Climate Compatible Growth

COP27 POLICY BRIEF SERIES

De-risking off-grid electrification finance and fostering standalone system deployment policies are key to achieving SDG7

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Summary

Providing more than 600 million people across sub-Saharan Africa with electricity by 2030 will require significant investments. Electrification models play a significant role in informing electricity access policy in many sub-Saharan African (SSA) countries. Current electrification models used for electrification planning in some SSA countries do not account for realistic financing conditions in their analysis. This shortcoming can lead to infeasible electrification outcomes and consequently poorly informed policy, particularly considering that the different technologies i.e., grid-extension mini-grids and standalone systems, face different risks. Failure to reflect these risks could slow down current electrification efforts. In this brief we discuss the importance of accounting for country and technology specific risks in electrification models and provide takeaways for policymakers intending to accelerate electricity access across sub-Saharan Africa.

Key Policy Recommendations

- For effective policymaking, **policymakers should account for realistic cost of capital in their electrification planning models**, otherwise they risk slowing down electricity access efforts.
- **Access to low-cost financing is key to increasing deployment of off-grid electrification in sub-Saharan Africa**. Policy levers targeting electrification finance are therefore promising tools.
- For policymakers intending to increase private sector financed mini-grid deployment, **developing targeted policy and financial de-risking measures that support private sector mini-grid development** is crucial.
- Accounting for realistic financing conditions, **standalone systems will likely play a larger role in electrifying sub-Saharan Africa than has previously been assumed**. A robust international policy that minimizes the need to adapt these systems to specific countries will be necessary.

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IMAGE: MICHAEL WILSON / UNSPLASH

Electrification models & financing condition shortcomings

Reaching the UN Sustainable Development Goal 7 (SDG7) on universal access to "modern, affordable, reliable and sustainable energy for all" by 2030 will require significant efforts by policymakers and financiers to enable energy technologies to be deployed. Renewably powered off-grid electrification Mini-grids (MGs) and Standalone systems (SASs) (powered primarily by solar PV plus batteries) are expected to contribute significantly to this goal. This is because they are able to reach previously inaccessible regions for technical and economic reasons. The International Energy Agency estimates that off-grid technologies will contribute to powering approximately two thirds of sub-Saharan Africa's unelectrified population by 2030 [1].

Integrated least-cost electrification models are currently playing a key role in informing electricity access policy decisions by governments and international organizations in sub-Saharan African countries, particularly with regard to technology choice. However current state-of-the-art models lack a realistic account of country and technology specific financing conditions (typically assuming a uniform financing cost of 8% [2–4]), and failing to differentiate between technologies [3, 5–6]. This has also observed in some national electrification plans (e.g., the Rwanda National Electrification Plan 2019 [7]). While financiers place emphasis on financing conditions to inform investments in electrification, policymakers do not reflect these factors in their policymaking tools. This can lead to poorly informed policies.

In this policy brief we highlight why this shortcoming in electrification modelling could dampen electricity access efforts in sub-Saharan Africa. This policy brief answers the question *"How does the cost of capital influence electrification modelling outcomes?"*.

