SDG7 GAP ANALYSIS REPORT

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FOREWORD

One third of the world's population lacks access to reliable energy and almost 10 per cent of the world, or 700 million people, have no access to electricity. 47 per cent of these are located in Sub-Saharan Africa. This entrenches poverty since electricity is the anchor for socio-economic development and vital to the provision of education, water and sanitation, and modern healthcare services.

The Africa Minigrid Developers Association's (AMDA) mission is to address this poverty.

AMDA works with governments, international donors, funding partners and the private sector to create a conducive policy environment across Africa and help developers access appropriate long-term financing so as to scale the deployment of Decentralised Renewable Energy systems on the continent. This is because minigrids work; they are an effective and efficient way to connect millions of Africans living in rural and peri-urban communities to the immense opportunities that reliable, consistent and affordable energy provide.

The study conducted in 15 markets across Africa – Uganda, Kenya, Tanzania, Ethiopia, Zambia, Nigeria, Togo, Côte d'Ivoire, Niger, DRC, Cameroon, Benin, Mali, Zimbabwe and Mozambique – shows that adopting a Least-Cost Model for electrification, which combines minigrids and National Grid extension programs, will save USD 90 billion by 2030.

Imagine what this saving can do if reinvested in expanding mechanized agriculture, making modern healthcare more accessible, building better educational institutions and strengthening the manufacturing sector, amongst other social development initiatives. This is the multiplier effect of electrification and the inherent power of Decentralised Renewable Energy.

This SDG7 Gap Analysis Report is prescient since governments and the development community are realizing that current electrification efforts that are biased towards National Grid extension programs mean Africa will not meet the SDG7 target by 2030.

The report also serves as a clarion call for governments, international donors and funding partners to take decisive action today and work with the private sector to harness the power of minigrids. This is the only way we can sustainably uplift the 600 million Africans lacking access to electricity by 2030, and ensure they benefit from a rising continent.

Jessica Stephens
Chief Executive Officer
Africa Mingrid Developers Association

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EXECUTIVE SUMMARY

Of all the services necessary for general human wellbeing and economic prosperity, perhaps none is as important as electricity access. All other services are hinged on the availability of high quality and reliable electricity. Water, education, sanitation and decent settlements, among others, are inextricably linked to electricity access. Important as this is, the majority of the world`s poor lack basic electricity services. Africa leads across the globe with the highest population that is unelectrified. Recently, governments and development partners have ramped up efforts to increase electricity access, but most of the funding has been channelled to national utilities to extend the national grid to underserved areas. Extending the grid is unnecessarily expensive, especially in rural settlements, and seldom delivers adequate services. The uptime for utilities in Africa is around **42%,** and the result is that many connected households have to do without electricity for more than half of a day. Other interventions like solar home systems, though important and beneficial, hardly deliver the quantity of electricity required to power appliances beyond lighting and televisions.

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One of the most effective but not often considered ways of reaching the unelectrified with reliable, affordable, clean and abundant electricity faster and conveniently is deployment of minigrids. Minigrids, as this report will prove, deliver the same quantity of electricity like grids, have better services **(97% uptime compared to 42% for grids),** can be easily deployed and require almost half the capital cost of grids to connect households. With all these self-evident benefits, it is natural to expect that governments and development partners will channel more funding to the minigrid sector, but the antithesis is the case. The minigrid sector has struggled with the financing necessary to scale and expand services to the most deserving populations. While this can be attributed to a dearth of information on the potential and economics of minigrids, significant studies and publications exist to corroborate this.

To further build evidence on why minigrids should be prioritized in national electrification plans, Africa Minigrid Developers Association (AMDA) has developed an electrification model of 15 African countries where AMDA has active members **(Uganda, Kenya, Tanzania, Ethiopia, Zambia, Nigeria, Togo, Côte D`Ivoire, Niger, DRC, Cameroon, Benin, Mali, Zimbabwe & Mozambique)**. This is to help understand the electricity access deficit by 2030, given the current trajectory in electrification and population growth and the cost of achieving universal access by 2030 under business as usual **(100% grid extension)** and least-cost (grid extension, minigrids and solar home systems) models. From our modelling and analysis, here are our main findings:

- Adopting a comprehensive or least-cost model to electrification integrating grid extension, minigrids and solar home systems (SHSs) will cost **US$ 119 Billion**, to achieve universal access in the **15** countries by **2030** while a Business-as-Usual (BAU) grid-centric approach will cost **US$ 209 Billion** resulting in cumulative savings of **US$90 Billion**.
- It costs about – or more than - **US$800 (40% of cost of connection which is around US$2000)** to subsidize rural electricity connection via the main grid - more than what is needed to connect the same customer with a minigrid at **US$ 733**.

- Population growth in the 15 countries will hit **968 million** from the current **732 million**. Out of these **587 million (69%)** with a majority **410 million** rural dwellers will have no access to basic electricity services given the prevailing electrification rate.
- Of the 15 countries considered in this study, Kenya is the only country on a path to universal access by 2030 with 96% electrification rate. Many other countries will record marginal increase with others like Uganda slumping below their 2020 rates due to rising population growth.
- Government subsidies will be required for all pathways to universal electrification but by leveraging the private sector and building efficient decentralized grids, the amount of subsidies needed can be radically reduced, saving governments millions.
- Both public and private subsidies need to be pegged on performance.

From these findings, it is evident that with proper capital allocation, African countries can achieve SDG 7 faster and cheaply. Decades of grid-extension efforts have not delivered electricity to the most deserving, so it is highly unlikely that the grid alone will achieve SDG 7 in a single decade. As can be seen, the capital cost of connecting one household with the grid can connect two households with even better electricity services using a minigrid. For African countries struggling with a number of development challenges, the savings accrued from such an initiative can be used to build better schools, improve healthcare, boost agriculture and manufacturing and construct hundreds of kilometres of roads and other necessary infrastructure.

There is some good news, which is that a number of countries like Zambia, Nigeria and Kenya are considering minigrids in their electrification masterplans. However, the proportion of minigrids is still too low to realize the full benefits and realize meaningful savings. Some countries still lack political support which is necessary for minigrids to scale. With this report, we invite governments, development partners, policy makers, consultants, and other energy stakeholders to consider a least-cost approach to electrification, with minigrids playing a central role.

INTRODUCTION

1.1 Background to the report

The minigrid market in sub-Saharan Africa is worth **$3.6 billion**[1] according to the Africa Development Bank. Other studies and organizations estimate it could be more than this. According to the State of the Global Minigrid Market Report 2020, minigrids have the capacity to electrify **111 million households** in Africa, Asia and the Island nations. To date, 600 million people in sub-Saharan Africa remain unelectrified, with a majority of those electrified having unstable and unreliable access to power. Minigrids, despite showing great potential, command a very small market owing to limited investments in the sector and a dearth of enabling policies from key stakeholders. To date, only **42,000 households (approximately 200,000)** people are served by private sector minigrids in sub-Saharan Africa.

Achieving universal energy access calls for a non-conventional approach to electrification, especially rural electrification. Historically, grid extension has been the primary means of connecting households to the electricity, but with the advent of decentralised renewable energy options coupled with plummeting hardware costs and increased private sector involvement, a blend of grid extension initiatives, decentralised minigrids and standalone solar systems provides the surest way to reach even those hitherto considered difficult to reach.

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[1] Energy Mix Report. (2020). Mini-grids Market in sub-Saharan Africa Worth $3.6bn – AfDB. Available at: https://www.energymixreport.com/mini-grids-market-in-sub-saharan-africa-worth-3-6bn-afdb/

National grids in Africa are already overburdened, leading to poor services to customers. In Nigeria, with an installed capacity averaging 12.5 GW, only between 3.5 GW to 5 GW or a third of the installed capacity is typically available for transmission to the customers.[2][3] This is due to losses in transmission and distribution and challenges in the supply chain of gas, the bulk of the fuel used in generation. In Kenya, Kenya Power experienced system losses of 23% in 2020 equivalent to **KES 16 billion (approx. US$ 160 million)** in revenue.[4] With 10 years left to achieving SDG 7 targets, relying on the grid will be technically challenging and result in a lot of capital expenditure, not just to connect households but to improve and update the grid. Decentralized renewable energies can defer, and, in some cases, free up the investment required to maintain and extend the grid to unconnected houses—investments that can be used to build other infrastructure projects.

In Africa, particularly, electrification efforts are competing with increased population growth rates. Electricity is an indispensable service, without which millions of people are unable to live fulfilling and productive lives. Basic human services like education, healthcare, safety among others are inextricably linked to availability of quality, cheap and reliable power. Africa further faces a poverty emergency. Increasing manufacturing capabilities and building the necessary infrastructure required to grow economies and lift millions out of poverty calls for investment in technologies that can deliver quantity and quality.

Africa Minigrid Developers Association (AMDA), a trade association representing minigrid developers in Africa, seeks to build an evidence base for minigrids in Africa. To date, the association has developed a model that aggregates the amount of savings that can be realized by considering an integrated approach to electrification. This report is a compilation of best approaches to electrification, potential savings from an integrated approach to electrification and the main policy gaps in Kenya and Zambia as more in-depth case studies. With it, we hope to demonstrate that integrating minigrids and other decentralized renewable energy technologies into the National Electrification Plans (NEP) is not just necessary in achieving SDG 7, but it makes economic sense as well.

1.2 Overview of Electricity Access in Focus Countries

Africa Minigrid Developers Association (AMDA) currently represents 35 members operating in 15 countries in Sub-Saharan Africa. Though many sub-Saharan African countries are considered homogeneous, when it comes to electricity access, there is a discernible difference in a number of countries. Some countries like Mauritius are almost attaining universal access, while some like Burundi and Chad are still below 10% access rates.

