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Rethinking African electrification and power sector decarbonisation strategies and support in an era of just transition partnerships

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Abstract

The Just Energy Transition Partnership between South Africa and several international partners has garnered significant global interest as a model for supporting energy transitions in developing economies. This paper discusses the diversity of energy system challenges across Africa and the differences enabling environments for energy transition and identifies countries that require and have the enabling environment for an accelerated phase-out of fossil fuels under JETP-like structures. The paper also analyses the status and trends in electrification in Africa, particularly in Sub-Saharan Africa, and outlines the constraints to rapid electrification, the shortcomings of past external support to Africa's power sector, and the key megatrends are crucial to energy system planning in the region. The policy implications of the constraints, shortcomings, and megatrends, including JETPs and the role of external development partners, are also discussed. Overall, it is argued that while some African countries may benefit from JETP-like structures, the majority may not need bilateral agreements such as JETPs and that their energy needs would be better served by prioritising the development of regional electricity markets and addressing the constraints and shortcomings that have led to poor electrification outcomes in the past.

Keywords: Just energy transition partnership, electrification, decarbonisation, power pools, regional electricity markets.

JEL Codes: J08, J23, J3, J48, J6

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Introduction

The Just Energy Transition Partnership (JETP) between South Africa and France, Germany, the United Kingdom, the United States of America, and the European Union (the International Partners Group) was one of the most impressive things to come out of the COP26 climate summit. Not even the surprise announcement indicating the commitment by China and the United States to work together to achieve the 1.5 C temperature goal set out in the 2015 Paris Agreement could beat South Africa's take home from the summit.

The significance of the deal lies in its novelty and potential. For one thing, the deal constitutes a pioneering model of country-specific, 'whole system' climate finance partnership based on well-formulated country needs. In terms of potential, the partnership promises to mobilise far greater funding for South Africa's just transition needs through catalytic use of the funds, including concessional and grant funding and guarantees.

Given the novelty and potential of such a country platform for supporting energy transitions in developing economies, it is not surprising that the concept of JETP has attracted significant global interest. Indeed, because of the positive reception to the JETP, the G7 group of countries have signalled the possibility of negotiating similar partnerships with coal-reliant emerging economies like Indonesia, Vietnam and India but also Senegal, a growing gas producer (G7 Germany, 2022).

In Africa, other oil and gas producers grappling with the economic and social consequences of energy transitions are considering their own JETPs for climate-friendly development pathways. Such growing interest in African countries looking for their own JETP raises questions about, first, whether all other African countries need such a 'bilateral' agreement scheme for their energy needs, and second, what kinds of energy development strategies and support are appropriate for Africa. This paper addresses these questions by identifying countries that require and have the enabling environment for accelerated energy transition under JETP-like structures. It is argued that for most African countries, however, what is required is a scale-up of electricity access and thus fitting/appropriate energy development strategies and support measures are those that prioritise energy access and are informed by (1) Factors that have shaped the poor electrification outcomes, (2) Failings of past energy development support measures (3) New megatrends crucial to Africa's energy system planning.

Following this introduction, the rest of the paper is structured as follows. Section 2 highlights the diversity of energy system challenges and differences in enabling environment for energy transition to identify African countries for whom an accelerated phase-out of fossil fuel under JETP-like structures is justified. Section 3 examines the status and trends in electrification in Africa, highlighting the particularly poor outcomes in Sub-Saharan Africa (SSA) despite increasing efforts and support during the past two decades. In Section 4, the constraints to rapid electrification, the shortcomings of external support to Africa's power sector, and the key megatrends crucial to Africa's energy system planning are outlined. Section 5 then draws on the analysis in the preceding section to interrogate key and strategic policy questions, including the implications of JETPs for regional power integration. Finally, Section 6 presents the key overarching policy implications, including the role of external development partners.

Is Just transition partnership deal necessary for all African countries?

Zimbabwe Africa's energy landscape is extremely diverse. It presents different energy structures, different levels of infrastructure development and consequently varied energy issues in terms of electrification rate, carbon intensity, and capacity for renewable energy transition. The diversity of the continent's landscape effectively defines distinct solution space for each country in terms of meeting Sustainable Development Goal (SDG) 7 targets on energy access and renewable energy transition.

As a reminder, JETPs are in support of global climate goals. They are meant to decarbonise carbon-intensive power systems by phasing out fossil fuels (especially coal) while increasing the share of renewable energies in the energy mix (G7 Germany, 2022). Additionally, considering the gap between the volume of finance required and funds provided under South Africa's JETP, it is apparent such partnership counts on a broader enabling environment to mobilise additional local and international capital through catalytic use of funds, including concessional and grant funding, as well as guarantees.

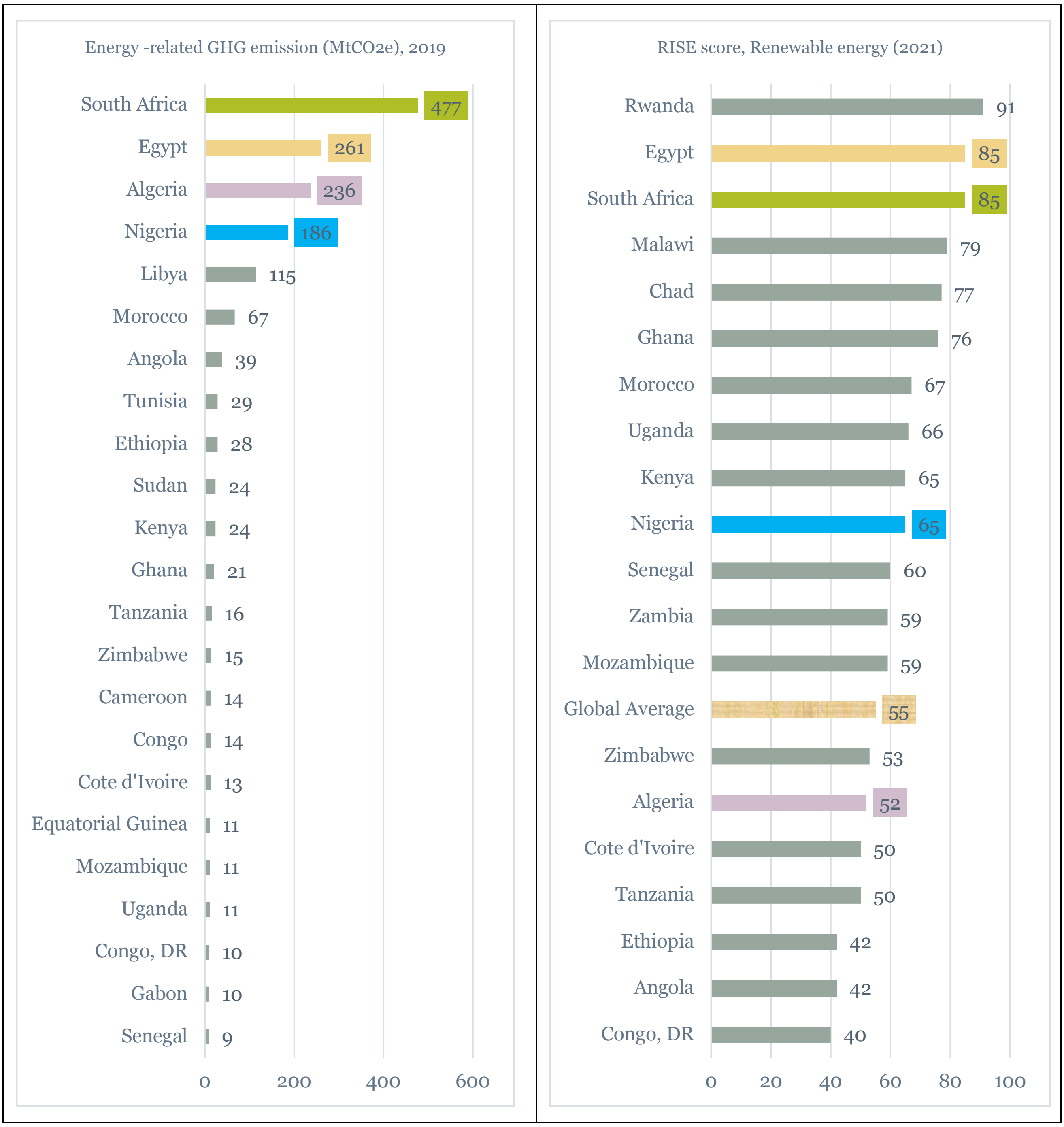
In both regards, South Africa is undoubtedly a perfect candidate: it is the continent's most significant and world's 13th biggest greenhouse gas emitter (2020) due, in large part, to coal dominant power system that generates up to 85% of electricity from coal-fired power plants (European Commission et al., 2021; Tyler & Mgoduso, 2022). Besides, the country's relatively favourable enabling environment to attract investment into sustainable energy is apparent – from infrastructure development and a well-developed capital market to institutional, policy and regulatory environment.

Apart from South Africa, however, few other countries come close to matching these criteria. Stated differently, only a few other African countries require and are well-equipped for accelerated energy transition under JETP-like structures. Notable among these are **Nigeria, Egypt and Algeria**. In 2019, the three countries were the third to fifth biggest polluters on the continent, behind the Democratic Republic of Congo and South Africa, with the energy sectors being the key sources of emissions. Furthermore, in terms of enabling environment, the relatively favourable position of these countries can be inferred from metrics from the World Bank's Readiness for Investment in Sustainable Energy (RISE) that compares the quality of national policy and regulatory environment for attracting investment into sustainable energy as well as several other measures including the World Economic Forum's Global Competitiveness Index, the most recent AfDB Africa Industrialisation Index as well as UNCTAD's World Investment Report on foreign direct investment (FDI) flows (See Figure 1).

However, for most other African economies, an accelerated energy transition through JETP-like structures is hardly justified. For one thing, energy-related emissions from these countries are not only minimal, but also, for most of them, the energy sector is not the top source of emission. For instance, in 2019, the energy sector was the top source of emissions for just 16 African countries[1]. For the remaining majority, agriculture (20), land-use change and forestry (17), and industrial processes (1) were the largest sources of emission (see Appendix A). On the other hand, the country context and energy markets are mostly unfavourable to attract private sector investment into renewable energy.

[1] Country (emission in MtCO2e): South Africa (477.1); Egypt (260.75); Algeria (235.57); Nigeria (186.31); Libya (114.87); Morocco (67.05); Tunisia (28.99); Ghana (20.79); Congo (14); Eq. Guinea (10.8); Gabon (10.2); Mauritius (4.23); Eswatini (1.05); Cape Verde (0.65); Seychelles (0.61); Comoros (0.32)

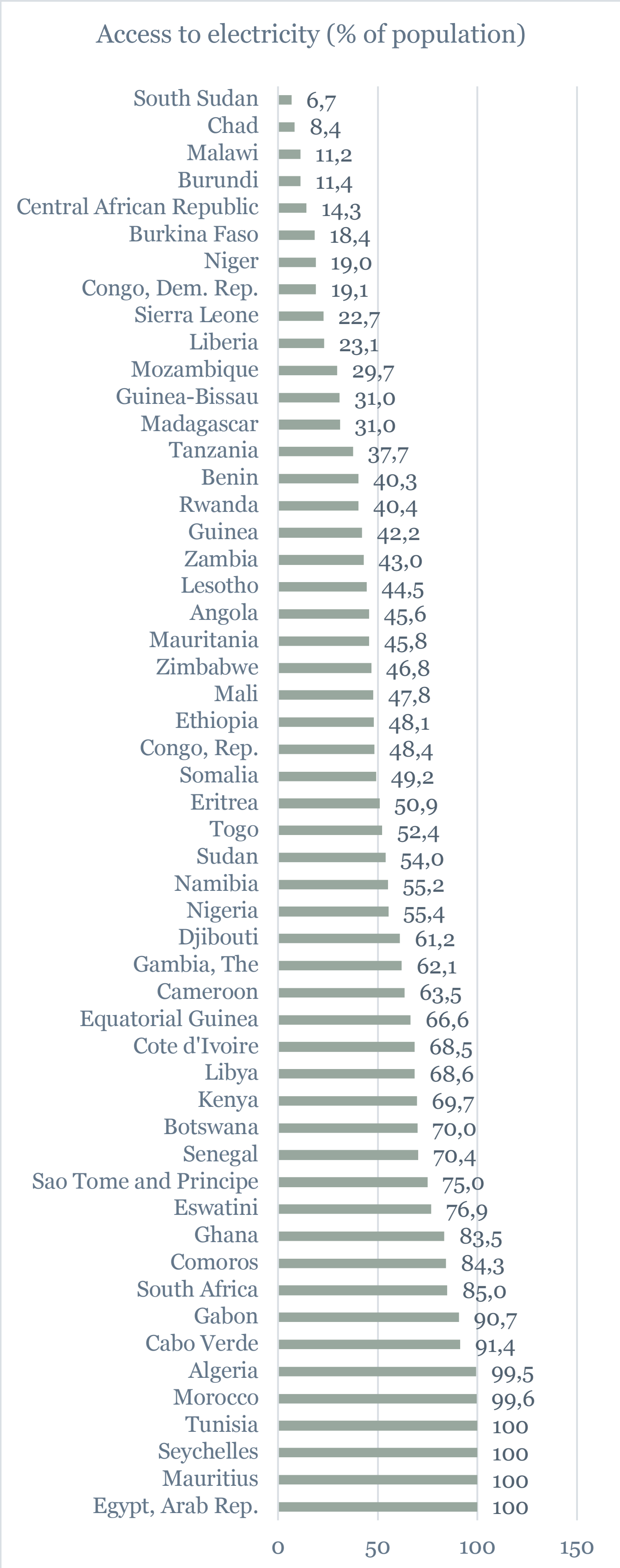
Figure 1:The need and enabling environment for an accelerated energy transition.

