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Structuring For The Last Mile

Financing The Next Era of African Electrification

Source: GEAPP

With support from: The Rockefeller Foundation

Part I: The Current Landscape

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Where we are, and what works

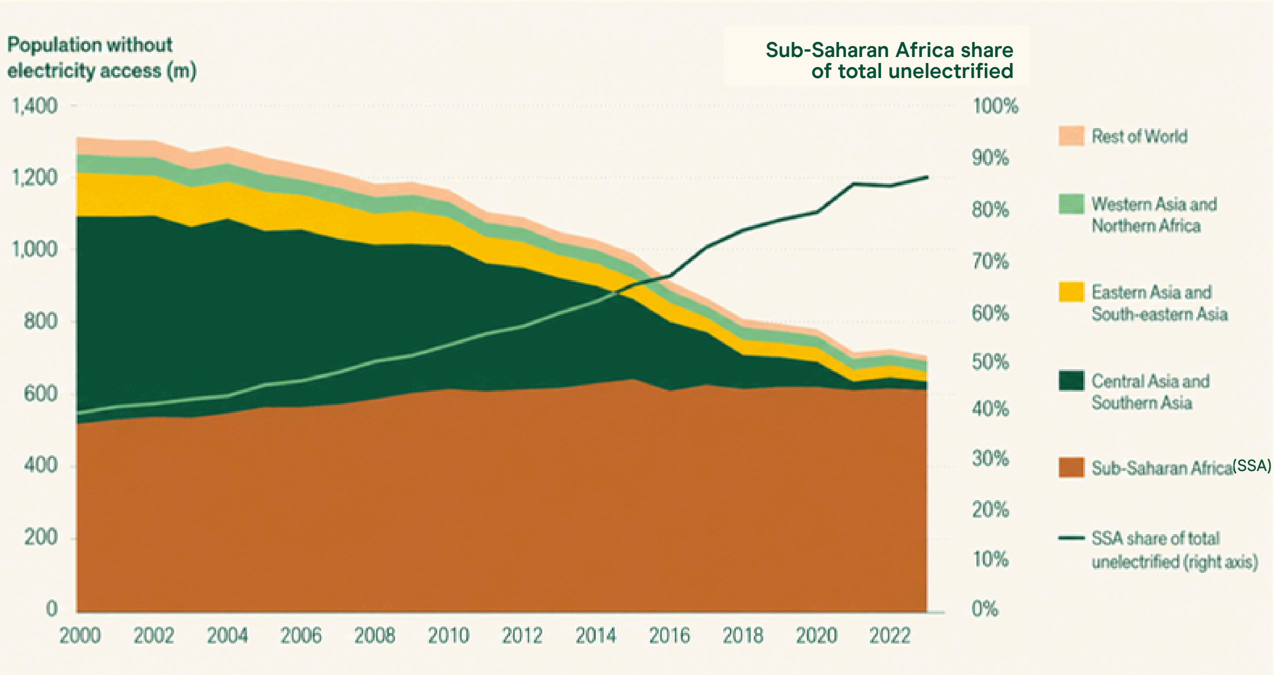
Since 2000, more than 2.5 billion people have gained access to electricity, and 93 percent of those gains occurred in low- and middle-income countries.[3] Progress has been most dramatic in Asia, where the number of countries with significant access gaps[4] has fallen from nearly 20 in 2000 to only a handful today; Latin America and the Caribbean show a similar pattern, with all but three countries now at or near universal access.

Though not easily won, these gains were delivered through government-led national electrification programs that combined integrated planning of generation, transmission and distribution, clear institutional mandates and substantial public investment. Utilities played a central role by coordinating system expansion and enabling cross-subsidies from higher-paying customers. This mean electrification could be treated as a sovereign-backed infrastructure mandate rather than a series of projects. This, in turn, created bankable sector conditions – including credible offtakers, cost-recovery frameworks and long-term planning – which enabled private capital to participate at scale through public-private partnerships, including independent power producer agreements. By underpinning revenues through cross-subsidies and sovereign support, governments reduced risk and provided the predictability required for long-term capital to flow.

Scale and urgency of the challenge in sub-Saharan Africa

While the world has made strides, sub-Saharan Africa is now the global epicenter of electricity poverty. In 2023, 565 million people in the region lacked electricity, representing 85 percent of the world's remaining access deficit.[5] System-wide conditions that require coordination and planning to make electrification investable are often missing.

Figure 1: Number of people without access to electricity by region; percentage of unelectrified in sub-Saharan Africa (SSA)



Source: *SDG 7 Tracking Database*

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[3] Catalyst Energy Advisors analysis based on data from 'SDG7 - The Energy Progress Report 2025' and UN DESA
[4] Defined as over five percent of the population remaining unserved
[5] ESMAP, Tracking SDG 7 Electricity Access Dataset (2025)

Progress has been held back by market fragmentation, limited government funds and a legacy of sovereign indebtedness that has constrained utility investment capacity, compounded in some contexts by conflict. With many utilities unable to access long-term capital on sustainable terms, development partners and private actors have in recent years focused investment on the expansion of distributed energy technologies, particularly as solar and battery costs fell. That market-led pathway is now reaching an affordability ceiling and fragmented efforts have not yet produced a clear route to universal access.

To confront the access deficit directly, The World Bank and African Development Bank, supported by partners such as The Rockefeller Foundation, Global Energy Alliance for People and Planet, and Sustainable Energy for All (SEforALL), launched Mission 300 with the objective of connecting 300 million people by 2030, while mobilizing $90 billion in public and private capital. To align delivery with these targets, Mission 300 uses national energy compacts, which are government-led frameworks that define national pathways for strengthening utilities, leveraging regional power pools and formally integrating distributed renewable energy. By consolidating fragmented development partner efforts into a single investment plan, the compact process is intended to create the structural conditions needed to attract significant capital. Each of these plans looks different: government finances, regulatory capacity, existing policies, population density and market maturity vary widely, shaping which interventions can succeed and at what scale.

Diverse national trajectories

Countries across sub-Saharan Africa have followed markedly different electrification paths over the past two decades, shaped by both structural conditions and institutional choices. Urbanization and income growth are the strongest statistical predictors of access gains, since denser, higher-income areas tend to have lower costs to serve and stronger utility revenue bases. Even after accounting for these factors, roughly 40 percent of cross-country variation remains unexplained,[6] which is where institutions, planning choices, regulatory environments, existing facilities and resources, and coordination between public and private actors become decisive.