Lack of electricity access is a major impediment to growth and development in these countries. Unsurprisingly, countries with low rates of electrification are some of the poorest, without basic infrastructure and services like decent schools and housing, healthcare, roads etc. There is a direct correlation between a country`s economic growth and GDP per capita with the amount of electricity consumed per capita: countries with high GDPs per capita have higher electricity consumption per capita and vice versa. Economic poverty can and will be addressed by dealing with energy poverty first - a reality that governments and donors should be aware of.

[2] Energy for Growth Hub. (2019). How Big is Nigeria's Power Demand? Available at: https://www.energyforgrowth.org/memo/how-big-is-nigerias-power-demand/
[3] GET.invest. (2021). Nigeria. Available at: https://www.get-invest.eu/market-information/nigeria/energy-sector/
[4] Business Daily. Available at: https://www.businessdailyafrica.com/bd/markets/market-news/system-losses-kenya-power-sh16bn-revenue

In this report, we scan through 15 minigrid markets in Africa namely, Kenya, Tanzania, Uganda, Ethiopia, Zambia, Côte D`Ivoire, Cameroon, Nigeria, Democratic Republic of Congo, Mali, Togo, Mozambique, Benin, Zimbabwe and Niger. These markets illustrate the realities of many sub-Saharan Africa countries.

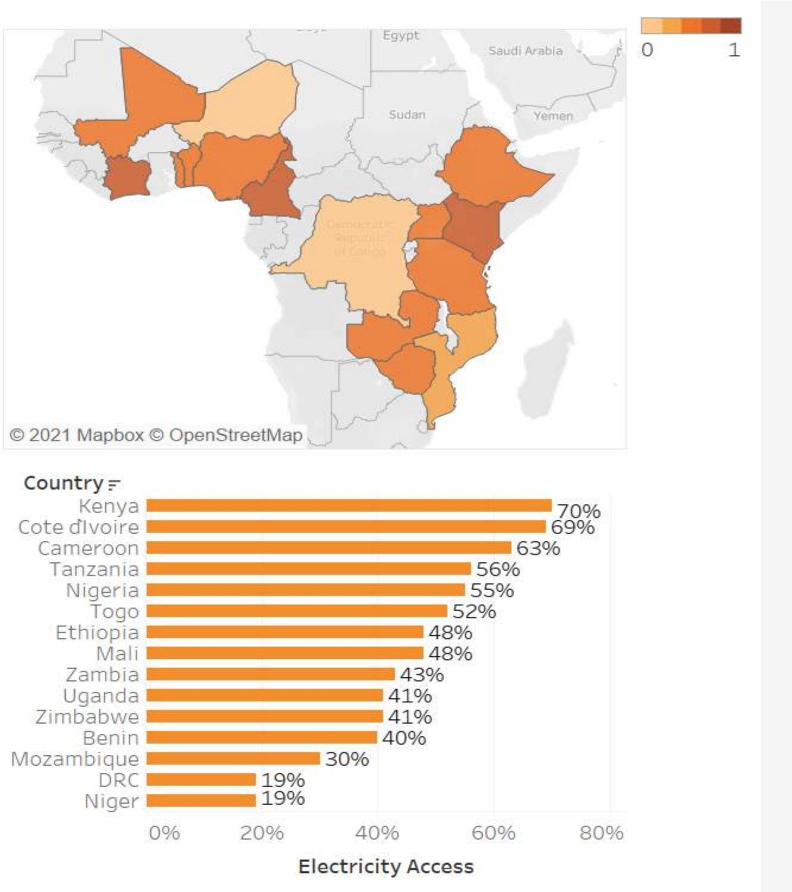

Figure 1: Electricity Access in Key African Markets (Source: SEforALL Tracking SDG7 tool)

1.3 Evolution of Electrification

1.3.1. 20th Century Centralized Electric Grids

The first grids to be constructed in the early 20th century, otherwise known as First Generation Minigrids, were decentralized in nature, and electrified small parts of cities or medium-sized towns. As demand for power grew, it became necessary to build large power systems and link them via transmission lines[5]. This led to the centralization of electrification in most wealthy countries. The main electricity infrastructure consisted of mainly fossil-based synchronous power plants connected to a high-voltage transmission lines which evacuated power at high voltage to a sub-station for distribution to consumers. From the sub-station, electricity was distributed to industries and houses using low and medium voltage (LV/MV) lines. Metering was done using analogue meters and connection was quite expensive but often with government subsidies. This technology proved ideal in many urbanized economies. Generation, transmission and distribution was done by a state monopoly, but to improve efficiency, many monopolies were unbundled depending on government policies, but to date, many utility companies, particularly in Africa, are still vertically integrated.

[5] MGP & BNEF. (2020). State of the Global Minigrids Market Report 2020

1.3.2. 21st Century On-grid and Decentralized Off-grid Systems

With the proliferation of energy technologies, coupled with the urgency of achieving universal energy access, the 21st Century has seen a significant departure from the 20th Century centralized, non-renewable grids. An integrated approach involving grid-extension initiatives, decentralized minigrids and standalone solar systems is quickly becoming mainstream. This has been necessitated by the need to reach rural off-grid communities who will have to wait decades before the grid arrives. The International Energy Agency estimated in 2011 that 70% of rural households would be better served economically by off-grid solutions like decentralized minigrids and solar home systems. To be frank, none of these three technologies can be said to be least-cost; rather each solution is affordable depending on the demographic being served:

Grid Extension : Extending the grid is best suited to urban or peri-urban populations who live in close proximity to the grid;

Minigrids : Minigrids are least-cost when we have people far off from the main grid but densely populated enough to justify the construction of minigrid infrastructure;

Solar Home Systems (SHSs) : SHSs are suitable in sparsely populated areas which are located many kilometres off the main grid.

We considered the International Energy Agency (IEA) definition of electricity access, which states, `Electricity access entails a household having initial access to sufficient electricity to power a basic bundle of energy services – at a minimum, several lightbulbs, phone charging, a radio and potentially a fan or television – with the level of service capable of growing over time.[6]

Figure 2: Electricity access ladder

[6] IEA. (2020). Defining Energy Access: 2020 Methodology. International Energy Agency. Available at: https://www.iea.org/articles/defining-energy-access-2020-methodology

METHODOLOGY

The African Minigrid Developers Association (AMDA) developed an Excel Model that aggregates potential savings that will be realized if 15 African countries employed a least-cost approach to achieve SDG 7 as opposed to a business as usual (BAU) scenario. The model developed can be summarised in the chart shown below.

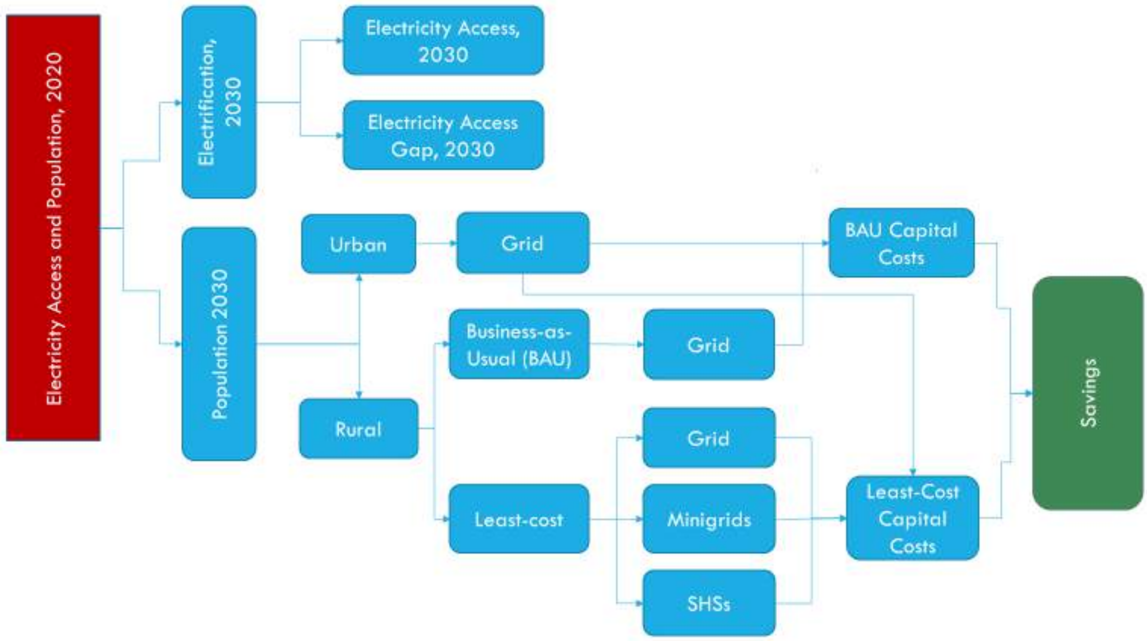

Figure 3. Model Showing Potential Savings for Countries that Employ Least-cost Approach

Our application of the terms business as usual (BAU) and integrated or least-cost approach is as defined below:

Business as Usual: This assumes that governments would continue future electrification efforts using a centralized approach where the public utilities (main grid) would be the sole driver of electricity access for the un-electrified populations. As such, we were able to map out what such capital costs (CAPEX) would be from a public financing perspective between now and the SDG 7 target year (i.e., 2030).