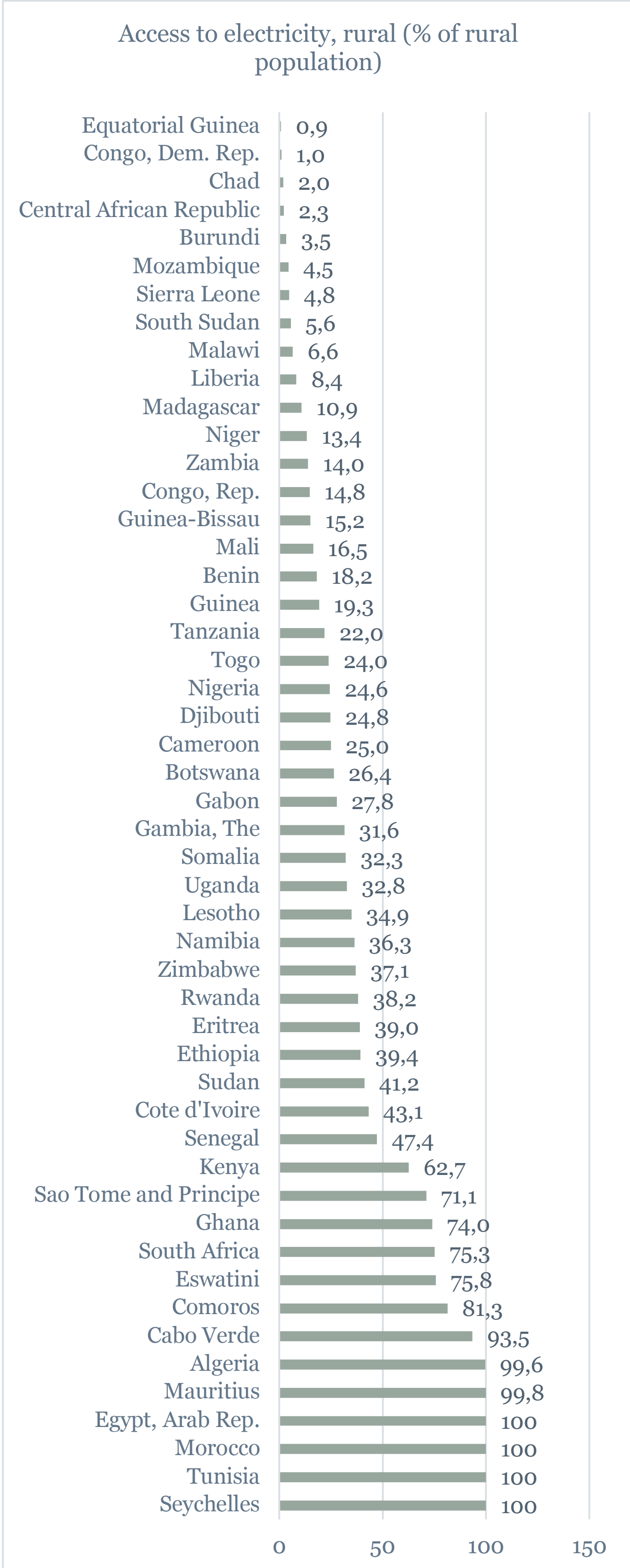


Source: Based on RISE and Climate Watch CAIT Data

Certainly, for the vast majority of other African countries, the most significant energy system challenge is electricity access which is less than 50% in most places and dropping to less than 1% in rural areas (See Figure 2).

Figure 2:Overall and rural electrification rates by country, 2019





Source: Based on World Bank data

In 2019, Egypt was one of four African countries with 100% electricity access. On the other hand, Algeria and South Africa had a 99% and 85% electricity access rate, respectively, while only 55,4% of Nigerians had access to electricity. Thus, among the countries that require fossil fuel phase-out, Nigeria presents a unique case of a country that combines a highly polluting (carbon-intensive) energy system with a low electrification rate. In fact, of the over 585 million Africans who lacked access to electricity in 2019, 15.3% are in Nigeria[2].

For most African countries that combine minimal energy-related emissions with limited energy access, the immediate priority is not energy transition. Instead, they need a scale-up of energy access. In other words, the transition required for the typical African power grid can be thought of as 'vertical' because total output must rise rapidly. The few others (Egypt, Algeria, South Africa), by contrast, face a 'horizontal' energy transition starting from a high base.

At this point, it is worth emphasising that considering the urgent need for energy access and poor industrial development and job creation outcomes across Africa, the objectives of energy transition ought to be far-reaching economic diversification that creates decent jobs; environmental stewardship and climate resilience; and universal access to affordable, reliable, sustainable and modern energy. However, an accelerated wholesale phasing out of fossil fuels without due consideration to the carbon intensity of the energy sector and the quality of enabling environment required, the goals of economic transformation, job creation and indeed affordability of clean energy output would hardly be realised (See Box 1).

Box 1: Implications of country context and enabling environment for energy transition outcomes

For the majority of African countries without the comparative advantage in attracting private sector investment and provisioning of renewables-related goods and services, a significant debate in development economics about whether countries, within the context of their resource potential, should be complying with or defying their existing comparative advantages eerily comes to mind (see, for example, Lin and Chang, 2009). Two key points are worth making here. (1) Some of the key drivers underpinning comparative advantage, such as human, institutional and technological capabilities, are policy-induced; (2) Most resource-dependent African countries face the imperative of diversifying their productive structures to avoid the hazards of commodity dependence and vulnerability to climate change (IRENA, 2022).

These points notwithstanding, it is critical that support for energy transition play to the strengths and weaknesses of African countries, whether in terms of their industrial capacities, commodity and trade dependencies, or skills base, as this has implications not only for the cost and affordability of energy outputs but also the localisation of supply chains that are crucial to job creation.

Consider, for instance, the technical challenge of integrating high levels of variable renewable energy (VRE) into power grids. The sophisticated operational (grid management) capabilities required for integrating high shares of renewable energy are not yet widely found in Africa. Experiences in Kenya, Senegal, and South Africa, where there has been a relatively successful integration of VRE into the power mix, point to the reality of technical challenges. For instance, in Kenya, the recent integration of VRE (wind and solar PV) into the grid that brought the contribution of VRE to the national installed capacity to 14.6% from 0.3% in 2003 has introduced

[2] Even more, for those with electricity access, reliability is not promised making Nigerians the largest users of oil-fired back-up generators on the African continent (IEA, 2019).

unprecedented challenges in power system operations as power system operators and planners struggle with increased variability and uncertainty affecting their ability to balance demand and supply (GIZ & MoE, 2020). Underpinning these challenges are the country's limited power systems control automation, minimal operating reserves, weak distribution and transmission network, and limited VRE forecasting capabilities. The immediate consequences include additional costs of associated ancillary services to manage the current share of VRE, the value of which is estimated at $50 million per year (Mutua, 2020).

It is useful to add that while rapid improvements to operational capabilities can be made (and experiences across the continent testify to this), the present discouraging conditions in many countries' power sectors cannot be waved away. Indeed, the widespread inability of African utilities to perform the basic functions involved in supplying electricity illustrates the scale of the challenges they will face to transition to more technically demanding intermittent sources of low-carbon power.

Conspicuously, as key features and outcomes of auctions for renewable energy-independent power projects across Africa show, the country context and national enabling factors have implications for not only price outcomes and scope for local content requirement but also cost implications emanating from foreign exchange currency risks.

Table 1:Main features and outcomes of renewable energy auctions

	South Africa	Uganda	Zambia	Ghana	Namibia	Malawi	Ethiopia	Senegal
Year	2011 - 2018	2014	2016	2016	2017	2017	2017	2018
Auction Demand	6,300 MW (4 rounds) Multiple RE	4 x 5 MW Solar PV	2 x 50MW Solar PV	1 x 20MW Solar PV	1 x 37 MW Solar PV	Max 80 MW Solar PV (4x sites)	1 x 100 MW Solar PV	2 x 30 MW Solar PV
Site Selection	Developer	Developer (3km - grid)	Selected by govt.	Developer (input from offtaker)	Selected by govt./ utility	Substations identified by govt.	Selected by govt.	Selected by govt.
Local Content	40% min	None	None	20%	None (but 30% local shareholding)	5% develop ment & construction 20% O&M	15%	None
Evaluation	70:30 Price: Economic Development	70:30 Price: Technical	Price	Not clear	70: 30 Price: Technical	Price	70:30 Price: Technical	Price
PPA	20 Years	20 Years	25 Years	20 Years	20 Years	25 Years	20 Years	20 Years
Guarantees	Sovereign	Sovereign & Liquidity	Sovereign & Liquidity	Sovereign & Liquidity	None	Sovereign & Liquidity	Sovereign	Sovereign & Liquidity
Winning Price (USDc/ kWh)	4,7*	16,37	6,02	11,47	6,02	7,35 – 10,35 (TBC)	Below US$c6 (TBC)	4,7
Currency	ZAR	US$/EUR	US$	US$	NA$	US$	US$	US$
Financial Close	Yes	Yes	Yes/No	No	Yes	No	No	No

Source: Kruger et al. (2018)

Table 1 provides an overview of some of the main features and outcomes of renewable energy auctions in sub-Saharan Africa. A few important points are worth highlighting:

At less than USDc 5/kWh, South Africa records the lowest price across the Sub-Saharan African (SSA) region even though price was the primary evaluation criterion used in the winner selection process for the other auctions (except Uganda). While the price outcomes are partly explained by auction design and implementation elements (e.g., sizes of the projects, the timing of the auction, the amount of de-risking in the program, and the presence of concessional finance), the broader enabling environment factors are crucial drivers as risks the county and market context portend are accordingly priced into infrastructure projects.

Compared to South Africa's market attractiveness - underpinned by a host of factors including market size, deep local capital markets, and reasonable credit ratings - Uganda, for instance, has the highest price outcome. Uganda's high price outcome, while partly due to auction design features (e.g., the small sizes of the projects), the risky environment has also been indicated as a possible reason (Meyer et al., 2015). Indeed, while low prices in other contexts, including Zambia and Senegal, could signal efficient outcomes in what can be considered a high-risk investment context, such analysis obscures the concessional finance and other support measures, including the provision of land, permits, interconnection facilities and other information/studies - all of which have been instrumental in achieving these price outcomes but are not necessarily replicable in other contexts.

With the unit cost of electricity in many African countries about double the global average ($0.14/kWh) and far higher than in many emerging economies such as Bangladesh ($0.06/kWh), and India ($0.08/kWh), promoting accelerated energy transition in national grids without consideration of national enabling factors risks driving prices for electricity even higher. Higher electricity costs of would have a major negative impact on the pace of economic development, access to basic services that require power (such as healthcare), and the standard of living across the continent, more generally.

Besides price outcomes, it can equally be inferred that the country context, particularly industrial capacity, is crucial to achieving local benefits through local industrialisation and community ownership. Apart from South Africa, local content requirements are minimal in auctions, suggesting not only the prioritisation of cost-effective pricing as the main objective of most auction programs in the region but also the realisation that local supply chains are as yet unable to provide many of the services and products needed to support stringent local content requirements[3]. Thus, localisation is seen as not feasible, given the manufacturing sector capacity in many countries. This observation is worrying, given that the African Union's Agenda 2063 establishes the links between energy and industrialisation (AUC, 2015).

Africa's energy transition must mean more than "transitioning from a fossil fuel-intensive energy system" or just installing technologies that help drive global decarbonisation. Indeed, the promotion of accelerated energy transition without due consideration of differences in productive capacity across the continent has had the effect of making many African countries consumers rather than producers of low-carbon technologies, limiting the creation of jobs and

[3] The pattern of ownership of renewable energy patents shows South Africa as an obvious leader on the African continent with 63% of total African patents, followed by Egypt with 8% (UNEP, EPO 2013). Northern Africa—represented by Egypt (18 patents), Algeria (12) and Morocco (11)—follows suit but lags significantly behind South Africa. Other realities, such as Ghana, Burundi, Mali, Senegal and Zimbabwe, have less than 1% of total African mitigation patents, with only Kenya reaching 1.2%. The rest of Africa possesses 3.9% of patents (25 over 657 in the entire African continent) (Pistelli, 2020)

other socio-economic benefits relating to construction, operations and maintenance. However, for the transformation of the energy systems to be just, the continent's industrialisation, employment, and development ought to be central, given that the exclusive patterns of jobless and inequality-enhancing growth among African countries are driven by poor structural change and economic transformation.

The importance of country context is also apparent in currency used in auctions. Apart from Namibia and South, all other auctions offer remuneration in hard currency – usually the US dollar. Often a requirement for improving the bankability of long-term contracts in countries that often face rapid currency depreciation and which do not have local capital markets deep and/or experienced enough to finance these projects (Eberhard & Naude, 2016), foreign currency-denominated power purchase agreements have cost implications for renewable energy projects in instances of exchange rate depreciation and highlight the importance of macroeconomic stability for renewable energy generation.

In sum, global and regional studies identify, besides project and programme level factors, country-level elements, including stable country context; clear policy framework; transparent, consistent and fair regulation; and coherent power system planning, among others, as crucial determinants of outcomes of renewable energy auctions. Without considering such country-level enabling factors, indiscriminate promotion of energy transition could have price and cost implications as well as potential local benefits in industrialisation and employment

Overview of the progress and current state of electrification in Africa

The concept Despite significant strides in transformation and growth in recent decades, the electricity sector in Africa lags behind other regions in terms of generation capacity, the quality of the grid, per capita consumption and the access rate. In 2021, while Africa accounted for nearly 18% of global population, the continent generated only 3.2% of the world's electricity, with just two countries, South Africa and Egypt, accounting for nearly half of that. At 897.5 terawatt-hours(TWh), Africa's electricity generation in 2021 was only a little over half of India's (1714.8), with a similar population—and the average electricity consumption per person was 520.18 kilowatt-hours (kWh), which is one-sixth of the global average and compares to 9662.23 kWh in North America, 5066.80 kWh in Europe, 4250.03 kWh in the Middle East, 2969,71 kWh in the Asia Pacific and 1785.07 in South and Central America. Moreover, the total installed generation capacity in 2021, estimated at 244.3 gigawatts (GW), is comparable to the capacity China added in just two years between 2017 and 2019 (IRENA, 2019).