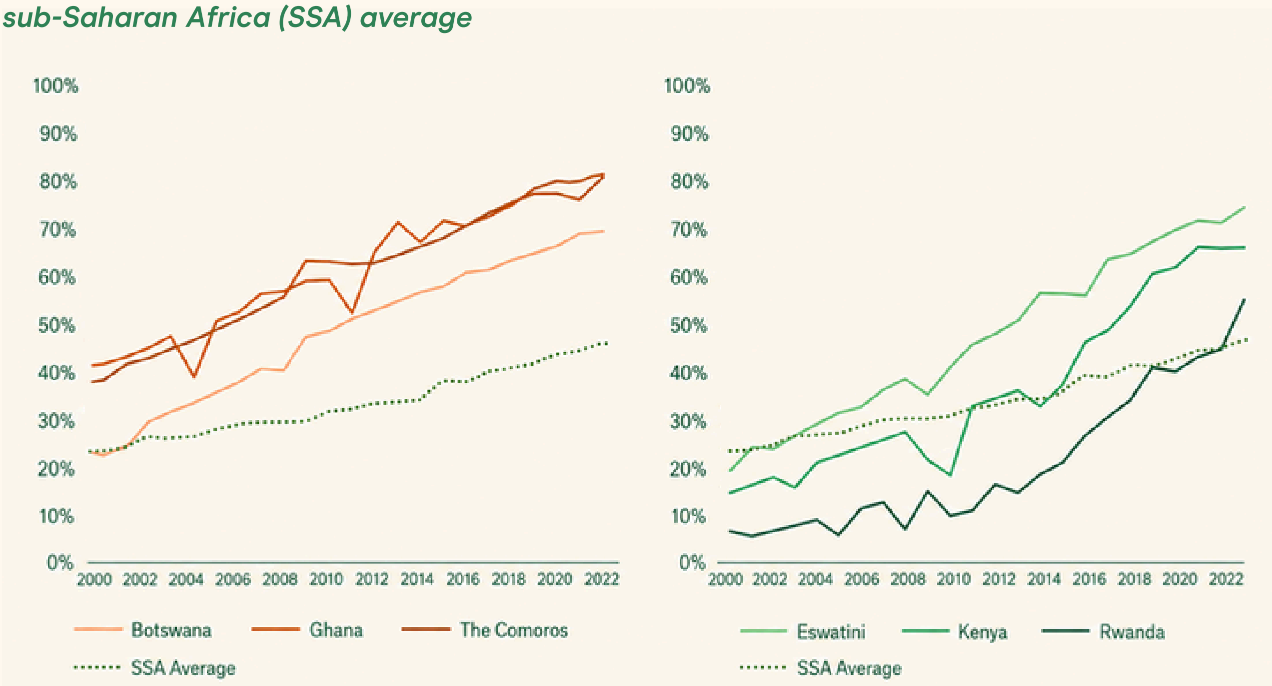
Viewed through this structural and institutional lens, two broad patterns emerge. A first group began the 2000s with relatively high electrification rates and has expanded steadily, typically at annualized rates of 3-4 percent. Ghana, the Comoros and Botswana illustrate this trajectory and are now approaching – or are within reach of – universal access, reflecting both favorable baseline conditions and institutions capable of sustaining execution over time.

A second group started from very low access but engineered rapid growth. Kenya, Eswatini and Rwanda stand out as countries that outpaced regional growth averages even after controlling for structural conditions. Their gains reflect deliberate national efforts to combine grid densification and expansion with decentralized solutions, mobilize development finance and create a stable environment for private-sector participation. In some cases, early surges have slowed in recent years, underscoring the need for sustained institutional commitment.

Source: GEAPP

[6] Catalyst Energy Advisors analysis based on World Bank urbanization, GDP, and access data.

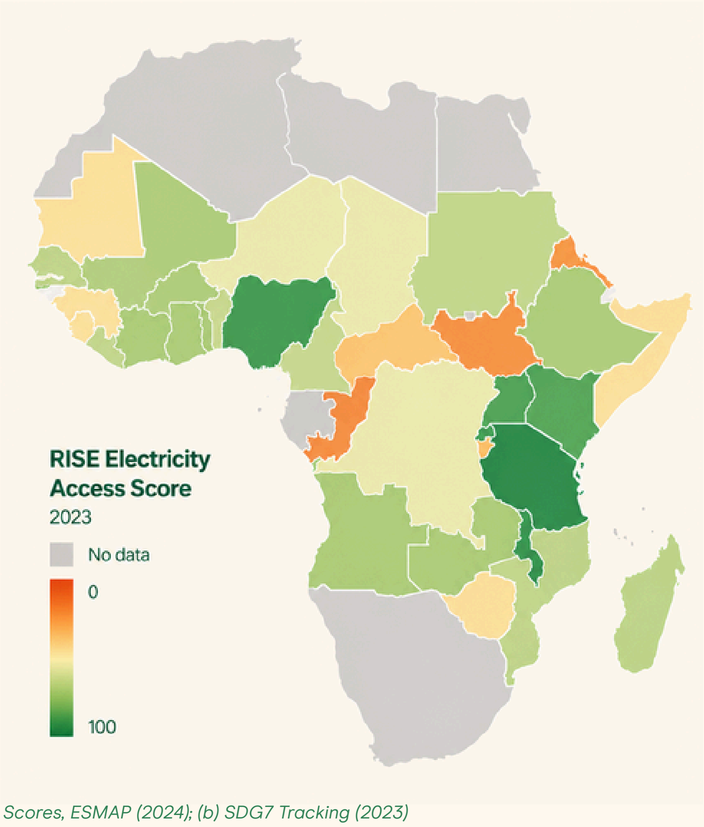
Figure 2: (a) Electrification rate evolution for Botswana, Ghana and the Comoros vs. sub-Saharan Africa average, (b) Electrification rate evolution for Rwanda, Eswatin, and Kenya vs. sub-Saharan Africa (SSA) average



Source: *SDG7 Electricity Access Database, ESMAP (2025)*

These divergent pathways are visible in The World Bank's Energy Sector Management Assistance Program (ESMAP) Regulatory Indicators for Sustainable Energy (RISE), which assess the strength of electrification policies and regulations. Higher-scoring countries tend to have clearer rules, well-defined institutional mandates and more predictable funding mechanisms. Still, RISE also reinforces that policy quality alone is not enough: progress depends on institutions that can execute and financing arrangements that fit country conditions.

Figure 3: Strength of a country's policies and regulations supporting universal electricity access



Source: *RISE – Electricity Access Scores, ESMAP (2024); (b) SDG7 Tracking (2023)*

Enabling approaches observed across successful electrification efforts

Across these varied country experiences, a set of enabling approaches appears repeatedly as contributors to accelerated progress. These include:

Investments in generation and transmission capacity

- Large-scale investment in generation and transmission has often preceded and enabled later electrification gains, and it remains important: without adequate supply, networks cannot expand and consumption cannot grow.

- But supply is increasingly not where the constraint binds. Capacity is upstream of the things that determine access: a network to carry power to households, tariffs those households can afford, and utilities solvent enough to connect and serve them. East Africa illustrates the gap directly. Large public investments in hydropower and geothermal generation expanded supply faster than networks and demand could absorb it. In Ethiopia, Uganda and Kenya, periods of suppressed demand have reflected downstream constraints in networks, affordability and consumption, rather than a lack of generation.

- The implication is that, even where supply has been secured, the increasingly binding challenge lies in distribution: reaching dispersed, lower-consumption households at a cost they and their utilities can sustain. That is the terrain where distributed renewables become most relevant, and the focus of much of this paper.

Use of public budgets and targeted subsidies for distribution grid expansion

- Countries that have made rapid electrification progress have relied on publicly-led programs that combine public budgets, concessional finance and targeted subsidies on connection costs to extend access. A common feature across these approaches is the explicit socialization of capital costs, decoupling access from a household's ability to pay at the point of connection.

- In Rwanda, social-category targeting through the Ubudehe classification system has enabled the state to fully subsidize connection materials for the poorest households, ensuring that access expansion is not constrained by income at the household level. In Tanzania, rural grid expansion has been financed through capital subsidies covering an estimated 85-90 percent of connection costs, with remaining costs absorbed through public funding and utility balance sheets. The Tanzania Rural Electrification Expansion Program (TREEP) has delivered rapid access gains, providing electricity to more than 4.5 million people, exceeding its original target of 2.5 million, and connecting over 1,600 health facilities and nearly 6,000 education facilities.[7]

- Similarly, Kenya's Last Mile Connectivity Programme (LMCP) combined donor-supported public finance with utility-led rollout and cross-subsidization within the national grid, allowing connection costs to be spread across existing consumers and public resources rather than borne by new low-income households. LMCP-connected households were 37 percentage points more likely to use electricity than comparable households outside the program. Some 96 percent of the cohort used electricity primarily for lighting, with secondary uses limited to phone charging and basic entertainment, reaching levels of demand that a standalone solar system could have met in many cases. The subsidy was decisive in overcoming the cost barrier, but much of the demand it unlocked did not require a grid connection to serve. The lesson is not that targeted subsidies fail, but that their value depends on matching the subsidy to the least-cost technology for the demand that exists. Gains in connection volumes do not automatically translate into higher electricity consumption or broader economic transformation.

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[7] World Bank, Changing Lives and Livelihoods in Tanzania, One Electricity Connection at a Time (2022)

Beyond these enabling factors, success depends on stronger regulatory frameworks that give private operators certainty, credible investment plans based on least-cost planning that can mobilize development finance and, in distributed renewable energy markets, standards and licensing reforms that professionalize the sector.

