REVISITING REFORMS IN THE POWER SECTOR IN AFRICA

AFRICAN DEVELOPMENT BANK GROUP
GROUPE DE LA BANQUE AFRICAINE
DE DÉVELOPPEMENT

ACKNOWLEDGEMENTS

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Professor Anton Eberhard of the Graduate School of Business, University of Cape Town, led the core team of researchers conducting the study. Gabrielle Dyson managed research, consultations, and presentation of findings. Olakunle Alao developed the methodology of indices, collated, and represented the data. Catrina Godinho advised the team on the research design and drafted political economy analysis, and recommendations.

The study team gratefully acknowledge the leadership, constructive feedback and support from the AfDB Power Systems Development Directorate (PESD) and the APUA teams, and specifically the following people: Mr. Batchi Baldeh, director of the power systems development department; Mr. Abel Didier Tella, director general of the APUA; Mr. Jacques Moulot, manager of power utilities division; and professional experts of the PEVP complex and various Bank units, including the AfDB's regional offices.

The team also acknowledges the valuable comments of the validation meeting at inception and final stage of the document.

The study is based on inputs from power sector experts in 42 countries across the African continent. Questionnaire respondents represent a variety of stakeholders including national utilities, government ministries, regulators, and independent experts. We wish to express our sincere gratitude and recognition of the time and efforts contributed to provide thoughtful and detailed answers to the questionnaire, and thank respondents for their valuable insights.

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FOREWORD OF THE AFRICAN DEVELOPMENT BANK (AFDB)

I would like to start by recognizing the good news that Africa has some of the fastest growing economies in the world, according to the AfDB's African Economic Outlook 2018 and 2019. The African Power Sector is also currently undergoing its fastest rate of growth. For example, in 2017, the sector installed total electricity capacity reached 175 GW (from 165 MW in 2012), of which 35 GW was renewable. This clearly shows that investment in power generation is indeed expanding, and for the first time, in 2017, at a pace that is higher than the population growth rate. [1]

However, the bad news is that despite the growth of the power sector, close to 600 million Africans remain without electricity, which is the life-blood of development. Utility performance in many countries has been poor mainly due to governance and management challenges, poor planning, inadequate human capital development and non-cost-reflective tariffs: This has resulted in poor quality of supply and service provision, characterized by frequent and ubiquitous load-shedding, high technical and financial losses and widespread customer dissatisfaction. Consequently, many industries and consumers have been forced to produce their own power, often at significantly higher costs (reaching $0.40/KWh), although the reduction in prices of solar appliances have helped to reach grid parity in some instances.

Inevitably, the power utilities must be transformed! The above challenges faced by power utilities are diverse, and have significantly limited the ability of utilities to recover the cost of investments made along the power value chain, and achieve profitability and credit-worthy balance sheets.

As a response to the above, the Bank launched in 2016, the New Deal for Energy for Africa (NDEA), based on a strategic partnership arrangement aimed at mobilizing finance and expertise to provide universal access to electricity on the continent by 2025, in line with the Bank's Light-up and Power Africa initiative, which is expected to drive the Bank's High Fives development agenda. A new Vice Presidency for Power, Energy, Climate and Green Growth, was established in 2017 to drive bank-wide efforts to implement the NDEA, of which utility transformation, regional power trade and green growth are central components.

The current study falls under the "Sustainable Utility Transformation (SUT)" agenda of the Bank. The report is timely and takes stock of the outcome of more than thirty years of power sector reforms, through an evidence-based approach: It highlights evolving trends in policy, regulatory and institutional reforms; technology, financing, business models and critical success factors for private sector participation. Indeed, the performance of most utilities, irrespective of their institutional structure (vertically integrated, fully or partially unbundled) have been hindered by inadequate tariff structures and subsidies, large debts, contingent liabilities and budget deficits (in the order of USD 200 Million to over USD 25 Billion). Ministers of Energy and Ministers of finance will have to collaborate early and better!

I warmly encourage energy sector policy-makers, regulators, utilities, power pools, development partners, investors, consumers and other stakeholders to carefully read this report and embrace the complexity and diversity of challenges and potential solutions, specific to the circumstances of the power sector in all African countries. Ultimately, we have to work together and create the African utilities of the future.

Batchi Baldeh
Director,
Power Systems Development Department
African Development Bank

1 https://www.afdb.org/fileadmin/uploads/afdb/Documents/Development_Effectiveness_Review_2018/ADER_2018_Ch_2.pdf

FOREWORD OF THE ASSOCIATION OF POWER UTILITIES OF AFRICA (APUA)

Since its inception in 1970, APUA has achieved several milestones, including commissioning studies on electric interconnection networks in Africa, the establishment of an engineering school for the training of electrical engineers, and contribution to the creation of several Regional African Power Pool organizations. Among the more recent achievements, we can mention:

- The holding of the Constituting Assembly of the African Electro-technical Standardization Commission (AFSEC) in February 2008 in Accra. The idea of creating a body to develop standards suited to African conditions was advocated by APUA since the early 2000s. Later, the African Union Commission (AUC) and the African Energy Commission (AFREC) endorsed this idea.
- The assessment study on reforms in the African power sector.

At the request of APUA, a study on the outcomes of reforms in the electricity sector in Africa was commissioned, with financing from the European Union through the BizClim initiative. The findings of the study were presented during a conference held in Brussels (Belgium) on 27th and 28th March 2008. Among the recommendations of the conference, there was the need for drafting a compendium of reform best practices in Africa. The Compendium was divided into separate sections, each of which described an identified practices considered good, relative to the implementation of a major objective of the reform process. The Compendium was designed to include strategic analysis and decision-making support tools for Government authorities, experts, power companies, other decision-makers and international organizations having an interest in the African power sector.

- In order to strengthen the role of African Power Pools,

APUA actively participated in the creation of the Regional Power Pool of Central Africa (PEAC), which is a specialized body of ECCAS (Economic Community of Central Africa) and the Eastern Africa Power Pool (EAPP), which is a specialized body of COMESA (Common Market for Eastern and Southern Africa). Thereafter all Regional Power Pools, i.e. the COMELEC (Maghreb Electricity Committee), WAPP (West African Power Pool), SAPP (Southern Africa Power Pool), PEAC, and EAPP agreed, under the auspices of APUA and AFREC (AUC), to sign an MOU for cooperation in 2005 in Lusaka.

Over the last decade, many things have changed within the African power companies, most of which are members of APUA. Did we succeed in improving the commercial, financial, technical and managerial performance of national power companies, which is the main objective of most of the power sector reform programmes? What have the various power sector reforms achieved? The context of a substantially strengthened collaboration and privileged partnership between APUA and the African Development Bank in recent years, gave us an interesting opportunity to join forces and revisit the 2008 study on the African power sector reforms; and to deepen the analysis of their impact in a context of profound changes in the sector, including the breakthrough and impact of new disruptive technologies.

I am convinced that with the findings of the present report, drawing lessons from the weaknesses and challenges of the African power sector, there is no doubt that, together, we will come up with ways and means of making informed decisions for the efficient management of the power sector across Africa.

Victor Mundende, MD
Zambia Electricity Supply Corporation Limited (ZESCO)

Abbreviations

AfDB	African Development Bank
AFREC	African Energy Commission
APUA	Association of Power Utilities of Africa
BOO	Build-Own-Operate
BOOT	Build-Own-Operate-Transfer
COMELEC	Maghreb Electricity Committee
CSP	Concentrated Solar Power
DFIs	Development Finance Institutions
EAPP	East African Power Pool
EPC	Engineering, Procurement and Construction
EPSRA	Electric Power Sector Reform Act
ERI	Electricity Regulatory Index
ERP	Enterprise Resource Planning
ESMAP	Energy Sector Management Assistance Program
FiT	Feed-in-Tariff
GISs	Geographic Information Systems
GPS	Global Positioning Systems
GoU	The Government of Uganda
GW	Gigawatt (capacity)
IMF	International Monetary Fund
IPPs	Independent Power Producers
ISO	Independent System Operators
kWh	Kilowatt-hour (energy)
MIRA	Managing Infrastructure Investment, Reform and Regulation in Africa
MW	Megawatt (capacity)
NDEA	New Deal on Energy for Africa
NEPP	National Electric Power Policy
NERC	Nigerian Electricity Regulatory Commission

Abbreviations

PESD	Power Systems Development Directorate
PEVP	Power, Energy, Climate Change and Green Growth
PI	Performance Index
PIDA	Programme for Infrastructure Development in Africa (AfDB)
PIDA-PAP	Programme for Infrastructure Development in Africa Priority Action Plan
PPA	Power Purchase Agreement
PSP	Private Sector Participation
PV	Solar Photovoltaic
REA	Rural Energy Agency
RE	Renewable Energy
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
REPO	RE-Purchase Obligation
R-G	Reform-Governance Index
RI	Reform Index
RRI	Regulatory Reform Indicator
SAIDI	System Average Interruption Duration Index
SAIFI	System average Interruption Frequency Index
SAPP	South African Power Pool
SE4ALL	Sustainable Energy for All
SPPs	Small Power Producers
SUT	Sustainable Utility Transformation
USD, $	United States Dollars—all prices in this report are stated in USD
WAPP	West African Power Pool
WB	World Bank

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Executive Summary

Background and existing utility performance related initiatives

This report updates previous African Development Bank (AfDB) and Association of Power Utilities of Africa (APUA) assessments of power sector reforms in Africa. APUA conducted a study in 2008 on reforms in the African power sector, focusing on 19 countries. The 2008 study examined the reasons, drivers, and triggers underlying reforms; actors promoting the reforms; the design and implementation of reforms; the impacts on utility performance; and the key success and failure factors of reforms. The 2008 study was complemented by a Compendium of best practices (2009), drawn from nine country case studies. The case studies provide implementation guidelines in three categories: financing investments; improving efficiency; and designing legislative and regulatory frameworks to meet reform objectives.[2]

In 2016, the AfDB introduced a new partnership-driven initiative, called the New Deal on Energy for Africa (NDEA). This initiative aims to "Light up and Power Africa" with a stated target to achieve universal access to electricity on the continent by 2025.[3] The AfDB's Vice-Presidency for Power, Energy, Climate and Green Growth (PEVP) works to support the AfDB's member countries and power sector actors to achieve the aims of the NDEA, including through providing technical assistance for planning, development, and financing projects that will increase generation capacity; extend and strengthen power networks, build regional power markets, and improve the performance of power utilities.

The AfDB launched the "Sustainable Utility Transformation (SUT)" Agenda, in 2017, which aims to accelerate turning around of African power utilities towards creditworthiness and internationally benchmarked performance. The SUT's main action areas are 1) least-cost integrated resource planning; 2) sector and utility governance, management and leadership; 3) sector and organizational reforms, and financial sustainability; 4) human capital development; and 5) smart partnerships.

With this report, the AfDB and APUA examine African experiences to provide valuable lessons on the implementation and success factors of reforms. These lessons should guide the design of policies, programs, and regulatory frameworks to adapt to new challenges. Understanding the policy implications is essential to support efforts to catalyze Africa's progress, or to facilitate a 'leapfrog' development with respect to other regions. This report also sharpens the focus on mapping and answering new needs and concerns that derive from recent technological trends, innovations, and transformations affecting the economy, politics, and power sector.

Methodology of the study

Local answers and perspectives—gathered through 30 extensive questionnaires from utility professionals in the APUA's membership network, as well as other sector experts—were critical in shaping this research. Their insights provide both broad and specific understanding of their countries' situation, allowing us to :

1. Examine past decades of experience in power sector reform and map the processes, events, contexts, drivers, and outcomes (or current status) in the power sector.
2. Turn towards the horizon of reforms, by surveying the level of understanding, interest and anticipation of new or forthcoming trends and challenges among respondents from different countries.

The study's first premise is to examine the experiences of African electricity sector stakeholders relating to power reforms. The aim is to produce a local perspective on the current implementation status, spread, and landscape of reforms in Africa (section 2), the contexts and drivers surrounding those reforms (section 3), a view to the pressing changes and challenges on the horizon (section), and policy implications for contending with future needs (section 5). This meets the call for African countries to define a shared vision and goals for the power sector, giving countries space to define a path to development aligning with their specific needs.

Power sector reform status– reflecting another wave of reforms :

Beginning in the 1990s, Development Finance Institutions (DFIs), especially the World Bank (WB) and International Monetary Fund (IMF) offered countries conditional loans attached to structural adjustment requirements that encouraged economy-wide liberalization, commercialization, and restructuring. In particular, they offered financing to some governments linked to reforms in the power sector, including adopting the 'standard model' to respond to failures in the utilities.

The 'standard model' reform elements promoted by the DFIs recommended :

- Commercializing electricity utilities and corporatizing their management;

[2] B. Pauly et al., Best Practices: Power Sector Reform in Africa, UPDEA/APUA, www.apua-asea.org/updea/archiv/UPDEA_Best_Practice_en.pdf.