As shown in the table above, the rate of electricity access differs significantly by region. While most North African countries have achieved near-universal access to electricity, a significant deficit remains in SSA. In fact, the electricity sector in SSA stands out for all the wrong reasons. The sub-region has the lowest electricity access rate of any region in the world –although there is great variation across the sub-continent ranging from 6.7% in South Sudan, 50.9% in Eritrea to 91.4% in Cape Verde. At an electrification rate of 48.35% in 2020, over 549 million people constituting 74.6% of the globally unelectrified population, lived in SSA.

Table 2:Electricity generation, access and consumption by region

Region/Country	Electricity generation (Terawatt-hours), 2021	Global share of electricity generation (%), 2021	Share of global population (%), 2021	Access to electricity (% of population), 2020	Electricity net consumption (billion kWh), 2021	Electricity net consumption (kWh), 2021
North America	5383.5	18.9	6.4	99.84	4835.0	9662.2
Commonwealth of Independent States	1488.0	5.2	3.1	100.0	1275.8	5208.0
Europe	4032.5	14.2	8.6	100.0	3430.0	5066.8
Middle East	1305.6	4.6	3.3	96.2	1109.0	4250.0
Asia Pacific	13994.4	49.2	53.9	97.0	12366.0	2969.7
S. & Cent. America	1364.8	4.8	8.3	98.5	1167.0	1785.1
Africa	897.5	3.2	17.5	56.0	713.0	520.2
Northern Africa	393.2	1.4	2.6	98.9	315.0	1535.7
Egypt	209.7	0.7	1.3	100.0	169.0	1621.0
Algeria	84.3	0.3	0.6	99.8	69.0	1546.5
Morocco	41.0	0.1	0.5	100.0	35.0	937.2
Other Northern Africa	58.2	0.2	0.8	96.5	43.0	2275.8
Sub Saharan Africa	504.4	1.8	14.9	48.4	398.0	342.1
Southern Africa	248.7	0.9	2.8	51.2	253.5	1170.7
South Africa	244.3	0.9	0.8	84.4	191.0	3181.1
Other Southern Africa	4.4	0.02	2.0	38.2	62.5	399.4
Western Africa	92.5	0.3	5.3	53.2	72.5	176.6
Eastern Africa	116.4	0.4	4.1	49.6	31.2	101.8
Central Africa	46.8	0.2	2.5	31.1	36.7	186.3
World	28466.3	100.0	100.0	90.5	25343.0	3233.9

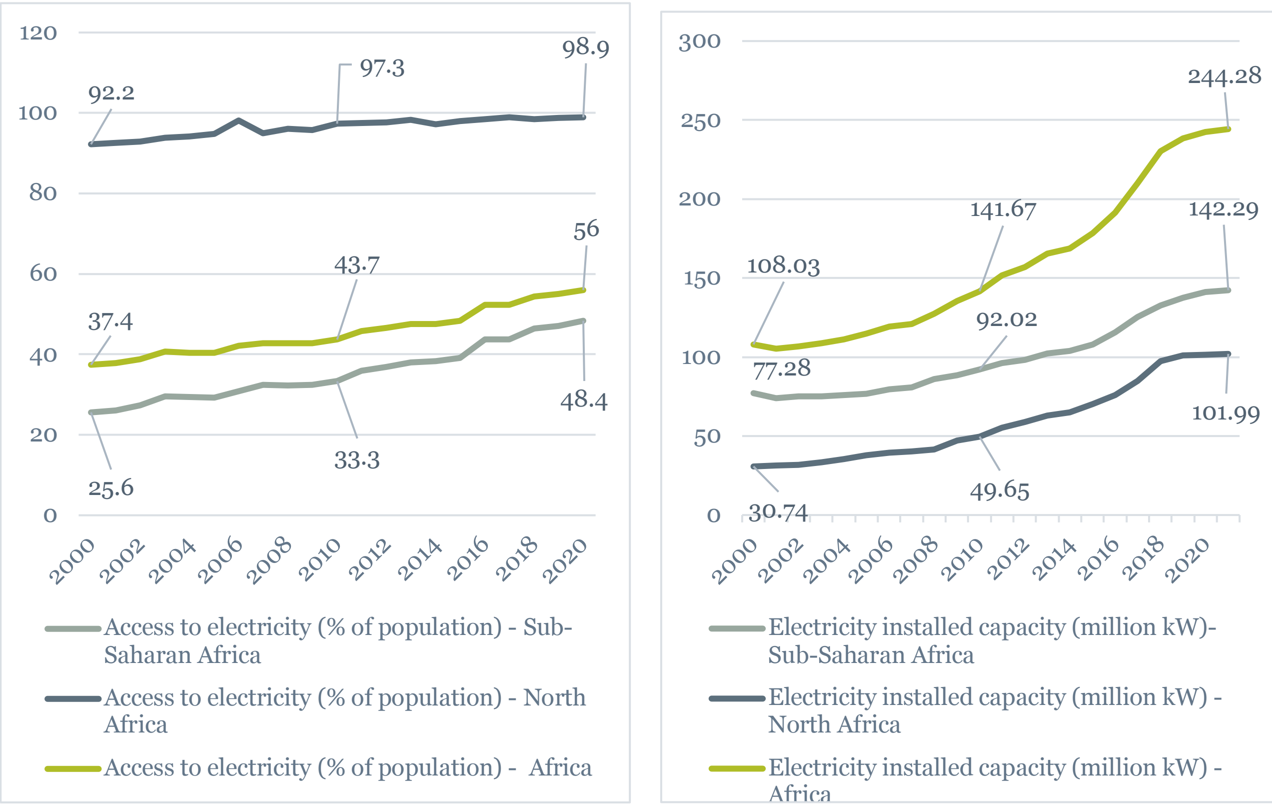
Data sources: IEA, World Bank, and bp Statistical Review of World Energy (2022)

Nearly half of the sub-region's electricity generation (248.7 out of 504.4 TWh) is from one country (South Africa), with the remaining 260.1 TWh spread among the other 45+ countries in the region. Moreover, in most countries, there is a wide margin between installed generation capacity and power supplied such that Nigeria, for instance, reports an installed capacity of 13GW, but its ageing grid delivers only about 5GW to a population of 200 million (ESMAP, 2019). Consequently, SSA has the lowest per capita electricity consumption - 342 kWh per person yearly, or approximately 7% of the European average.

Electricity is consumed almost exclusively by the affluent and urbanised. With a rural electrification rate of 28.69%, more than two-thirds of SSA's population–largely rural and poor—are left out of the service delivery paradigm. And for the predominantly urban population that has access to electricity, the quality of supply is very low, with power outages being frequent, prolonged, and widespread (Nduhuura et al., 2018).

The grim state of energy deprivation is not to suggest there has not been any progress. On the contrary, African countries have made significant advances in increasing electricity generation capacity and expanding electricity access, especially over the past decade. However, because population growth has outpaced the rate of expansion in many parts of SSA, the goal of universal access to modern energy remains elusive. For instance, while the rate of access to electricity in SSA as a whole rose from 25.6% in 2000 to 48.4% in 2020, approximately 587 million people still lacked access to electricity in 2020, an increase of about 91.6 million people over 2000, with many of them in rural areas.

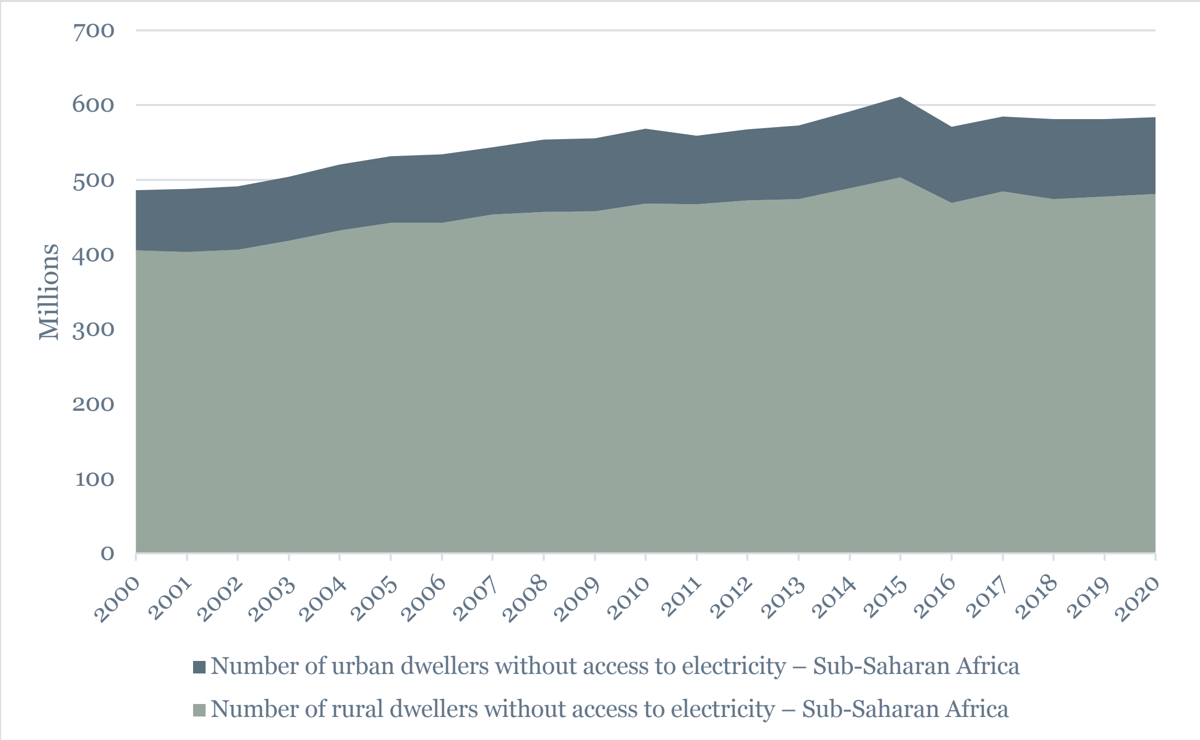
Figure 3:Trends in electricity generation capacity and electrification, 2000-2020



Source: World Bank Data

Rural electrification has been particularly poor in many parts of SSA, reinforcing a persistent urban-rural divide characterised by a 76% electrification rate in urban areas compared with 28% in rural areas (2020). As such, even as the rural electrification rate rose from 11.8% in 2000 to 28.7% in 2020, over 81% (approximately 476 million) of the almost 587 million people without electricity access in 2020 lived in rural areas.

Figure 4: Trends in the number of unelectrified population in SSA



Source: Based on World Bank Data

The most significant improvements in rural electrification over the past two decades have come from Eswatini, Ghana, Kenya, Morocco, Cape Verde and Comoros – all recording over 50 percentage point change in rural electrification rate. On the other hand, Equatorial Guinea and Djibouti show declines in rural electrification rates by over 30 percentage points each over the past two decades.

Advancing electrification in Africa: A review of obstacles, past failures, and current trends

The reality of trends in energy infrastructure investment and access rate is at odds with the rising aspirations of the international community and national governments to reach every consumer with reliable, affordable, and sustainable energy solutions by 2030. This lack of access to electricity imposes significant constraints on modern economic activities, the provision of public services, quality of life, and the adoption of new technologies in various sectors such as education, agriculture, and finance. (Blimpo & Cosgrove-Davies, 2019). Considering that energy is the primary enabler of economic development and an essential component of several SDGs if universal energy access in SSA continues to be a distant objective, a large part of the 2030 Agenda for Sustainable Development will remain out of reach, depriving the region of the possibility to build a prosperous future. Guaranteeing energy access is, therefore, the priority of most SSA countries (Pistelli, 2020).

It is reasonable to assert that the current low equilibrium of the power sector marked primarily by an abysmal rate of electrification, particularly in SSA - as well as renewable energy generation that is very far from reaching its full potential - is shaped not only by inherent structural challenges but also gaps in external support given that external actors have been a vital source of support for the power sector. At the same time, there are at least four major trends that will impact the region's electricity future (i.e., urbanisation, technological change, regional integration, and climate change) and thus add a new layer of complexity to electrification efforts and outcomes. The JETPs, for instance, manifest a renewed global consciousness about climate change and call for difficult choices regarding energy mix. Looking ahead and envisioning improved electrification outcomes requires a reassessment of long-standing assumptions, perceived barriers, and default decisions. Stated differently, the poor electrification outcomes and emerging trends call for a rethink of the continent's energy development strategies and support, interrogating past electrification and energy transition strategies, support measures and outcomes. Three key issues worth probing are (1) Structural challenges to electrification in Africa, (2) Failings of external support for energy development in Africa and (3) The megatrends with significant implications for the future of Africa's power sector.