Where progress has stalled, the constraint is often the absence of an integrated framework that aligns tariff and subsidy policy with investment priorities, planning and execution. Without this coordination, public utilities and private operators struggle to regain creditworthiness, development partners operate through unconnected projects, and private actors face shifting rules. The lesson is that structural conditions shape the starting point, but coordinated, sequenced and well-resourced institutional action determines how rapidly connections can scale.

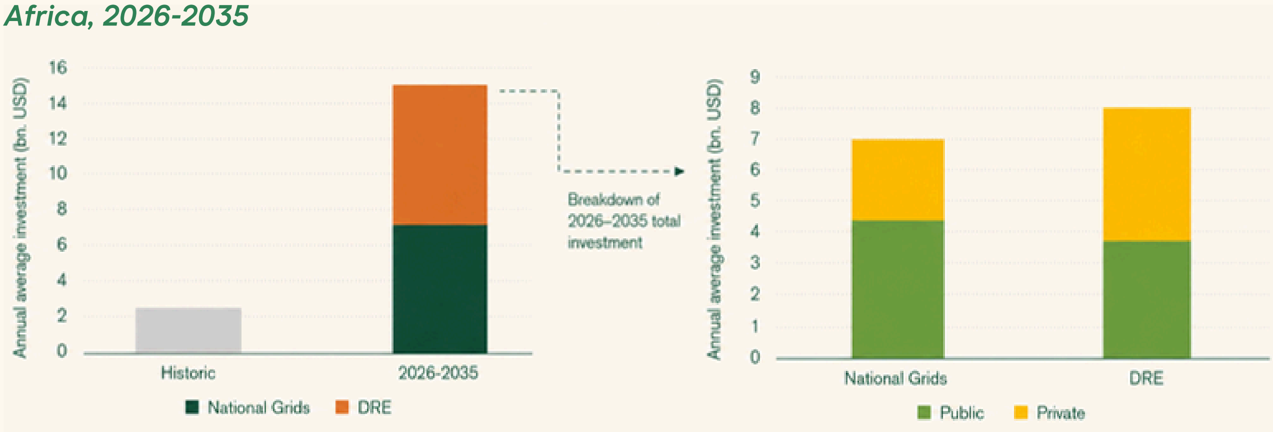
For most of the region, however, this kind of coordinated, sustained institutional action remains the exception rather than the rule. The aggregate picture is one of a delivery system under strain across all its modalities, with progress slowing, customers still without durable service, delivery still fragmented and capital pulling back. The four sections that follow examine why.

Falling behind, not catching up

As it stands, demography is outrunning electrification. Over the last decade, sub-Saharan Africa has connected roughly 27 million people per year,[8] while the UN projects population growth of about 32 million annually over the next decade.[9] Even maintaining recent performance would therefore widen the absolute access gap, which underpins the International Energy Agency (IEA) assessment that universal access cannot be achieved before 2035, and makes the original 2030 Sustainable Development Goal (SDG) target unattainable.

Capital flows tell the same story. The IEA projects that achieving universal access in sub-Saharan Africa by 2035 will require an average of $15 billion per year, yet commitments in 2023 amounted to less than $2.5 billion.[10]

Figure 4: Annual average investment needed by technology and by provider in sub-Saharan Africa, 2026-2035



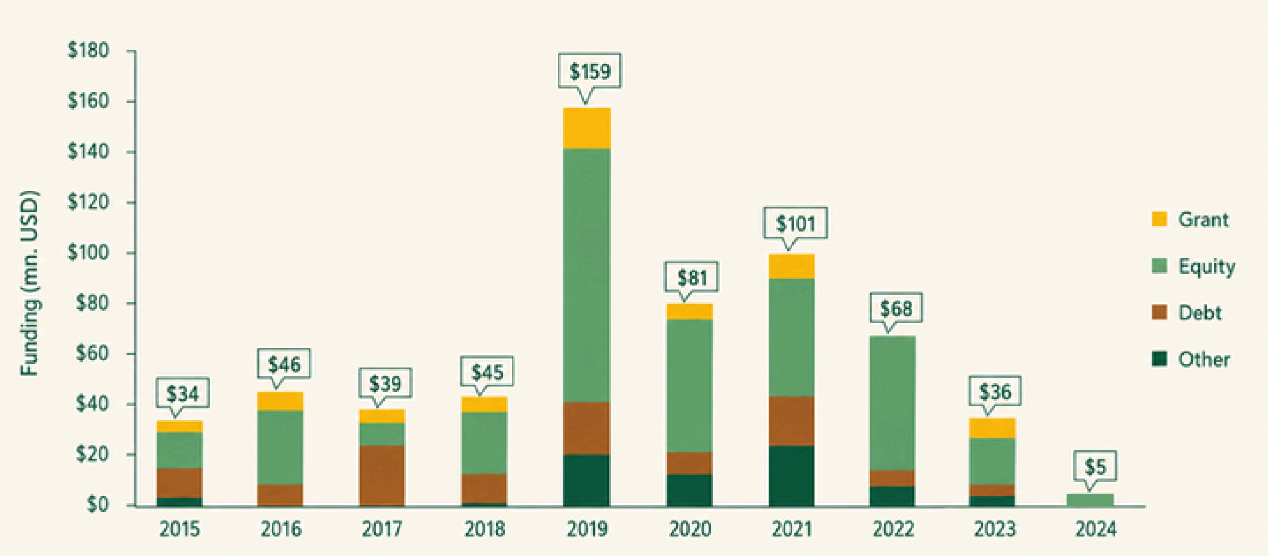
__Note:__ Right chart shows the breakdown of the 2026-2035 total investment by source and investor type. Figures are based on IEA's Accelerating Clean Cooking and Electricity Services Scenario (ACCESS), which aims to close the electricity access gap by 2035 and achieve universal clean cooking access by 2040. Power generation investment needs for national grids are not included in the totals.

__Source:__ Financing Electricity Access in Africa, IEA (2025)

Even the capital that has supported the sector's growth to date is pulling back. Isolated grid[1] funding has declined significantly over the past few years and off-grid company funding has fallen for the last two consecutive years, ending 2024 at its lowest point since 2015.

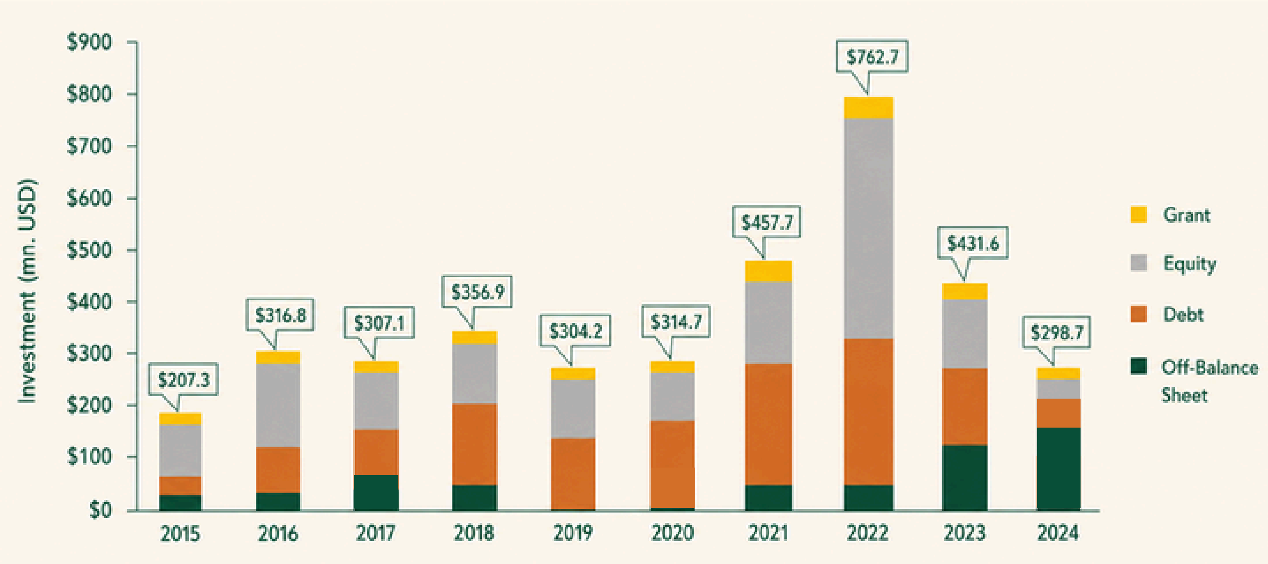
[8] ESMAP, Tracking SDG 7 Electricity Access Dataset (2025)
[9] UN DESA, Population & Demographic Indicators (2024)
[10] IEA, Financing Electricity Access in Africa (2025)
[11] Including standalone mini-grids and metro-grids