[3] African Development Bank, Light Up and Power Africa – A New Deal on Energy for Africa, www.afdb.org/en/the-high-5/light-up-and-power-africa-%E2%80%93-a-new-deal-on-energy-for-africa/ , The Light and Power pillar is to drive the implementation of the four other high five themes (Feed Africa; Industrialize Africa; integrate Africa; improve the living conditions of African).

- Restructuring national monopoly companies to separate generation, transmission, and distribution services;
- Creating independent regulation and adopting cost-reflective electricity tariffs;
- Opening the sector to Private Sector Participation (PSP); and
- Introducing competition in the market through large-scale procurements, with the goal to reach full competition for wholesale and retail customers.

The 'standard model' reforms have targeted all segments of the power sector value-chain in Africa, and in very different ways. Power utilities have been subject to restructuring efforts in many countries, to streamline incentives and increase operational efficiency by unbundling generation, transmission, and distribution segments (see section 0). Most countries have created regulatory entities to oversee licensing of sector operators and govern tariffs, and pricing (see section 2.2). Private capital has been widely introduced in the generation segment, which can easily accommodate Independent Power Producers (IPPs) to build new power plants and connect to a national grid. Many countries have also tested other forms of PSP, like concession contracts for a private entity to run the power utility (see section 3). Competition for the procurement of additional capacity for power generation was mostly done through IPP auctions.

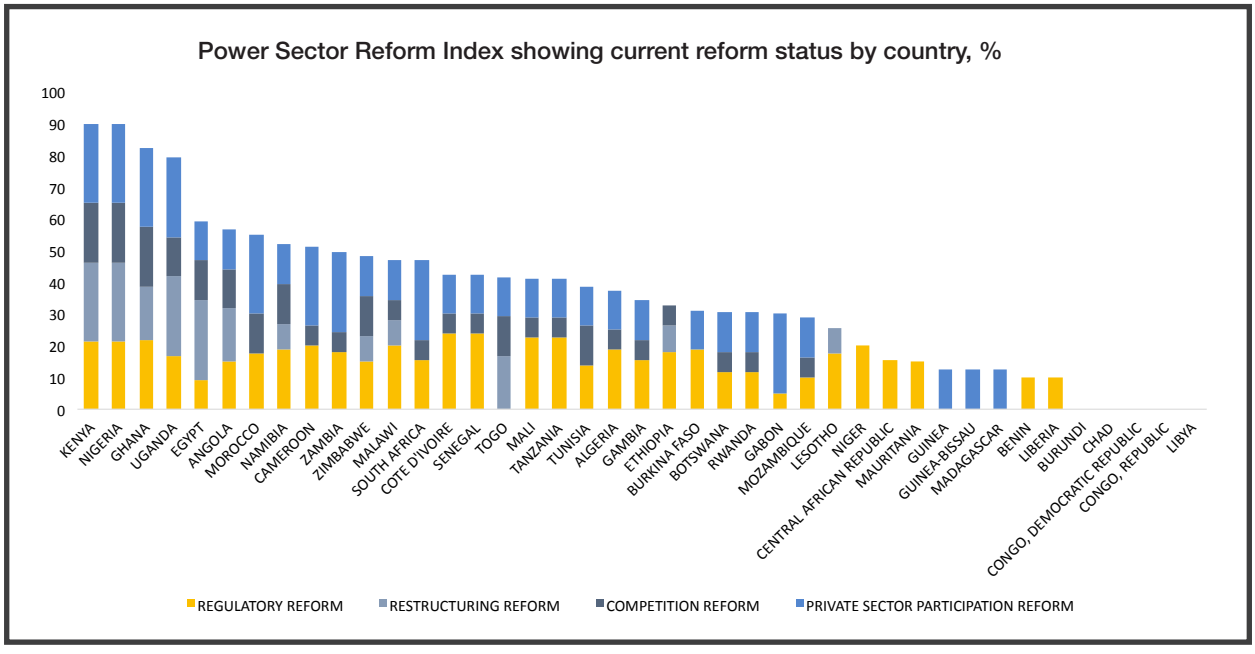
However, the prescriptive form of the proposed structural adjustments in the standard model often failed to communicate with local concerns, visions, and needs. The logics and intended results of reforms seemed unclear or cynical to most sector stakeholders, translating to poor levels of local ownership and support of the measures. Suspicion of foreign lenders, investors, and development institutions, combined with the strategic importance of electricity networks and assets, stoked fears that reforms were designed to favor private sector parties, thereby disadvantaging local entities, and threatening energy security.

In addition, the first wave of reforms generally did not prioritize social and political goals of expanding access to electricity and clean energy sources, nor improving equity or affordability. Instead, parallel initiatives often had to be implemented to foster progress in those areas, such as through specific electrification and rural energy programs and funding to increase access, and targeted subsidies and/or cross-subsidies to support lifeline tariffs for low-income households.[4]

The landscape of reforms in African power sectors today

The power sector in Africa still largely retains the traditional integrated monopoly utility structure, although many have included IPPs. Only 10 of the 42 countries included in this study have partially or completely unbundled the sector (i.e. 24%).[5] Other countries are considering the possibility of restructuring and creating an independent system operator to carry out responsibilities for least-cost generation planning, power procurement, system operation and power dispatch, and transmission and distribution planning. Countries with more extensive record of reforms, such as Kenya, Nigeria, Ghana, and Uganda, therefore rank higher compared to others (see below).

Regulatory reform has been the first step in the reform process for most African countries: 33 of 42 countries in this study have established an electricity regulator (i.e. 79%). Establishing independent regulation intends to create an equitable, rules-based playing field for electricity providers, consumers, and private operators through clear rules and mechanisms to oversee the sector and cost-reflective tariffs for utilities. Independence from



[4] See section 4.

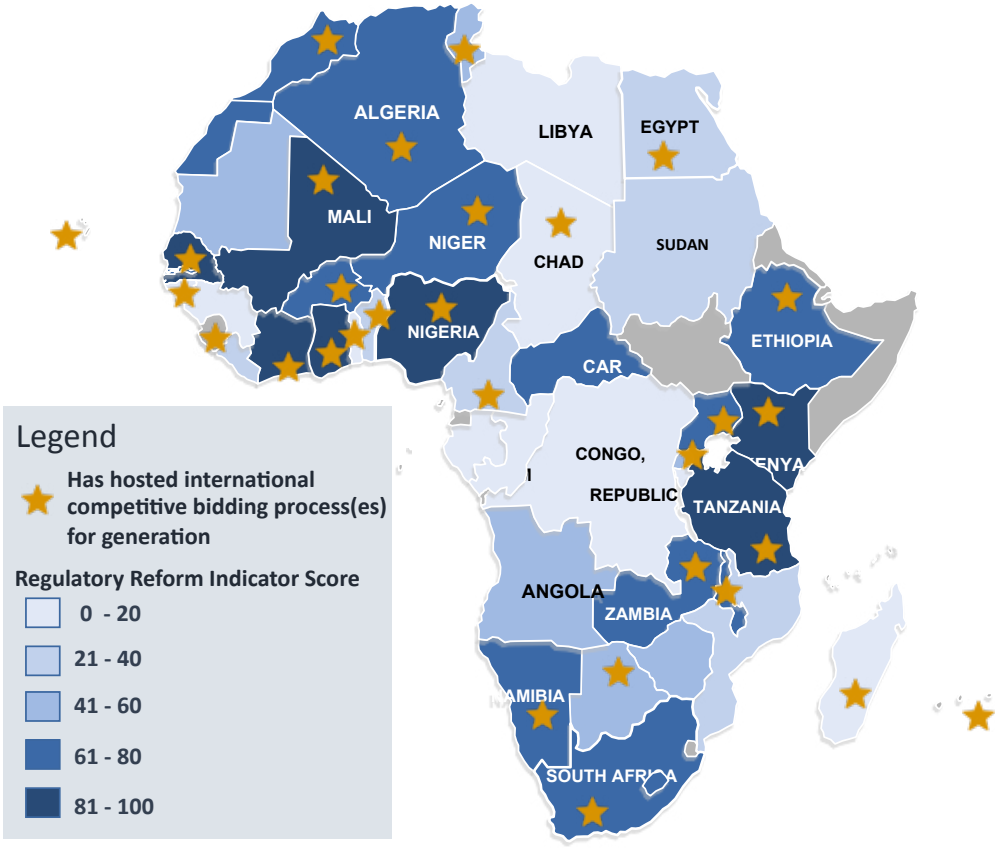
[5] List of 10 Countries that restructured: Algeria, Angola, Ethiopia, Ghana, Kenya, Lesotho, Nigeria, Sudan, Uganda, Zimbabwe

government and other interests remains a challenge for many electricity regulatory bodies in Africa, hampering their ability to carry out effective regulatory functions.

Opening up capital investment flows in the African power sector is often at the forefront of reform goals. The fastest-growing sources of private sector investment in the sector are IPPs, alongside Chinese-funded projects. IPPs are now present in over 30 countries, with 270 operating or in construction totaling over 27 GW of capacity. These represent about $51.7 billion in investments (see figure below). Transmission investments have not benefited from the same influx of private investment as generation. Only a handful of countries have some form of private participation in transmission. Private management has been introduced in the form of concessions, affermage, and full privatization programs in different segments of the power sector in several countries. Occasionally, this has caused controversy and even contract reversal. The quality of governance—including corruption levels, rule of law, and regulatory environment—is a key factor to support transparency and stability for private investment in the sector.

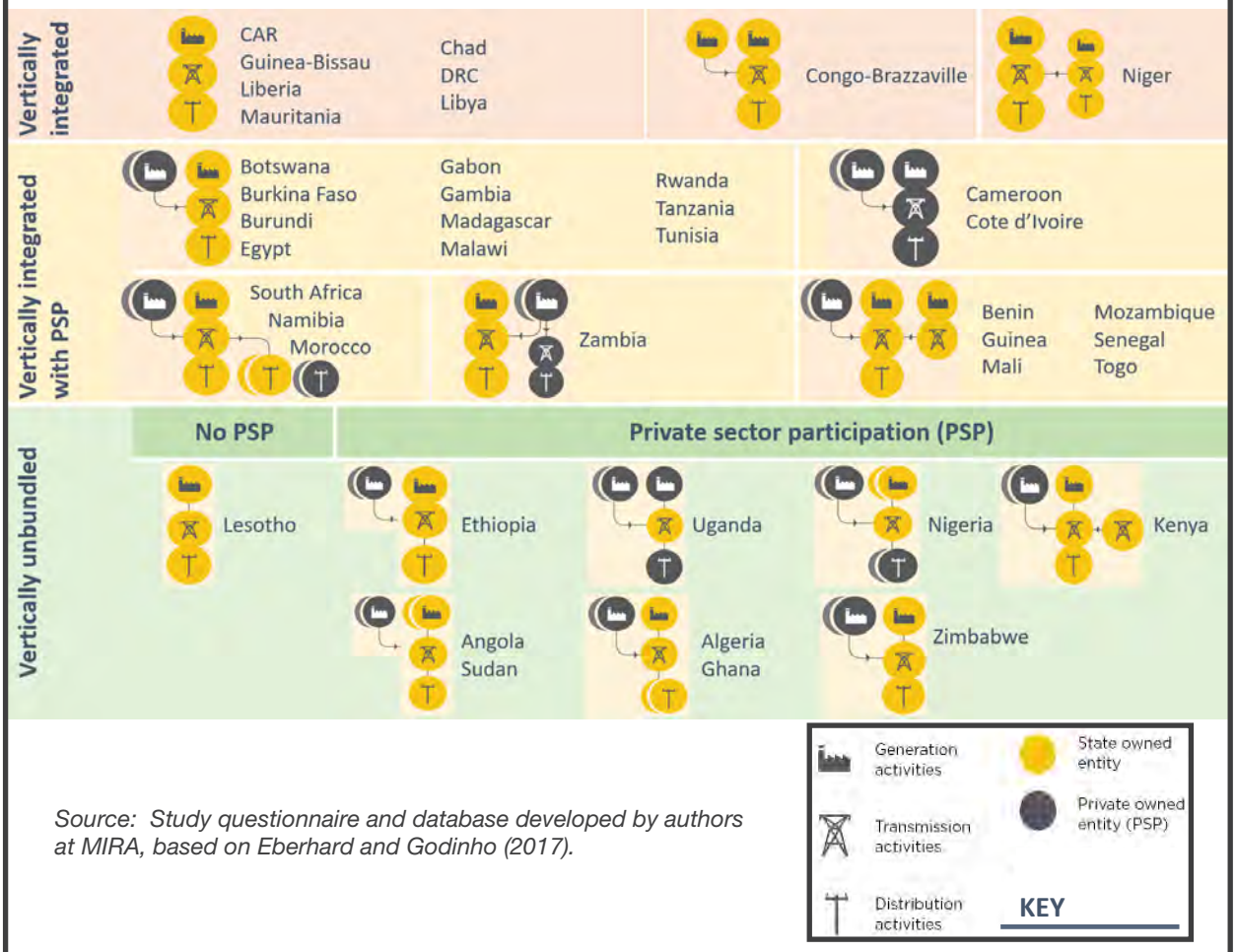
When it comes to closing gaps in electricity access and affordability, reforms are far from sufficient to fix the problem (see section 4). Complementary policies, planning, funding, and purpose-built agencies for electrification all contribute to give direction to power sector reforms, helping countries to expand electrification, energy access, and affordability for poor households. Most African countries have established national agencies in charge of rural electrification. Supply and transport of low-cost power in the continent require major investments and planning in regional integration and transmission interconnections, some of which are already underway (section 5). Meanwhile, the institutional, structural, and procedural adjustments required by 'standard model' reforms have become a cornerstone of many countries' Renewable Energy (RE) policies, by paving the way for transparent, even-handed, reliable, and competitive procurements for renewable generation (section 6).