1. Challenges to increasing electricity access in Africa

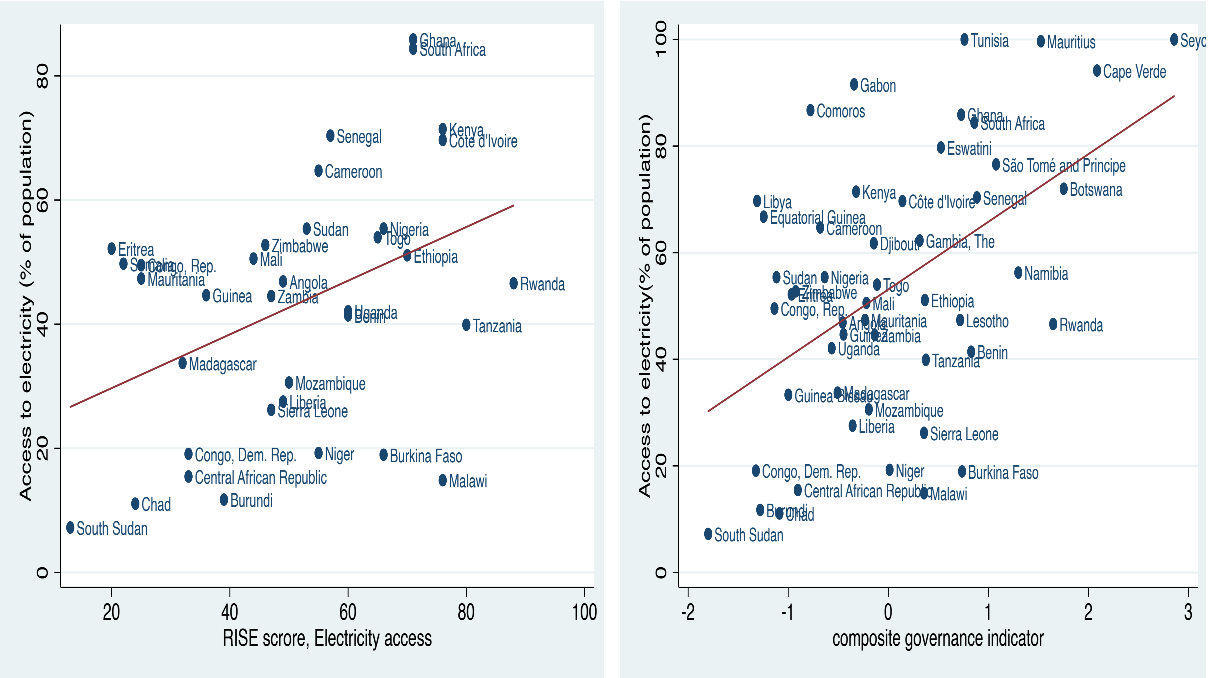
Despite the substantial energy potential, increasing access to electricity has proved challenging, particularly in SSA. A review of existing evidence points to the role of **urbanisation, population density and governance** (both country and power sector specifically) and **access to credit from financial institutions** (Byaro & Mmbaga, 2022; Fischetti, 2022; Tehero, 2021; Poloamina & Umoh, 2013). These factors have shaped the outcomes of energy system development and support and will continue to do if not adequately addressed.

Consider governance challenges. Social, political and economic instability and uncertainty constitute a significant factor that has hindered progress in electrification across SSA and will shape outcomes of energy system support, including enabling green energy transition (Raimondi, 2021). While corruption and political instability limit the scope for and the success of often poorly implemented policy instruments, inconsistent legal and regulatory frameworks hinder the ability of countries to attract domestic and private investments, which are fundamental for the financing of energy projects. Social unrest and widespread poverty have the same effect, as the ability of consumers to pay for private services is often uncertain, and this discourages private investors (Ndung'u & Shimeles, 2022). In addition, most countries' unstable financial situation limits governments' ability to finance interventions in the energy sector, whose infrastructure is very poor (Raimondi, 2021; Fischetti, 2022).

Figure 5 demonstrates a strong and positive correlation between the rate of electricity access and the World Bank's RISE score for electricity, which measures the quality of countries' policy and regulatory support for electrification in SSA (see left panel). The panel on the right similarly shows a strong positive relationship between the rate of electrification and the quality of broader country governance[4]. Countries that have recorded significant gains in the rate of electrification over the past two decades (e.g., Ghana) have benefited from a coherent and sustained political will or favourable historical context, including adequate national electrification strategy that addresses the institutional, technical, and financial aspects involved in electrification in a systematic and coordinated manner. For many others, however, an adequate regulatory framework is needed to attract investment in all areas of the sector (generation, transmission infrastructure, distribution, and operational management) and to fill the gap where public funding falls short in non-existent(Blimpo & Cosgrove-Davies, 2019; World Bank 2017).

[4] The aggregate governance indicator is a composite of six dimensions of governance: voice and accountability; political stability and absence of violence/terrorism; government effectiveness; regulatory quality; rule of law; control of corruption

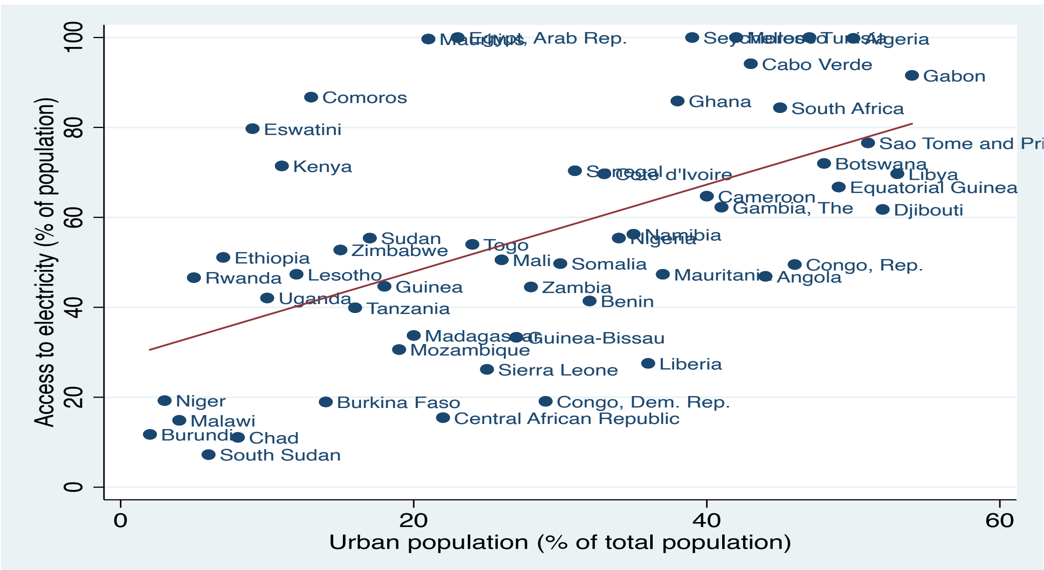
Figure 5: Electricity access vs country and power sector governance



Source: Based on World Bank RISE and WGI Data

Other factors, particularly low urbanisation and population density, have impeded the rate of electricity access by increasing the per capita cost of electrification and challenging its financial viability. Conspicuously, the predominance of rural dwellers among the unelectrified in SSA (Figure 4) points to a nexus between urbanisation and electricity access. For instance, the relatively higher urbanisation rate in North Africa (56.2% compared to 41.3% in Sub-Saharan Africa) and geographic clustering have been identified to at least partly underpin the near-universal electricity access in North Africa. (IEA, IRENA et al., 2021). To demonstrate, Figure 6 below shows a positive correlation between the rate of electrification and the share of the urban population in SSA.

Figure 6: Electricity access vs urbanisation in SSA



Source: Based on World Bank Data

Altogether, these factors have shaped and will continue to influence the outcomes of external support for electrification in SSA and thus ought to be carefully examined to inform electrification efforts going forward. Tendencies in urbanisation within countries, for instance, constitute a powerful megatrend that must be considered in defining an appropriate balance of grid and off-grid solutions (Blimpo & Cosgrove-Davies, 2019).

Besides increasing electrification, a number of structural constraints have also impeded the integration of greater shares of renewable energy into the African power mix. However, if increasing access to electricity in a fossil-fuel-dominant power system is challenging, increasing the share of renewables is even more difficult. Specifically, ensuring substantial penetration of renewables in power mixes requires highly efficient and economically sustainable power systems, costly infrastructure investments, and appreciable industrial capacity for optimum gains, which are largely lacking in most countries. (Pistelli, 2020).

Box 2:Structural constraints to renewable energy penetration in the power mix

1. Limitations of external support for electrification in Africa

The power sector in Africa has been the destination of increasing international financial support, with funding support estimated at US$8 billion in 2015. Key players have been the World Bank, the European Union (EU) (i.e. EU institutions + EU Member States) and the African Development Bank (AfDB), the USA, the Climate Investment Funds, the Arab Fund for Economic and Social Development (AFESD), the OPEC Fund for International Development (OPEC-FID) and China (Hafner et al., 2018).

Despite the increasing volume of external support for the power sector in Africa, the currently low levels of electricity access in SSA calls for a step-change. In fact, according to one estimate that SSA's power sectors require around 70 billion US$ per year to ensure universal access to power by 2030 (Mentis et al. 2017). This estimate of required investment implies an almost ninefold increase per year of the estimated 2015 US$ 8 billion volume of external support. At the same time, the poor electrification outcomes, mainly in SSA, call for a reassessment of support strategies to avoid past shortcomings and improve future outcomes. A review of the extant literature points to shortcomings in international/external support for electrification in SSA, including **fragmentation**, **mistargeted interventions**, and **failure to address governance challenges** and **demand side constraints** (Fischetti, 2022; Ndung'u & Shimeles, 2022; Blimpo & Cosgrove-Davies, 2019).

Consider first the issue of fragmentation of external support. At any point in time, there are several trackable initiatives wholly or partially devoted to the electrification of SSA originating from Europe, America, the Middle East and Asia. While at the continental level, there are also initiatives such as the AU's Programme for Infrastructure Development in Africa (PIDA) in place providing support and coordinating national efforts, there are numerous other bilateral, regional and multilateral initiatives and programmes with similar aims of contributing to the development of Africa's energy markets and the improvement of access to power across the continent. What emerges, however, is that while the plethora of institutions, programmes and initiatives afford the testing of several approaches, many of them overlap in terms of objectives and content, creating inefficiencies and increasing transaction costs (Hafner et al., 2018). Certainly, the continent's needs are poorly served by such a fragmented system as funding is generally transferred through overly bureaucratic delivery structures that combine high transaction costs with low impact, thus resulting in most finance being earmarked for small-scale projects rather than sizeable programmes (Africa Progress Panel, 2015).

A related challenge to coordinating external support for the power sector in Africa pertains to the AU's weak interlocutory power in representing the continent in the international arena and the relations with regional blocs like the EU. It is argued that while the AU is supposed to be an integrated, harmonised trading and negotiating bloc (like the EU is to Europe) and a strong power in the international arena, it is none of these things. From its weak institutional structure to its apparent lack of authority, legitimacy and coherence, it is argued that perhaps the AU might not be the best interlocutor to represent Africa in the international arena (Akokpari & Bimha, 2020)

For the EU, a major source of support for Africa's power sector and especially in terms of renewable power generation, a key shortcoming is a misdirected focus on small-scale residential access to energy[5] rather than on large-scale energy infrastructure (Njenga & Temwanani, 2022). By largely focusing on smaller, more commercial projects that yield an economic profit in the short-term but do not lead to a significant impact in the long-term, the EU has refrained from dealing with the core issue - i.e., lack of large-scale energy infrastructure. In effect, while such interventions have brought power to small villages and communities through small-scale energy infrastructures, such as mini-grids and solar PV installations, they have resulted in the provision of unreliable, intermittent, and inefficient energy, and only for a few hours per day/week due to the absence of an efficient and large-scale national energy infrastructure to sustain them (Mutiso, 2019; Nolasco, 2021)

Such mistargeted interventions represent a poor and inadequate conception of energy poverty in Africa that misses the scale of the challenge of providing access to energy in the developing world. Specifically, it ignores the challenges of providing residential access to electricity without an efficient national energy system and indeed fails to realise the kind of access that truly eradicates energy poverty and can power development (Anuga & Njenga, 2022; Mutiso, 2019).

Another deficiency of external support for electrification in Africa is the failure, particularly by the EU, to address the bad governance problem in SSA. Bad governance, characterised by corrupted governments and extractive institutions, has been major obstacle to both scaling up renewable energy and implementing large-scale projects in SSA (Acemoglu & Robinson, 2012; Anuga & Njenga, 2022). This is especially true when it comes to scaling up renewable energy, which requires an enabling institutional and economic environment that poor governance systems cannot provide (Mutiso, 2019). While the EU have, over the years, actively worked to improve governance outcomes in Africa, it has not been able to fully fix this issue, which is an inherently indigenous one (Njenga, 2022; cited in Fischetti, 2022). This is manifest in the fact that while the promotion of good governance is theoretically at the centre of its external strategy, in cooperation with SSA, the EU has always refrained from seriously addressing the challenges posed by inefficient and corrupted governance (Mutiso, 2019). Consequently, to avoid dealing with this complex, systemic issue, it has favoured quick, short-term fixes in the energy sector, which have not been fully effective because energy policy does not exist in a vacuum and cannot be properly and successfully implemented without sound governance and institutional structures (Fischetti, 2022).

Finally, external support for electrification in Africa has almost exclusively focused on supply issues such as the lack of adequate generation and poor or missing distribution systems to the neglect of demand-side constraints related to the uptake of electricity. However, the challenges of energy access

[5] The focus on residential access to energy has been evident in the projects implemented under the umbrella of Africa-EU cooperation since the implementation of the (African, Caribbean and Pacific) ACP-EU Facility, which focused on the electrification of small rural communities in Africa

are so varied and intertwined that reaching users does not necessarily guarantee a good quality of supply, nor even it ensures accessibility by the side of low-income users (Hafner et al., 2018; Hogarth & Granoff, 2015). As is the case in many countries, even in areas where grid service is available, many households are not connected to the grid. Similarly, in rural areas where stand-alone solar systems are available, only some households have them. Both scenarios are a testament to the implication of demand-side constraints, including the unaffordability of connection fees and/or consumption tariffs because of a lack of adequate and regular income (Blimpo & Cosgrove-Davies, 2019; Hafner et al., 2018).

2. Contemporaneous megatrends with significance for electrification strategies

Besides the structural constraints to electrification and fault lines in external support of Africa's power sector, the continent is faced with four key megatrends – namely, **urbanisation, technological change, regional integration and climate change -** that could affect the efficiency of electrification efforts. It is, thus, crucial to understand the extent and impact of these trends and factor them into electrification strategies and support. What is challenging, though, is the evolution and timing of these factors that are quite uncertain, with some element of country-specificity that complicates thinking about electrification rollout (See Blimpo & Cosgrove-Davies, 2019; Pistelli, 2020)

Start with urbanisation. While from a low base (about 472 million people [38%] in 2015), the urbanisation rate is rising rapidly. By 2040, more than half the population in Africa are projected to be urban dwellers. The largest cities today record as fast as 4% annual growth (Lall, Henderson, & Venables 2017). Looking ahead, the increased urban population should make it cheaper to provide electricity to more people, given that it is less costly to connect urban areas. However, existing evidence points to the need for proactive planning that ensures that transmission and distribution networks are available before the migration from rural areas occurs to reduce costs, increase efficiency, and avoid the growth of slum communities (See Lall et al., 2017; Regan et al. 2016).