Figure 5: Isolated grid funding trends



Source: *Benchmarking Africa's Minigrids Report, AMDA (2024)*

Figure 6: Standalone solar company funding trends



Source: *GOGLA*

Mission 300 is the sector's most ambitious response to this trajectory. Its targets imply an acceleration of historic electrification rates that can inadvertently prioritize rapid, visible connection gains. It will be necessary to strengthen the frameworks that ensure affordability, reliability, cost recovery and long-term system sustainability so that this pressure delivers durable, investable electricity systems rather than temporary, low-quality connections.

The next customers are structurally different

Households still without durable service tend to live in remote, lower density or agricultural areas and earn less than the cohorts connected before them. Roughly 82 percent of the region's off-grid population is rural.[12]

[12] ESMAP, Tracking SDG 7 Electricity Access Dataset (2025). The urban-rural split is a simplification, and recent research suggests that many unelectrified people are within an hour of an urban agglomeration (Jessica Kersey, Samuel Miles, Vivek Sakhrani, Bryan Bonsuk Koo, Setu Peltz. A geospatial perspective on electrification strategy in urbanizing Africa. Applied Geography, Volume 180, 2025). However, these populations still have low incomes, and poor infrastructure makes them hard to serve.

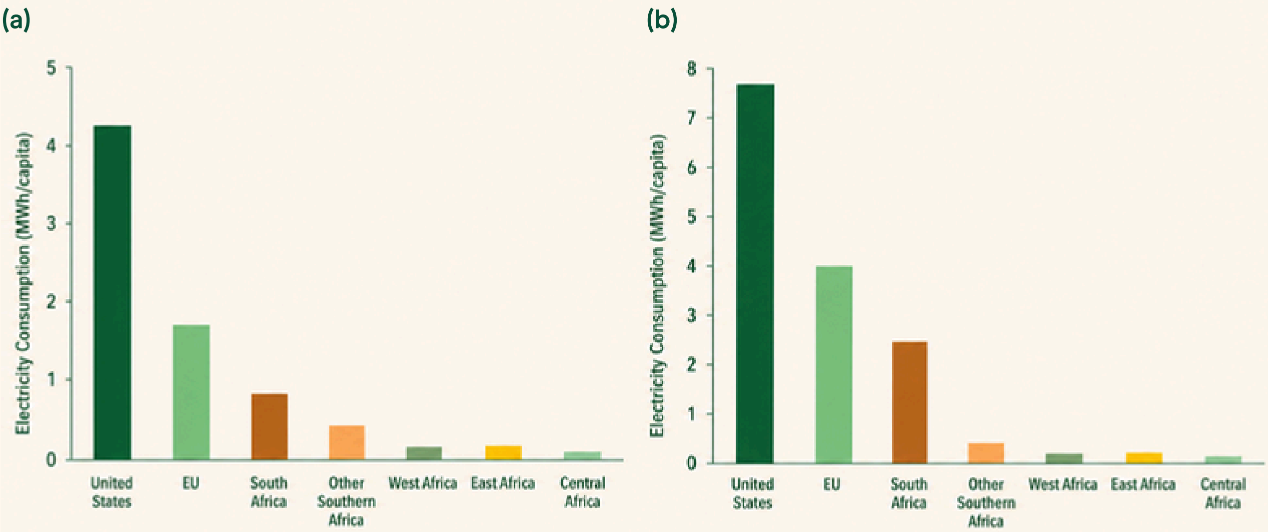
Millions of these households were in fact connected at some point, only to see that connectivity functionally disappear. This was often a result of grid connections that became too unreliable or too costly to use, solar home systems that are no longer operational (due to customer payment defaults or unresolved technical issues) or isolated grids whose operators have failed to sustain service delivery.

The defining barrier across all of these pathways is affordability. There is a significant gap between the cost of delivering power and the ability of households to pay for it, with families unable to afford connection fees, ongoing payments, or both.

Grid investment does not automatically translate into higher access rates: high up-front connection fees have historically posed a barrier, often preventing households from connecting to the grid. While some governments subsidize or amortize connection costs, others add distance-based surcharges that end up penalizing more remote rural households with the least ability to pay.

Even when initial connection fees are subsidized, consumption often falls below available capacity as tariff levels remain unaffordable for many rural households. Analysis suggests that, in most countries, a large share of unelectrified households would struggle to afford even a $10 monthly electricity bill. Disclosures from national utilities expanding in rural areas illustrate this starkly: the Kenya Power and Lighting Company reported average rural household consumption of just six kilowatt-hours (kWh)[1] per month in 2021 (72kWh a year), and newly-connected households in Rwanda were using just 3-4kWh per month in 2017-2019.[2] At these levels, monthly bills fall below $1, reflecting a usage profile limited to a few LED lights, phone charging and running a fan or TV for a few hours a day.

Figure 7: (a) Annual residential electricity consumption per capita (2022) and (b) Annual non-residential electricity consumption per capita (2023) in megawatt-hours (MWh)/capita/year



Note: *Figure (a) illustrates per capita electricity consumption for electrified households, while Figure (b) shows total non-residential electricity consumption for the entire population.*

Source: *Catalyst analysis based on IEA and EIA data*

When customers cannot pay enough to cover infrastructure investments or operating costs, the provider, whether a utility or private company, becomes financially fragile. This is not an argument against supporting low-income households, which remains essential, but against the way that support is currently structured: infrastructure oversized to demand that has not yet emerged, connections planned in isolation from the productive uses that build consumption

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[1] IOSR Journal of Economics and Finance, Assessing the Socio-Economic Determinants of Household Electricity Demand, Vol. 16, Issue 3, 2025

[2] Joel Mugyenyi, Bob Muhwezi, Simone Fobi, Civian Massa, Jay Taneja, Nathaniel J. Williams, Vijay Modi, Post-connection electricity demand and pricing in newly electrified households: Insights from a large-scale dataset in Rwanda, Energy Policy, Volume 198, 2025.

and financing that cannot accommodate demand as it grows. The alternative is to meet customers where they are and scale over time as the conditions for more productive use of energy develop.

Figure 8: Household affordability for various electrification solutions by sub-Saharan Africa country

Note: *Y axis is the share of households that can afford. We assume different monthly minimum payment levels for the electrification solutions: $3.40 for PAYGo lanterns (total price of $56, 10 percent down payment, 15-month tenor); $7.50 for Tier 1 standalone solar (total price of $125, 10 percent down payment, 15-month tenor); and $10 for grid or isolated grid connections. For the latter, this threshold reflects the estimated revenue required to cover the cost of service delivery, distinguishing this analysis from standard metrics that typically assess the affordability of a fixed consumption bundle (e.g., 30 kWh/month).*

Source: *Catalyst analysis based on World Bank Poverty Headcount and GOGLA sales data*

But reaching them durably requires delivery and financing models matched to their geography and incomes, not those of earlier waves of customers.