International competitive tenders for power generation in Africa



Source: Study questionnaire, MIRA database (2019) and AfDB (2018).

Structure of electricity sectors and private participation in 43 countries

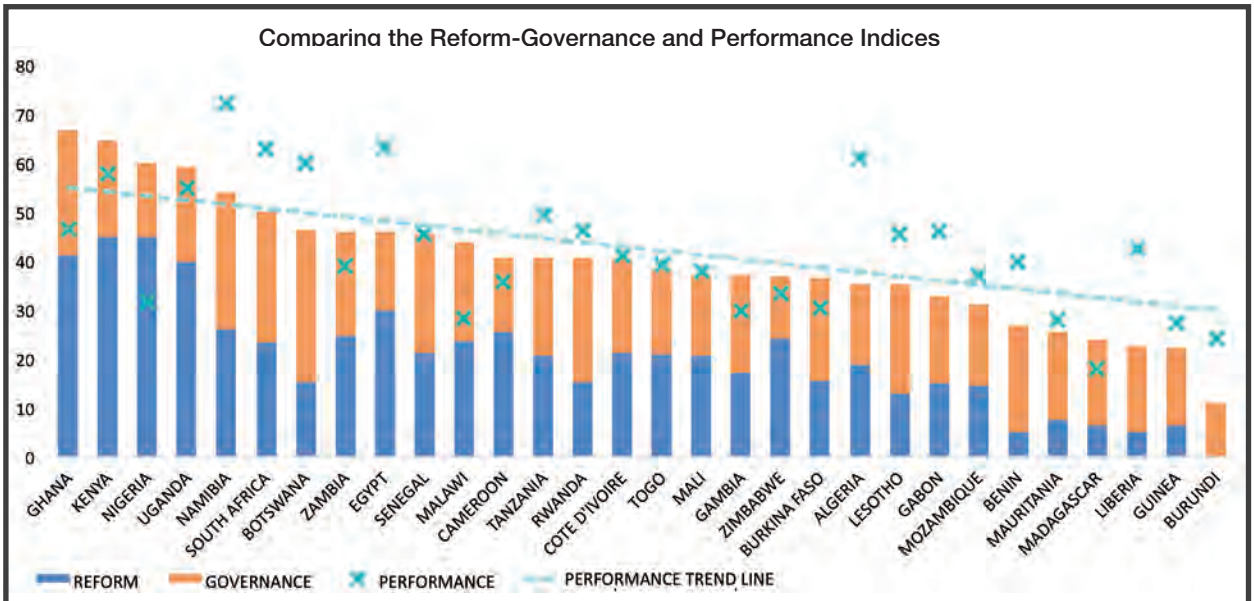


Source: Study questionnaire and database developed by authors at MIRA, based on Eberhard and Godinho (2017).

Reforms have indirect effects on the performance of the power sector. This study developed a Reform-Governance Index and Performance Index to compare the levels of reforms adopted in a country, and rank the performance of its power sector. Aligning the indices suggests relationship between a country's adoption of reforms, its quality of governance, and the performance of its power sector. While several outliers occur, which prompt further analysis, a defined positive trend is evident, especially when the quality of governance in the country is considered (Figure below).[6] This fits the understanding that political, economic, and financial measures to reform and improve a power sector can only enjoy full success in stable, transparent, rule-based environments. However, those do not paint the whole picture. In addition to governance, the success of any reform relies heavily on the local ownership and support for each measure. Improving performance measures like electricity access and affordability depends on solid planning processes for rural electrification, as well as targeted policy interventions, regulatory initiatives, and funding allocation. Operational and financial performance improvements similarly require effective planning environments, adequate institutional and investment capacity, and targeted interventions to improve management and technical capabilities.

Mini-grids and off-grid electricity supply models—especially those that harness small modular renewable generation technologies—are increasingly attractive and cost-competitive for remote communities. Over half of study respondents (all in sub-Saharan Africa) report the existence of a mini-grid industry in the country. These industries are rapidly growing, especially with support from development institutions, notably the AfDB.

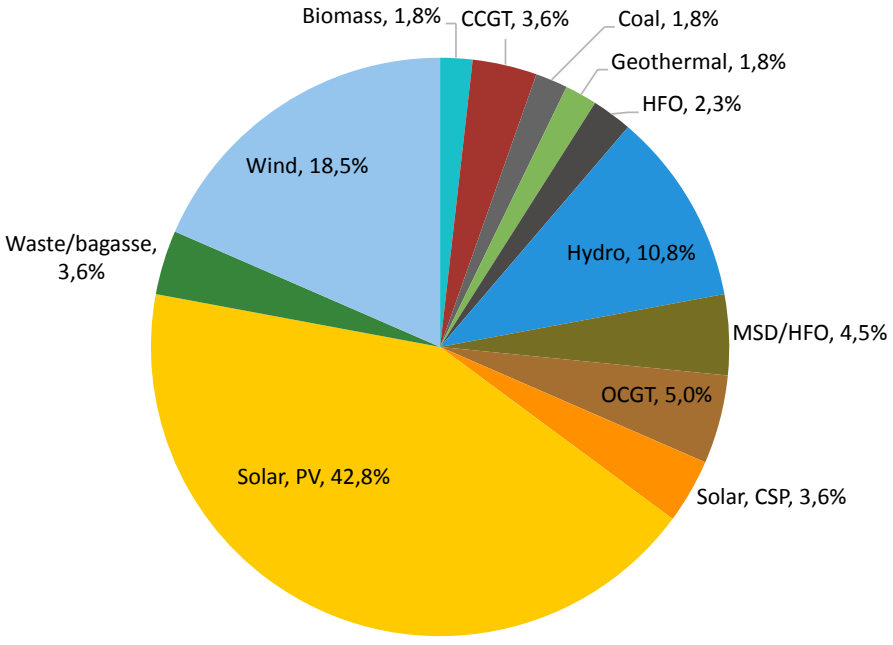
[6] The R-G and performance indices have a correlation coefficient of 0.58 (Pearson coefficient, where a perfect correlation is 1.0). This indicates a positive, moderately strong correlation. Excluding the governance indicators—comparing only reform with performance scores—reduces the positive trend between reforms and performance to 0.45.



Source: Authors' indices derived from study questionnaire, complemented with data from SONELGAZ (2012), World Bank (2014), World Bank (2016), EEHC (2017), NamPower (2017), World Bank (2018), AfDB (2018).

Ongoing efforts for regional electricity interconnections remain an important tool for supporting optimal system performance. Since the 1990s, various power pools, common electricity grids, and binational electricity generation and transmission systems in Africa have provided a new avenue for regional-level power planning. Nevertheless, power trade still lags behind anticipated targets. Many African power pools suffer from funding deficits. Inadequate transmission investment, and maintenance also impede power pools from reaching the desired capacity of trade.

Unprecedented breakthroughs in prices of solar and wind energy in the past decade have spurred African countries to take advantage of variable renewable generation technologies. All study respondents report that a national law or policy to promote renewables has been adopted in their country. Opening up generation to private investment has been a major driver of renewable additions to national grids. In the past decade alone, over 42 percent of new capacity additions through IPPs has been for solar PV, and over 37 percent for other renewables including wind, hydro, biomass, and geothermal generation. Auctions (international

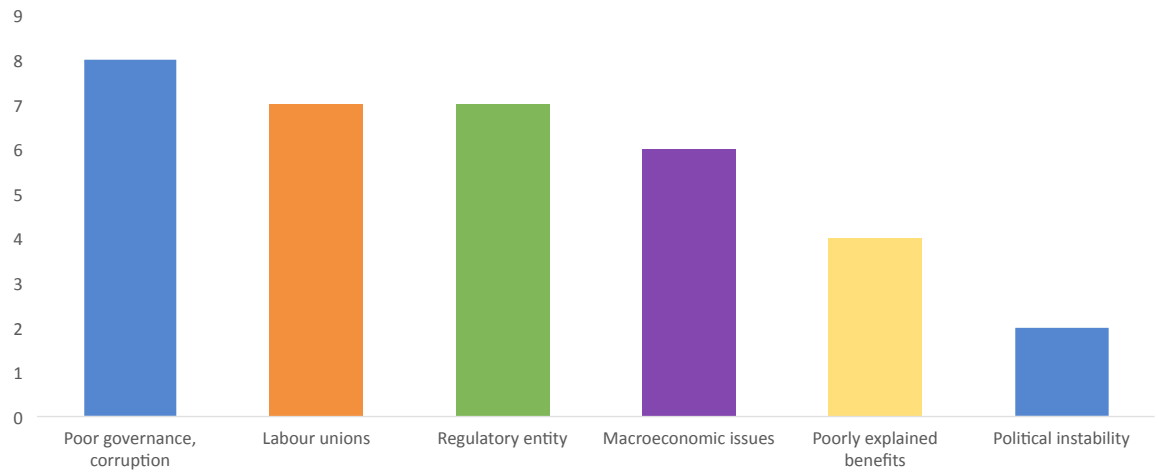


IPP additions since 2008, by technology type

competitive bidding programs) are now a well-established trend to guarantee lowest prices for new RE projects.

The political-economic contexts of reforms

Managing the complex political economy of power sector governance remains a challenge for many African countries. The sector is economically central and therefore highly politicized, which creates a contested discussion around reforms. Reform programs are often explained as strategies to improve utility performance, attract investment, and stem financial crisis. Moreover, stakeholders invoke problems with governance, corruption, and entrenched political interests to explain the stalling or failure of reforms. Political instability has contributed to these challenges for many African power sectors. Macroeconomic forces have also shaped the story of reforms, often in unexpected ways, for example due to high exchange rate and fuel price volatility, inflation rates, and currency devaluation impacting utilities' financial performance and governments' budgets. In other situations, a lack of clear leadership and technical knowhow have burdened the implementation and follow-through of reforms.



Obstacles to reforms—frequency of responses

Reforms looking forward: opportunities and challenges

Today, technological and financial innovations combine with political, economic, demographic, and environmental shifts to herald a new era for the African electricity landscape. Power networks will transform in response to these changes, which will reorder electricity grids and redefine stakeholders' roles. This raises new questions for the sector's economic policy and management. Utilities, regulatory frameworks, and power markets require new solutions to adapt to evolving roles, dynamics, structures, and players.
Sector experts surveyed on the future of the power sector, report an elevated sense of urgency surrounding the topic of attracting investments, followed by questions of energy security, and utility performance. Unsurprisingly, respondents also rate electricity connections as a serious matter for the future of the sector. Climate change appears as an area of moderate concern. Political questions of state sovereignty and governance provoke the least attention from sector professionals.

Disruptive technologies are opening new opportunities and provoking the need for new regulatory, policy, and economic tools to harness them. Capacity additions in Africa until 2030 will be dominated by hydropower resources, natural gas, solar, wind, geothermal, and biomass. Meanwhile, electricity demand in Africa is to grow by almost 6% annually, and up to 11 percent in some regions. Solar and wind energy are breaking through, facilitated by successful auctions, to deliver cheaper unsubsidized grid-connected power in Africa. For a new generation of consumer-producers—or prosumers—electricity is expected to flow in both directions as individuals gain control over their energy generation (with solar home systems) and their consumption (with smart devices). Distributed ledgers or blockchain technology could arise as a household-to-household payment technology. Countries with low electrification levels present rewarding opportunities for mini-grids and off-grid systems.Smart grids with new geometries will also begin to emerge in response to these disruptions.

These changes can rapidly impact African power sectors. Most countries still have low electrification rates and small grids, and no wholesale or retail power markets are yet operating on the continent. Africa has the opportunity to embrace innovations in enabling technologies, business models, system operation, and market designs. Countries will need to revisit the 1990s-era ideas of utility restructuring, to build creative

solutions to increase the power sector's agility and resilience. These are essential if the power sector is to embrace new technologies and business models, while attracting new sources of financing in a sustainable manner. Independent system and market operators will need to be established to manage grid variability, flexibility, reliability, strength, and quality.