Integrated approach: This assumes that governments would allow for least-cost planning into future electricity decision making where both public and private players collaborate to bring cost-efficient electricity connections to the underserved. The three main technologies that we mapped were main grids, mini grids and standalone solar home systems (tier 2 only).

The year for achieving SDG 7 was taken to be 2030 for all these countries. Some countries like Kenya have projections to achieve this earlier while others like Tanzania have no written commitments to achieve this by 2030. The model projects electrification rate given the current population growth and urbanization rates; status and rate of urban and rural electrification in all the 15 markets to paint a picture of electrification in the short and long-run. Urban population is allocated to grid extension since it`s cheaper to extend the grid in many urban centres and rural electrification is divided among grid extension, minigrids, and solar home systems at a specified ratio depending on population density, rural analysis, the ideal technology allocation for rural electrification in all the countries under consideration is as below.

Table 1: Ideal technology allocation for rural electrification in countries under consideration

Country	Grid	Minigrids	SHSs
Kenya	15%	20%	65%
Uganda	15%	50%	35%
Tanzania	35%	40%	25%
Ethiopia	15%	50%	35%
Zambia	15%	50%	35%
Nigeria	15%	50%	35%
Togo	15%	50%	35%
Cote D'Ivoire	15%	50%	35%
Niger	15%	50%	35%
DRC	15%	50%	35%
Cameroun	15%	50%	35%
Benin	15%	50%	35%
Mali	15%	50%	35%
Zimbabwe	15%	50%	35%
Mozambique	15%	50%	35%

Note: The model allows for varying allocations between classes. The analysis and savings presented in this report use the above allocations.

2.1 Capital and Subsidy Allocation

These were assumptions that enabled us to calculate the capex costs for each of the technologies across the countries in the study. These were:

- Cost per connection of main grid connection: Here we assumed that the entire unit capital cost i.e. 100% of connection cost would be publicly funded by African governments and bilateral and multilateral donor agencies and other development partners.
- Capex subsidy needed per minigrid connection: Using public data on current donor minigrid financing, and internal estimates, we allocated the dollar value of part (50% of connection cost) of the capex cost per minigrid connection to allow for subsidies so as to lower the overall electrification budget using an integrated least-cost planning approach.
- Capex subsidy needed per SHS connection: Using public data and internal estimates, we allocated the dollar value of part (33% cost of purchasing a tier 2 solar home system) of the capex cost per SHS connection to allow for subsidies so as to lower the overall electrification budget using an integrated least-cost planning approach.

Based on these assumptions, we allocated subsidies at 100% of the prevailing connection rates for grid connection; 50% of connection costs for minigrids; and 33% the total purchase price for a solar home system. The breakdown of subsidies per technology is as below:

Table 2: Breakdown of subsidies per technology

Technology Split	Capital Cost of Connection/Purchase	Subsidy Allocation	Rate of Subsidy Allocation
Grid Extension	$1500	$ 1500	100%
Minigrids	$1000	$ 500	50%
Solar Home Systems (SHSs)	$600	$ 200	33%

The model contains analyses from 15 countries, but in this report, we provide data for cumulative savings and have annexed seven (7) case studies from 15 of the countries considered.

COST OF IMPLICATIONS OF ACHIEVING SDG7

3.1 Electricity access and subsidies under Business as Usual

Rural electrification has always been heavily subsidized by national governments around the world. While many public electric utilities are billed as commercial entities, provision of electricity to the citizens often overrides commercial interests. This is particularly true in Africa where grid extension to communities in many instances is dependent on the government. Politicians campaign on a platform of providing electricity access to the electorates and this involves extending the distribution lines, constructing new transmission lines and expanding generation.

This scenario has resulted in poor services to the customers and financially bleeding utilities. Due to poor returns on investment, the utility lacks the incentive to provide high quality service. Many utilities have an uptime averaging 40-50% with a tier 3-4 access which is a far cry from minigrids, which have an uptime of more than 97% and a tier 4-5 access[7].

In countries like Nigeria, it is estimated that most utility customers have a secondary source of power like a diesel generator in case of a power outage. It is estimated that more than 70% of Nigerian firms use private diesel or petrol generators totalling 14 GW in capacity, dwarfing the 3.5 GW to 5 GW delivered by the national grid.[8]

According to a survey of 39 utilities in sub-Saharan Africa, it was discovered that utilities get a subsidy that enables them to sell electricity at prices averaging 41% - and up to 80% - less than their unsubsidized Levelized Cost of Energy (LCOE). This means that utilities receive subsidies worth 40% of their connection costs[9]. With connection costs exceeding $2000 in rural areas, a 40% subsidy is equivalent to more than $800. According to the Benchmarking Africa`s Minigrids report 2020 by AMDA, unsubsidized minigrid connection costs in 2018 averaged $733[10] meaning government subsidies alone to extend the grid in rural areas is more than required to connect a household to a minigrid, which guarantees a higher service level and uptime, is more customer-centric and has the potential to stimulate rural economies by focusing more on productive uses of electricity.

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[7] ESMAP. (2019). Minigrids for Half a Billion People.
[8] Reuters. (2019). RPT-Nigeria's Diesel-dependent Economy Braces for Clean-fuel Rules. Available at: https://www.reuters.com/article/nigeria-power-diesel/rpt-nigerias-diesel-dependent-economy-braces-for-clean-fuel-rules-idINL5N26928S
[9] ibid
[10] AMDA. (2020). Benchmarking Africa`s Minigrids

Nearly all utilities in sub-Saharan Africa are not financially solvent, and majority of them sell electricity at a loss. The average fully cost-reflective tariff of 39 utilities in sub-Saharan Africa is $0.27/kWh with more than 25% of utilities requiring a cost-reflective tariff of more than $0.40kWh[11]. This is particularly difficult for rural, sparsely populated customers who on an average have lower disposable incomes than their urban counterparts and, on an average, use much less electricity which does not justify constructing expensive transmission and distribution lines from a central station. Only 2 out of 39 (Seychelles and Uganda) utilities charge tariffs that enable them to fully recover their costs[12].

3.2 Leveraging Private Capital to Reduce Public Utilities` Capex and Opex Costs

Extending the central grid to far-flung rural communities with modest electricity consumption patterns is prohibitively costly and economically unviable. This has presented a dilemma of balancing universality and commerciality. Minigrids are designed to address this. Firstly, they are constructed with grid interconnection capabilities to easily integrate into the main grid once it arrives allowing for transmission and distribution support at the end of the line[13]. This in return frees or defers public capital which would have been used to extend the grid over long distances without a significant market, thus reducing the capital costs of constructing public transmission and distribution lines.

Secondly, minigrids promote income-generating activities in rural communities, which increase electricity consumption. As a result, when the main grid arrives, there is a thriving market with the ability to pay customers, which in turn increases their financial capabilities. Finally, most minigrids utilize modern smart metering technologies, remote monitoring infrastructure and mobile payment platforms which utilities can leverage to cut down on their operations and maintenance costs once the assets are acquired.

3.3 Implications to SDG 7 under Comprehensive Approach (15 Markets)

The Model developed by AMDA considers electrification over a 10-year period (2021-2030) using a Business as Usual (BAU) grid extension approach and a comprehensive approach integrating grid extension, minigrids and solar home systems (SHSs). The model provides a projection of electrification rates taking into account the current population growth rates and rate of urban and rural electrification in the 15 markets and provides an analysis of electrification in the short and long-run. Urban population is allocated to grid extension since it`s cheaper to extend the grid in many urban centres and rural electrification is divided among grid extension, minigrids, and solar home systems at a specified ratio depending on population density, rural electrification rate (grid availability or nearest grid line) and other factors. Subsidies were allocated at **100%** of the prevailing connection rates for grid connection, **50%** of connection costs for minigrids and **33%** the total purchase price for a solar home system. The breakdown of subsidies per technology is as below:

Table 3: Breakdown of subsidies per technology

Technology Split	Cost of connection	Subsidy cost to gov't
Grid Extension	$ 1500	100%
Minigrids	$ 500	50%
Solar Home Systems (SHSs)	$ 200	33%

[11] ESMAP. (2019). Minigrids for Half a Billion People
[12] ibid
[13] ibid

The second level of analysis involved estimating the energy access deficit in 2030 taking into account the population growth and current rates of electrification. From our analysis, only 42% of approximately 732 million citizens in the 15 countries are electrified and this figure is likely to drop to 39% equivalent to 968 million citizens in 2030. In summary, 587 million (69%) citizens from these 15 countries will have no access to electric services in 2030 with the current rate of electrification.