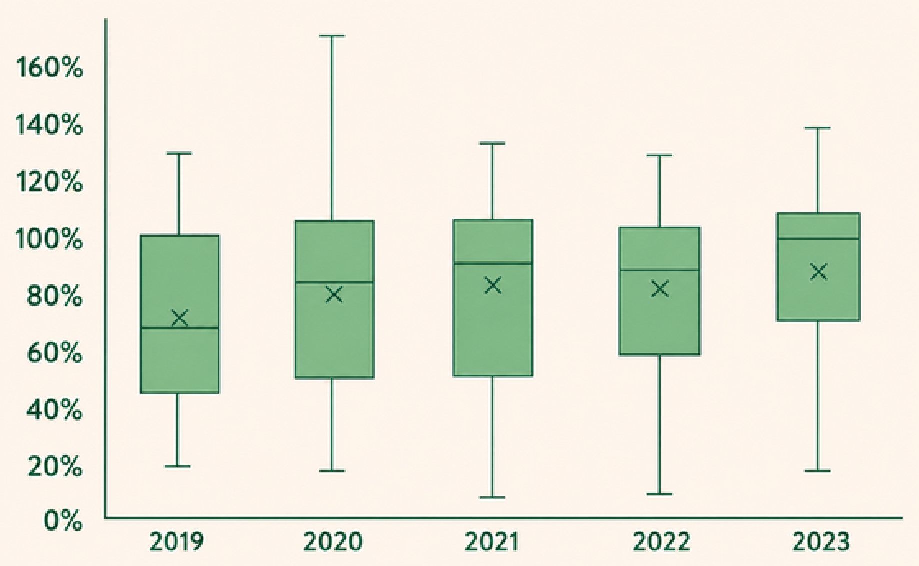
Delivery is too fragmented to bring costs down

Today's delivery models share a single failure: none has reached the scale or concentration of customers needed to make service consistently affordable. Utilities often lose money on the customers they have. Isolated grids struggle to amortize costs across the customers they reach. Standalone solar disperses too thinly to keep aftersales viable. In Africa, none of these models has produced the operational efficiency that durable, affordable service requires.

The utility side of the system shows the dynamic at its most acute. The average vertically integrated utility in Africa recovers just 80 cents for every dollar of operating costs and debt service combined.[15] Without subsidies, most utilities cannot cover their day-to-day expenses and existing debt obligations, let alone fund new investment. This financial precarity triggers a vicious cycle of service degradation. When utilities cannot recover their costs, maintenance budgets are inevitably cut, leading to frequent blackouts and voltage fluctuations. This unreliability destroys consumer confidence and drives a destructive wedge between the utility and its user base.

[15] World Bank, Utiity Performance and Behavior Today (UPBEAT), 2025; five-year average performance

Figure 9: Sub-Saharan Africa utility operating and debt service cost recovery – excluding subsidies (2019-2023)



Note: *The box-and-whisker plot illustrates the distribution of annual cost recovery among utilities in Sub-Saharan Africa (SSA). The sample includes national vertically integrated operators, sub-national entities, and unbundled providers specialized in generation, transmission, or distribution. In this chart, the 'x' marker represents the average cost recovery, the blue box denotes the interquartile range (25th to 75th percentiles), and the whiskers extend to the minimum and maximum values within the sample.*

Source: *Utility Performance and Behavior in Africa Today (UPBEAT) database, World Bank (2025)*

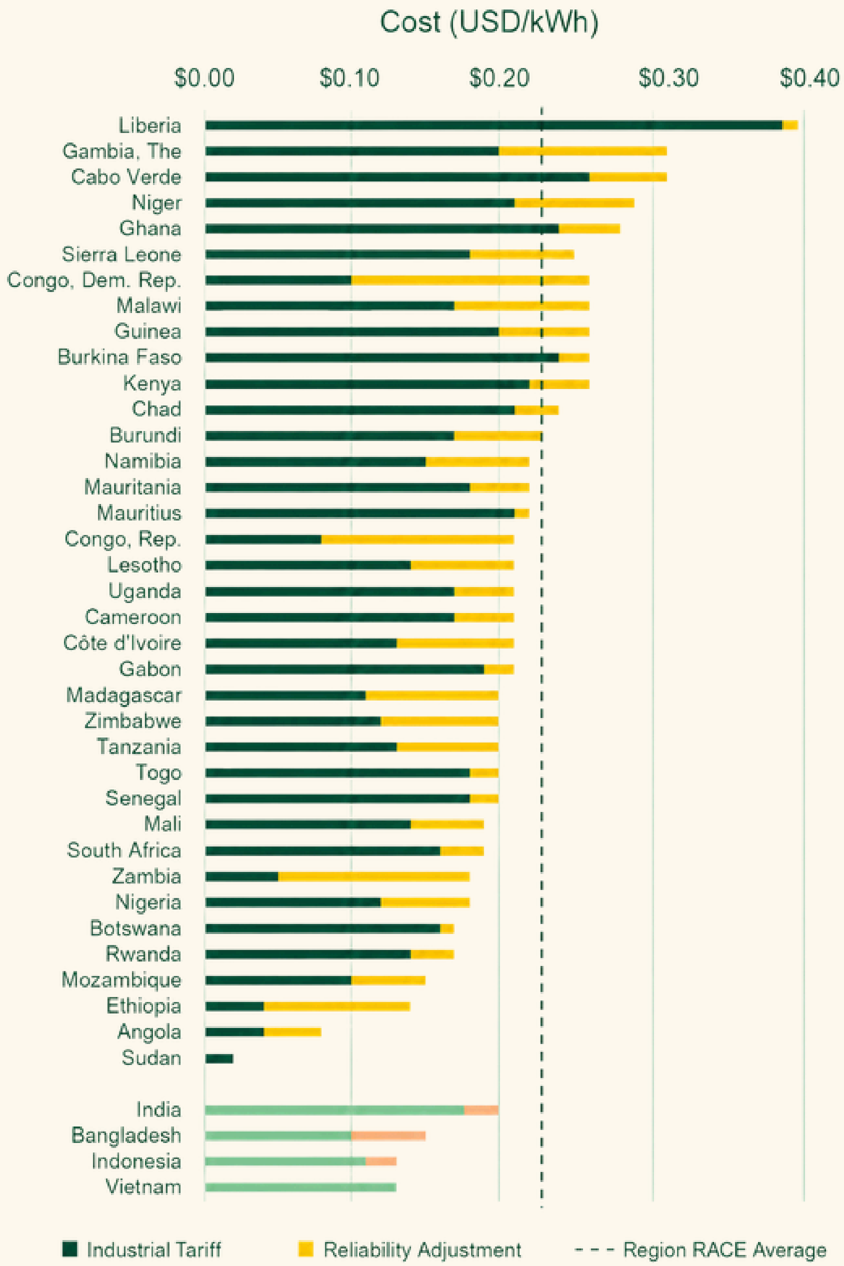
Source: GEAPP

Households may resort to theft or non-payment, while public institutions often accumulate massive arrears. Households that can afford stopgaps self-procure backup power through generators, batteries or small solar devices. Generators now supply nearly nine percent of sub-Saharan Africa's electricity,[16] costing households an estimated $28-50 billion per year on fuel, plus an additional 10-20 percent in maintenance.[17] These hidden costs push the true cost of electricity far above nominal tariffs.

Figure 10 below highlights how the impact of unreliable power systems translates to much higher effective power prices in sub-Saharan Africa, a reality captured by the Reliability-Adjusted Cost of Electricity (RACE) metric, which measures the actual cost of delivered electricity after accounting for outages, backup generation and power quality. Across the region, RACE for industrial users averages 51 percent higher than the posted tariff, underscoring how unreliability acts as an additional tax on firms and erodes the economic value of a grid connection.

[16] Global Energy Alliance for People and Planet, Powering People and Planet, 2022
[17] IFC, The Dirty Footprint of the Broken Grid, 2019

Figure 10: Reliability-adjusted cost of electricity (RACE) for industry in sub-Saharan Africa



Source: *Energy for Growth Hub (2020)*

This dynamic is most visible in the rapid growth of the commercial and industrial sector. Faced with rising tariffs, chronic outages and voltage instability, firms increasingly invest in captive generation and wheeling projects to secure cost certainty and operational reliability. For many businesses, the reliability-adjusted cost of grid electricity now exceeds the levelised cost of self-supply, even before accounting for the economic losses associated with outages.

