World Development Indicators (WDI).

Figure 5: Electrification Rates at Randomly Varied Price Levels throughout Africa



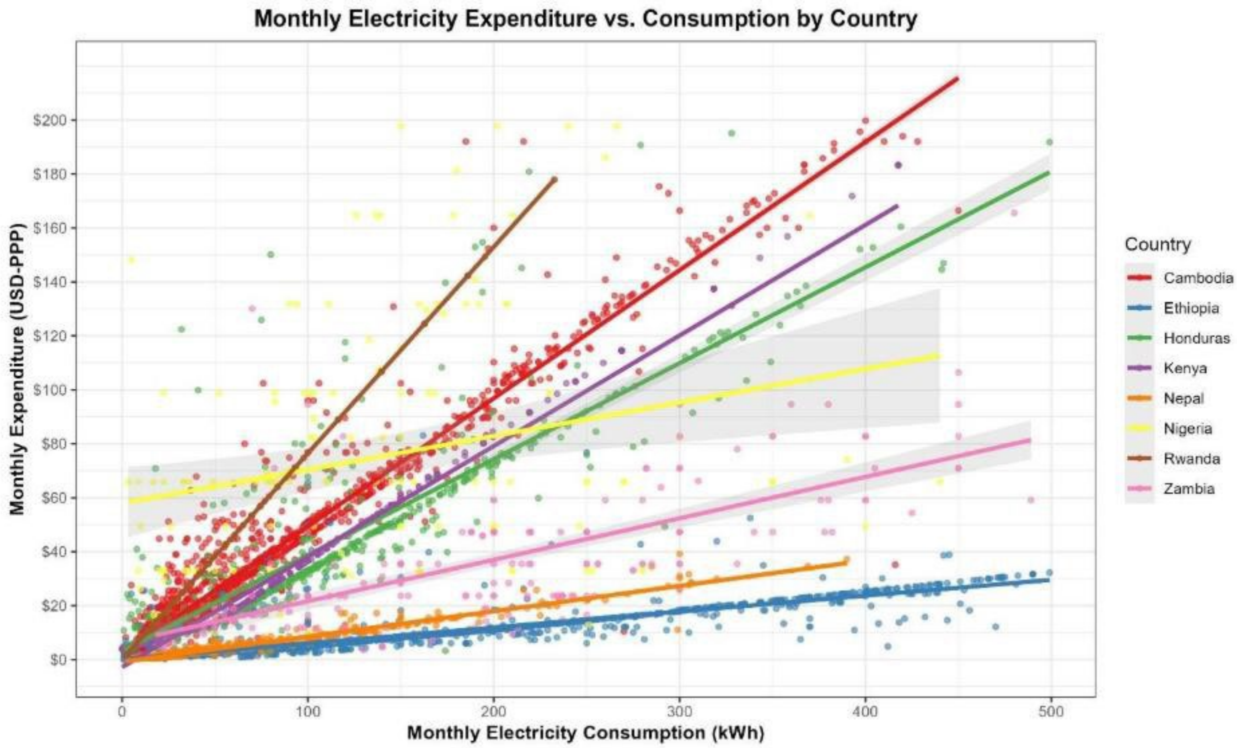
Notes: Estimated connection rates based on Lee et al (2020) in Kenya, Chaplin et al (2017) in Tanzania, Grimm et al (2020) in Rwanda, and Sievert and Steinbuks (2020) in Burkina Faso, Senegal, and Rwanda. The line shows a flexible third-order polynomial which approximates the demand curve suggested when combining the results of these studies. Round points are those from Lee et al (2020), triangular points are those from Chaplin et al (2017), square points are from Grimm et al (2020), and diamond points are those from Sievert and Steinbuks (2020). Note that points from Rwanda reflect willingness to pay outright for a solar home system with four lights and six charging ports. Points from Lee et al (2020), Chaplin et al (2017) reflect experimentally varied prices and corresponding electrification rates, while those from Grimm et al (2020) reflect the results of an incentivized Becker-DeGroot-Marschak elicitation. The non-subsidized connection price in Tanzania differs between rural and urban households, so we simply take the average. However, the higher price in Tanzania was likely insufficient to cover costs because the utility lowered the connection cost for all customers around the time of the study without any apparent change in costs. As such, it is not clear that the new "full" price level was sufficient to cover costs.

Figure 6: Distribution of Internal Wiring Costs



Notes: Data come from the World Bank's Multi-Tier Framework (MTF) survey, which provides nationally representative data on energy access at the household level. All MTF surveys represented in this figure were conducted between 2016 and 2018.

Figure 7: Electricity Expenditure vs. Consumption by Country



Notes: figure uses World Bank Multi-Tier Framework data.