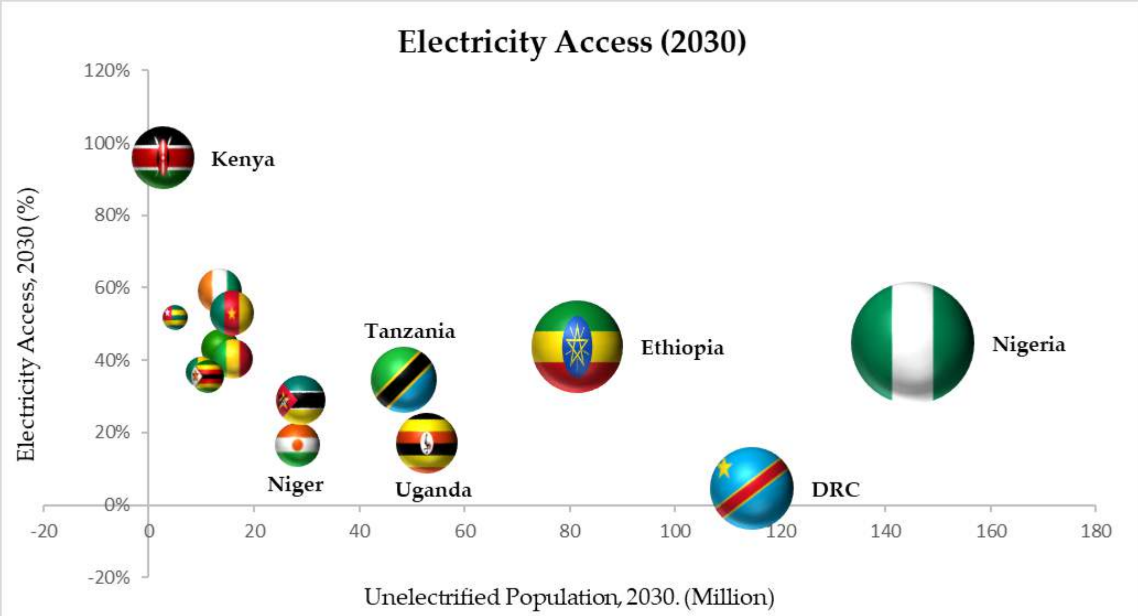


Figure 4: A chart showing electricity access, unelectrified population in 2030

The third analysis was estimating the amount of money required and subsequent savings by considering a Business as Usual (BAU) approach, vis-à-vis a comprehensive approach integrating grid extension, minigrids, and solar home systems (SHSs). The data shows that achieving universal access by 2030 using a Business as Usual approach will require approximately US $ 209 Billion while a comprehensive approach will need a fraction of that—US $ 119 Billion resulting in a total cumulative savings of US $ 90 Billion.

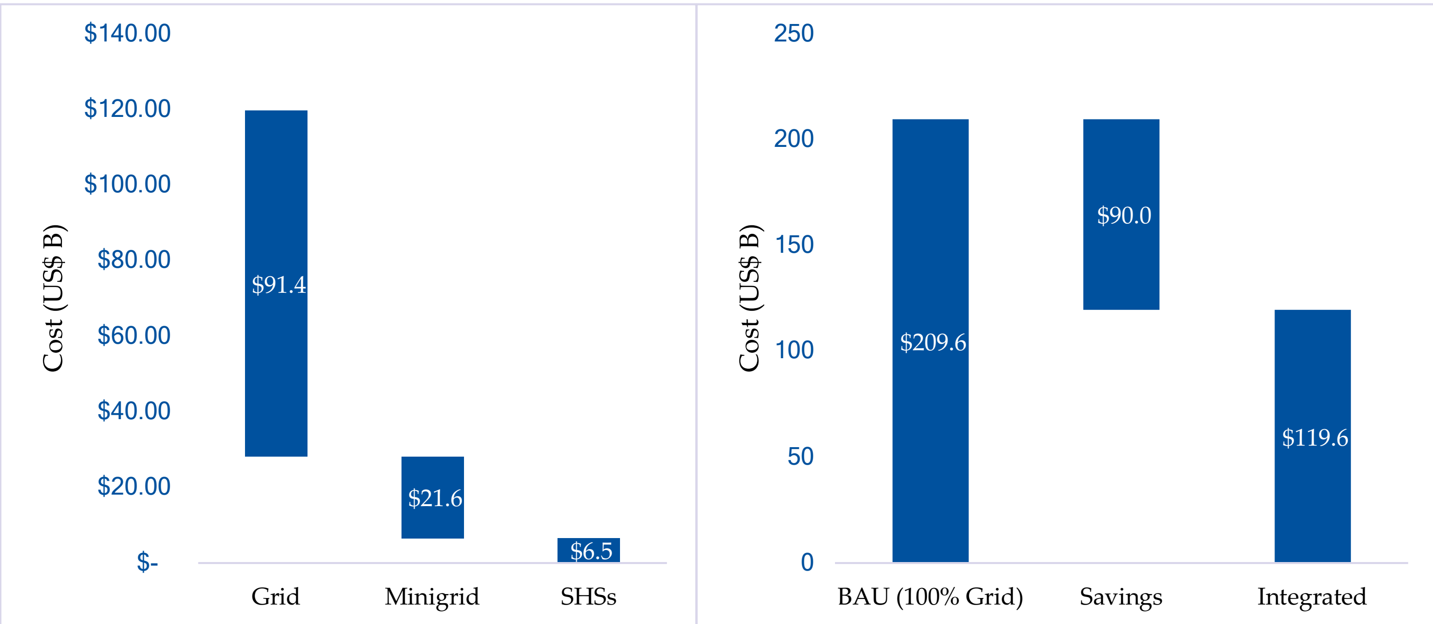


Figure 5: A chart showing cost of achieving SDG 7 under BAU and Comprehensive Approach

POLICY, REGULATION AND SDG7

Achieving universal electricity access will largely be determined by government policies and regulations. Good intentions must be followed by a clear commitment to implement and actualize them. A good policy and regulatory environment increases private capital flows from investors required to achieve SDG 7. Many governments from the selected markets have very elaborate electrification strategies, some of them adopting a comprehensive approach to electrification but political goodwill to implement them is largely lacking. In all these countries, electrification has substantially been a public function with the national utility having monopoly to distribute and connect customers, so the rise of private decentralised utilities is often seen as an encroachment on the utility`s remit. While this may not be publicly acknowledged, it is clear in practice that many governments have not wholly embraced the privatisation and decentralisation of electricity generation and supply.

©Standard Microgrid

Utilities in most African countries are highly subsidized, resulting in an end use tariff that is not cost-reflective. Subsidies to utilities are both implicit and explicit and the benefit of reduction in costs is reflected in the end-use tariff. Political pressure to maintain a certain threshold of prices is also evident in most tariff-setting cycles.

Subsidies provided to state utilities by donors and financiers for rural electrification in most cases are not tied to service level performance indicators. On the other hand, private sector minigrids are not adequately subsidised, yet they provide a service level of more than 95% in comparison with an average service level of utilities which ranges from 40-50% for the same tier of access.

Of all policy frameworks, those that regard licensing, subsidies, tariffs, grid integration and asset acquisition are particularly important. Recently, governments have created special agencies to expedite rural electrification, like the recently inaugurated rural electrification agencies (REAs) in a number of countries. These entities are responsible for a number of functions regarding electrification but some governments still parcel out some responsibilities among state-owned agencies and administrative units, which creates additional layers and disharmony in the regulatory procedure. The risk component is weighed against three markers—low, medium and high—depending on the government actor responsible for oversight and enforcement. This can be an independent entity, a political leader like the Minister for Energy or a regulator with consultation or accountability to a political leader. For this report we will consider the political risk component in Kenya and Zambia only.

4.1 Political Risk Review—Case Studies

4.1.1 Kenya

Kenya has probably the most agencies in sub-Saharan Africa domiciled under the Ministry of Energy. The most significant as far as electrification is concerned is Kenya Power, Rural Electrification and Renewable Energy Corporation (previously Rural Electrification Authority) and the regulator Energy and Petroleum Regulatory Authority (formerly Energy Regulatory Commission). REREC`s precursor REA was established to fast-track electricity access in rural areas particularly social institutions like schools and hospitals through grid extension and densification. They were also tasked with constructing public minigrids, mostly diesel-powered or hybrid in far-flung hard-to-reach regions where there was no grid nearby. EPRA is responsible for regulating the entire energy and petroleum sector including upstream oil explorations. They grant licenses and develop regulations to guide the exploitation, distribution and consumption of all energy sources.

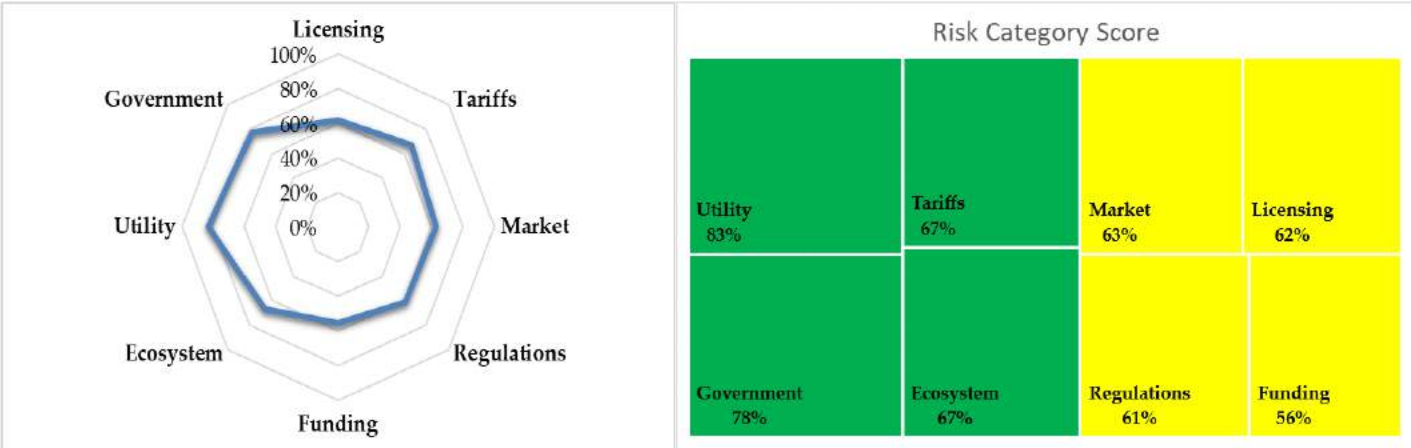
©PowerGen

Kenya has a fairly mature minigrid and solar market in Africa. The country has a National Electrification Plan but it`s not publicly available, making it impossible for minigrid developers to plan for minigrid sites, which increases operating risk. The country has gazetted minigrid regulations and the regulator will embark on public participation as per the requirements of the constitution before finalizing the process. Each site must apply for a license independently and the licensing procedure is not clear cut as there are no established licensing requirements. Tariffs are set by the regulator, but these are not always cost-reflective; many Minigrid operators charge similar amounts despite different capex and opex costs. There exists a grid integration framework, but it remains to be seen how private sector Minigrid operators will be compensated under the different proposed methodologies when the grid arrives.