Meanwhile, fast-tracking rural electrification may mitigate urbanisation, reducing the flow of people into already overcrowded cities where infrastructure is stretched. Evidence from Ethiopia, for instance, suggests that rural electrification results in a 26% reduction in rural-urban migration (See Fried & Lagakos 2017). A slower rate of urbanisation could thus help make the planning of urban electrification more manageable.

Altogether, rapid urbanisation marked by a stark population shift from rural to urban areas will have a striking impact on the pace and strategic thrust of electrification efforts. On the one hand, to the extent that urbanisation results in sparser rural populations, it will make rural electrification less financially attractive and could skew service to off-grid solutions. On the other hand, rapid urbanisation would imply increase in electricity demand, given higher per capita electricity consumption in urban areas. Such increasing demand would mean a need for continuous upgrading and expansion of the supply, transmission, and distribution systems which can be challenging for most African utilities that mostly lack financial viability.

Second, technological change and innovation are affecting the power sector, offering cheaper, more powerful off-grid systems based on renewable energy technologies. Notably, the solar home system capable of powering a television, radio, lights, and cell phone charging are projected to fall further with increasing innovation and reduction in production cost (IEG 2016). And while these innovations are dominantly taking place in developed nations, they are already spilling over into Africa. A typical example is evident in start-ups in the African off-grid solar market using innovative pay-as-you-go schemes linked to mobile money and cloud services that allow remote electricity consumption monitoring (McKibben, 2017). These trends reflect innovation in Africa's off-grid development that calls for dynamic thinking about electrification options.

Third, the regionalisation of energy systems constitutes a megatrend with significant implications for electrification in Africa. Regional power interconnection and trade through power pools have long existed with the objectives of increasing energy security; optimising energy resources; coordinating and cooperating on planning, development, and operation; increasing supply; and facilitating competition in the sector. However, today, a number of factors are reinforcing regional power interdependency. For instance, the coronavirus pandemic, the most recent Russia-Ukraine, and their disruptive effects have underscored the importance of locating energy supply chains closer to home. Additionally, increasing usage of variable renewable energy (VRE) makes regional power pools crucial because, unlike internationally traded oil and gas, renewables intrinsically need to use electricity as a carrier, making international power interconnection crucial. For African countries, the signing of the landmark African Continental Free Trade Area (AfCFTA) agreement in July 2019 also emphasises the region's willingness to increase regional integration. While it is a trend yet to materialise, it is noteworthy that the AfCFTA could facilitate the realisation of a continental vision to create a single electricity market. In sum, regional power interconnection and trade hold great potential with significant implications for electrification strategies and support required at national and regional levels.

Finally, the global climate crisis necessitates difficult choices regarding the energy mix. For African countries, climate change-induced drought is affecting the vast hydroelectric potential. Countries such as Zambia have experienced reduced electricity generation from hydropower systems due to a drop in water levels in the dams (Mfula, 2016; Blimpo & Cosgrove-Davies, 2019). At the same time, global commitments to reduce carbon emissions are driving the momentum renewable energy transition that has implications for power generation decisions. Nonetheless, climate change and energy transition issues are contentious, requiring countries to determine their own energy transition trajectory. Thus, while there is a general agreement about the need to scale up energy generation if universal energy access is to be attained by 2030, the appropriate power mix is still contentious. Despite divergent positions regarding what Africa's power mix should be, it is becoming increasingly clear that renewable energy technologies will be important to meeting energy demands, given their cost competitiveness in some countries. Questions remain, however, about which fossil fuels ought to be replaced in order to meet climate goals without jeopardising the continent's development goals, as well as which countries require accelerated energy transition under JETP-like structures, and these are questions that require interrogation to inform electrification strategies and support.

Rethinking electrification strategies and support in Africa

Any hope of reaching a good level of universal access to modern energy by 2030 in Africa requires a step change in the electrification rate in SSA. It is evident that a number of inherent domestic structural challenges coupled with gaps in external support underpin the manifestly high level of energy poverty in SSA despite decades of support. Today, the region faces other major trends, like urbanisation, technological change, regional integration and climate change, that complicate decisions regarding electrification strategies and support. In such a blurred situation, analytical considerations of the structural challenges of electrification, the shortcomings of external support and the key megatrends are crucial in rethinking electrification strategies and support that balances carbon reduction (energy transition) and access to electricity. These considerations are employed to address key policy and strategic questions pertinent to electrification strategies and support in SSA.

1. Grids, Mini-Grids, or Stand-Alone Systems?

At the confluence of low population density (scattered populations), rising urbanisation, huge infrastructural gap, disproportionally large unelectrified rural population, and technological change that has made off-grid solutions readily available, a crucial question is what electrification option—grid connections, mini-grid and stand-alone solutions – offer a cost-optimal pathway to reach universal access to electricity? The question is complex, and no silver bullet exists. Two points, however, seem to be essential: (1) The viability of grid extension, mini-grid construction and stand-alone system delivery will depend on a number of factors, including costs of technologies, distance to the central grid, demand density (population density, household electricity demand) and local resource availability -e.g., renewable energy potential for wind power, solar PV and hydropower including mini-hydropower (Lucas et al., 2017; Hafner et al., 2018); (2) The required relative shares of investment in grids, mini-grids, and stand-alone systems can vary significantly by country[6].

It is important to emphasise that, despite the predominance of rural poor among the unelectrified in SSA, national grid expansion will still be the primary electrification option for reaching universal access for a number of reasons. First, the pattern of rapid urbanisation in SSA means that big cities, peri-urban localities and related industrial areas will likely retain the largest share of electricity consumption (Blimpo & Cosgrove-Davies, 2019; Hafner et al., 2018). Second, studies of the customer experiences in terms of off-grid energy solutions in Africa show that for households that use electricity for income-generating activities, energy consumption steadily grows beyond the capacity of off-grid technologies suggesting the need for grid electricity if electricity access is to contribute to the enhancement of economic livelihoods beyond basic energy access for lighting and charging cell phones (See Lee et al., 2016; Caine et al., 2014; Jacobsen, 2007; Leo, 2015; ESMAP, 2015).

To be sure, an increased focus on grid expansion and productive use of electricity should not end up downplaying the role of decentralised approaches. Grid-based electrification is only an attractive option in densely populated areas, with an expected high demand for electricity and/or within a reasonable distance of existing high-voltage power lines. However, large parts of SSA do not satisfy these criteria, with large, sparsely populated rural areas where many households have a meagre income. Indeed, for the majority of the unelectrified population in SSA who live in sparsely populated rural areas far from the central grid with a severe lack of financial resources and related low electricity demand, decentralised electrification systems could play a vital role in bringing electricity them at a reasonable cost. Even transitioning from a kerosene lamp to basic electricity services provided by solar home systems may significantly affect a household's welfare (Lucas et al., 2017; Pachauri & Brew-Hammond, 2012).

IEA estimates that 54% of Africans without access would be best served using decentralised approaches (IEA, 2017). However, most policymakers in SSA plan for universal electrification mainly in terms of national grid expansion. As a result, despite substantial efforts to extend central grids, the electrification rate in SSA has barely kept up with population growth (Ahlborg & Hammar, 2014; Pachauri & Brew-Hammond, 2012). Thus, while there has been a significant focus by the international community and private sector on off-grid solutions, such solutions are largely excluded from national electricity planning. Consequently, energy providers focusing on off-grid electrification experience a range of partly overlapping challenges, including a lack of a level playing field (Bhattacharyya, 2013; Rai et al., 2016). However, this ought to change, as a more significant effort to deploy mini-grids and stand-alone

[6] For instance, extending high voltage transmission lines could be attractive in high density, high electricity-demand countries like Nigeria, but less economically feasible in countries with a low population density and electricity demand, such as Ethiopia

solutions will be instrumental and necessary to achieve universal access by 2030.

As a reminder, a stark shift in population from rural to urban areas, as highlighted earlier, could skew electricity service provision to more off-grid solutions, at least for the initial phases of electrification. On the other hand, off-grid access technologies can help meet the 'basic' electricity needs of rural populations, which could slow down urbanisation processes. In addition, a reduced rate of rural-urban migration could have slowed down grid/electricity demand and air pollution, which has become a dominant feature of many crowded African cities (See UNICEF, 2019).

Ultimately, while not all countries and scenarios will require waiting for grid expansion to increase electricity access, further technological progress will be required to cost-effectively support productive uses such as off-season farming, value-added agro-processing, and promoting other small businesses (for instance, hairdressers, eating establishments, tailors). Still, governments can make a good start by including off-grid electrification as an essential component of power sector plans, supporting the market development of mini-grid and stand-alone systems, and making electricity affordable for the poorest households.

2. The role of renewable energy in Africa's energy future

As noted earlier, the effect of climate change-induced drought on Africa's hydroelectric power generation, coupled with a broader global commitment to reduce carbon emissions with the transition to renewable energy sources at its core, calls for difficult choices and has implications for power generation decisions in Africa. However, with energy access representing one of SSA's major barriers to socio-economic development, electrification certainly represents a priority. Transitioning to cleaner forms of energy is, thus, only a complementary concern, second to providing energy access. Stated differently, if the majority of the population does not have access to energy, it does not have anything to transit away from (Pistelli, 2020; Hafner et al., 2018). Notable exceptions, of course, are South Africa, Egypt, Algeria, and Nigeria, which combine relatively high energy access (except Nigeria) with high carbon-intensive power systems demands shift to a low-carbon power mix.

This is not to suggest that renewable energy technologies have no place in electrification in the majority of other African countries. Indeed, for the many countries on the continent that require accelerated electrification, the role of clean energy sources will continue to be strategic, thanks to the crescent competitiveness of renewables. Additionally, SSA is experiencing (slowly) rising living standards and a wave of industrialisation, urbanisation, and economic and demographic growth, which will lead to an exponential increase in the African demand for energy. Getting Africa's future energy mix sustainable is thus crucial to avoid the negative impact of climate change (Hafner et al., 2018; Pistelli, 2020). Additionally, through renewable energy technologies, off-grid access to electricity can, as noted above, contribute to achieving better levels of 'basic' access across the continent and effectively slow down the rate of urbanisation (Pistelli, 2020).

Actually, there already are endogenous determinations to move towards cleaner energy sources driven by African governments' desire to reduce the cost of energy access and enhance energy security. Nevertheless, on the other hand, the desire to leverage support from the international community to achieve sustainable development has driven African countries to align with global aspirations under the Paris Agreement to increasingly use cleaner energy sources. This is manifest in the National Determined Contributions (NDCs) to the Paris Agreement and the energy plans of many SSA countries that indicate an initial move towards the energy transition, with some governments contemplating the idea of leapfrogging and shifting directly to renewable (Pistelli, 2020).

It is important to highlight that while there are significant differences among African countries in terms of economic structure and institutional capacities, overall, countries in Africa rank low on the Energy Transition Index designed by the World Economic Forum, signalling their lack of readiness for the energy transition. In fact, even the most competitive markets like Kenya and South Africa that have commissioned a significant number of renewable energy projects in the last few years, inefficiencies of the power sector and the inadequacy of the energy infrastructure (typical structural constraints in the SSA context) currently make the substantial penetration of additional capacity a tough challenge.

In this context of under-achievement marked by a low electrification rate and inefficient power sector, talking of 'wholesale' accelerated energy transition may be an overstatement, although a shift to cleaner energy sources is partly taking place. This speaks to speed, timing, sequencing and modality of expanding the share of renewables in the power mix, including the need for power sector reforms and the time-bound use of relatively less polluting natural gas as transitional fuel (See Box 3).

Box 3:Energy transition and industrial development

Energy development in Africa is intrinsically related to the continent's current socioeconomic woes. The current energy resource mix, based heavily on non-renewable fossil fuels, has failed to provide populations throughout Africa with complete, reliable, and ultimately sustainable energy. In many parts of the continent, reliance on fossil fuels, both as a domestic fuel and an export commodity, has not only had devastating effects on local environments but has also failed to deliver electrification at the needed pace. In effect, low electrification rates have exacerbated socio-economic inequalities (including gender and rural-urban divides), contributed to a lack of energy security, hindered industrial development and increased unemployment.

Within a status quo of high population growth (and hence increasing energy demand), rapid urbanisation, persistent commodity dependence, exposure to price volatility, limited productive capabilities and heightened vulnerability to climate change, it is easy to envision a transition to renewable energy/deployment of renewable energy a core part of structural economic transformation on the African continent, with the development of green industries holding large potential to reduce various forms of dependencies, including structural, technological and single commodity trade-related. In fact, according to IRENA, most SSA countries will benefit from reducing fossil fuel imports and generating renewable energy domestically because this will boost job creation and economic growth (IRENA 2019; Pistelli, 2020).

However, the possibility of realising far-reaching economic diversification from energy transition depends on the country's context, including the economic structure and institutional capacities. Given the differences across Africa, it is, thus, apparent that each country embarks on the energy transition from its own starting point, implying different sets of strengths and weaknesses. Accordingly, the timing and modality of energy transition support at the national level must be sensitive to these if the broader development outcomes are to be realised.

A related issue regarding the power mix at the heart of global climate discourse is divestment from fossil fuels. For African countries that have traditionally been less emitters and at the receiving end of the severest economic impact of climate change, such a sweeping divestment could lead to severe socio-economic and political consequences (Oramah, 2022). Recent increased demand for fossil fuels from advanced economies following the crisis in Ukraine shows that energy transition is not immune to the impacts of major environmental, economic and geopolitical events and that the trade-offs between energy affordability, security, and sustainability exist and need to be carefully considered (WEF, 2022). For African countries, such developments point to the complexities and trade-offs inherent in the energy transition and thus call for a balanced approach that delivers on the imperatives of sustainability, energy affordability, and energy security and access.