Figure 8: **Index for borrowing from financial institutions** (Source: World Bank, 2025b)

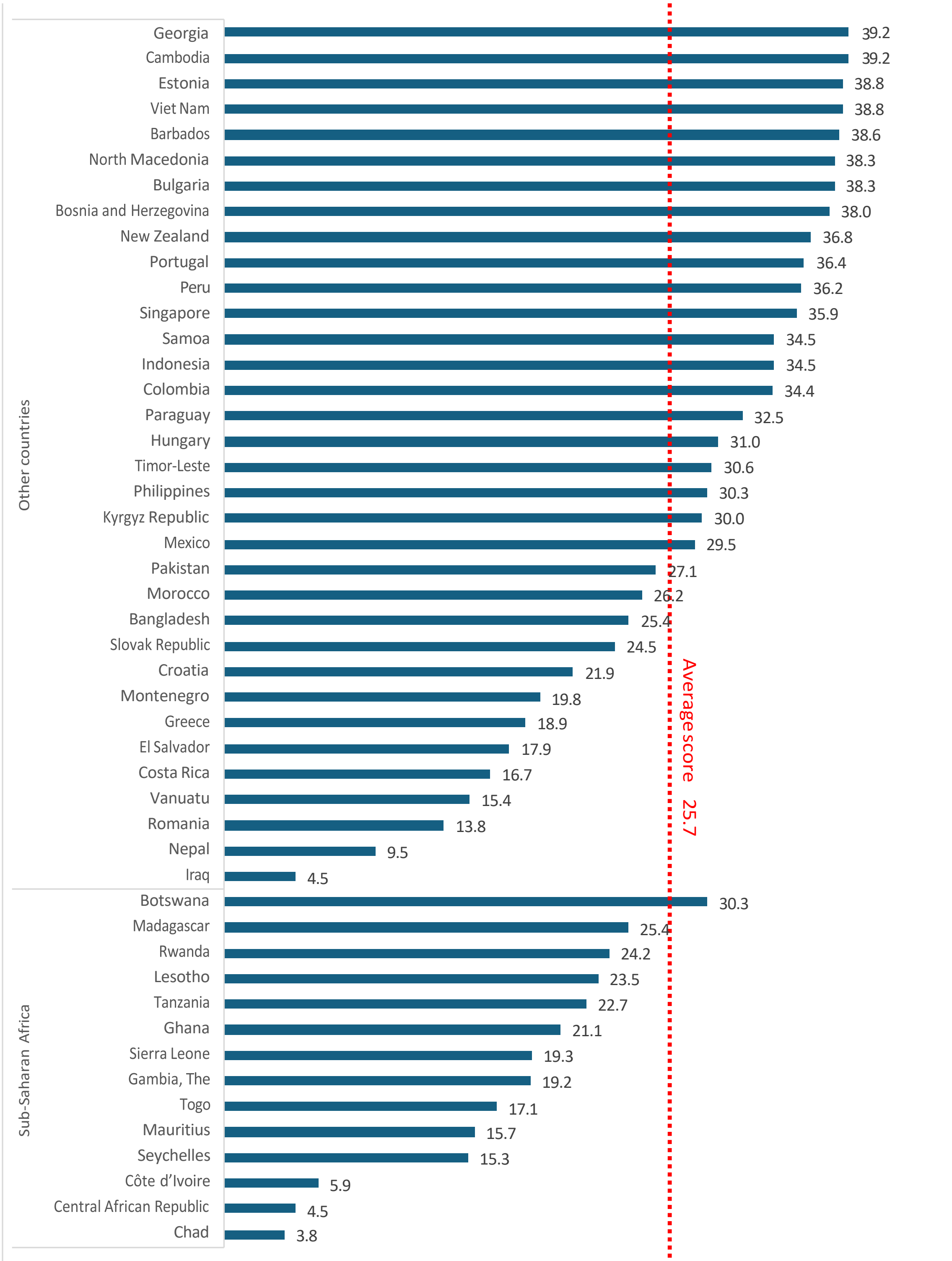
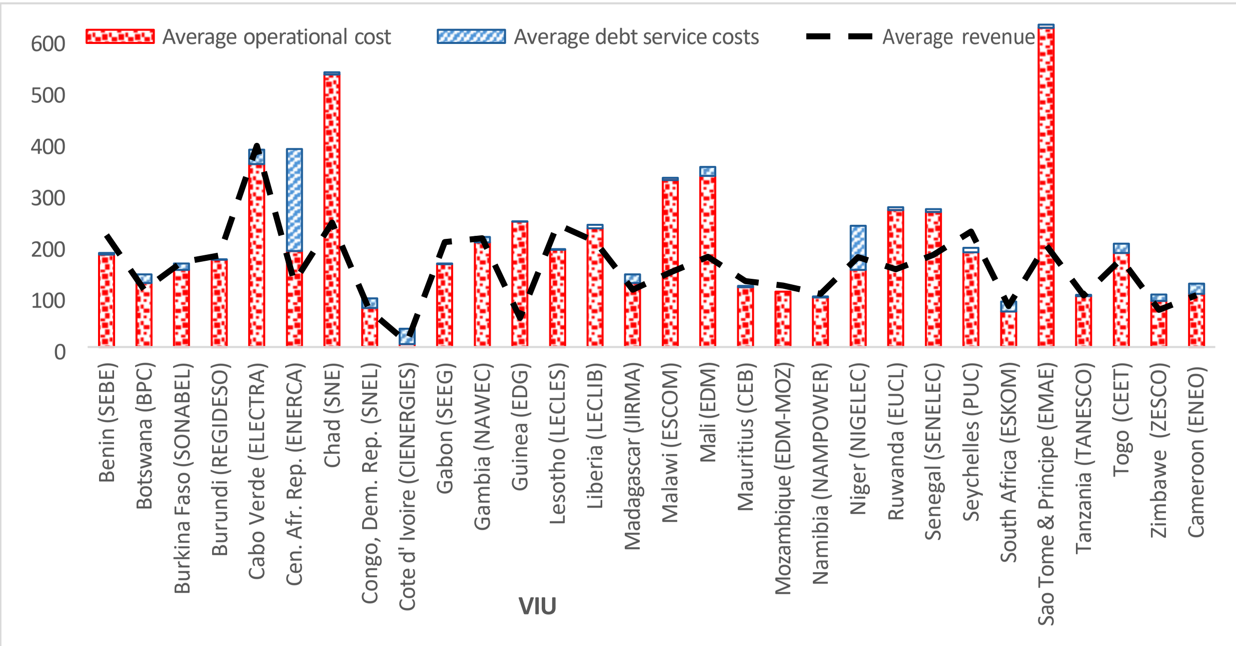