Methodology

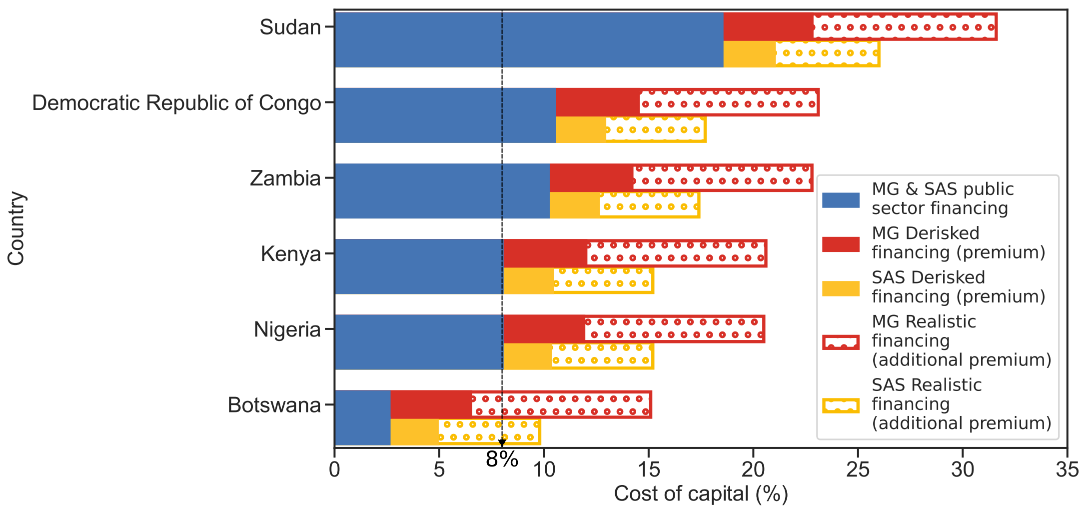

Figure 1: Figure showing the different cost of capital estimates for different financing scenarios (public, realistic, and de-risked financing) and different electrification technology options (grid extension, mini-grids, and standalone systems). The stacked bars reflect that additional premium to the public financing scenario.

As part of our analysis, we estimated country and technology specific cost of capital for grid-extension, MGs, and SASs based on different sources of finance for different countries across sub-Saharan Africa. We defined different financing scenarios representing the different sources of finance (public and private sector) and the additional risks and capital structures in the off-grid electricity sector:

- *Public financing* – where electrification is solely financed by public sector.
- *Realistic financing* - reflecting the current status quo in electrification financing (grid extension is financed by the public sector, MGs & SASs are still nascent and financed by private sector).
- *De-risked financing* – scenario where grid extension is still financed by the public sector and the off-grid electricity sector (still financed by private sector) matures (cost of capital of MGs and SASs decrease relative to the realistic financing scenario).

The cost of capital estimates were quantified and triangulated using empirical data and semi-structured interviews with experts in financing electrification in developing countries, including project developers, impact investors, and industry experts. We applied these cost of capital estimates to an open-source household electrification model (OnSSET) [3, 8] and observed electrification analysis outcomes between 2018 – 2030 (see original publication by Agutu *et al*. 2022 for further details and modelling assumptions [9]). Through the cost of capital, we were able to observe how country differences and technology specific risks (grid extension vs MGs vs SAS) influence least-cost electrification options. It is well understood that a uniform cost of capital is a crude assumption that is usually out of step with reality [10–11]. This research applied a much more realistic range of cost of capital estimates – which ranged from 9.8% to 32.2% – depending on the country and technology (see sample countries in **Figure 1**). These observed differences in the cost of capital are because the different technologies have different inherent characteristics and are financed differently: MGs are infrastructure-based technologies with long payback periods, which exposes them to the risks faced by low-carbon infrastructure based technologies in developing countries [12]. Some key risks include weak enabling policy environments, politicized decision-making and uncertain land/property rights regulations. Comparatively, SASs are more product-like with shorter payback periods [10]. The cost of capital for SASs would therefore be lower than MGs. Further, MGs and SASs are typically financed by the private sector while grid-extensions are typically financed by governments – whose country-specific risks differ across the continent.

Our estimates provide similar values to empirical real-world estimates (see Agutu et al. for further details [9]). The cost of capital is therefore a good metric for analysing how country and technology differences influence least-cost electrification plans.

> *“Cost of capital is a good metric for operationalizing risk”*

Limitations of analysis

We note that the approach used to develop the cost of capital estimates is a first approximation given the limited available financial data. Nevertheless, based on the triangulation approach of the analysis the estimates provide sensible initial estimates. Further, the model does not look at sub-national variations in the cost of capital which can vary significantly depending on the country. This analysis excludes Cape Verde, Comoros, Sao Tome & Principe, Mauritius, Ivory Coast, Sierra Leone, and Mali, for which country-specific GIS data was unavailable at the time of the development of this research. Finally, our analysis provides results assuming Tier 3 electricity demand around 365 kWh per household annually (as per the World Bank multi-tier framework [13]), which could also vary depending on the customer segment and region.