As expected, the role of fossil fuels in Africa's energy future has been particularly contentious within policy discussions. In balancing the continent's energy for development and global climate goals, it is almost agreeable that Africa may be the first continent to develop without coal. On the other hand, natural gas is still favoured because it is a cleaner option than coal—not only in terms of greenhouse gas emissions but also in terms of air pollution. Additionally, natural gas reserves are better distributed across the continent - i.e. Nigeria, Mozambique, Angola, and Algeria are all important natural gas producers, whereas the coal industry is virtually concentrated in South Africa (Blimpo & Cosgrove-Davies, 2019). The argument here is that the switch from inefficient and polluting energy sources to more efficient options, which is required for climate change action, must take care to stimulate rather than hamper the region's development. Indeed, besides regional power interconnection, integrating VRE into power grids requires "firm" energy sources like natural gas to ensure reliability.

3. *Accelerating energy access and driving power sector decarbonisation: The role of regional power integration*

Regional power system integration with a specific focus on transboundary interconnection and power trade has been an important strategy for developing countries to help provide reliable, affordable electricity to their economies and citizens. For Africa, the dominant nation-based energy system planning and investment are deemed sub-optimal for at least three reasons: (1) National energy markets are often too small to justify the investments needed in particular energy supply options (2) The geography of the cleanest and cheapest energy supply options do not necessarily correspond to political boundaries (i.e. may lie across national borders) (3) Cross-border energy supply often provides diversification of energy source – a key component in energy security (World Energy Council, 2005). Hence, for African economies faced with a multiplicity of power system challenges, including low access rates, poor reliability and security and fossil fuel dominance, regional power system integration holds a number of promises, including increased economic efficiency, improved access and security of supply, enhanced environmental quality and wider deployment of renewable energy resources (See Box 4).

Box 4. Major benefits associated with regional power system integration and trade

Increased economic efficiency: Investment in regional power integration and trade offer economic efficiency gains by reducing investment requirements, investment risks, and operational cost through economies of scale (Economic Consulting Associates, 2010; World Energy Council, 2005; United Nations, 2021; Tehero, 2021). For African economies, the small size of individual energy markets coupled with the fragmentation of energy development initiatives means regional power integration is relevant to reduce the average power supply cost through scale effects. Notably, according to one estimate, effective implementation of regional power pools could lower power investment costs in Africa by US$80 billion through 2040 (Castellano, Kendall & Nikomarov, 2015).

Improved access and security of supply: Regional electricity markets allow sharing of operational reserves and installed capacity balancing generation surpluses and shortages in national power systems. This ensures improved access and security of power supply without necessarily requiring domestic power generation. With significant differences in energy resource endowment across the continent, getting power from energy-rich neighbours can not only lower costs but also improve system flexibility, reliability, and security of supply by expanding and diversifying the supply portfolio of different energy resources and sources (Blimpo & Cosgrove-Davies, 2019; UN, 2021; World Energy Council, 2005). For African economies, the small individual energy markets and poor utilisation of the continent's enormous energy resources due to uneven regional and country distribution that creates demand/supply imbalances make regional power integration particularly relevant.

Enhanced environmental quality: Developing and using clean energy sources through regional power integration can help enhance the environmental quality of life. With fossil fuel-dominant power systems, emissions from fossil fuels used in electricity generation have severe environmental impacts, affecting public health and quality of life. Given that the continent is endowed with significant but unevenly distributed renewable energy potential, regional power integration allows deploying these resources reducing dependence on high-carbon fuels and decreasing the corresponding air pollution and GHG emissions. (World Energy Council, 2005).

Wider deployment of renewable energy resources: Renewable energy resources such as hydro, geothermal, or wind are site-specific and thus are not easily transportable except through electricity interconnections (IRENA, 2019). Grid/power interconnection, therefore, facilitate the development and enhance the efficiency of variable renewable-energy integration. As a continent, Africa has one of the world's highest variable renewable energy potentials. However, important regional variations call for investments in interconnectors and well-managed regional power pools to allow for the deployment of large-scale renewable projects (Hafner et al., 2018). Indeed, for many African countries hoping to achieve levels of VRE penetration as high as 30%by 2030, progress will depend on the availability of dispatchable power – either hydro, geothermal, biomass or gas – and on the pace of investment in power networks.

Indeed, if there is one thing that the coronavirus pandemic has underscored, it is the importance of diversifying and regionalising energy supply chains (IRENA, 2022; Pistelli, 2020). Across the continent, while electricity trading remains limited, the potential for expansion is great. Africa is home to several regional power pools and cross-border interconnections, as well as interconnection projects that enable neighbouring countries, in theory, to share backup power and engage in electricity trading. (IRENA, 2022). Existing pools consisting of physical interconnections, either complete or in progress, are the Eastern Africa Power Pool (EAPP), Southern Africa Power Pool (SAPP), West African Power Pool (WAPP), Central Africa Power Pool (CAPP) and Comité Maghrébin de l'Electricité (COMELEC).

The maturity and effectiveness of these interconnected networks vary widely, however, with the most significant regional trading taking place in the SAPP, having developed a regional electricity market that allows free electricity trading between Southern African Development Community (SADC) member countries. The others either need significant infrastructure investments or have failed to evolve from bilateral power trade to a multilateral trading platform (Pistelli, 2020; IRENA, 2022; Maupin, 2013).

Overall, African power pools have generally had to contend with insufficient investment in shared generating and transmitting infrastructure, a lack of trust among states, a nationalistic outlook to electricity planning, poor regulatory and institutional space and a preference for bilateral agreements over regional ones (Medinilla et al., 2019). In effect, most African energy markets remain effectively isolated as existing cross-border power infrastructures remain either limited or underutilised despite efforts to develop functional regional electricity markets[7] (World Bank, 2020).

For the longer term, proposals have been advanced to transform the continent into a global powerhouse by connecting all African power pools to form a single African electricity market (AfDB, 2020b). The African Union (AU) in June 2021 launched the African Single Electricity Market (AfSEM), which is meant to interconnect all 55 African Union Member States through an efficient, affordable and sustainable electricity market, the implementation of which will be supported by a Continental Power System Masterplan currently being developed by the African Union Development Agency (AUDA-NEPAD), to establish a long-term continent-wide planning process for power generation and transmission involving all five African power pools (IRENA, KFW & GIZ, 2021).

A major bottleneck to cross-border power trade is the slow pace of infrastructure investments in interconnected transmission and distribution networks as well as storage. In fact, even the SAPP, the most advanced power pool in Africa, three of the twelve member countries (i.e., Angola, Tanzania and Malawi) are yet to be connected to the common grid. Underpinning such infrastructure gaps across the power pools is the dearth of finance. First, the fiscal constraints of most governments, as well as the poor financial health of national utility companies, limit the ability to invest. At the same time, there has been limited scope for private-sector investment. Notably, external finance, which has been overly dependent on, has not been readily available, making electricity trade less quick or smooth than wished (Pistelli, 2020).

Most regional power pools have priority transmission line projects (cross-border interconnectors or national projects with regional significance) that face substantial financing constraints. Besides, the Programme for Infrastructure Development in Africa (PIDA) exists as a joint initiative of the African Union Commission, the African Development Bank (AfDB) and the New Partnership for Africa's Development Planning and Coordination Agency and has a clear list of necessary, bankable infrastructure projects with highest potential impacts for energy access (Anuga & Njenga, 2022).

While the EU, for instance, is a key partner, progress on these regional projects calls for more donors/funding partners or creditors. This is particularly so at the EU level – not only between the various EU Member States but also between the various EU institutions – since the EU as a whole represents a top player in supporting Africa's electrification. In addition, the presence of other international actors as financiers for public infrastructures through the PIDA is required for acceleration (Maupin, 2013; Hafner et al., 2018). Overall, increased coordination of external development partners in support of priority regional energy projects and related harmonisation of regulatory frameworks required for regional electricity trade is, thus, urgent.

For international development partners, supporting regional infrastructure constitutes a viable means of avoiding fragmentation and short-termism by investing in projects that yield a long-term positive impact and that focus on scaling up the infrastructure for renewable energy. This also implies prioritising large-scale energy crucial for industrialisation. It is noteworthy that while the strategic importance of such an

[7] In 2019, South Africa, Nigeria, Ghana and Mozambique were the largest electricity exporters in Africa while Namibia, Togo, Zimbabwe and Angola were the largest importers(IRENA, 2022).

investment approach is being slowly adopted, particularly by the EU[8] , other development partners are yet to catch up (Fischetti, 2022; EU Commission, 2022). Indeed, while the challenges to achieving functioning power pools go beyond financial and technical challenges to include political economy constraints pertaining to the nonalignment of interests among role players, the vulnerabilities that hinder the development of regional energy integration could be mitigated if international actors contributed, pragmatically, to fostering 'positive interdependence' through support in developing priority transnational infrastructure (Pistelli, 2020).

4. Implications of JETPs for investments in regional power integration

As highlighted above, regional power integration and trade constitute a strategic approach to cost-effectively scaling energy access, ensuring reliability and security, and decarbonising power systems through the integration of higher shares of VRE into the regional power mix. However, mistargeted interventions by internal development partners in the energy sector have led to fragmentation and limited finance for funding regional power interconnections and facilitating electricity trade. When one considers the need for additional partners at the regional and continental levels to fast-track investment in priority regional and continental energy infrastructure, the emergence of JETP-like structures raises questions about whether such 'bilateral' arrangements structures could hold back progress on regional projects by using African governments' time and energy to negotiate smaller country-by-country projects and the conditions for the private sector to feel more comfortable investing.

In a sense, JETP should not necessarily detract but rather be complementary to regional projects if one considers the unique energy system challenge of potential candidates of JETP as suggested. However, the complementarity of the JETPs hinges greatly on simultaneously fast-tracking the funding of crucial regional projects and the development of regional electricity markets to allow for the trade of renewable energy within African sub-regions to meet ambitious, scaled-up Africa-wide targets for both the environment and development. Within the SADC region, for instance, South Africa holds a strong position on the international energy scene and consequently represents a key actor at the regional level in the energy sector, with the national utility accounting for almost 80% of the total regional demand (producing and supplying) (Maupin, 2013).

Certainly, donor coordination among the International Partners Group under JETPs could serve as a model for supporting investments in regional power interconnections and promoting power trade. Without concurrent support to fast-track investment in planned or ongoing large-scale regional energy infrastructure and facilitating a multilateral trading system, support for the energy sector at the national level, including JETP deals, will have a number of adverse implications, including (1) inefficient power system investments due to focus on national self-sufficiency rather than an inter-country perspective (2) limited integration VRE into power systems (3) export of cheaply generated renewable energy outside Africa, amidst energy poverty (4) hampering the potential emergence of regional value chains in renewable energy technology products

Inefficient power system investments: Without enhanced interconnection and multilateral power trading, the pursuit of power generation at the national level will lead to inefficient generation investments with generation capacity constraints due to under-investment in some cases, while there is over-investment in other cases. The implications are higher production and transaction costs and counterproductive competition. In the SAPP, for instance, it is estimated that aligning investment

[8] It is apparent in the Africa-EU Green Energy Initiative which makes reference to several energy integration projects at the regional level

regional electricity market could save the region about $42 billion over 25 years compared to countries acting in isolation (CDC, 2021). Nevertheless, the efficiency implications of regional power integration and trade go beyond cost competitiveness to continuous investment in fossil fuel power generation, which can be avoided by leveraging power trade to import renewable energy power.

Limited decarbonisation of power systems: Without massive investments in interconnectors and the regulatory and market reforms required to use them, the prospects of integrating high shares of renewable energy on the grid in African countries that lack dispatchable generation (hydro, biomass, geothermal, gas) will be much reduced. Transmission and distribution networks remain relatively rudimentary in most African countries, constraining the ability to move low-carbon power from where it is best generated to where it is most needed, to import power when domestic renewable output is low, to export excess renewable energy output when it is high, and to integrate energy storage. As a continent, Africa has one of the highest VRE potentials in the world, but there are important regional variations that call for investments in interconnectors and well-managed regional power pools. To rapidly scale VRE, the management of weak and disjointed power systems across most regions will need to be dramatically strengthened.

Export of cheaply generated renewable energy outside Africa, amidst energy poverty: Delaying regional power interconnection and trade increases the possibility of the JETP deals serving to produce cheap renewable energy that would then be exported out of the continent. Already, African countries export fossil fuels out of the continent and without proper regional electricity markets, rent-seeking dependent relations with international actors typical of oil and gas will be replicated with renewable energy (Fischetti, 2022). While Europe, for instance, seeks to capitalise on Morocco's ample renewable resources to meet climate goals by importing green electricity, much of the continent would hardly benefit from cheap renewable energy generation in leading African countries without a functional electricity market.

Hampering the potential emergence of regional value chains in renewable energy technology products: Without regional power interconnection and trade, the potential of creating regional clusters and supply chains in the renewable energy sector and leveraging local capabilities and setting local firms on a path to competitiveness through economies of scale and cost reductions will be lost. Integrating local suppliers into regional or other supranational supply chains can enhance their productivity. Similarly, promoting industrial complementarity can prevent duplication of efforts in the same activities and avoid the fallacy of assuming that something true in one country is also true in neighbouring countries operating in the same regional markets. It can also make local content policies more efficient and effective. Intraregional specialisation in different renewable energy value chain segments can exploit the complementarity of assets across the region. African regions have complementary strengths, from critical minerals abundance to manufacturing capacity and proximity to important trade routes (IRENA, 2022). Such an approach would support the acquisition of new comparative advantages and provide opportunities for economic diversification across Africa.

5. Facilitating investments in SSA power sector: The importance of reforms

The energy sector in Africa has suffered from the same chronic difficulty as African infrastructural projects in finding adequate investments due to the lack of domestic funds as well as to a higher perceived regional risk underpinned by domestic factors of instability, such as political struggles, GDP fluctuations, corruption, and lack of transparency as well as currency risk (Bilotta & Colantoni, 2018). However, the challenge extends well beyond broader macroeconomic and political risks and from weak protection of contract and property rights involving dysfunctional power sector and electricity markets (Hafner et al., 2018). High technical losses, managerial weaknesses, illegal electricity connections and political interference are common features of the electricity sector, with governments often viewing power utilities as sites of political patronage and vehicles for corruption (Tehero, 2021; Hafner et al., 2018).