This shift is underpinned by the growing affordability of storage. Battery costs have fallen about 10 percent per year since 2017, reaching $112 per kilowatt-hour in 2025, sharply reducing the cost of storing solar energy. Adding battery storage now costs about $33 per megawatt-hour to the cost of supply. That puts hybrid systems below the cost of diesel generation and increasingly competitive with grid electricity for large power users in many African markets.[18]

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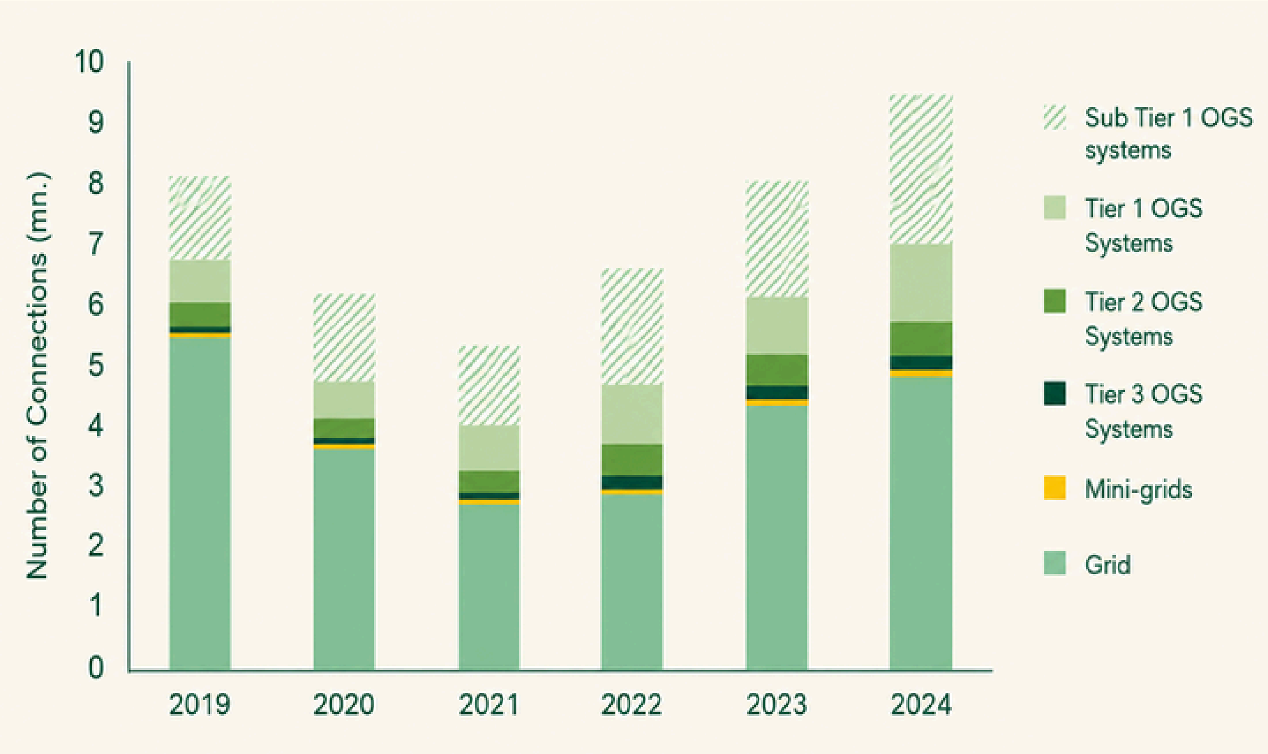
[18] AFSIA - 2026 Africa Solar Outlook report

As commercial and industrial customers exit or sharply reduce grid consumption, utilities risk losing meaningful revenue sources, weakening their ability to cross-subsidize households and invest in network maintenance.

Distributed renewable energy emerged, in part, in response to this market opportunity, but it has scaled along a parallel track of fragmentation. Falling solar costs, digital platforms and development partner funding have enabled isolated grid and standalone systems to emerge not just as stopgaps, but increasingly as formal components of national strategy. Today, according to ESMAP's RISE 2024 report, 83 percent of the region's 35 access-deficit countries include decentralized systems in their electrification plans.[19]

Figure 11: Net new connections in sub-Saharan Africa by type, 2019-2024



Note: *Figures are net of system retirements based on conservative lifetime estimates of two years for 'grey market' standalone solar systems and four years for quality-verified systems.*

Source: *Catalyst analysis based on data from GOGLA (2024), AMDA (2024), and IEA (2024)*

Standalone solar – which provides basic energy services as retail products – has become a major volume driver, but the depth of access remains limited: more than half of deployments are lanterns or low-power kits that fall below the threshold at which a connection counts as electricity access. This is not disqualifying in itself. The value of these systems is that they meet customers where they are: for many rural households the immediate priority is reliable lighting and small appliances, which smaller, low-cost systems can deliver quickly and without significant infrastructure. The risk is that an entry point becomes a permanent destination.

Grid densification and extension continue to deliver the vast majority of high-power connections and account for most new access. By contrast, isolated grids have not made a discernible impact on aggregate access numbers, despite substantial development partner attention.

[19] ESMAP, Regulatory Indicators for Sustainable Energy (RISE), 2025

These differences in depth and reach reflect a deeper structural split. The distributed renewable energy sector has evolved along two distinct tracks: some providers specialize in delivering affordable basic power to households through standalone solar systems, while others focus on higher-capacity connections serving businesses, institutions and productive uses through isolated grids or larger distributed systems.

Unlike national grids, isolated grids do not have urban industrial centers to cross-subsidize rural homes. They face higher generation and distribution costs because of their smaller scale and remote locations, and most operators lack the track record and technical resources of conventional utilities. Many countries maintain uniform national tariffs to avoid inequities between rural and urban consumers, a policy goal that is understandable, but makes many isolated grid projects financially unviable without substantial subsidies.

Standalone solar: rewarding volume, not service

Standalone solar is the lowest-cost way to deliver basic service in low-density areas, and in practice the only option sized for what lower-income households on national and isolated grids actually consume. Bolstered by financing innovations, like the pay-as-you-go (PAYGO) model, these systems have scaled fast across rural sub-Saharan Africa, reaching millions with basic lighting and some additional electricity services where the grid is not present or not reliable. An estimated 40 million households now own a small solar system, with roughly 3.5 million new households acquiring one each year.