Most power sector stakeholders are aware of these new power market trends. They recognize that RE technologies are breaking through, and that a future boom of mini-grids will make power systems more decentralized. Most professionals surveyed also believe the impacts of these trends will be felt within the next 5 years.

However, **most sector professionals surveyed have reservations about whether the institutions in their power sector are sufficiently prepared to tackle the upcoming challenges presented in the questionnaire.** These respondents cite the need for additional capacity building, to strengthen organizational, operational, regulatory, and financial capacities. Policy support and new financial mechanisms are additional factors that respondents believe would facilitate institutions' ability to adopt new business models and manage upcoming challenges.

Design and implementation implications for the next wave of reforms

The prescriptive approach of the 'standard model' has not been the expected panacea for power sector challenges in African countries. Power sector reform and development have been slow and demanding processes in most parts of the world and is a continuing process. However, adapted elements of the 'standard model' reforms are still relevant for boosting sector performance, in particular to :

- Separate and clarify roles and responsibilities between government, private sector and utilities, especially through regulatory reform;
- Establish an independent power sector regulator with a legal mandate to make effective, transparent, and fair licensing and tariff decisions; ensure regulators' budgetary and decision-making independence;
- Make tariffs predictable and cost-reflective, using smart subsidies as the need arises;
- Create a clear legal and regulatory framework to guide PSP in generation, transmission, and distribution investments;
- Build capacity for least-cost, dynamic power generation, transmission, and distribution expansion planning;
- Adopt competitive procurement processes for new power generation; and
- Improve incentives and structures for utility governance, management, and regional power trade to underpin their technical, and financial performance.
- Facing the future requires proactive policy, regulatory, market, and institutional reforms. Transformations in the power sector call for a framework of flexible reforms that catalyze efficient investment in centralized and distributed energy systems, and minimize conflicts of interest in the sector, including by:
- Unbundling generation from transmission to create independent transmission, system and market operators and remove potential conflicts of interest;
- Embracing innovations in enabling technologies and business models, including via investment in local manufacturing of power equipment;
- Freeing up markets for distributed energy systems;
- Developing complex, efficient metering and billing systems, and capacities, to interact with consumers who increasingly also become producers of energy;
- Designing tariff, policy, and market reforms to incentivize investment in distributed energy resources, and energy efficient technologies;
- Investing in transmission interconnections and associated soft infrastructure (power pools, regional planning, regulation, and system operation); and
- Creating common policies, rules, and enforcement mechanisms among members of a power pool participating in cross-border trade.
- This study shows that reforms are successful in the context of enabling contextual political factors, including good governance, and stability. Successful reforms require careful consideration of relevant political-economic factors and processes, through:
- Including key members of the general public, civil society, sector stakeholder, political actors and groups, and the private sector when planning reforms;
- Recognizing the dynamics of entrenched political and economic power;
- Considering national contexts through the course of the reform program in a transparent, open process;
- Evaluating any reform proposal against the possibility that it will help to meet the country's objectives in the sector;
- Accounting for macroeconomic problems when designing and planning for reforms;
- Considering power sector development as a combination of best-fit approaches, rather than a choice between market-based or state-led approaches;
- Monitoring and evaluating processes, actors, and actual performance during and after reforms;
- Planning flexible and durable, suitably paced and sequenced reform programs; and
- Helping to shape and standardize institutional norms for data collection and sharing on the power sector across African countries, at a national level and through international learning centers, such as through the African Energy Portal (launched in 2018 by the African Development Bank), and the African Energy Commission (AFREC) database.


QY50K
XCMG
GDC
总质量：40400kg

1 POWER SECTOR REFORMS IN AFRICA—REFLECTING ON EXPERIENCE AND ANTICIPATING ANOTHER WAVE OF REFORMS

The African electricity landscape has transformed in the past two decades. A suite of power sector reforms—including independent regulation, commercialization, unbundling of centralized utilities, and introducing PSP and competition—have been applied to different degrees, to address different problems in different contexts, and with different results (Eberhard, 2017). Power sector stakeholders and funders are now putting these reforms back under the microscope, re-examining their effectiveness to improve governance and performance in the power sector. Technological and financial innovations, combining with political and economic shifts, are heralding a new era for the electricity landscape, prompting new questions for the sector's economic policy and management.

African countries pursued power sector reforms from the 1990s, adapted from a 'standard model' advanced by DFIs, notably the World Bank Group. Governments depended on external donor funding, which often came in the form of structural adjustment packages: requiring the governments to reform strategic sectors of the economy through separation of powers and functions, and introducing market-based incentives (Gore, 2018). But to date, Africa has not adopted the full 'standard model' suite of reforms (Kapika, 2013). Nowhere in Africa do wholesale or retail electricity markets exist, and only a handful of countries have created independent grids, unbundled from state-owned generation. [7]

Disruptive technological and financial innovations are triggering new changes in power markets, institutions, and business models. These innovations prompt the need for new reform solutions to reconfigure utilities, regulatory frameworks, and power markets. At the same time, many African countries are still grappling with basic questions of extending electricity access to remote or poor populations and improving operational and financial performance of utilities to allow sustainable electricity service and investment.

This report updates previous AfDB and APUA assessments of power sector reforms in Africa. The APUA, in partnership with the EU conducted a study in 2008 on reforms in the power sector, focusing on 19 countries in Africa. The 2008 study examines the reasons, drivers, and triggers underlying reforms, and actors promoting the reforms; the design and implementation of reforms; the impacts on utility performance; and the reforms' key success and failure factors. The 2008 study is complemented by a manual of best practices (2009), drawn from nine country case studies. The case studies provide implementation guidelines in three categories: financing investments; improving efficiency; and designing legislative and regulatory frameworks to meet reform objectives.

The AfDB and the APUA lead and participate in on-going initiatives and partnerships to improve the performance and financial viability of electricity sectors across Africa, to help to advance universal and reliable electricity access, alleviate poverty, and power industrial development. In 2016, the AfDB introduced a new partnership-driven initiative (NDEA). This initiative aims to "Light up and Power Africa" with a stated ambition to achieve universal access to electricity on the continent by 2025. [8] The AfDB's Vice Presidency PEVD works to support AfDB member countries and power sector actors to achieve the aims of the New Deal, as well as through the provision of technical assistance for planning, developing, and financing projects that will increase generation capacity, extend and improve the performance of power grids, and transform the structure and the functionality of power utilities.

With this report, the AfDB and the APUA offer learnings from African experiences to provide valuable recommendations on the implementation and success factors of reforms. Understanding those policy implications is essential for the effort to catalyze Africa's progress or to enable a 'leapfrog' development with respect to other regions. This report also sharpens the focus on mapping and grappling with new needs and concerns that derive from recent technological trends, innovations, and transformations affecting the economy, politics, and power sector.

1.1. Overview of the challenges of the power utilities

Utilities globally are facing a wave of new challenges in line with technological advances, as well as evolving consumer and market demands for more customized services. But most African power utilities still struggle with fundamental challenges, hampering their capacity to provide basic affordable, sustainable and reliable electricity supply and services to their customers. This translates into close to 50 percent of Africans lacking electricity, low levels of industrialization and small share of manufacturing in the GDP, and high unemployment rates. Indeed, the average value added from manufacturing as a percent of GDP remained at 10% in sub-Saharan countries in 2017,[9] in decline for the past twenty years; that of East Asia and Pacific is around 28 percent (World Bank, 2019).

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[8] See the African Development Bank's *Light Up and Power Africa – A New Deal on Energy for Africa*, www.afdb.org/en/the-high-5/light-up-and-power-africa-%E2%80%93-a-new-deal-on-energy-for-africa/. The Light and Power pillar is to drive the implementation of the four other high five themes (Feed Africa; industrialize Africa; integrate Africa; improve the living conditions of African).

[9] The "Manufacturing, value added" share of GDP measures the role of manufacturing in the economy.

The difficulties that obstruct service provision relate to challenges in various operational and technical dimensions, including planning, managerial, financial (cost versus tariff), commercial, human capital and technical losses. Combined, these significantly limit the ability of utilities to recover the cost of investments made along the power value chain, and achieve a credit-worthy balance sheet. Indeed, the performance of most utilities is hindered by large debts and deficits of the order of USD 200 Million to USD 25 Billion, compounded by poorly structured tariffs that drive deficits deeper by each kilowatt-hour of energy (kWh) supplied (irrespective of the utility's institutional structure: vertically integrated, fully or partially unbundled). According to a 2018 AfDB portfolio analysis of eight IPP projects in seven countries, governments have contingent liabilities of close to USD 1.65 billion (PEVP internal statistics 2018).

Over the years, the old business model of centralized generation and grid-based services has served fairly well in urban areas, but has proved to be ineffective to address the demand in rural and remote areas. African countries with the highest energy accessibility, such as Algeria, Egypt, and Morocco, used a combination of grid connected and RE based off-grid solutions to achieve complete electrification.

1.2. Understanding the story of power sector reforms

Reforms in the power sector in Africa have been pursued, above all, as economic policy tools to enhance operational efficiency and transparency, and boost investment in electricity infrastructure. Looking beneath the story of economic efficiency, reforms tell a story of financial crisis, investment needs, and development ambitions for the wider economy.

Governments began setting targets to expand power systems, increase capacity to meet demand, to connect to more customers, and help to promote economic and social development. But investments remained scarce, and external financing was out of reach. Financially unsustainable utilities consistently struggled to finance and manage system expansion and modernization, leading to power deficits, huge under electrified populations, and frequent blackouts or load shedding. This further hobbled the economic development of African countries, extending socio-economic inequalities and grievances among populations disappointed by the outcomes of independence.

Beginning in the 1990s, DFIs, including the World Bank and IMF offered countries conditional loans attached to structural adjustment requirements that encouraged economy-wide liberalization, commercialization, and restructuring. In particular, they offered financing to some governments linked to reforms in the power sector adopting the 'standard model' reforms to respond to failures in the utilities.

The 'standard model' reform elements promoted by DFIs include :

- Commercialising sector practices and corporatizing utility management
- Establishing independent regulation and committing to principles of cost-reflective electricity tariffs (to protect the financial sustainability of utilities)
- Restructuring the national monopoly power companies through vertical and horizontal unbundling of generation, transmission, and distribution services
- Opening up the sector to PSP and competition (both for and in the market), and creation of an independent system and market operator (ISO) (Eberhard and Godinho 2017).

While many countries accepted such structural adjustment packages and recommendations, no African country implemented power sector reforms as extensively as in other regions, such as Latin America and Eastern Europe.

'Standard model' reform packages promised a pathway for state-owned utilities to open up to commercial operation and attract private, market-based investments. This would prop up flagging generation plants and ease the power supply crises that caused widespread blackouts and load shedding.

But the prescriptive form of structural adjustments often failed to communicate with local concerns, visions, and needs. The logics and intended results of reforms seemed unclear or cynical to sector stakeholders, translating to poor levels of local ownership and support of the measures. Suspicion of foreign lenders, investors, and development institutions, combined with the strategic importance of electricity networks and assets, stoked fears that reforms were designed to favor private sector parties, thereby disadvantaging local entities, and threatening energy security.

The first wave of reforms generally did not prioritize social and political goals of expanding access to electricity and clean energy sources, or improving equity or affordability. Rather, parallel initiatives were often implemented to foster progress in those areas, such as through specific electrification and rural energy programs and funding to increase access, and targeted subsidies and/or cross-subsidies to support lifeline tariffs for low-income households. [10] The political sustainability of reforms improved when governments combined the 'standard model' measures with topics that garner more grassroots support and can deliver political returns, such as energy access and affordability, as well as emphasizing improvements to supply reliability and service quality.

[10] See section 4.

1.3. Anticipating a new wave of changes and reforms from 2019 to 2030

The coming years herald major new challenges for power sectors worldwide. New actors and technologies bursting onto the scene will catalyze rapid changes in the landscape and needs of the sector. [11] For example, the explosion in new capacity additions from variable renewable energy, thanks to drastic price drops, succeeded by a similar cheapening in energy storage costs and technology proliferation, will trigger a need for new grid management approaches and rules, including needs for utility business models. Likewise, traditional regulatory and business models face new challenges as well as opportunities in the rise of mini-grids and off-grid electricity providers in under-electrified areas (including energy communities that wish to gain independence from national systems). These transformations are being swept along with increasing digitalization, the arrival of proactive, self-generating consumers (prosumers), and the electrification of transport and electric vehicles.

Some actors in the power sector are foreseeing shifts in their roles, or even losing status, in response to these new trends. Fuel suppliers for private gensets may have an option to diversify into the domestic solar panels business—or explore other interesting avenues for small-scale energy providers. In the context of greater regional integration, power trade, distributed energy and consumer-owned systems, transmission system operators and distribution utilities could have entirely new job descriptions and responsibilities.