Consequently, power utilities in SSA have so far failed to develop flexible energy systems to provide firms with a reliable power supply and people with access to power. According to a 2016 study of SSA utilities, only the utilities of two countries (i.e., Seychelles and Uganda) fully covered operational and capital expenditures, with all other utilities running quasi-fiscal deficits[9] that required subsidisation by the state (Trimble et al. 2016).

Underpinning the poor performance of power utilities in the sub-continent are capacity gaps in institutional settings and human resources and inadequate policy and regulatory frameworks to attract investment (Tehero & Aka, 2020). Regarding policy and regulatory frameworks, many of the poorest performers in the World Bank's Regulatory Indicators for Sustainable Energy (RISE), an index measuring the quality of electricity policy and regulation, are in SSA, with the sub-region persistently having, overall, the least developed policy and regulatory environments to attract investment into sustainable energy. In 2021, for instance, the SSA region significantly lagged the global average of 60 by nearly 30 points. Of the 39 African countries assessed, 13 were in the red zone, while only two countries from the SSA region (Rwanda and Kenya) were in the green zone. Meanwhile, most electricity access and renewable energy pillar indicators were in the yellow zone (ESMAP, 2022).

Capacity gaps in institutional settings and human resources are also binding constraints. Infrastructure projects, including power interconnections, cannot be planned, implemented, and maintained at national and regional levels without a sufficient mass of trained and skilled professionals. Additionally, realising the potential for regional power integration requires high-level and yet flexible institutions capable of gaining the confidence of international and regional actors in the energy field (World Energy Council, 2005)

Figure 7:Regulatory Indicators for Sustainable Energy, Overall Score (2021)

Source: Based on RISE Data

[9] **Defined as the difference between the actual revenue collected and the revenue required to fully recover the operating costs of production and capital depreciation**

Another primary challenge of energy markets is poorly targeted subsidies. SSA spends around US$ 25 billion annually on energy subsidies (Coady et al., 2015). These energy subsidies are either largely inequitable, mostly benefiting higher-income groups as they consume the most, or profoundly detrimental to the development of energy systems creating a disincentive for maintenance and investment in the energy sector, perpetuating energy shortages and low levels of access. In terms of renewables, the lack of a clear national strategy for the energy sector, unequal tax burdens, a lack of incentives for renewable energy technologies and significant subsidies for fossil fuel-based energy technologies are factors that create an unequal level playing field for investors, especially in medium and small-scale decentralised energy systems (Bhattacharyya, 2013; Rai et al., 2016; Lucas et al., 2017).

Increasing and strategic use of international financial assistance is undoubtedly critical for Africa's electrification if a good level of access to electricity by 2030 is to be attained. However, the step change in investment required means that international financial assistance is not enough to meet the financing needs of Africa's power sector. A way forward, in terms of bridging the financing gap, is to scale up international private investments, and for this reason, domestic reforms are needed across SSA countries to create viable and attractive investment environments. Stated differently, the power sector in SSA needs reforms to facilitate international investments. Power sector reforms, including authorisation of private sector participation, for instance, in the electricity supply industry as independent power producers (IPP), can result in timely power generation expansion (Hafner et al., 2018; Tehero, 2021).

Two key power sector reforms are fundamental: reform of power utilities and energy subsidies. Potential complementary reforms, including deepening of the financial sector or enhanced infrastructure (such as roads). Modernising the often large and informal economies and investing in skills are also crucial to help translate electrification into rising incomes and jobs (Hafner et al., 2018).

Altogether, undertaking these reforms to enhance energy access and greater integration of renewable energy into African power systems will bring significant benefits in terms of human well-being, socioeconomic development, and the environment (Fischetti, 2022). To be sure, the international community, particularly international public finance institutions, have accompanied private investors via direct financing, blended finance tools or risk-sharing mechanisms. The provision of such risk-mitigation and credit-enhancement tools often helps cover the country's risk faced by international energy companies and institutional investors with the hope that such risks might change over time as the political situation in a country evolves (Hafner et al., 2018). The reality, though, is that while these programmes effectively mobilise private investments in power generation, they cannot address the deep causes of inefficiency and the unsustainability of the sector. They need to be complemented by other initiatives along the electricity value chain for the power system to benefit effectively.

6. Obstacles to energy access beyond power supply: The demand

The supply-side barriers notwithstanding, the rate of access to electricity in SSA is substantially lower than it could be, considering the levels of income and the electric grid footprint (Blimpo & Cosgrove-Davies, 2019). What emerges is that despite primary policy focus on supply-side challenges to electricity access, there are significant demand-side challenges that impede uptake where there is an electricity grid nearby or readily available off-grid technologies. For example, according to one estimate, median electricity uptake is only 57% among households that live near the electricity grid in 20 SSA countries for which comparable Living Standards Measurement Study (LSMS) data are available[10](Blimpo & Cosgrove-Davies, 2019).

Ultimately, demand and supply constraints to electricity access in SSA are interlinked. The significant evidence of gaps in electricity uptake across African countries (See Chaplin et al. 2017; Lee et al. 2016), when considered in conjunction with the need to urgently scale up electricity access, raise an important policy question about the relative contribution of demand and supply constraints to explaining the substantial electricity access gap, particularly in SSA. Other relevant questions pertain to the pattern, barriers, and drivers of electricity uptake.

Regardless of which uptake figures one considers, it is apparent that there is much room for progress if the demand-related challenges are to be identified and appropriately addressed. However, just like electricity supply, rates of electricity uptake vary significantly across and within countries: they are high in a few countries such as Cameroon, Gabon, Nigeria, and South Africa, and very low (often below 50 percent) in other countries including Liberia, Malawi, Niger, Sierra Leone, and Uganda (See Table 3). Within-country uptake rates also vary, with a high concentration around big cities, urban and peri-urban areas (Blimpo, Postepska & Xu 2018).

A study of the evolution of electricity coverage, access and population in 10 African countries suggests that if all households that live near the grid were to connect, the average access rate would nearly double for these countries (Blimpo & Cosgrove-Davies, 2019). The question of why households near power grids remain unconnected is complex and requires a detailed assessment of demand-related issues. A review of the existing evidence, however, points to three major constraints that, from a basic consumer theory perspective, make uptake not feasible for consumers, namely, high connection charges[11], low and unpredictable household income, and low expected gains from electricity uptake (Blimpo & Cosgrove-Davies, 2019; Blimpo et al. 2018).

Indeed, addressing these challenges together with supply-side constraints is crucial to driving the required increase in access to electricity. However, faced with multiple constraints and limited resources, policy question regarding the relative contribution of demand and supply factors to the significant access gap is salient.

While separating the supply issues sharply from demand-related issues is not straightforward, a decomposition of the access gap in 31 African countries reveals that pure demand-related factors account for about two-fifths (37%) of the access gap, with significant variations across geographies, countries, and subregions (Blimpo, Postepska & Xu 2018). As one would expect, the supply-side constraints accounted for much of the access gap in rural areas (42 percent relative to 32 percent for the demand gap), while demand-side barriers dominated in the urban areas (70 percent relative to 11 percent for the supply gap). Now given that the majority of the unelectrified in SSA are rural dwellers and that supply-side constraints accounted for much of the access gap in rural areas, it supposes that supply-side barriers, including generation capacity and extension of infrastructure, are much more of a challenge than demand, although demand challenges are also significant.

[10] Other data sources with different sets of countries indicate higher or lower gaps (46% uptake using Demographic and Health Surveys [DHS] and 70% using the most recent Afrobarometer survey

[11] Electricity connection charges across SSA are often high relative to the level of income in most countries. But besides connection charges are other connection related barriers including long waiting times and connection requirement and standards that are challenging for the poor

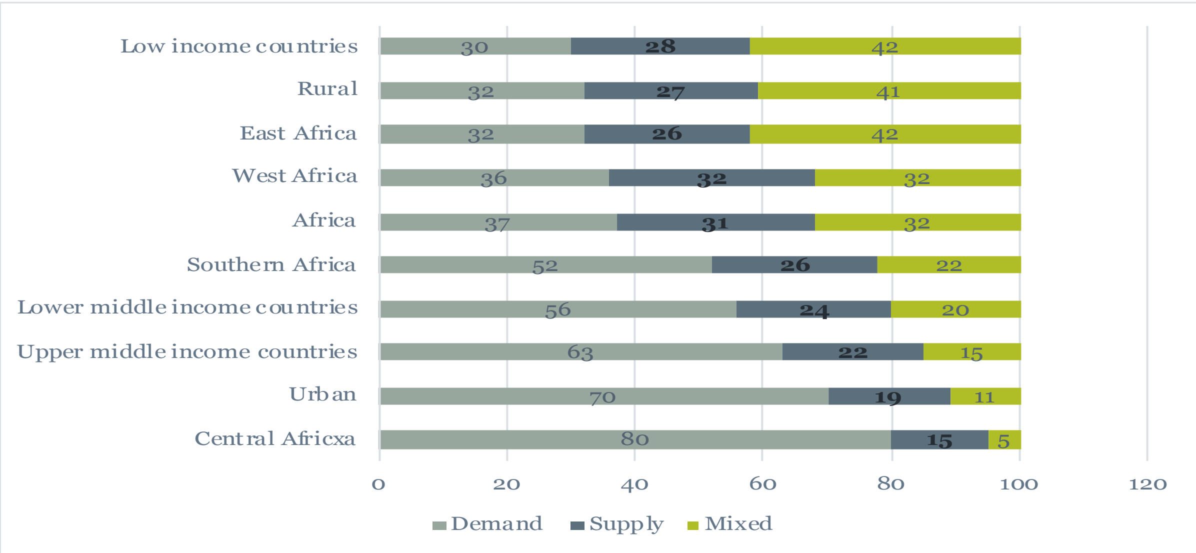
Table 3:Electricity uptake according to different sources (%)

Data source / Country	Afrobarometer	LSMS	DHS
Median Uptake	70	57	46
South Africa	98	90	
Nigeria	96	-	75
Cape Verde	95	-	-
Gabon	93	-	-
Cameroon	91	70	-
Cote d'Ivoire	88	65	-
Ghana	87	82	81
Mali	85	56	42
Sao Tome and Principe	85	-	-
Sudan	84	-	-
Senegal	81	73	52
Mauritania	-	77	-
Zimbabwe	76	-	60
Togo	75	78	64
Benin	74	-	-
Botswana	70	-	-
Namibia	70	-	62
Eswatini	60	-	-
Lesotho	65	-	53
The Gambia	-	-	65
Madagascar	64	-	29
Zambia	63	52	46
Guinea	62	67	-
Mozambique	60	-	-
Burkina Faso	58	-	42
Kenya	55	-	48
Tanzania	55	37	45
Congo, DR	-	55	44
Ethiopia	-	53	-
Burundi	51	-	-
Sierra Leone	48	57	34
Liberia	47	35	13
Congo	-	47	-
Niger	46	58	-
Uganda	45	50	30
Rwanda	-	-	40
Malawi	35	23	-
Chad	-	24	26

Source: Adapted from Blimpo and Cosgrove-Davies (2019)

Across the sub-regions, Central Africa is the most affected by demand-side constraints, representing 80 percent of the access gap, followed by Southern, West, and East Africa. Furthermore, across income groups, demand considerations accounted for 56 percent of the overall constraint in lower-middle-income countries, compared with 30 percent in low-income countries, where infrastructure development lags further behind. Overall, across countries (and regions), demand considerations increase as income level rises, indicating that countries with rising income can expand the grid to more deprived areas – thus mitigating supply constraints (Blimpo & Cosgrove-Davies, 2019).

Figure 8:Decomposition of electricity access gap by the type of constraint



Source: Adapted from Blimpo and Cosgrove-Davies (2019).

Addressing the demand constraints to electricity uptake will be crucial to ensuring universal energy access. The multiplicity of the demand challenges means, however, that resolving them is not simple. Nonetheless, a number of crucial points are worth highlighting: (1) Without addressing demand-related challenges that underpin low electricity consumption and below-cost tariffs that make connecting additional households unprofitable, utilities will continue to face financial disincentives to streamline the connection process and remove access barriers (2) To ensure the financial viability of the power sector and sustained development gains, it is essential to target enhancement of economic impact of electrification through firms and productive use (3) Prioritising reliability of power supply is crucial to enhance uptake and productive use of electricity (4) Coordinating electrification with complementary initiatives such as road infrastructure investment, access to finance, skills development, public service delivery, for instance, is crucial to maximising gains from reliable electricity (Blimpo & Cosgrove-Davies, 2019).

Key overarching policy implications

This Narratives around just energy transitions have been quite diverse and contested within African countries and between African and advanced countries (Hege et al., 2022). The emergence of JETP deals as an innovative financing mechanism is, therefore, taking place in a heated moment of contestation regarding Africa's role in climate mitigation as well as a dynamic continental and international political and economic landscape characterised by global energy and economic turbulence associated with the consequences of the Covid-19 pandemic and the war in Ukraine. Adding further complexity is the fact that the continent has the worst power system outcomes, albeit with significant disparities across countries, despite significant and growing investments and is further confronted with megatrends that have significant implications on how to address energy system challenges. Against this background, the potential of JETPs first lies in identifying countries that need accelerated energy transition and second in reassessing energy development strategies and support to advance complementary measures within which the innovative financial partnership plays a catalytic role.

This paper set out to accomplish these, identifying Nigeria, Egypt and Algeria as other African countries (besides South Africa and Senegal) for whom accelerated energy transition under JETP-like structures is justified. It is emphasised that for the majority of African countries, energy access and reliability are the primary challenges. In addition, the structural barriers and failings of energy development strategies and support and the key megatrends crucial to Africa's energy system development have also been underscored. Finally, key and strategic policy questions are interrogated, giving analytical consideration to emerging trends, constraints to rapid electrification and shortcomings of external support to Africa's power sector.