The government does not have a well-defined implicit and explicit subsidy program for private developers however, a number of organizations like the GIZ, and the Green Minigrid Facility (GMG) have rolled out technical assistance programs and grants i.e. Results Based Financing (RBF) schemes targeting private minigrid developers for a couple of sites in select communities. The RBFs are paid after successful construction and connection.

Kenya Power has recently been experiencing financial challenges due to a combination of factors and this is bound to go on as many commercial and industrial customers who form the main revenue base have switched to cheaper and reliable Commercial and Industrial (C&I) solar. Kenya has a fairly stable political environment but there is often uncertainty during the electoral year. Though significant progress has been made in the management of elections, legitimate concerns of possible unrest exist among potential investors—local and international. Investors usually adopt a wait-and-see posture until the elections are held and determined before committing to invest. This, too, increases the political risk as some of these projects can take long periods of time to actualize.

To understand electricity access political environment, we used eight indicators namely: i) Licensing; ii) Tariffs; iii) Market; iv) Regulation; v) Funding; vi) Ecosystem; vii) Utility and; viii) Government with different questions and a score of between 0-100% depending on the risk indicator. The national political risk indicator was arrived at by averaging the sum of all the eight measures. Red, yellow and green colour codes are adopted for graphical representation as follows: Red, X<-33%; Yellow, 33%<X<67%; Green, X->67%. Kenya`s national score was 67%, which falls within the green region. The charts below show the scores for the other indicators.



Figures 6 and 7: Political Risk Scores for the eight indicators in Kenya

4.1.2 Zambia

Zambia has a fairly developed minigrid and solar market. Even before the advent of solar hybrid minigrids in many African markets, Zambia had already rolled out a few small hydro minigrids in select regions leveraging on their many years of hydro development. Zambia, like many other African countries, has established a rural electrification authority to guide and fast-rack rural electrification. There is also an independent regulator who is in charge of setting the regulatory framework and setting the tariffs. Licensing for minigrids is standardized and the process is similar to grid-tied licensing, but it is possible to get a generation and distribution license at once. The regulator has developed with the assistance of the European Union under the IAREP, a minigrids framework and regulations to provide a light handed approach to minigrids on licensing, technical specifications, tariff setting and grid integration processes. The regulations are yet to be gazetted in order to become fully operational to minigrids.The government is very open to minigrids but there are no comprehensive electrification plans adopting an integrated approach to electrification. The only semblance of a least cost electrification plan was a consultant`s report which was largely discredited by major stakeholders as not reflective of the reality on the ground. The national utility is not financially solvent and the government is keen on public private partnerships in rural electrification.

There has been attempts at subsidizing private sector - led rural electrification, but this can be attributed to development partners and not the national government. The World Bank inaugurated the Electricity Service Access Program (ESAP), which will offer partial grant subsidies to private sector companies to expand electricity access in select rural households and strengthen the capacity of key energy institutions, address regulatory barriers and develop financial mechanisms leveraging private sector engagement.

The biggest bottleneck facing minigrid deployment is land acquisition due to chiefs' rights which fall outside of ERB`s remit. Politically, the country is fairly stable. The government is on an aggressive borrowing pathway as it enhances its infrastructure and there is a fear it might default on payments. While this may not directly affect rural electrification, it may affect the economic health of the country, particularly the financial sector, with the national currency depreciating affecting minigrids revenue and tariff volatility. This has raised a lot of international concerns about the long-term viability of the National Grid.[14]

To understand the electricity access political environment, we used eight indicators namely: i) Licensing; ii) Tariffs; iii) Market; iv) Regulation; v) Funding; vi) Ecosystem; vii) Utility and; viii) Government, with different questions and a score of between 0-100% depending on the risk indicator. The national political risk indicator was arrived at by averaging the sum of all the eight measures. Red, yellow and green colour codes are adopted for graphical representation as follows: Red, X<-33%; Yellow, 33%<X<67%; Green, X->67%. Zambia`s national score was 63% which falls within the yellow region and the charts below shows the scores for the other indicators.

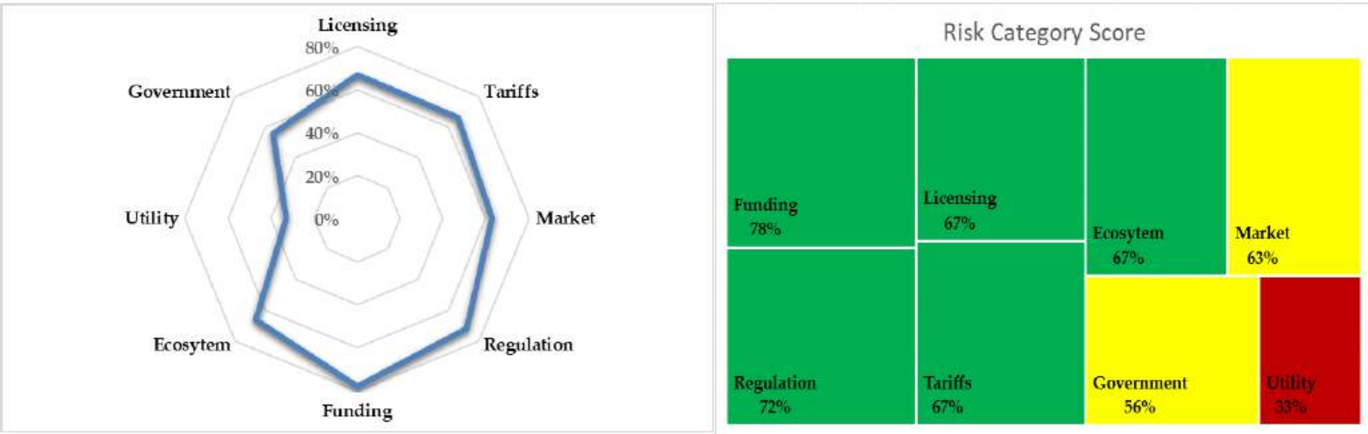


Figure 8 and 9: Political Risk Scores for the eight indicators in Zambia

CONCLUSION AND RECOMMENDATIONS

5.1 Key Findings

Our analysis, which is supported by previous research from IEA and others, clearly shows the billions of dollars of donor and Africa government dollars that taking a truly integrated energy planning approach will save.

Population in Africa is rising at a rate not commensurate to electricity access; in many of the countries surveyed population growth is outstripping electricity access efforts. Even with increased urbanization, a significant number of African citizens will still be living in rural areas requiring out-of-the-box approaches to electrification. Centralization of electrification was borne out of need as economies grew and become more connected.

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A comprehensive approach to electrification is going to be more economical and technically feasible for many African countries over a Business-as-Usual approach. The main selling point of a comprehensive approach is cost and speed. Achieving universal access by 2030 in the 15 markets alone using a comprehensive approach will save the countries US$ 90 Billion and bring reliable high-quality electricity to deserving populations in the shortest time possible. Moving forward, a multi-tier framework should be adopted in understanding electricity access over a binary ‘yes/no’ approach which does not factor in multi-dimensional issues like electricity quality, quantity, service level etc.

Many utilities in Africa are financially insolvent. This is going to be the reality for many utilities in the foreseeable future unless there is a radical shift to include public private partnerships in electricity connection. Utilities are largely subsidized up to—or more than--$800 to connect rural customers. This sum can connect a rural household with a high-quality minigrid electricity. Government subsidies are largely lacking for private decentralised utilities; the only subsidy programs available for private minigrids are by development finance institutions like the World Bank, Africa Development Bank and development partners like the GIZ. Even with that, these subsidies are still low compared to public subsidies. Most subsidies for private developers are in the range of US $ 400 per connection. The RBF facility in Nigeria pays US$ 350 per connection which is less than half of public subsidies.

The levelized cost of electricity (LCOE) for solar hybrid minigrids is expected to be lower, or in the worst-case scenario, be at par with the levelized cost of electricity (LCOE) for unsubsidized utility tariffs by 2030 due to plummeting hardware costs, economies of scale and increasing load factor to 40%[11]. Achieving the required economies of scale for private minigrids will require support in form of subsidies and grants from the government, development finance institutions and other development partners.

Achieving universal access by 2030 will rise and fall depending on government policies and the regulatory environment in place. In most of the countries surveyed, governments have committed to achieve universal access by 2030 and have established national electrification strategies and rural electrification authorities (REAs). However, few governments have least-cost electrification plans and for the few that have, they are not optimal (like Zambia). Licensing, land acquisition rights, environmental impacts assessments etc still take inordinate amounts of time to be finalized. Minigrid policies are still lacking and for the few that have, implementation is still a challenge. Despite the changing nature of electricity access to decentralised approach, government functions are still very centralized and sometimes shared between different government entities making it even harder to navigate the bureaucracy.

Many decisions regarding minigrid regulation are still made by political appointees, thus increasing the political risk. In some scenarios an independent regulator is tasked with regulation but with consultation or oversight from a political appointee. Transparency especially with national electrification plans from the utility is lacking, making minigrid developers wallow in uncertainty, thus increasing the risk of asset seizure when the grid arrives for countries with no clear grid integration and compensation policies.