Source: GEAPP

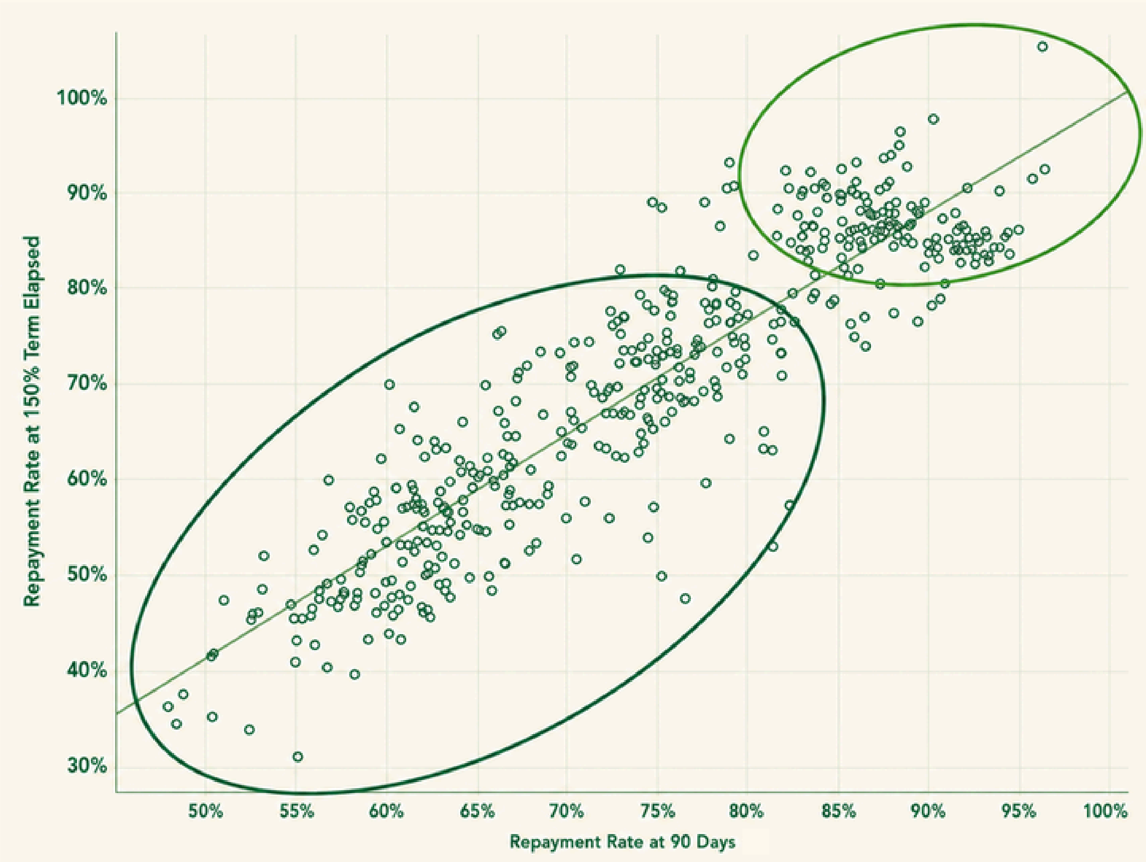
But the commercial model has been built on a fundamental misalignment. Results-based financing programs have, in recent years, rewarded volume (new sales) over value (long-term repayment), leading to a dual sustainability crisis that threatens to undo a decade of progress.

The first challenge relates to credit practices. Volume-based incentives encourage companies to engage in high-risk, poorly underwritten lending, pushing products into households that fall far below the affordability ceiling to maintain growth narratives.

This has been enabled by the fact that most of the sector operates in regulatory grey zones where oversight of consumer finance is weak.[20] Repayment performance across the sector reflects these structural weaknesses: benchmarking data shows that low repayment rates stem less from households' ability to pay than from how PAYGO credit is structured. Many companies market PAYGO plans as flexible "pay when you can" products rather than treating them as asset-finance loans with rigorous underwriting. This undermines repayment discipline and exposes households to risks that would be unacceptable in regulated energy markets.

[20] Kenya has recently taken steps to regulate non-deposit-taking credit providers, including PAYGo solar companies, through proposed rules that introduce licensing, reporting, and consumer-protection requirements. See Bowmans - Kenya: Draft regulations for non-deposit-taking credit providers.

Figure 12: PAYGO companies are adopting bad business practices to boost sales figures



Note: *Data points represent monthly contract cohorts (i.e., groups of new PAYGo customers who all started their loan in the same month) across 12 countries. The red circle highlights low-performing cohorts and the green circle highlights higher-performing cohorts. The trendline and high correlation between repayment rate at 90 days and repayment rate at 150 percent of term elapsed suggests that repayment is primarily driven by onboarding quality (i.e., the quality of sale).*

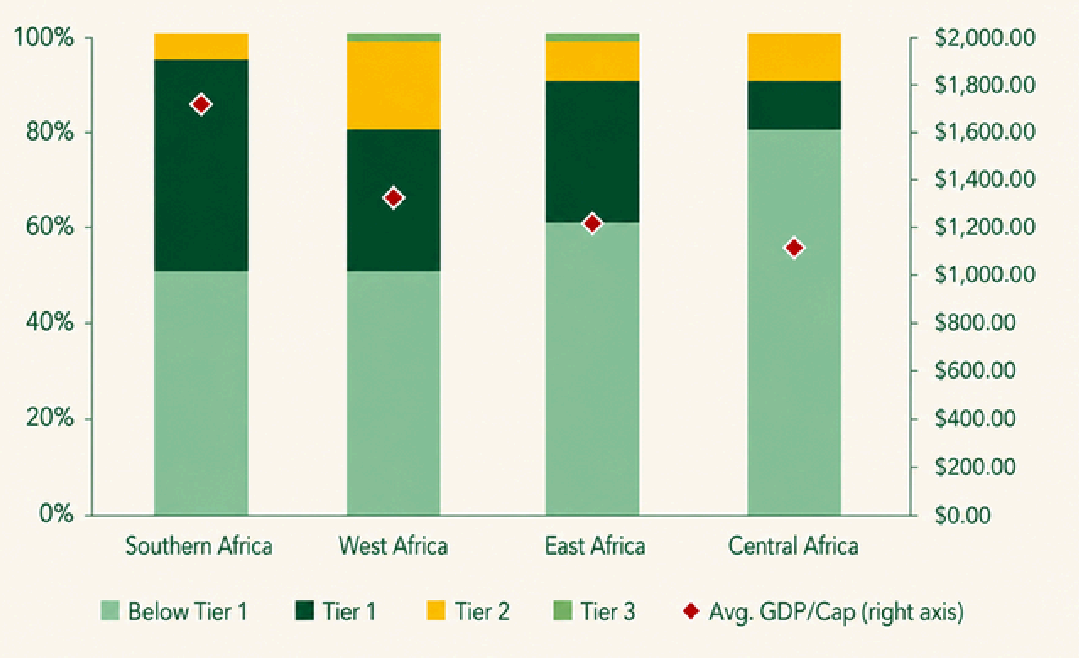
Source: *MAF Lab (Former PAYGo Lab) (2025)*

A recent results-based financing facility launched in East Africa in 2025 illustrates how payments tied strictly to connection targets can trigger destructive boom-and-bust cycles. Outsized upfront subsidies drove an explosive surge in monthly sales ranging from 300 to 1,400 percent as companies slashed deposits to capture rents. However, this volume came at the expense of portfolio health. Providers reported a 15 percent drop in repayment rates as they prioritized subsidy collection over customer creditworthiness. When the facility's funds were exhausted in under a year, the artificial market collapsed and left companies exposed to severe liquidity challenges. This compounded focus on volume leads to substantial impairments of underlying receivables and creates a vicious circle in which weak repayment undermines working capital, limits after-sales service and further depresses repayment.

The second challenge relates to the continued use of standalone solar systems. Only 27 percent of off-grid solar products are quality-verified,[21] leaving low-durability products widespread in the market and accelerating waste generation. Even in the case of quality-verified products, of the 375 million solar energy kits sold since the early 2000s, an estimated 75 percent have fallen into disrepair. This is not an issue of product quality but of inadequate maintenance and aftersales support: 90 percent of these broken products remain readily repairable. Distributors face long lead times for spare parts and many manufacturer warranty regimes are built around replacement rather than repair.[22]

[21] ESMAP, GOGLA, & Dalberg, Off-grid Solar Market Trends Report, 2024
[22] SolarAid, State of Repair in the Off-Grid Solar Sector, 2024

Figure 13: Average tier of quality-verified systems sold in sub-Saharan Africa (2015-2024)



***Source:** Catalyst analysis based on GOGLA sales (2015-2024) and WB's GDP per capita (2024) data*

Similar to the unsustainable credit dynamics, failures in prolonged use of standalone systems are rooted in misaligned incentives that prioritize volume of sales over the provision of reliable electricity services. Providers have no formal obligation to invest in the complex logistics required to maintain systems over time. This is particularly the case with batteries, the most frequent point of failure, which their replacement often constrained by proprietary, anti-tamper designs intended to secure loan repayment.

Underlying all of this is a structural problem: the lack of national frameworks for standalone solar deployment. In most countries, rollout functions as a competitive free-for-all, which prevents geographic clustering, limits economies of scale and keeps costs unnecessarily high. By failing to designate exclusive or protected service territories, the current model prevents companies from achieving the route density required to make aftersales service and collections financially viable.