Conclusion and policy recommendations

INCREASING MINI-GRIDS DEPLOYMENT DEMANDS LOW-COST FINANCE

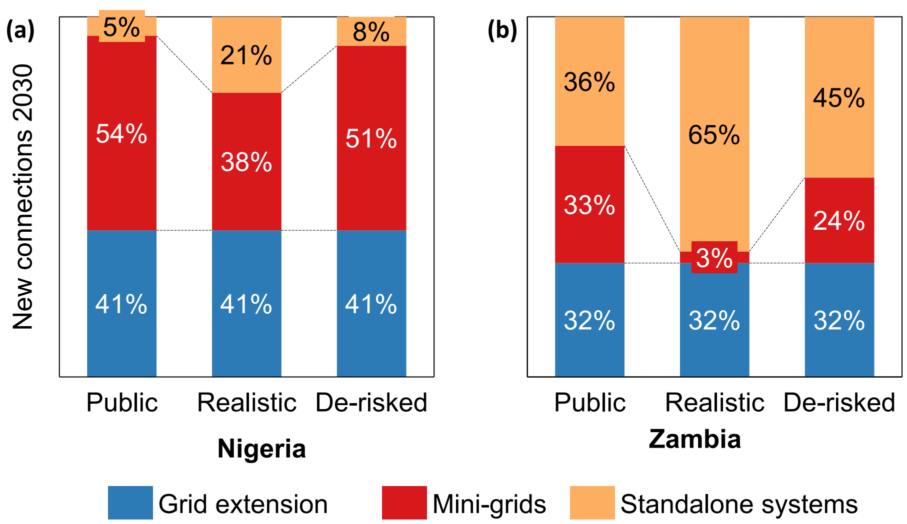

Figure 2: Newly connected populations by 2030 for different electrification technologies in Nigeria (a) and Zambia (b) for different financing scenarios

One key finding from our analysis was that high shares of MGs can only be achieved through low-cost finance. This can be done through public financing or through increased efforts towards de-risking the status quo (realistic) off-grid electrification sector financing conditions. **Figure 2** shows the shares of electrification technologies for different financing scenarios. Here we focus on results for Nigeria (high population density country) and Zambia (low population density country) to highlight how different country characteristics influence electrification technology choice. The shares of SASs decrease for both Nigeria and Zambia in public and de-risked scenarios when compared with realistic financing conditions. Further we see that at realistic financing conditions, for a country like Zambia – with low population densities – the absence of efforts to lower the cost of capital (Figure 2b), would mean that MGs would barely contribute to the country's electrification mix.

International organizations and Development Finance Institutions are aiming to increase MG deployment in sub-Saharan African countries in the coming years through initiatives such as the UNDP-led Africa Minigrids Program [14], the Africa Development Bank's Sustainable Energy Fund for Africa [15]. **In light of this, it is important that significant efforts are directed toward lowering the high cost of capital for MGs.** This can be done through financial de-risking efforts [16], such as provision of concessional debt[1], which is vital for private sector financed off-grid technologies. **For governments, policy de-risking measures that grant private sector companies compensation upon grid arrival will need to be put in place.** The measure addresses the risk of grid encroachment which is a key barrier to increased mini-grid deployment [16].

STANDALONE SYSTEMS (SASs) HAVE A LARGER ROLE TO PLAY IN ELECTRIFYING THE CONTINENT

Secondly, we observed that SASs will have a more significant role to play in electrifying sub-Saharan Africa than has previously been assumed. According to our analysis [9], the cost of capital is particularly important in high risk, low population density contexts where infrastructure-based systems (MGs) are in competition with product-based technologies (SASs). SASs are favoured over MGs in these contexts, mainly because of the higher costs of distribution infrastructure which makes MGs infeasible in these contexts, and the higher cost of capital for MGs.

Zooming into country-specific shares of standalone systems (see **Figure 3**), we see that the shares of SASs by 2030 would be significantly higher at realistic financing conditions than previously assumed (i.e., when uniform financing conditions were assumed across all countries and technologies). Densely populated countries like Nigeria (which account for the lion share of the current unelectrified population in sub-Saharan Africa [1]), show a 4 fold increase in the share of SASs than the previously assumed (Figure 3a) share, with approximately 33 million people (21%) being powered through SASs as opposed to the previously estimated share of 8 million (5%).