External physical-economic forces are also interacting—beyond the decisions that take place in local electricity markets—to change weather and climate patterns. These gradual yet unpredictable shifts in our environment create another set of consequences and parameters for electricity production, policies, and economics. They force African power planners to confront questions of climate forecasts and resource scarcity, to envisage building a secure energy future with domestic resources.

The new actors and economic relationships that are starting to take shape will change the power system physically with greater decentralization and re-ordering of power grids. Consumers and providers will be increasingly interconnected and localized. Consumers will gradually take greater control of their energy usage and production, including through solar home systems, smart meters and smart homes, storage solutions, and electric vehicles. Some technologies will become ubiquitous as they become economical for all; others will rapidly lose economic value and could become stranded assets.

This could accompany another push to unbundle state-owned generation system from the transmission and system operator. System designers will realize the need to assign more responsibilities, skills, and capacity to Independent System Operators (ISO) to respond to these changes, manage increasingly complex energy demand and production patterns, and engage in real-time power trade.

1.4. Mapping the approach of this study

This study's first premise is to examine the experiences of African electricity sector stakeholders relating to power reforms. The aim is to produce a local perspective on the current implementation status, spread, and landscape of reforms in Africa (section 2), the contexts and drivers surrounding those reforms (section 3), a view to the pressing changes and challenges on the horizon (section), and policy implications for contending with future needs (section 5). This meets the call for African countries to define a shared vision and goals for the power sector, giving countries space to define a path to development that aligns with their specific needs.

In line with the continent's development agenda—and its inspiring slogan, Africa Rising—African power sectors must rise to meet the new pressures and harness opportunities of technological, demographic, political, economic, and environmental changes that present themselves in 2019. This study has sought out local answers and perspectives to provide both broad and specific understanding, not only relying on discrete technical data.

African power sectors require a creative approach to respond to rapid global innovation in energy technologies and markets, identifying what types of reforms and implementation strategies will be useful and necessary to unlock the desired transformation. The electricity sector has a central role to underpin and catalyze green growth strategies. Countries need to define context-specific models for future reforms, ensuring local ownership to embrace solutions that will work to meet countries' needs. This will provide an antidote to negative ideas or apprehension about reforms, often centered around losing sovereignty or control.

Research for this report was carried out through an extensive questionnaire, destined for power sector stakeholders, notably national utility professionals (see Annex 1 for a full methodological presentation of the questionnaire). The questionnaire has been designed with two perspectives :

1) To examine the past decades of experience and map the reform processes, events, contexts and drivers, and outcomes (or current status) in African countries.
2) To turn towards the horizon of power sector reforms, by surveying the level of understanding, interest and anticipation of new or forthcoming trends and challenges, among respondents from different countries and different power sector institutions.

Utility members of the APUA in 42 countries, plus

[11] See section 4.

Tanzania, were invited to participate in sharing their country's experiences with reforms and the lessons from their power sector. Respondents from 26 countries—and various sections of those power sectors—contributed significant efforts to provide data through the questionnaire. Annex 2 provides a list of respondent entities and countries represented.

This report combines information gathered through the questionnaire with data from two composite indices, designed to provide a snapshot of understanding of the state and extent of reforms in African countries, as well as a snapshot of power sector performance (see section 2, and a full methodology in Annex 3). The Reform and Performance Indices consider the 42 African countries represented by member utilities of the APUA, where sufficient country data is available to calculate each sub-indicator. [12] Combined with data on quality of governance from the Worldwide Governance Indicators (Kaufmann, Kraay, and Mastruzzi 2010), the indices give a sweeping perspective on the interplay between reforms, governance, and performance in the power sector in Africa.

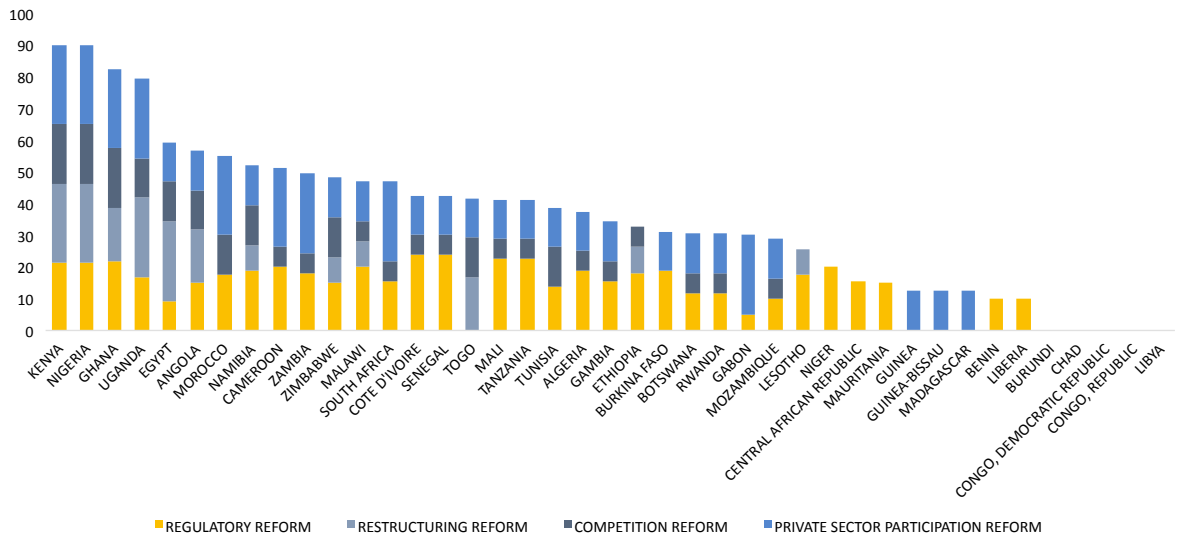
[12] Tanzania, not currently an APUA member, is also included.

2. THE LANDSCAPE OF REFORMS IN AFRICAN POWER SECTORS TODAY

African countries have adapted 'standard model' reforms in different degrees to restructure the power sector (section 2.1), introduce new governance and regulatory frameworks (section 2.2), and open up to PSP and competition (section 3). These reforms interplay with other dimensions of power sector planning, expansion, and policy, as well as through efforts to expand electricity access (section 4), to interconnect national grids, to allow cross-border, regional power trading (section 5), and to transition to clean energy systems (section 6).

The 'Reform-Governance' (R-G) Index developed for this study provides a starting point to chart the diffusion of power sector reforms across 41 countries. [13] This composite index, outlined in detail in Annex 3, combines a Reform Index (based on four indicators of reform) with a governance dimension (based on six global governance indicators). The Reform Index ranks countries according to the extent of reforms that have been implemented in each of four categories: regulatory reform, allowing PSP, encouraging competition in the sector, and restructuring the utility. Countries with a more extensive record of reforms, such as Kenya, Nigeria, Ghana, and Uganda, therefore rank higher compared with others (see Figure 1). Those four countries have implemented variants of every aspect of 'standard model' reform (though none has applied every reform to the fullest extent, so none receives 'full marks'). Five other countries have also adopted measures in each of those categories, but to lesser degrees, while others have chosen not to apply reforms in one or more of those categories.[14]

Figure 1 — **Power sector Reform Index showing current reform status by country, %**

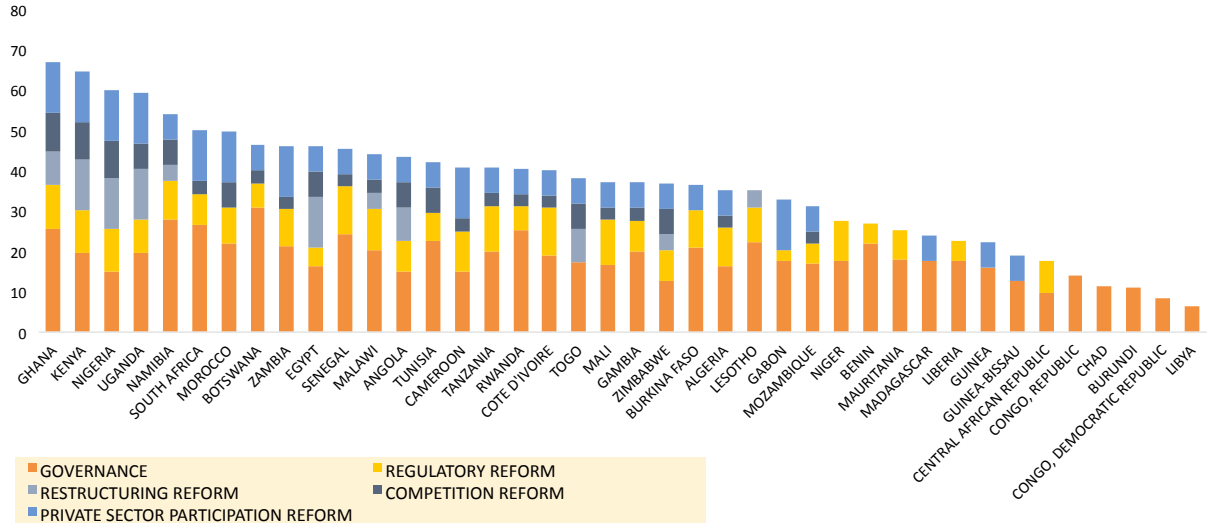


Source: Authors' indices derived from study questionnaire, complemented with data from AfDB Electricity Regulatory Index (2018) and World Bank (2016).

[13] Sudan is excluded due to lack of information on regulatory reform.
[14] See Annex 3 for a full methodological explanation of the Reform and Performance Indices.

Figure 2 below shows the composite R-G Index, which combines the Reform Index with worldwide governance data, assigning both scores—from the RI and the governance indicators—equal weight (World Bank 2019).

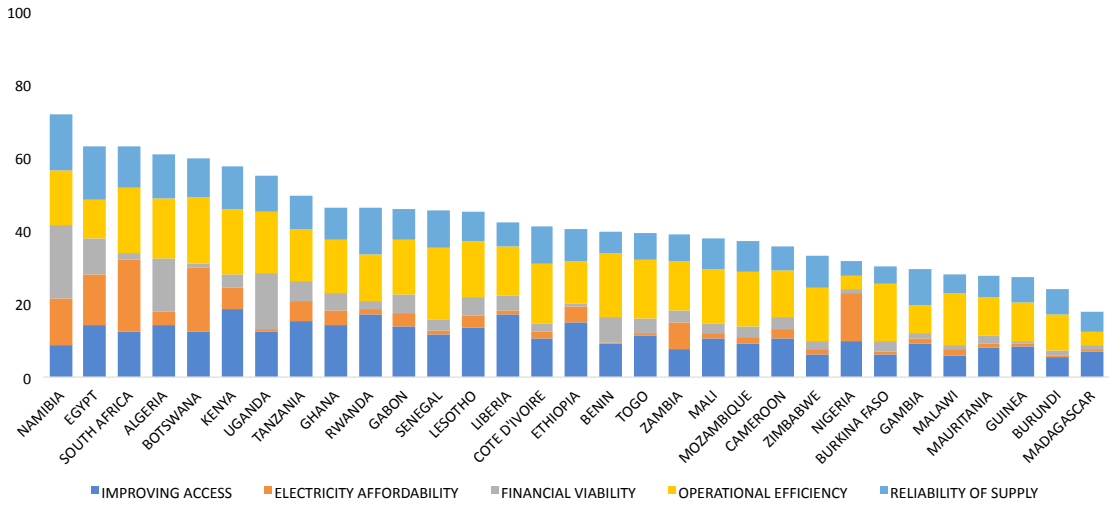
Figure 2—**R-G Index showing reform status combined with governance rankings (equally weighted)**



Source: Authors' indices derived from study questionnaire, complemented with data from AfDB Electricity Regulatory Index (2018) and World Bank Worldwide Governance Indicators (2018).

A Performance Index was developed to compare performance in the power sector of 31 countries across five distinct dimensions. The index compiles five indicators to reflect each dimension, using data derived from existing databases and analysis supplemented by questionnaire responses from 26 countries, as well as public performance data updated to latest available information. Figure 3 shows the Performance Index scores across 31 countries for the PI, with disaggregated indicators for representing the utility's financial performance (financial viability), technical performance (operational efficiency), electricity supply reliability, affordability, and improvement in access levels ; including all countries covered by the PI. These indicators are designed to give a snapshot picture of the power sector's current level of operation, including its progress towards universal access (through a measure of the improvement in expanding access over the period since 2007). Annex 3 provides detail on the definition of each indicator.