5.2 Way Forward

At the very basic, all African countries need to develop a comprehensive or least-cost approach to electrification. From our analysis, a least-cost approach is a technical and economic silver bullet for achieving universal access by 2030. Financially solvency of utilities is pegged on leveraging private capital to reduce capex and opex costs. Overreliance on grid extension as the primary and singular mode of electrification even in economically unviable environments has proven not to be a very prudent way of using public resources. A fraction of the same can be used to provide better services and free up capital to be deployed in other essential services and infrastructure development. Subsidies are and will still be needed for private developers until a point when they will have reached scale to grow without subsidies. While there are many ways to apply subsidies, subsidy parity between public and private utilities is a good place to start. Decentralisation of licensing, permitting and other regulations pertaining minigrid deployment is necessary. This will reduce time and effort taken in acquiring them. All regulations regarding electrification should be harmonized and domiciled with one government entity and administrative bottlenecks and hierarchies at the community level eliminated. The electricity regulator should be completely independent with clear-cut objectives anchored in law to minimize political risks associated with individual political appointee.

ANNEX: ELECTRICITY ACCESS AND DEFICIT COSTS

Case Studies

Kenya

Kenya is not only hailed as a renewable energy powerhouse in Africa, but as one of the countries to have made significant strides in expanding energy access around the world alongside Myanmar, Rwanda, Bangladesh and some others in the last decade. This has been achieved through a blend of aggressive grid-expansion efforts by the Kenyan government, coupled with a thriving solar market especially solar home systems (SHSs) and favourable government policies that have allowed a private sector-led electrification to scale.

The current national electrification rate in Kenya stands at approx. 65-75% depending on data source. Rural electrification rate is way below this and in some frontier counties like Turkana the rate of electrification can be as low as 15%. The current population according to 2019 National Census is 47.2 million and this is expected to hit 67 million by 2030 from the population growth rate assumed. At the current rate of electrification, Kenya is one of the countries out of the 15 expected to reach universal access by 2030, with the model projecting a national electrification rate of 96% in 2030. This will require a concerted effort involving extending the grid in feasible urban and rural areas, deploying public and private minigrids and delivery of solar home systems (SHSs).

Achieving universal access by 2030 under a Business as Usual Approach (BAU) will cost Kenya approx. US $ 10 billion while a comprehensive approach integrating grid extension, minigrids and SHSs will cost approximately US $ 5 billion—a half the amount for the same or even better level of service whilst saving US $ 5 billion to be used in other infrastructure expansion efforts. Thankfully, Kenya has shown interest in expanding solar off-grid systems in form of solar hybrid minigrids and standalone systems. A combination of these three are expected to play a significant role in achieving universal access by 2030.

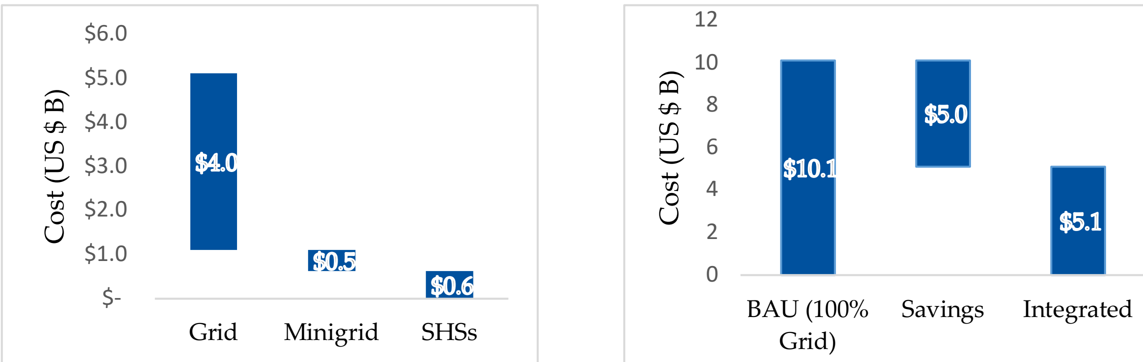


Figure 10: Cost of achieving SDG 7 in Kenya under BAU and Comprehensive Approach

Zambia

Zambia`s current population stands at approximately 15 million residents and is expected to hit 24 million by 2030. The total installed capacity nationally is 2800 MW, with hydro accounting for the largest share at 85%. Only 4% of the rural population is connected to the main grid in 2020. This has generated interest in off-grid solutions like solar home systems and extending the main grid to sparse populations is economically unfeasible.

Development Finance Institutions (DFIs) like the EU and the World Bank have been working in electricity access for a while and have been leveraging innovative programs to stimulate and grow a private sector-led rural electrification. The Electricity Service Access Program (ESAP) is a World Bank-funded program to address electricity access expansion in rural settlements using off-grid solutions. The program will offer partial grant subsidies to private sector companies to expand electricity access in select rural households and strengthen the capacity of key energy institutions, address regulatory barriers and develop financial mechanisms leveraging private sector engagement. Another key initiative is Beyond the Grid Fund for Africa, an initiative of the Swedish government to advance electricity access to a select number of countries in Africa. In Zambia, the program involves EUR 20 million in financing and hopes to connect 167,000 households (1 million Zambians) with modern energy services by 2021.[14]

Today, national electrification stands at 42% and rural electrification, which is mainly off-grid-led at 14%. These figures are not expected to change significantly by 2030 as the projected national electrification then will be 43%. A significant 13 million (57 %) Zambians, 10 million of them being rural dwellers, will have no access to electricity services by 2030, given the present electrification and population growth trajectories. Achieving universal electrification by 2030 under a Business as Usual (BAU) grid expansion approach will require US $ 5 Billion or US $ 3 Billion under a comprehensive approach which will yield savings amounting to US $ 2 Billion.

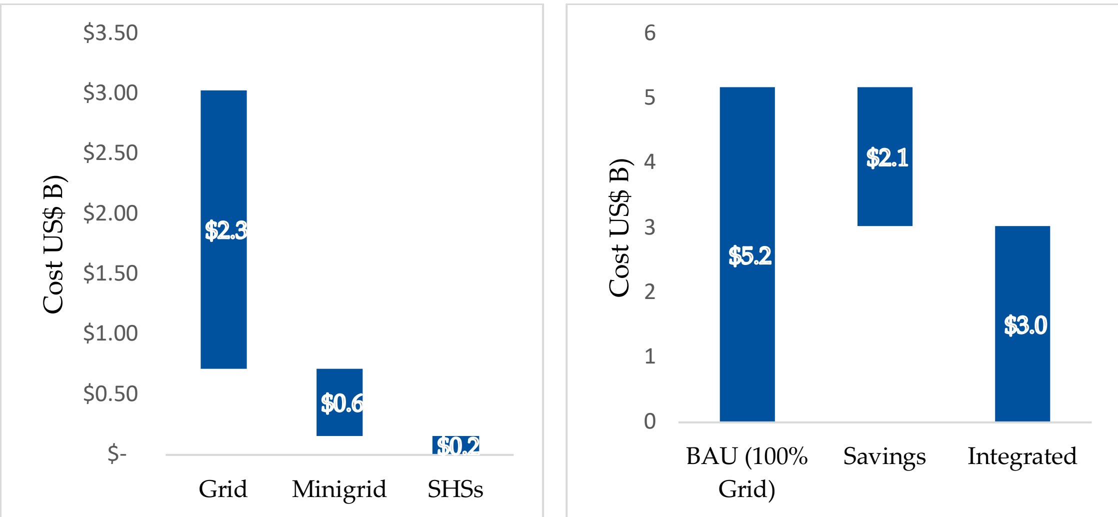


Figure 11 and 12: Cost of achieving SDG 7 in Zambia under BAU and Comprehensive Approach

[14] Beyond the Grid Fund for Zambia. (2019). From Zambia to Africa: Bringing Clean Energy Access to Five Million People Beyond the Grid. Available at: https://www.bgfz.org/

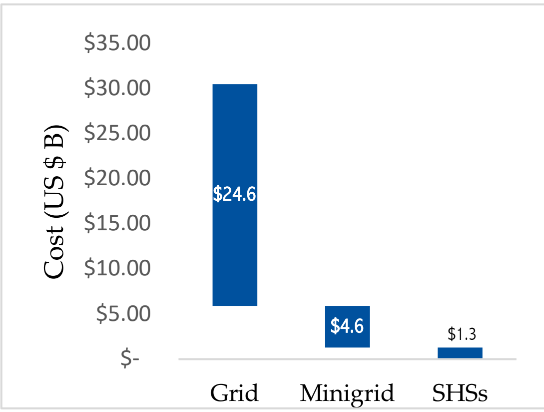
Nigeria

The largest economy and most populous country in Africa faces enormous energy access challenges. Not only is electricity access low across the country, but service is also exceptionally poor to those served by the grid. The total installed capacity in Nigeria is approximately 13000MW but the old and dilapidated grid can only deliver a meagre 5000MW to the 200 million population. Gas-powered plants are the main generation technologies, accounting for 80% of the installed capacity but underinvestment in gas infrastructure and lack of regulation affects the gas delivery value chain, hence the frequent power outages. These frequent disruptions in electricity supply have led to the proliferation of private diesel generators as back-up, which contributes significantly to CO2 emissions. Further, electricity access in Nigeria has a geographical divide: the northern areas of Kano region are particularly lacking in basic transmission and distribution infrastructure, compared to the wealthier and industrial oil and gas southern region.