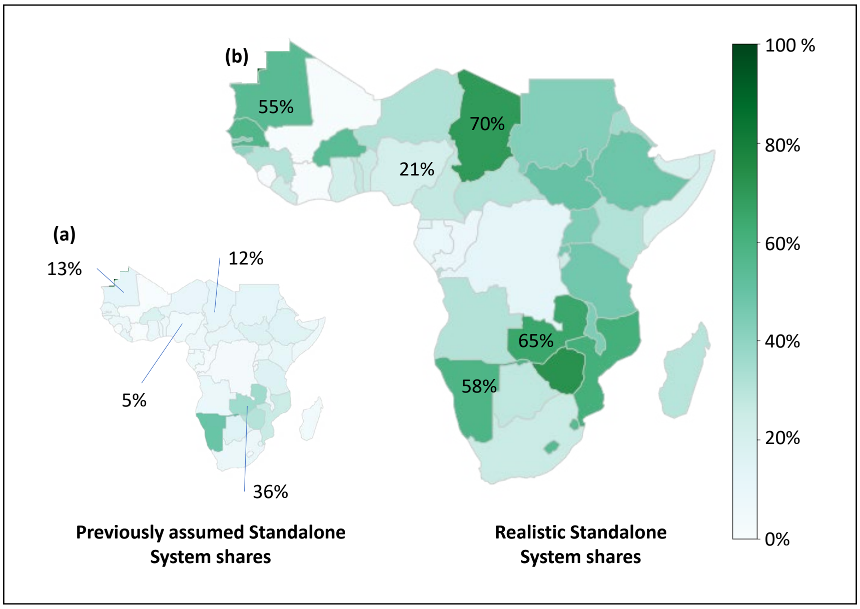

Figure 3: Estimated shares of standalone systems by 2030 for some countries in sub-Saharan Africa (a) based on previously assumed cost of capital estimates (8% across all countries and technologies) (b) based on realistic assumptions

[1] According to OECD concessional debt is extended loans with terms that are more generous than commercial loans. [21]

From a policy implementation perspective, financial de-risking efforts also need to be put in place for SASs (see previous point on MG) to lower their cost of capital. This is because SASs currently experience hurdles to increased deployment, particularly because of their high cost of capital [17] – 9.8–26% according to our estimates – while serving the lowest income customers. **One lever that could enable private sector SAS companies (key SAS energy service providers) to increase deployment, is incentivizing the adoption of a harmonized SAS standard.** Currently international SAS companies are expanding operations to new countries across the continent through acquisitions [18] or direct establishment in new countries [19]. The uptake of a harmonized global standard such as the World Bank Lighting Global standard [20] could ease deployment. Energy companies would be able to minimize costs through deploying the same technology to different contexts without having to redesign/adapt their technologies to different countries. They would therefore reduce technology transfer costs, especially when serving customers with typically low marginal returns.

> *"Standalone systems will have a more significant role to play in electrifying sub-Saharan Africa"*

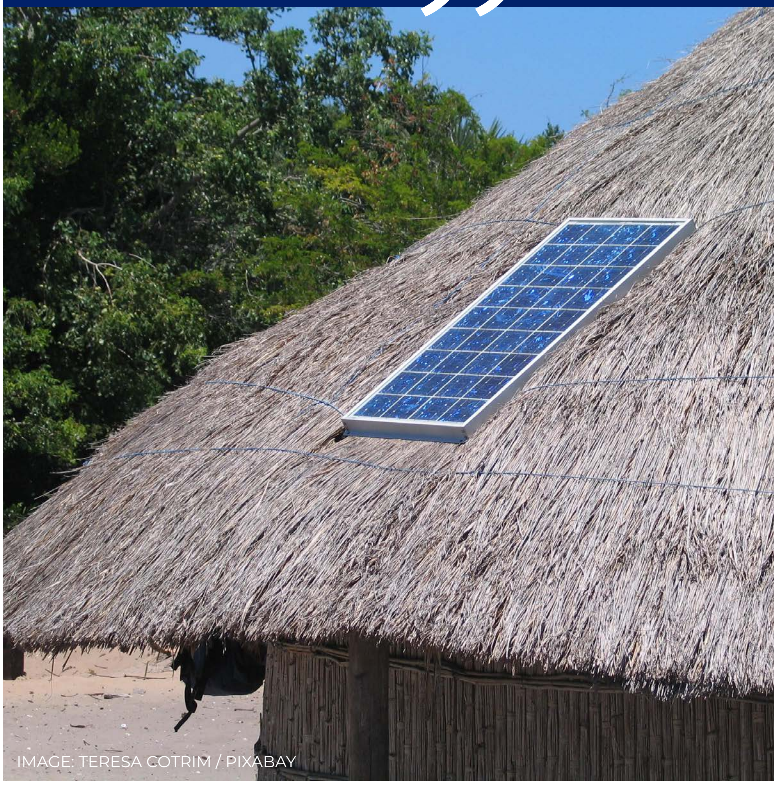

IMAGE: TERESA COTRIM / PIXABAY

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