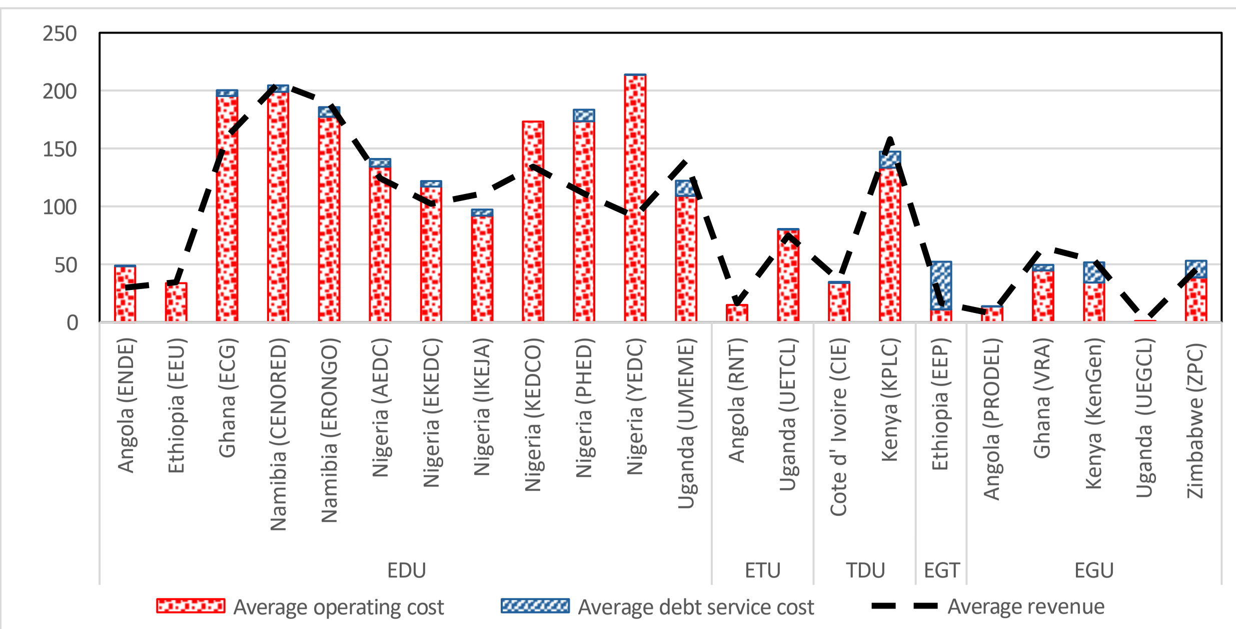
Table 1. S&P's sovereign long-term foreign credit ratings for SSA countries

Country	Rating	Date of Rating
Angola	B−	4-Feb-22
Benin	B+	20-Oct-23
Botswana	BBB+	17-Sep-21
Burkina Faso	CCC+	26-Jan-22
Cabo Verde	B−	19-Feb-21
Cameroon	CCC+	10-Aug-23
Côte d'Ivoire	BB−	6-Jul-21
Congo, Dem. Rep.	B−	28-Jan-22
Ethiopia	SD	15-Dec-23
Kenya	B−	2-Aug-24
Madagascar	B−	9-Oct-23
Mauritius	BBB−	21-Jul-23
Mozambique	CCC+	22-Nov-19
Nigeria	B−	4-Aug-23
Rwanda	B+	27-Jan-23
South Africa	BB−	8-Mar-23
Togo	B	17-Mar-23
Uganda	B−	9-Dec-22

Source: Various sources compiled by Wikipedia.
https://en.wikipedia.org/wiki/List_of_countries_by_credit_rating

Figure 9: **Average operational costs and revenue of electric utilities in SSA region (US$/MWh)**





Source: World Bank (2025c)