Nigeria has a thriving off-grid solar market backed by comprehensive minigrid policies. The Rural Electrification Authority has ambitious plans to connect off-grid customers with off-grid solutions like solar-hybrid minigrids and standalone solar systems. Nigeria is a pioneer in off-grid subsidies for off-grid solar in form of performance-based grants (RBF facilities) in collaboration with Development Finance Institutions (DFIs) like the World Bank and the Africa Development Bank. Recently, the World Bank rolled out a $350 million facility and the Africa Development Bank committed US $ 200 million to be used in upscaling solar hybrid minigrids and solar home systems.

Electricity access in Nigeria stands at 55% nationally, with rural electrification at 22%. Given the rate of electrification vis-à-vis population growth, national electrification is expected to drop to 44% (118 million citizens) while rural electrification slumps to 17% (18 million citizens) by 2030. In effect, 145 million (56%) citizens in Nigeria, many of them in rural settings, will have no access to basic electric services.

From our model, it is estimated that Nigeria will require US $ 48 Billion to achieve universal electricity access by 2030 under a Business as Usual (BAU) grid extension approach or US $ 30 Billion under a comprehensive approach integrating grid extension, minigrids and standalone solar systems resulting in a cumulative savings of US $ 18 Billion. Given the status of the Nigeria grid, it would be technically impossible to connect many more households without a significant upgrade of the entire transmission and distribution infrastructure, which will equally require enormous amounts of money outside of the connection costs.



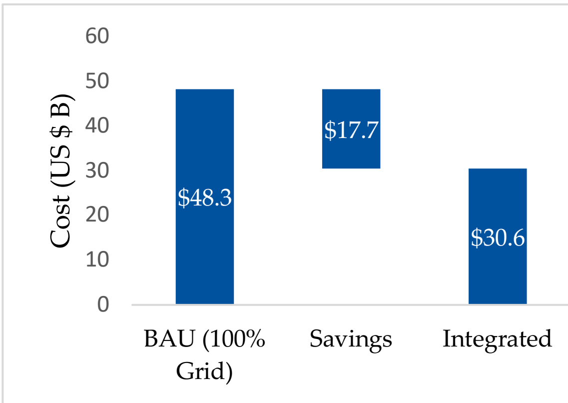


Figure 13 and 14: Cost of achieving SDG 7 in Nigeria under BAU and Comprehensive Approach

Tanzania

Tanzania`s current installed capacity stands at 1500 MW. Hydro-electricity has supplied most of the electricity but recent discoveries in natural in the southern parts bordering Mozambique has led to increased investment in exploitation of gas. Gas is thus expected to play a significant role in Tanzania`s electricity supply in the coming years.

Electricity access nationally stands at 34% with rural electrification lagging at 17%. While Tanzania was one of the pioneer countries in deployment of solar-hybrid minigrids, a lack of understanding and stability threatens to end the sector. TANESCO, the public utility reported an increase in electrification from 18% in 2011 to 29% in 2018. As welcome as this is, the growth is still low compared to her neighbours like Kenya which made serious strides over a similar period. According to the Electricity Supply Industry Reform Strategy and Roadmap, the government intends to connect 75% of the population by 2033 making it an outlier even compared to other African countries which are targeting universal access by 2030 or even earlier. This could be attributed to a focus on centralized grid-extension services most likely to utilize natural resources like natural gas, which may not favour a decentralized approach to electrification.

Our model estimates that according to recent trends in electrification, vis-à-vis population growth, national electrification by 2030 will stand at 34% and rural electrification at 15%. A significant 48 million (66%) Tanzanians, 42 million in rural dwellings will have no access to electricity. To achieve universal access by 2030 under a Business as Usual (BAU) grid extension approach will require US$ 25 Billion compared to US$ 14 Billion under a comprehensive integrated approach resulting in US$ 11 Billion total savings. For a country hoping to expand electricity access quickly and cheaply, adoption of a comprehensive approach is a compelling proposition. This, nonetheless, will require not just monetary investment but a redesign of electrification policies and regulations.

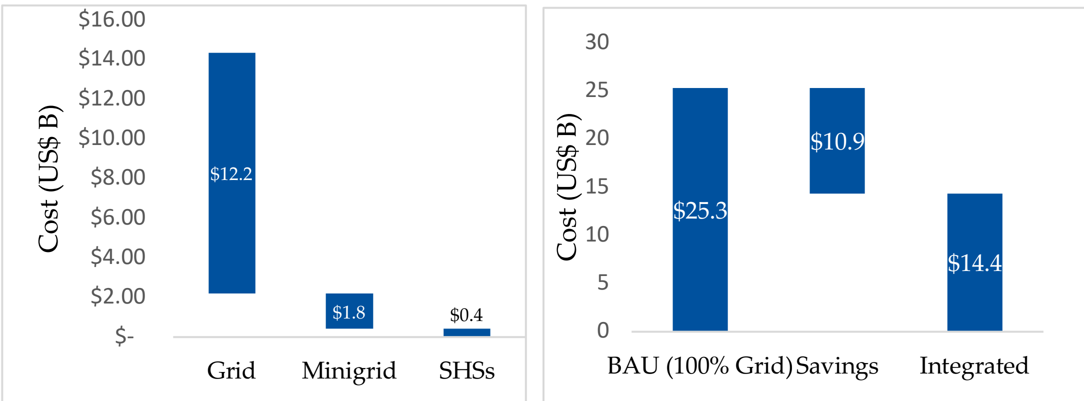


Figure 15: Cost of achieving SDG 7 in Tanzania under BAU and Comprehensive Approach

Uganda

Connecting rural households is probably the most vexing issue for utilities operating in sub-Sahara Africa. Even for those who are connected, consumption is very low at significantly under 30 kWh/month. National electrification today stands at 22%, with rural electrification standing at 11%, which is fairly consistent with her African peers. The government has ambitious plans to electrify Uganda using a blend of on-grid and off-grid solutions. Under the Rural Electrification Strategy and Plan (RESP, 2013-2022), the government plans to expand rural connectivity to 22% by 2022 using a mix of grid and off-grid initiatives.

The Uganda Rural Energy Agency (UREA) was established to oversee and coordinate this by leveraging private sector initiatives. Particularly, UREA was expected to catalyse market development by adopting end-user subsidies where off-grid solar companies selected in the programme were to receive a 50% subsidy to be transferred to the end-user. The project, however, had a very bad outcome as many solar companies abused it by not transferring the subsidies to the end-user, which led to an abrupt termination of the program.

Our model projects that in 2030, electricity access in Uganda will slump to 17% nationally and 8% rural electrification. A total of 53 million (83%) Uganda citizens will lack access to basic electricity services in 2030. Our financial model estimates that to achieve universal access by 2030 under a Business as usual (BAU) approach, Uganda will require US $17 Billion compared to US $ 9 Billion under a comprehensive approach. The total savings accrued by adopting an integrated approach will be US$ 8 Billion.

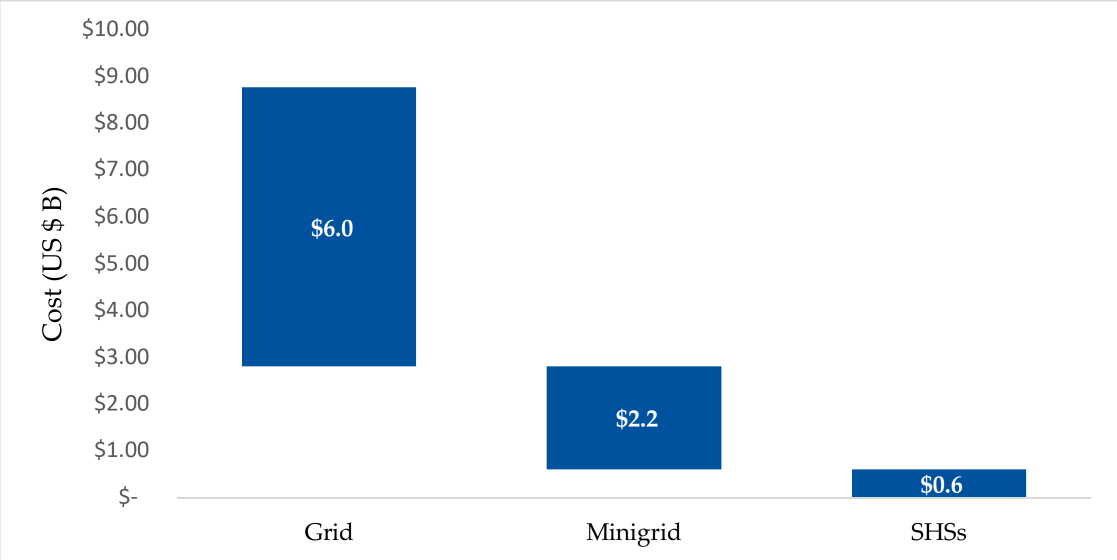


Figure 16: Cost of achieving SDG 7 in Uganda under BAU and Comprehensive Approach

Togo

Togo`s national installed capacity stands at 230 MW of which fossil fuels contribute 164 MW and hydro 66MW. Togo has very limited experience with independent power producers (IPP) and the first IPP contract came into force in 2010. The national utility is faced with similar technical and economic challenges that utilities in sub-Sahara Africa face. Only 5% of rural dwellers are connected to the grid. Togo particularly lacks a comprehensive approach to electrification leveraging grid and off-grid electrification.