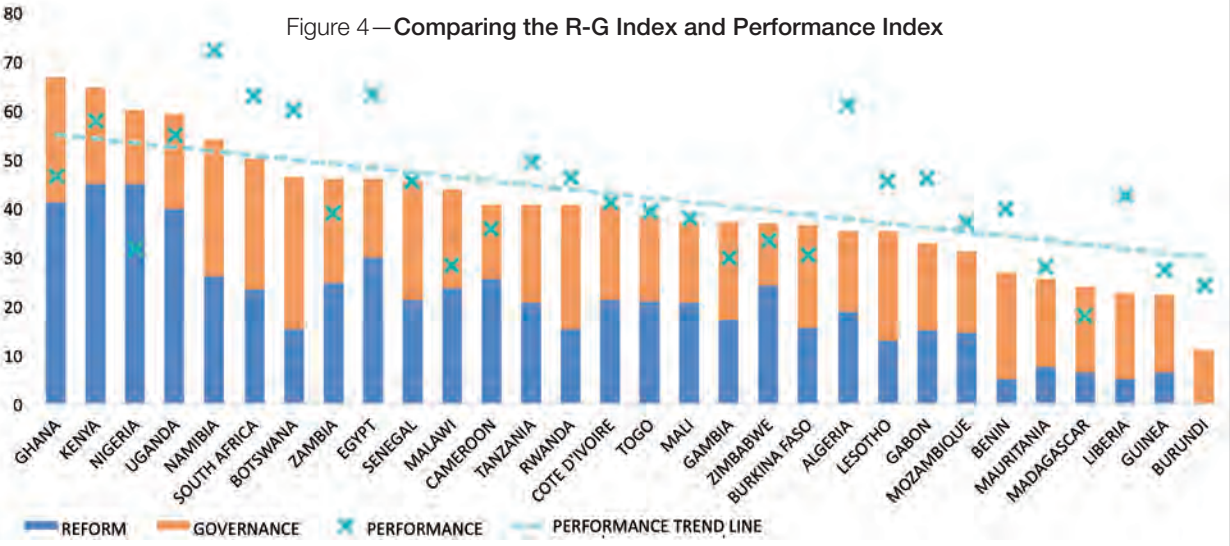
Figure 3—**Power sector Performance Index scores with disaggregated indicators, %**



Source: Authors' indices derived from study questionnaire, complemented with data from SONELGAZ (2012), World Bank (2014), World Bank (2016), EEHC (2017), NamPower (2017).

The R-G Index and Performance Index help to show how reforms interact with governance and performance in the sector to shape outcomes. The R-G Index combines Reform Index rankings with six key governance indicators. These contribute a critical dimension of 'quality of governance' to reveal the relationships between various types of reforms and the results observed in the power sector in terms of technical, operational, and financial performance (see Figure 4). The Performance Index—based on five widely-recorded measures of power sector performance—tracks the technical, financial, and operational record of African power systems. The five dimensions captured include the degree of improvement in electricity access, as well as level of affordability, financial viability, operational efficiency, and reliability of supply in the power sectors studied (where reliable data is available). Combining the Performance Index with the R-G Index helps to build a picture of how reforms have played out in vastly different countries, and power systems.

Figure 4—**Comparing the R-G Index and Performance Index**



Source: Authors' indices derived from study questionnaire, complemented with data from SONELGAZ (2012), World Bank (2014), World Bank (2016), EEHC (2017), NamPower (2017), World Bank (2018), AfDB (2018.)

Aligning the R-G and Performance Indices suggests that a relationship exists between a country's adoption of reforms, its quality of governance, and the performance of its power sector, and while there are a number of outliers which require interrogation, a defined positive trend is evident. [16] This fits the understanding that political, economic, and financial measures to reform and improve a power sector can only enjoy full success in stable, transparent, rule-based environments. However, these do not paint the whole picture. In addition to governance, the success of any reform relies heavily on the local ownership and support for each measure. Improving performance measures like electricity access and affordability depends on solid planning processes for rural electrification, as well as targeted policy interventions, regulatory initiatives, and funding allocation. Operational and financial performance improvements similarly require effective planning environments, adequate institutional and investment capacity, and targeted interventions to improve management and technical capabilities.

Scattered performance scores challenge the overall trend between the extent of reform-governance and progress in performance. These outliers highlight the need to closely examine each country's specific reforms and the interventions made to improve performance. A closer look at specific cases is essential to explain how certain countries and utilities have performed better or worse than others.

'Standard model' reforms have targeted all segments of the power sector in Africa, and in very different ways. Power utilities have been subjected to restructuring efforts in many countries, to streamline incentives and increase operational efficiency by unbundling generation, transmission, and distribution segments (see section 0). Most countries have created regulatory entities to oversee licensing of sector operators and govern tariffs and pricing (see section 2.2). Private capital has been widely introduced in the generation segment, which can easily accommodate IPPs to build new power plants and connect to a national grid. Many countries have also tested other forms of PSP, like concession contracts for a private entity to run the power utility (see section 3). Competition for the procurement of additional capacity for power generation were mostly done through IPP auctions.

Reforms have indirect effects in all areas of the power sector. When it comes to closing gaps in electricity access and affordability, reforms are far from sufficient to fix the problem (see section 4). Supply and transport of low-cost power in the continent require major investments and planning in regional integration and transmission interconnections, some of which are already underway (section 5). Meanwhile, the institutional, structural, and procedural adjustments required by 'standard model'

[16] The R-G and performance indices have a correlation coefficient of 0.587 (Pearson coefficient, where a perfect correlation is 1.0). This indicates a positive, moderately strong correlation). Excluding the governance indicators—comparing only reform with performance scores—reduces the positive trend between reforms and performance.

reforms have become a cornerstone of many countries' RE policies, by paving the way for transparent, even-handed, reliable, and competitive procurements for renewable generation (section 6).

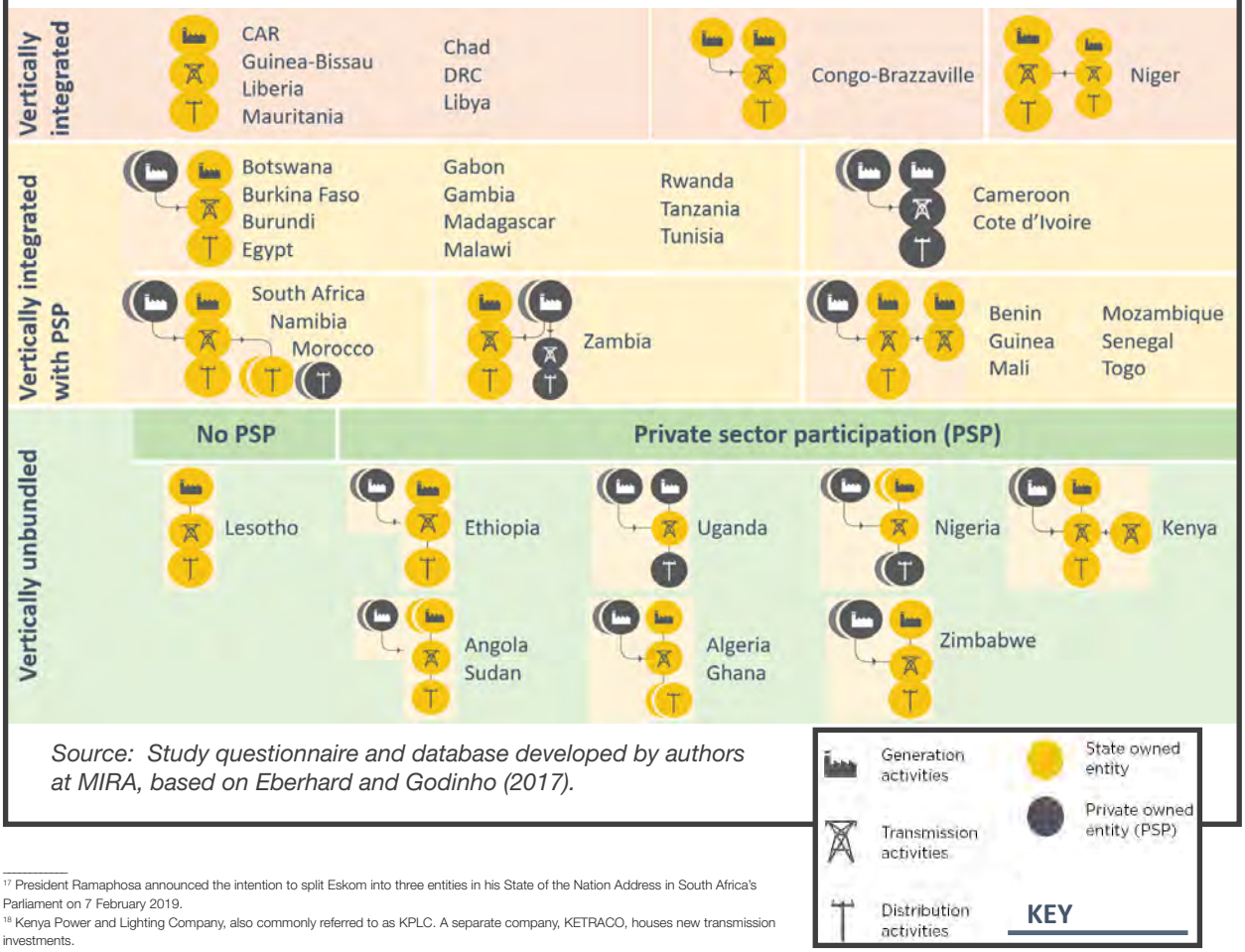
2.1. Structure of electricity utilities

Restructuring the national electricity utility is a key element of the 'standard model' of reforms propagated by DFIs worldwide since the 1980s. This process transforms a vertically-integrated monopoly company, often in stages, by vertically unbundling the generation, transmission, and distribution components into separate companies. Eventually, a power sector may transition through horizontal unbundling to allow multiple generation and distribution operators to compete for wholesale and retail business in a power market.

Power systems in Africa still largely retain the traditional integrated monopoly utility structure (predating restructuring reforms). Only 10 of the 42 countries represented by utilities with APUA membership (plus Tanzania) have partially or completely unbundled the electricity sector. In these cases, the monopoly utility has been separated into distinct generation, transmission, and distribution companies (in some cases, only separating generation or distribution from the other segments). The remaining countries have maintained integrated utility companies with various forms of additional state-owned and private participation in the sector. In some cases, generation, transmission, and distribution have been separated for operations but remain commonly owned under an umbrella state-owned company, such as in Egypt and Morocco. Figure 5 shows the variety of sector structures and types of private participation (through majority ownership or concession) in these countries.

Other African countries continue to consider creating separate, independent grid companies through vertical unbundling. South Africa, for example, is considering breaking up Eskom—a powerful but poorly performing utility, and the largest in Africa—to create an independent transmission company that would act as an independent grid company and transmission system operator or ISO. [17] The ISO would carry out least-cost generation planning, power procurement and contracting, system operation and economic dispatch, and transmission planning and operation. In principle, this reform intends to remove Eskom's conflict of interest of being both a generator and the single buyer of electricity from IPPs. The new framework—similar to the 'Kenyan model'—would require the independent grid company to contract least-cost power either from state-owned generators or from IPPs. In Kenya, majority government-owned utilities KenGen (generation) and Kenya Power (transmission and distribution) [19] are in separate companies. With this model, Kenya has succeeded in attracting high levels of private investment in the power sector and has been

Figure 5 — **Structure of electricity sectors and private participation in 42 countries**



Source: Study questionnaire and database developed by authors at MIRA, based on Eberhard and Godinho (2017).

[17] President Ramaphosa announced the intention to split Eskom into three entities in his State of the Nation Address in South Africa's Parliament on 7 February 2019.

[18] Kenya Power and Lighting Company, also commonly referred to as KPLC. A separate company, KETRACO, houses new transmission investments.

among the most IPPs in Africa (along with Uganda, which has also unbundled).

The most common sector structure in Africa today remains the vertically integrated utility with the participation of IPPs in generation. In some cases, the main utility operates alongside parallel state-owned or private companies in transmission, distribution, or generation (or a combination of those), such as the cases of Benin and Togo or Zambia. Countries that no longer have publicly-operated companies in generation and distribution tend to operate through long-term concession or lease contracts, such as in Cote d'Ivoire and Uganda (see Box 1). Nigeria is an exception, with full privatization of its distribution networks to eventually reach retail competition (at least in theory).

Box 1—**Restructuring reforms and private participation in Uganda**

Uganda was a strong candidate to receive World Bank structural adjustments after two decades of political instability, coups, and civil war unwound in the mid-1980s. Electricity services were crumbling: access rates remained below 5 % of the total population until 1995, among the lowest in Africa; generation capacity was down by 60 percent; and distribution losses reached up to 40 percent. A preliminary IPP agreement—for the Bujagali dam hydropower project—was signed in 1993 to help to ease the supply deficit, but an agreement was not settled until 2007 after a lengthy procurement (the plant was finally commissioned in 2012). The 1990s power crisis demanded decisive changes and an urgent influx of investment in the sector.