Across grid, isolated grid and standalone solar, the same pattern holds. Utilities cannot extend the grid to dispersed rural customers at a cost they can sustain. Isolated grids cannot achieve the density or scale required to amortize their costs. Standalone solar cannot establish the route concentration required to keep aftersales viable. Each modality pays a fragmentation premium, which flows through to the cost of power.

Private capital is mispriced because risks are misallocated

The shortfall in capital flowing to African electrification is a matter of quantity and of price. Too little of the capital available is priced for the work, and what is available costs roughly double infrastructure-grade financing[23] because the underlying risks have been allocated to actors that cannot reasonably absorb them. Private capital cannot close the gap when the underlying assets – whether financially weak utilities or low-margin off-grid providers – face risks that outweigh expected returns.

[23] Catalyst analysis based on LMIC infrastructure finance WACC reported by the IEA for large-scale power projects, c.f., prevailing rates for standalone solar companies and mini-grid developers.

The pattern is most visible in grid-connected power. Private participation has expanded over the last two decades, with most activity concentrated on generation. It began through competitive renewable auctions, such as The Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) in South Africa, GET FiT in Uganda, and Scaling Solar in Zambia,[24] which helped lower technology costs and improve procurement discipline. More recent growth has come organically, as cheap solar and storage has driven private commercial and industrial investment. Generation, however, is only one part of the system.

In the context of transmission, distribution and retail, the private sector has had relatively little involvement in expanding grid networks into rural areas. Engagement has been largely confined to engineering, procurement and construction roles rather than long-term operational responsibility. Only a small number of newer models, such as Anzana in Burundi and Zambia or ARC Power in Rwanda, are attempting private or semi-private distribution concessions. These are still the exception rather than the norm, and their long-term viability depends on clear regulatory mandates, transparent and predictable tariffs, and credible revenue collection frameworks.

Umeme's long-term distribution concession in Uganda is often cited as the strongest example of private participation in electricity distribution in the region. Umeme delivered substantial operational improvements – including a reduction in technical and commercial losses, from 38 percent in 2005 to 16.4 percent by 2019 – and an increase in collection efficiency to above 95 percent, supported by substantial capital investment in the distribution network.[25] Over the period, cumulative investment totaled $656 million.[26] The concession pragmatically focused on urban and peri-urban areas. Eventually, public and political support weakened, leading to a non-renewal of the concession and Umeme exiting the country in 2025.

Uganda's experience illustrates both the potential and the limits of private participation in electricity distribution. Well-designed concessions, supported by capable regulators and credible incentive frameworks, can materially improve utility efficiency and financial viability. In this sense, power sector reform works. However, improved utility performance does not automatically translate into expanded access or affordable tariffs for poor households. The pattern is not unique to private operators: any commercially disciplined utility, public or private, will prioritize viable customers and service areas absent explicit social policy, public subsidy and state-led investment in network expansion. The implication is that whatever the ownership, commercial performance cannot substitute for the state's role in delivering affordable electricity at scale.

The same dynamic plays out across distributed renewable energy, in sharper form. Isolated grid developers and operators face structurally high costs, insufficient demand and long payback periods. This is compounded by the expectation that they will absorb risks, from demand volatility to currency and political risk, that in successful electrification systems are typically socialized through public institutions. The prevailing model places full repayment risk on developers, which has proved difficult to finance at scale. Operators, in turn, are expected to maintain systems, manage collections and stimulate demand over multi-decade horizons without the financing, technical capacity or institutional support that public utilities can typically draw on. Much of the recent wave of development partner support has tended to privilege system development and new connections over sustainable, long-term operations.

Consumer risk is deeply embedded in the subsidy design itself, because developers are typically incentivized to maximize connection counts to unlock up-front capital. This creates a perverse incentive to roll out infrastructure to large numbers of low-consumption households, without a viable mechanism to cover ongoing operating costs, effectively locking the operator into a portfolio of loss-making customers.

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[24] IRENA, Renewable Energy Auctions: Cases from Sub-Saharan Africa, 2018

[25] Twesigye, P., Understanding structural, governance and regulatory incentives for improved utility performance: Learning from Umeme Ltd in Uganda, 2023

[26] Ibid

This creates a sustainability trap: to remain solvent without operational subsidies, operators must charge high, cost-reflective tariffs that exceed the local ability to pay. Consequently, customers are locked into a service they cannot afford to utilize, threatening the longevity of the connection itself.

Data from the Africa Minigrid Developers Association (AMDA) underscores this challenge: the average residential isolated grid customer in Africa spends only $2-2.50 per month on electricity, barely enough to cover average operating costs of roughly $1.75 per month.[27]

Table 1: Average monthly electricity revenue and consumption by region and customer category

Customer Category	Eastern and Southern Africa		Western and Central Africa	
	Average Revenue per User (ARPU)	Average Consumption per User (ACPU)	Average Revenue per User (ARPU)	Average Consumption per User (ACPU)
Residential	$2.50	6 kWh	$2.00	8.1 kWh
Commercial	$5.20	13.1 kWh	$10.00	39.8 kWh

Source: *Benchmarking Africa's Minigrids Report, AMDA (2024)*

The pattern repeats in standalone solar. Because PAYGO companies rely on commercial capital, they must recover costs quickly to recycle capital for growth. This incentivizes short repayment cycles and pricing structures that leave the poorest households paying the highest effective cost for the lowest level of service. When examining reach and penetration to the last mile, it has become increasingly evident that this approach has failed the poorest.

When operator revenues fall short, the risk transfers to the household in the form of service degradation or abandonment. In many countries, this precariousness is compounded by incomplete regulatory frameworks that leave unclear rules on downtime allowances, maintenance obligations and complaint resolution, effectively forcing customers to shoulder the risk of a failing system. The common thread is that credit and service-quality risks are systematically transferred to households, while the upside for providers remains tied to initial sales volumes and subsidy capture rather than long-term service delivery.

Taken together, these experiences point to a common conclusion. Across grid, isolated grid and standalone solar models, the binding constraint is no longer technology or operational capability, but how the work is structured, how risks are allocated, and how capital is priced. The dominant approach treats electrification as a siloed set of projects or companies in contrast with the historical record where universal access was achieved through state-led system building, underpinned by varying degrees of public risk absorption, cross-subsidization and long-term institutional commitment. In a global context dominated by increasing capital scarcity across public-private and concessional-commercial spectrums, it becomes increasingly imperative that these resources be structured and deployed so as to optimize value (and impact) for money. Models that rely on project-by-project investment, short-term commercial incentives and fragmented risk allocation have repeatedly failed to resolve affordability, sustain demand or support system-wide expansion. Where private participation has succeeded, it has done so within narrow, commercially viable segments, while outcomes that require risk socialization, long time horizons and political legitimacy have remained the responsibility of the state. While the state also has limits to what risks and payment obligations it can take on, the opportunity lies in structures that make the most of both public and private capital.

[27] AMDA, Benchmarking Africa's Minigrids Report, 2024

From diagnosis to architecture

The four dynamics laid out above are connected. Fragmented delivery keeps costs structurally high, and misallocated risk keeps capital expensive, leaving customers who lack durable service still out of reach. The response to date has been a patchwork: stepwise reforms and technology or business model fixes layered on top of each other without an underlying architecture. The evidence does not call for more capital flowing through existing models, but for a fundamental reset in how electrification is planned, financed and governed.

Most of the elements of that reset already exist. The financing landscape that delivered universal access elsewhere has been used across parts of the region for decades, in the form of public-private partnerships, infrastructure finance and structured market opportunities. The regulatory tools to support these approaches are proven. A decade of investment has brought distributed renewable energy technologies to maturity. And capital can be mobilized for the work, even if it is not yet priced for it.

What has been missing is the building blocks that bring these elements together: operators with clear delivery mandates in defined service areas, and risks priced and shared across the government, operator and financiers, with each carrying what they are best placed to manage. The second part of this paper offers an outline for that architecture.

Source: OkraSolar