A presidential directive called `CIZO` was issued in 2018 to increase rural electrification by 40% in 2022. Togo targets universal access by 2030 and to achieve this, a mixture of on-grid and off-grid strategies will be deployed. A strategy paper seen by AMDA estimates that Togo intends to deploy 300+ minigrids by 2030 effectively electrifying 55000 households; install 500,000 solar home systems and connect 400,000 `under the grid` customers and connect 270,000 new customers by grid extension.

The national electrification to date stands at 49% with rural electrification at 19%, with these rates expected to rise marginally by 2030. Given the rate of electrification, almost half of the entire Togolese population (5 million people) with a majority in rural settings (4 million) will not have access to basic electricity services. Achieving universal access under a Business as Usual (BAU) approach by 2030, will require US $ 2 Billion while a comprehensive approach will require half that amount saving the country a whole US $ 1Billion. A similar analysis by Lighting Global estimates that Togo will require an estimated CFA 83 billion (US$ 153 million) annually from 2018-2030 under a comprehensive approach to electrification to achieve universal access by 2030[15].

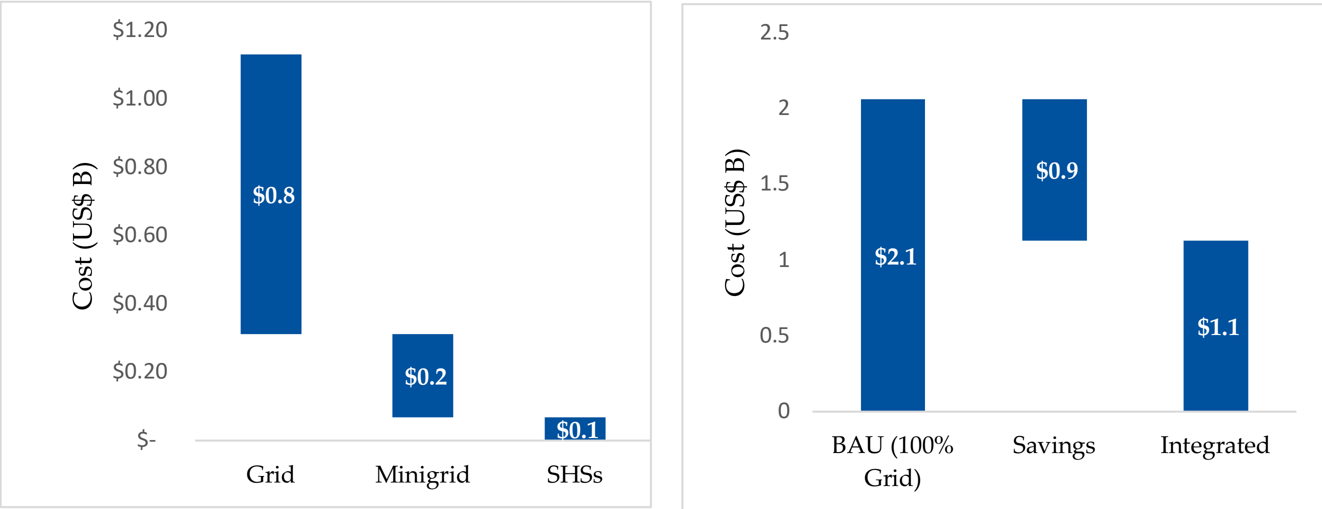


Figure 17: Cost of achieving SDG 7 in Togo under BAU and Comprehensive Approach

Benin

Benin is one of the countries in Africa with very low electrification rates. To date, the country`s installed capacity is 349 MW with the bulk of that supplied by diesel power plants. 75-95% of the country`s electricity consumption is imported from Nigeria, Ghana and Togo.[16] The country has had very limited experience with Independent Power Producers (IPPs), no regulatory authority and a largely incoherent electrification policy and generation masterplan.

Power Africa has recently stepped in through Millennium Challenge Corporation, which has deployed a US $ 350 million grant fund targeted at strengthening the power sector. The government of Benin has also committed to US$ 28 million towards the same. MCC will support tariff reforms, develop an enabling environment for IPPs, support the operational independence and financial viability of the national utility and support the government establish a masterplan for rural electrification. MCC set up the Off-grid Clean Energy Fund (OCEF) as a challenge or catalyst fund to leverage private sector involvement in rural electrification using either solar minigrids or standalone solar systems. The fund is in operation and a consortium of Powergen Renewable Energy and Sunkofa won a US$ 20 million tender to set up 40 minigrids to electrify 84,000 Beninese over a period of 2 years. Other companies and consortiums of companies have also been awarded contracts under the same fund to build and operate minigrids in a number of sites in Benin. These include Akuo Energy Africa, Energicity Corp, Engie PowerCorner among others.[17]

Benin is one of the many countries expected not to achieve universal access by 2030 given recent electrification patterns. While there is strong enthusiasm for off-grid solutions given the recent interventions

[15] Lighting Global. (2018). Togo Electrification Strategy. Available at: https://www.lightingglobal.org/wp-content/uploads/2018/12/Togo-Electrification-Strategy-Short-EN-Final.pdf
[16] Worldometer. (2016). Benin Electricity. Available at: https://www.worldometers.info/electricity/benin-electricity/
[17] Afrik21. (2020). BENIN: 11 Companies Selected for 8 Mini-solar Grids Projects in Rural Areas. Available at: https://www.afrik21.africa/en/benin-11-companies-selected-for-8-mini-solar-grids-projects-in-rural-areas/

in technical assistance, grant funds and regulatory support significant investments need to be deployed to achieve universal access. From our model, close to 10 million (64%) will be unelectrified in 2030. Achieving universal access under a Business as Usual (BAU) approach will require approximately US $3 billion and US $ 2 billion under a comprehensive approach.

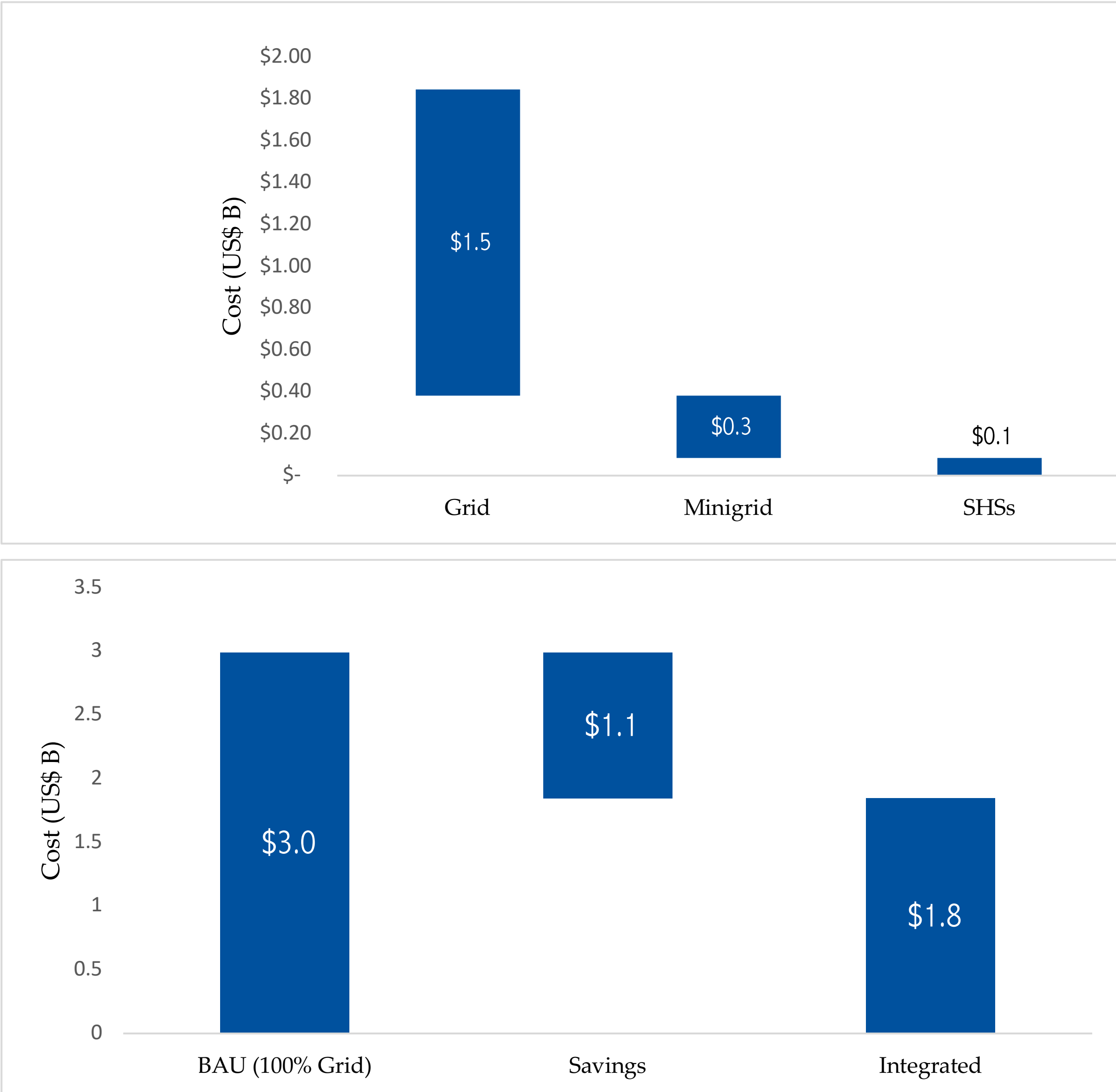


Figure 18: Cost of achieving SDG 7 in Benin under BAU and Comprehensive Approach

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