The Government of Uganda (GoU) began one of the most radical power sector reform programmes in Africa in 1998 with a new strategy plan and implementation plan for restructuring and privatization in the power sector, including full vertical unbundling of the utility. A new electricity act was passed in 1999. In the following 2 years, the GoU increased electricity tariffs by 100 percent, procured the first IPP in 30 years, and established an independent electricity regulator as well as a dedicated fund and board for rural electrification. The GoU then vertically unbundled the utility to three companies for generation (UEGCL), transmission (UETCL), and distribution (UEDCL).

The GoU has sought significant involvement from the private sector since generation and transmission services were separated in 2001. UETCL has procured 28 IPPs (totalling about 588 MW additional capacity and $1.6 billion USD of investments). UEGCL and UEDCL were put under 20-year concession contracts, negotiated in 2003 and 2005/2006, respectively. The distribution concessionaire, Umeme, received regulatory approval for several successive tariff increases from 2006 to 2012, alongside some public subsidies to support low-income users. Allowing cost-reflective tariffs ensured Umeme's financial health; the company was partially listed on the Uganda Securities Exchange in 2012.

Umeme has reduced technical losses substantially in recent years, although overall progress in improving performance has been slow, and the implementation of reforms has been criticized. Umeme faces political pressures in the period leading up to the scheduled renewal of its concession. Collections and financial performance are good, but tariffs are high, in part due to some of the early thermal IPPs. Uganda has succeeded in attracting private investment into IPPs. Its early thermal IPPs were expensive and contributed to high consumer tariffs. However, recent procurements have been more competitive, including its acclaimed GETFiT program, which incentivized investments into small hydro, biomass, and solar PV power plants.

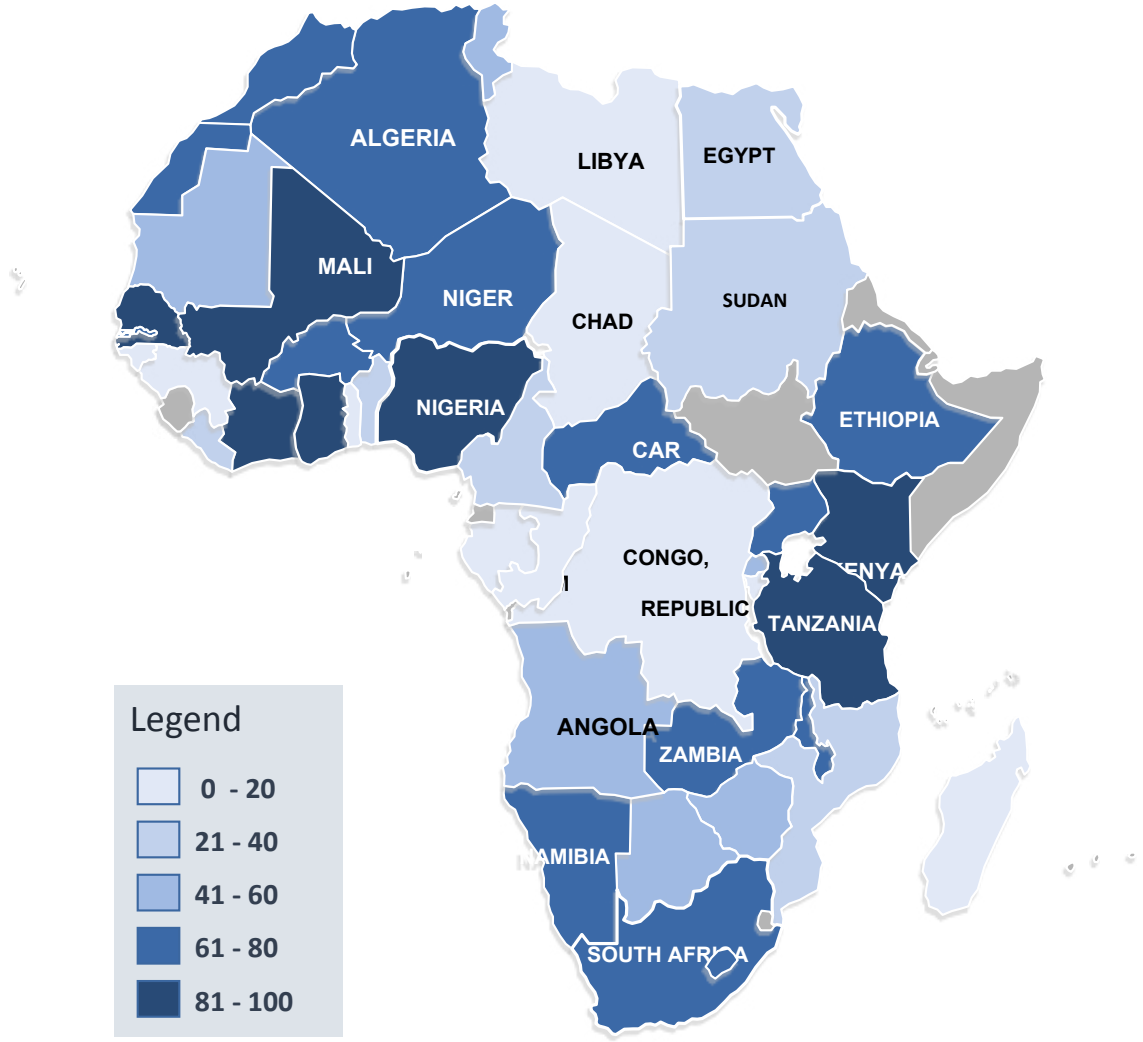
Recently, Uganda has turned to China to construct and finance two large new hydro plants. The costs of these are not yet public, but should allow more competitively priced generation costs, and increase the capacity of the country for export onto the EAPP regional grid.

2.2 Governance and regulation in the power sector

Regulatory reform is a core argument of the 'standard model', and for most African countries is first step of the reform process. Establishing clear rules and oversight mechanisms is essential before major changes to the sector structure, processes, or institutions can occur. Regulators, in principle, enable more transparent processes and mechanisms to migrate to cost-reflective tariffs, as well as price certainty for potential investors.

Regulatory reform requires establishing an independent regulatory entity backed by a robust legal and regulatory framework, most often in the form of an electricity law accompanied by regulatory acts. The independence of the regulator refers to its ability to operate and make important decisions without fear of political interference or disruption. This depends not only on the regulator's legal status as a statutory body—separate from government—but also on its budgetary independence and the appointment processes of its staff and decision-makers.

Figure 6—**Power sector regulation in Africa : Regulatory Reform Indicator** [19]



Sources: Electricity Regulatory Index 2018 (AfDB), reegle.com, and study questionnaire.

The creation of independent regulatory entities has diffused rapidly across Africa since the early 2000s—33 of 42 countries in this study have established an electricity regulator—more than any single other reform measure. In the past 2 years alone, Botswana, Liberia, Morocco, and Mozambique have established electricity regulatory agencies or passed laws providing for their establishment. In OECD countries, 'standard model' reforms usually followed a prescribed sequence, starting with regulatory reform and culminating in full wholesale and retail competition. The former measure is in some cases the only one adopted in African power sectors, which have favored regulatory reform as a straightforward solution to improve oversight, regulatory procedures, and transparency in decision-making. Only a handful of (small) power sectors still lack a regulator, notably Swaziland, Sierra Leone, and Equatorial Guinea (see Figure 6).

Regulatory reform intends to create an equitable, rules-based playing field for electricity providers and consumers. The regulator has the responsibility to ensure that risks are apportioned fairly between utility companies, end users, and private operators in the sector. This responsibility includes setting tariff regimes that allow adequate cost recovery for the electricity utility, while ensuring affordable electricity and creating the conditions for reliable, safe, and secure service for consumers. To achieve this aim, an independent regulator provides incentives for the utility to improve its technical and commercial performance. Such incentives help to ensure the utility's cost of service reflects appropriate commercial practices, and to avoid accounting for inefficient or misaligned use of finances by utilities. Regulators also administer licensing regimes, requiring certain types of operator in the power sector to apply for a license to generate, sell, transport, or distribute electricity, depending on specific conditions. They often play an important role in interpreting government policy and legislation to translate them into concrete rules, such as in instituting Feed-in-Tariffs (FiTs) or net metering regimes for distributed renewable energy.

[19] The regulatory reform indicator (a dimension of the RI) measures the degree of regulatory reform in the power sector based on four dimensions: the existence of a regulator, its legal mandate, its age (maturity), and independence from stakeholders. Annex 3 describes the methodology for calculating the indicator in full.

Box 2—**Regulatory reform in Nigeria**

Nigeria—with a population of 183 million, of which an estimated 40 percent still lack an electricity connection—struggles with multiple technical and commercial challenges in its power sector, including high losses, poor maintenance, poor financial viability, supply shortfalls, frequent outages, and unsustainable tariffs below cost recovery levels. After successfully privatizing the telecommunications sector, reforms seemed an obvious way to improve operational efficiency and electricity availability, and to attract private sector investment in the power sector. Reforms began in 2001 with the National Electric Power Policy (NEPP), leading to the 2005 Electric Power Sector Reform Act (EPSRA), which vertically and horizontally restructured the sector and privatized generation and distribution entities. It also created an independent regulator, Nigerian Electricity Regulatory Commission (NERC), and opened the market to private operators.

The National Assembly saw 'standard model' reforms as a way to mitigate corruption by distributing political influence across the power sector, but reforms failed to produce expected returns in performance. Gains are most visible in the generation sub-sector, through a strong influx of IPPs, with about $2.7 billion total investments.

According to the survey, the aggregate technical commercial and collections losses reported at privatisation were not improved after privatisation, which is contrary to the purpose of privatisation. Generally, the privatized companies showed worse collection and payment performance than when the assets were under government control. However, government and some investors have an opposite view for some of the DISCOs.

The AfDB-ERI regulatory governance and substance indices rank Nigeria's regulatory regime among the top three of 15 countries studied; however, mirroring the failing financial viability in the sector, and the low score in this study's performance index, the country has only a mediocre rank in the regulatory outcome index. NERC's regulatory decisions seem not to have had the intended positive effect on sector outcomes, pointing to broader failures of governance. The country ranks among the lowest 10 countries of this study according to the worldwide governance indicator. Widespread political instability in some states, currency devaluation, and corruption (including alleged inflated contracts alongside alleged kickbacks to officials) in Nigeria underline the pivotal role of macro-economic factors and the quality of governance in shaping sector performance outcomes.

Independence from government and other interests remains a challenge for many electricity regulatory bodies in Africa. Regulatory independence refers both to financial matters (for example, the regulator's budget is sourced from revenues distinct from government or other interference) as well as in the sense of operations and decision-making (for example, the appointment process for commissioners is transparent and fair, and they are prohibited from working with, investing in, or consulting to regulated utilities for a period following their term of office). Independence allows the regulator to accurately assess the utility's financials and cost of service, essential for making fair decisions on tariff regimes and service standards. The AfDB's ERI (2018) finds that only two of fifteen national regulators surveyed (Nigeria and Tanzania) have best practice rules prohibiting financial ties to ensure the independence of regulatory commissioners from the regulated utilities. Most regulators surveyed derive their funding from levies on regulated entities, sometimes also including licensing fees, though almost a third still rely on the government budget (in whole or in part) to fund their regulatory activities. In addition, the ERI survey revealed that 68 percent of regulators rely on government approval for the regulatory budget, further entangling government and regulatory interests.

Lack of regulatory independence and capacity contribute to the utility's financial woes when the regulator is unable to create a tariff structure that fully reflects the utility's costs of service. The AfDB-ERI shows that less than 10 percent of utilities surveyed have cost-reflective tariffs for the residential sector, while only 20 percent have cost reflectivity in commercial and industrial categories. Regulators also ensure quality of service by creating, monitoring, and enforcing service standards. Timely analyses of the utility's technical performance are essential to check if it is meeting its obligations to consumers. However, few regulators in the ERI report are carrying out frequent checks in line with best practice (every 3 months).