To conclude, several overarching policy implications from the analysis, including the role of development partners in fast-tracking energy access and decarbonisation beyond the boundaries of JETPs, are worth highlighting.

Diversity across African countries should inform the nature and design of energy development support provided.

African countries differ widely in terms of energy system challenges and needs, but also regarding economic profiles and development levels; energy resource endowments; institutional, technical, and human resource capacities and any attempt to generalise such dynamics risk being oversimplistic. In fact, for optimal outcomes, such diversity should inform the nature and design of energy development support.

Thus, while the top four energy-consuming African countries (Egypt, Algeria, Nigeria, and South Africa) with high GHG emitting power systems require radical renewable electricity generation innovations under a JETP-like structure, for the many other African countries grappling with energy poverty, the priority is to improve energy access to enable sustainable development and create better livelihoods. Importantly, beyond aligning energy systems challenges with support measures, consideration of the broader enabling environment has crucial implications for the cost of energy supplied and the realisation of socio-economic and environmental benefits.

In terms of energy transition, this implies pursuing a pragmatic African approach that allows for a gradual transition from fossil fuels and the use of a wide range of "cleaner" energy sources, including gas, while also adapting support measures and their design to individual context to ensure consistency with the larger context of the policy/ political agenda in the country.

Regional energy markets characterised by international power interconnection and trade constitute cost-effective means to accelerating energy access and decarbonising Africa's power grid and could help avoid fragmentation and inefficient power investments at national levels.

Regional power integration can help take advantage of efficiencies and economies of scale to cost-effectively supply reliable power and decarbonise Africa's power sector by increasing renewable energy integration into the power mix. By accelerating universal electrification through cross-border electricity trade, regional electricity markets could help avoid inefficient national-level investments, taking advantage of existing complementarities between different countries' resource bases. However, the current infrastructure deficits and dominance of bilateral arrangements are not sustainable, given the projected increase in domestic electricity demand at the national level. Delaying power interconnection will lead to inefficient national electrification, whilst without proper pooling arrangements that allow coordination in the planning and operation of the interconnected systems, it would be difficult for national utilities to continue to guarantee contractual amounts of electricity to the other partners. Development partners financing investment in small and fragmented markets stand to gain from a regional approach involving coordinated investment in the infrastructural, institutional, and regulatory arrangement required for the power market.

The diversity of energy system support required across Africa calls for comprehensive and coordinated support measures, exploiting complementarities where possible.

Aligning energy development support with individual country energy issues and needs means that while energy transition could be the priority in some countries, the primary challenge could be increasing energy access and reliability for many others. Broadly, however, most African countries seek to diversify their energy mix, enhance the security of supply, and maximise socio-economic and environmental benefits. Therefore, a coordinated approach that exploits the synergies and complementarities across the continent to optimal attainment of climate change mitigation, energy access and broader sustainable development goals is crucial. For instance, while few countries need and are well suited for accelerated energy transition under JETP-like structures with many others in need of energy access best served through regional electricity markets, aligning both measures would help exploit the synergies with gains not only in increasing electricity access and reliability but also greater decarbonisation of the continents power grid.

A holistic approach to universal energy access in Africa requires addressing not only the supply constraints but also the demand barriers that impede the uptake of both grid and off-grid solutions.

Any hope of reaching universal energy access in Africa requires a holistic approach beyond electricity supply to address demand-side barriers to limit uptake and utilisation. Even though the relative importance of demand and supply constraints to electricity access varies across countries, the role of demand-side barriers to electricity access is quite significant overall. For example, according to one estimate, if all households living within range of the electrical grid were connected to the grid, access rates would be well over 60 percent, on average, in Africa and nearly double the current rate in many countries. However, without an integrated electrification strategy, demand-side issues are often ignored. Indeed, without a holistic electrification approach that concurrently identifies and relaxes demand constraints, the financial viability of power utilities can be challenging, with universal energy access being a distant goal.

Power sector reforms should be the centrepiece of electrification efforts and even more so for decarbonising Africa's power sector.

The challenge of bringing modern energy to everyone in Africa is substantial, requiring a massive scale of investment. The technologies needed for tapping into the continent's energy resources are available, reliable, and cost-competitive. However, inefficiencies in the power sector and a broader unfavourable investment climate make it difficult to attract the private capital needed. The salient issues in the electricity sector include poor targeted and inefficient subsidies, insufficient local technical and managerial capacity, inadequate policy and regulatory framework and poor utility performance. Combined with weak domestic capital markets and an overall lack of economic and political stability, the barriers to private investment are still plentiful and constantly need to be overcome. Addressing these challenges through a holistic and integrated approach that fixes dysfunction in the power sector, builds capacity at both national and regional levels and pursues the complementary agendas (such as financial development) required to attract private sector investment is required.

Fixing the dysfunction of African electricity markets to unleash SSA energy transformation requires improving the policy and regulatory environment in most of the poorest performers facing low electricity access. Reforms and capacity building at national and regional levels are also essential to make African utilities financially viable for transformative change, including evolving the regional electricity market and shifting the power mix towards renewable energy sources.

Reforms are particularly important now to attract private capital given public finance constraints, the global competition for Foreign Direct Investment (FDI), the capital-intensive nature of energy projects and long payback periods and lead times. Importantly, the global goal of decarbonising the power sector requires an even more efficient and capable power sector and actors if the cost-competitive and economic diversification gains of increasing renewable energy shares in the power mix are to be realised.

Accelerating energy access is the priority of the majority of African countries, while the transition from fossil fuels to cleaner forms of energy is a complementary priority that should manifest variously across countries in terms of timing and modality.

Africa's energy problem number one is access, both 'basic' and 'industrial' access, that is, for households and industry, respectively. However, achieving universal electricity access does not have to interfere with climate goals not only because the continent's share in global GHG emissions is small but also the increasing competitiveness of renewable energies. Indeed, renewable energy is becoming more and more competitive and should/would play a key role in the electrification of the continent through a mix of centralised and decentralised production. For instance, in SSA, photovoltaic technology is already leading new investments in power generation, including in remote areas—where it is booming as a means to provide cheap electricity far from the grid. Additionally, the changing role of fossil fuels in the global energy landscape forces all countries, including African countries, to consider their potential and impact in the long term, which means not only taking action in terms of air quality and the environmental impact of upstream investment but also prioritising investments that accelerate access to modern energy. The wide diversity across African countries, however, means the mode, timing and speed of energy transition should be adapted to the country context while exploiting complementarity through regional electricity trade to spread advantages.

At the same time, recent events such as the Ukraine war have demonstrated that the energy transition is not immune to the impacts of major environmental, economic and geopolitical events and that the trade-offs between energy affordability, security, and sustainability exist and need to be carefully considered (WEF, 2022). For African countries, this calls for a balanced approach that delivers on the imperatives of sustainability, energy affordability, and energy security and access – in essence, driving a resilient energy transition. Balancing the multiple objectives also means adapting the speed and sequencing of transition/decarbonisation to the regional context, including minimizing the contribution to global emissions. Specifically, while coal certainly needs to be phased out, natural gas has a role in Africa's energy transition journey, serving as a transition fuel. The role of gas in Africa's power mix is justified not only by its abundance and relatively less polluting nature but also by the fact that the most widespread renewable sources—solar and wind—are variable, and thus in the absence of cost-competitive energy storage technology require some investments in 'firm' sources of power to stabilise power grids. Some selective and time-bound investments in gas power are thus important.

Delivering reliable and sustainable modern energy services for all requires a combination of decentralised and centralised approaches with a strategic focus on promoting productive uses towards the enhancement of economic livelihoods.

With recent rapid cost reductions, renewable energy technologies now represent the most cost-effective option to expand electricity access in most rural areas in Africa. Through off-grid renewable energy solutions, a variety of electricity services required to meet basic needs and strategically promote productive uses are now available. While solar lighting, for instance, represents a first step in the energy ladder, mini grids offer further opportunities to upgrade both the quality and quantity of energy supply. Achieving universal electricity access requires significant roll-out and scale-up of these decentralised electrification options. Not only do off-grid renewable energy solutions offer a crucial opportunity to accelerate the pace of electrification in Africa, but also reliable and environmentally sustainable energy sources can increase incomes in rural areas, open new economic opportunities and serve as a basis for broader rural development. However, achieving this potential requires a different view of off-grid solutions – as a promising market rather than a mere stop-gap – focusing on creating markets, encouraging the participation of local enterprises, and catalysing private capital into the sector. Currently, however, the shares of mini-grids and stand-alone systems in Sub-Saharan Africa are very small owing to the bias of electrification effort towards grid expansion and, consequently, lack of appropriate policy and regulatory framework. Dedicated policy and regulatory frameworks are needed to incentivise the private sector, foster innovative business and financing models and create enabling conditions for deployment.

The crucial role of decentralised solutions in overcoming many of the problems that hold back grid expansion should, however, not end up downplaying the role of centralised approaches. Whatever the gains from off-grid solutions, a narrow focus on off-grid solutions would make it more difficult to meet the soaring increase in energy demand. In many cases, while off-grid generation may offer the cheapest solution to ensure 'basic' energy access, it is instead largely insufficient to guarantee 'industrial' access, which is necessary to sustain the pace of economic development that the region needs. The ultimate goal is to supply electricity at a scale that can support community development and income-opportunity development. However, given the capacity and current level of solar technology, generating high-productivity activities going forward would require grid electricity. Combining both approaches while prioritising productive use of access is thus essential.

Complementary support for industrial development in Africa is crucial if electrification and energy transition is to be accelerated and contribute to far-reaching economic diversification.

Lack of industrial capacity underpins Africa's low electrification rate and limited addition of renewables to the power mix. On the one hand, the low levels of industrial development have led to relatively limited energy demand that effectively disincentivises new power generation by utilities, given the poor economic situation for households that hardly pay cost-reflective power tariffs. On the other hand, for fossil fuel-producing economics, the poor industrial capacity and limited economic diversification have been major sources of political barriers to energy transition owing to fear of job losses from the power sector. Energy sector development that fails to address these constraints would hardly create a virtuous cycle involving high energy demand, financially viable utilities, job creation, poverty reduction and inclusive growth. The importance of industrial development in enhancing electrification and energy transition can be inferred from the pattern of ownership of renewable energy patents that shows innovative and productive capacity across the continent. South Africa, for instance, has been an obvious leader on the African continent with 63% of total African patents, followed by Egypt with 8% (UNEP, EPO 2013; Pistelli, 2020). Northern Africa—represented by Egypt (18 patents), Algeria (12) and Morocco (11)—follows suit but lags significantly behind South Africa. Other countries such as Ghana, Burundi, Mali, Senegal, and Zimbabwe, have less than 1% of total African mitigation patents, with only Kenya reaching 1.2%. The rest of Africa possesses 3.9% of patents (25 over 657 in the entire African continent).

Energy supply will never ensure industrial development if adequate policy measures are not adopted by the government. In other words, energy access is a necessary—but not sufficient—condition for industrial development. As of now, there are only a few countries in the SSA region where industrial development could drive energy demand growth. South Africa, Kenya and Ethiopia represent different examples of this.

The challenge of bringing modern energy to everyone in Africa is a global challenge that requires active and coordinated participation of development partners in supporting infrastructure investments, incentivising energy market reforms, and providing capacity-building technical assistance at national and regional levels to simultaneously address supply and demand constraint.

Africa's power sector has multiple development imperatives, from enhanced energy efficiency, increased renewable energy in the energy mix, and improved energy access to better connectivity across the region. This implies the need for comprehensive support strategies and solutions that lie well outside the boundaries of JETPs. Direct investment support ought to be holistic, concurrently supporting electricity generation (both centralised power generation and off-grid) and transmission infrastructure. Better use of international public financing requires coordination and streamlining of financial assistance to reduce bureaucracy and redundancy. One way to achieve this is through coordinated support in developing priority transnational infrastructure required for regional energy integration. Donor coordination under JETP deals could be replicated at the regional level to support the evolution of a functional electricity market.

While African countries themselves should lead in igniting a virtuous cycle—notably by making the key reforms necessary to create a favourable investment environment- the international community has a role to play in terms of incentivising and supporting energy market reforms. Fixing power sector inefficiencies thus requires joint action of SSA countries and the international community reforming the governance of their energy sectors—without this, the needed international private investments will never materialise.

Additionally, development partners can play a crucial role where needed to help facilitate the interaction between private investors and governments through providing technical assistance for electrification planning, supporting the building of the right regulatory environment and raising the level of expertise of workers at both national and regional levels to build the institutional and human capacity set-up required to plan, build, operate and manage cross-border electricity interconnections.

Beyond the power sector, investing in effective leaders for SSA, without interfering with local politics or imposing an ideology, but rather by training African leaders to find local solutions to their local problems, including those that are related to bad governance, is crucial. Granted, there is no quick fix to governance, and institutional inefficiencies: capacity building, training, and leadership development are crucial. Solutions to Africa's problems must be endogenous and tailored to the African context by African leaders.

Those wishing to accelerate the pace of decarbonisation in Africa have work to do on many fronts. Areas requiring support include regulatory and market reforms, early adoption of energy storage, national and international transmissions and distribution infrastructure, and improved power network management capabilities.

Furthermore, owing to the limited contribution of African countries to historical GHG emissions as well as the massive endowment of fossil fuel and low electricity access, framing the energy transition as an opportunity for economic diversification rather than climate change mitigation is useful to strengthen broad local support. But much more than pushing a narrative, support for investment in local innovation, technology transfer, value chains, and industrialisation are crucial for success.

Finally, multilateral initiatives by development partners at continental and regional levels should explore diversifying interlocutors. Diversifying should in no way mean excluding the AU from the negotiation on energy policy but rather include some actors or instruments that are deemed more legitimate and that function more effectively. The AfCFTA, which exists under the AU umbrella but has the potential to be a better platform for cooperation between Africa and external partners, especially when it comes to the trade of energy and natural resources (Kende-Robb, 2021; Ross, 2022; Fischetti, 2022).

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