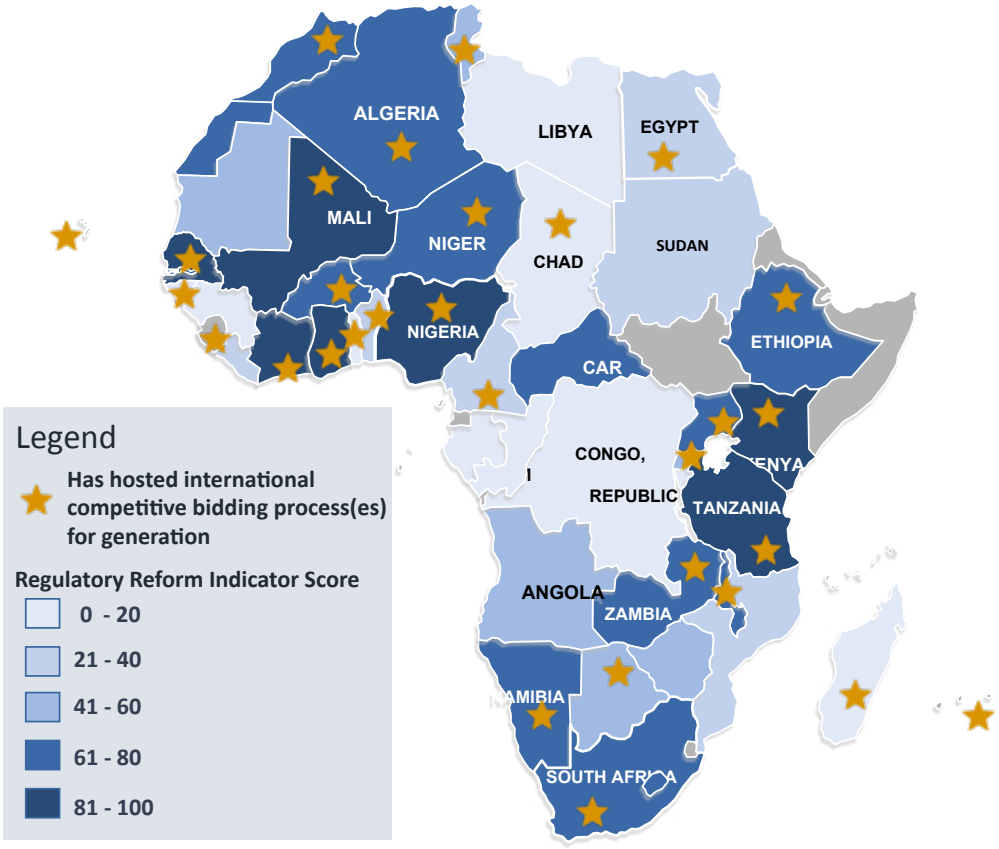
2.3. Financing and private participation in the power sector through the lens of reforms

Reform programs are often conceived as a tool to open up external investment and financing to the power sector. Allowing private investment engages with potential sources of capital that would otherwise be unavailable to develop and maintain the power sector. Infrastructure financing needs in African countries vastly surpass the—often stretched—public financing capacities. Since the beginning of reforms, most investments in the power sector still come from

the public purse. This has started to change in the past decade, as Chinese-funded projects and IPPs—funded largely by the private sector and DFIs through Build-Own-Operate (BOO) arrangements—have become the fastest-growing sources of investment in the region's power sector.

IPPs have spread across Africa and are now present in over 30 countries. At utility scale (greater than 5 Megawatt (capacity) (MW) generating capacity), 270 IPP arrangements are operating or under construction in Africa (MIRA database 2019). This represents about $51.7 billion in investments and 27.1 GW of installed generation capacity. [20] Figure 7 maps the countries on the continent that have hosted international competitive bidding processes for power generation (represented by a star symbol), highlighted against each country's Regulatory Reform Indicator (RRI) score (represented in blue). Reforms allowing external investment in generation are critical to enable this growth in investment, as well as other regulatory measures such as third-party wheeling, which allows privately-owned generation entities to sell power via the national transmission network to third-party users—including distribution companies, or large industrial and commercial customers. About half of questionnaire respondents report that third-party wheeling is permitted on the grid, creating opportunities for IPPs and independent distribution companies or large customers to trade power directly for a fee.

Figure 7—**International competitive tenders for power generation in Africa**



Source: Study questionnaire, MIRA database (2019) and AfDB (2018).

'Standard model' reforms including PSP also present a means to improve operational efficiency through private management in the sector, as well as capital investment flows. Transferring a publicly-owned and controlled company or assets to private ownership or management is a classic solution to a state-owned utility's inefficient technical and commercial performance. Such a transfer can occur under different arrangements and to different degrees across the power sub-sectors. In some cases, PSP contracts have fixed terms of up to 30 years, but they can also take the form of complete indefinite privatization. A power sector will typically introduce PSP in one sub-sector to begin—often in generation, with BOO or Build-Own-Operate-Transfer (BOOT) IPP arrangements, and sometimes in distribution services with franchising contracts.

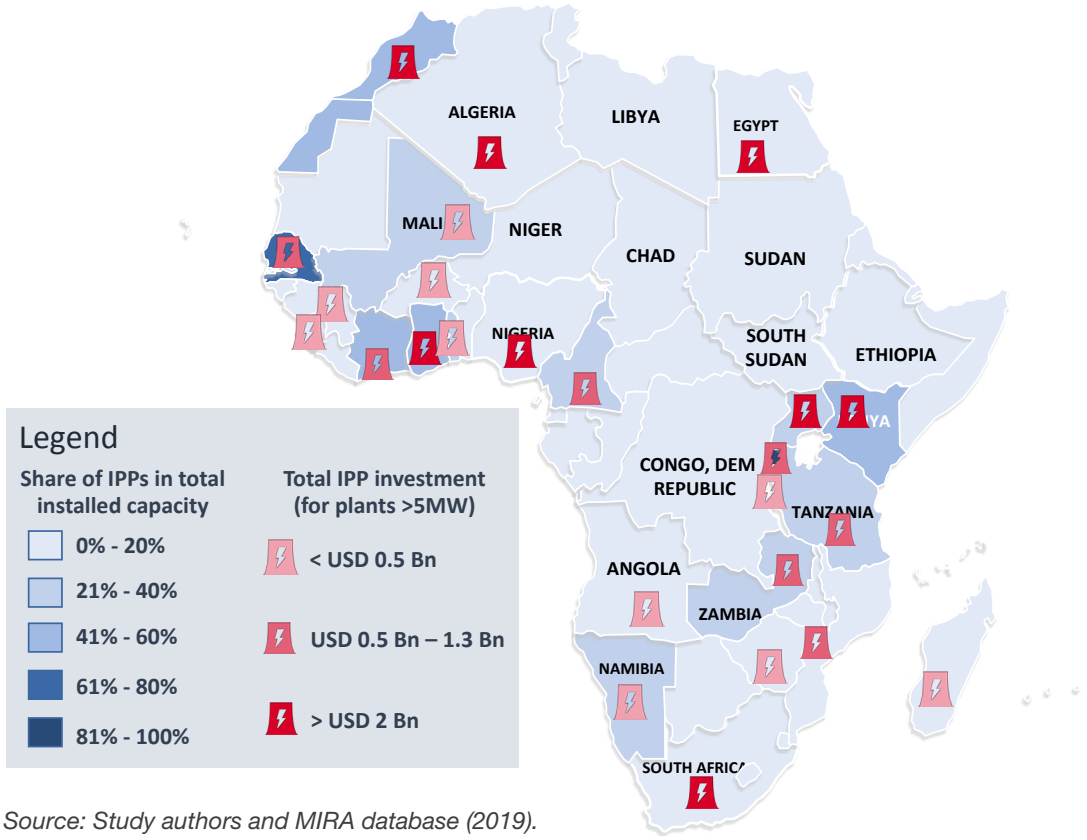
[20] See Annex 5 for additional data on IPPs in Africa drawn from the MIRA database.

Long-term concession arrangements, affermage or lease, private management contracts, and full privatization programs have been deployed across all segments of the power sector, including in transmission. Over half of the questionnaire respondents reported at least one such form of PSP having been used in their power sector. Countries with on-going long-term affermage or concession agreements include Cote d'Ivoire, Mali, Cameroon, and Uganda; the Ghanaian utility, ECG, also entered a concession agreement in 2019. These arrangements can be successful and long-standing: for example, the Government of Cameroon extended its 2001 concession of Eneo for 10 more years in 2017. They can also be subject to controversy, especially in cases of non-transparent procurement processes. Concessions sometimes provoke suspicion of profiteering by the private investor, or of outright privatization, with the associated fears of losing public control of essential assets. This leads to reversal or non-renewal of concession and private management contracts, as in the case of Senegal, which terminated the concession for Senelec after only 2 years in 2001, or the recent case of SEEG in Gabon.

The extent of reforms adopted in African countries are generally related to the amount of investments via IPPs. For example, countries such as Uganda and Kenya, which have independent transmission grids, have attracted the most IPP projects. In several cases, like Algeria and South Africa, additional factors contributed to stimulate the private investments, even when central aspects of the power sector have not been subject to reforms and retain traditional operational structures. Effective generation planning is essential to show the country has adequately prepared and anticipates generation needs for a defined period. Ensuring 'bankable' contracts with a financially viable utility off-taker, risk guarantees to support Power Purchase Agreements (PPAs), stable and predictable political environments, and well-designed and managed tender processes have all played in different contexts to boost investor confidence and mitigate risks.

Quality of governance (taking into account levels of corruption, political stability, rule of law, regulatory environment, and public accountability) is an important determining factor behind levels of PSP and investment in the power sector. Fragile or conflict-affected states wrestle with weak governance and precarious policy environments, which create added obstacles to attracting private sector investment. Countries like Angola that implement moderate reforms in PSP, but have low governance indicator ratings—including accountability, rule of law, and control of corruption—show slower rates of private investment. By contrast, South Africa has enjoyed high investment flows in generation from the private sector, even with a traditional monopoly utility structure. A well-designed and predictable auction program provides a strong impetus for this success, as well as high governance ratings in most areas (see Box 3).

Figure 8—**IPPs in Africa : share of total installed capacity (%) and investments per country (USD)**



Source: Study authors and MIRA database (2019).

The transmission sub-sector has not benefited from the same influx of private investment as generation in African countries—notably in sub-Saharan countries, where only a handful have some form of private participation in transmission. Most countries still finance transmission investments directly from utility revenues or from the government budget, which is a major constraint on expanding the network, and many countries rely on concessionary finance from DFIs or even grants from donor countries. Investment in transmission—both domestic and cross-border—is essential to connect low-cost, large-scale sources of electricity generation (particularly from solar and wind IPPs) with important distribution load centers in cities and towns. Sub-Saharan Africa has a combined transmission network smaller than that of the country of Brazil. [21] Per capita, Africa has fewer kilometers of transmission lines than other world regions, despite having much larger land mass and dispersed population, requiring more transmission capacity than would be expected (World Bank/PPIAF 2017).

Only 11 questionnaire respondents could provide data on the amount of transmission network expansion since 2010 (in kilometers); information on IPPs was much more forthcoming. Nigeria, with 8,000 km added since 2010, reported the greatest transmission expansion in recent years. Several countries—such as Mali and Cameroon—have put in place private concessions, as previously mentioned, as one way to pull capital into transmission. Gabon and Côte d'Ivoire introduced PSP in transmission through long-term affermage contracts with a vertically-integrated utility, where investors agreed to operate and maintain the transmission lines, but were not obliged to finance transmission assets (Africa Intelligence 2019). Zambia is the only example of a share of the transmission network being privately owned, indefinitely, through the Copperbelt Energy Corporation (an electricity company originally created to serve the mining industry in the northern part of the country).

Box 3—**Reforms and private participation in South Africa**

South Africa's department of energy designed a competitive tender program, the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP), to stimulate private investment in utility-scale RE generation. The national development plan and integrated resource plan set the following policy goals for South Africa in 2010 :

- To invest in infrastructure to support its economic and social goals, including 10,000 MW additional capacity by 2019 (a 23 percent growth on 2010 levels),
- To expand RE generation to make up 17,800 MW of the electricity mix by 2030, to meet the electricity needs of the country.

The REIPPP, launched in 2011, invites IPPs in successive rounds of auctions to submit proposals to develop projects from onshore wind, solar PV, Concentrated Solar Power (CSP), small hydro, biomass, biogas or landfill gas projects. The IPP bidding companies—or consortia—are required to have significant local ownership, including black ownership and community trusts, as well as foreign direct investment.

The programme has stimulated rapid IPP investments in South Africa, and over 5 years has catalysed bid tariffs to fall by 80% for solar PV and by 50% for wind, to around 0.043 USD/kWh for the latest bids (Eberhard and Naude, 2017). Some 24 projects were selected with capacity of over 2000 MW, and USD 4 billion in investments.

Some countries have moved to mitigate the perceived risk of foreign influence and control via private sector investment in the power sector, by stipulating a threshold for local participation or ownership. These thresholds are often called local content requirements in the context of renewable energy developments, and are often tied to procurement processes such as competitive auctions or feed-in-tariff regimes (see 3.6) (OECD 2015). South Africa's flagship auction program, REIPPPP, incorporates several locally-specific socio-economic factors and minimum requirements, which participating developers must comply with to out-perform competitors (see Box 3). In addition to the generation technology and price of power, proposals under the REIPPP are rated according to the local content of the proposed installation (defined in terms of the capital costs and costs of services for construction of the facility), estimated job creation under the proposed development, the share of local ownership of the facility, and measures for local community development (IRENA 2014). In a similar vein, a law and policy adopted in Ghana stipulates local content requirements for jobs and manufacturing in the oil and gas industry (Baako 2014).

2.4. Expanding connections to electricity

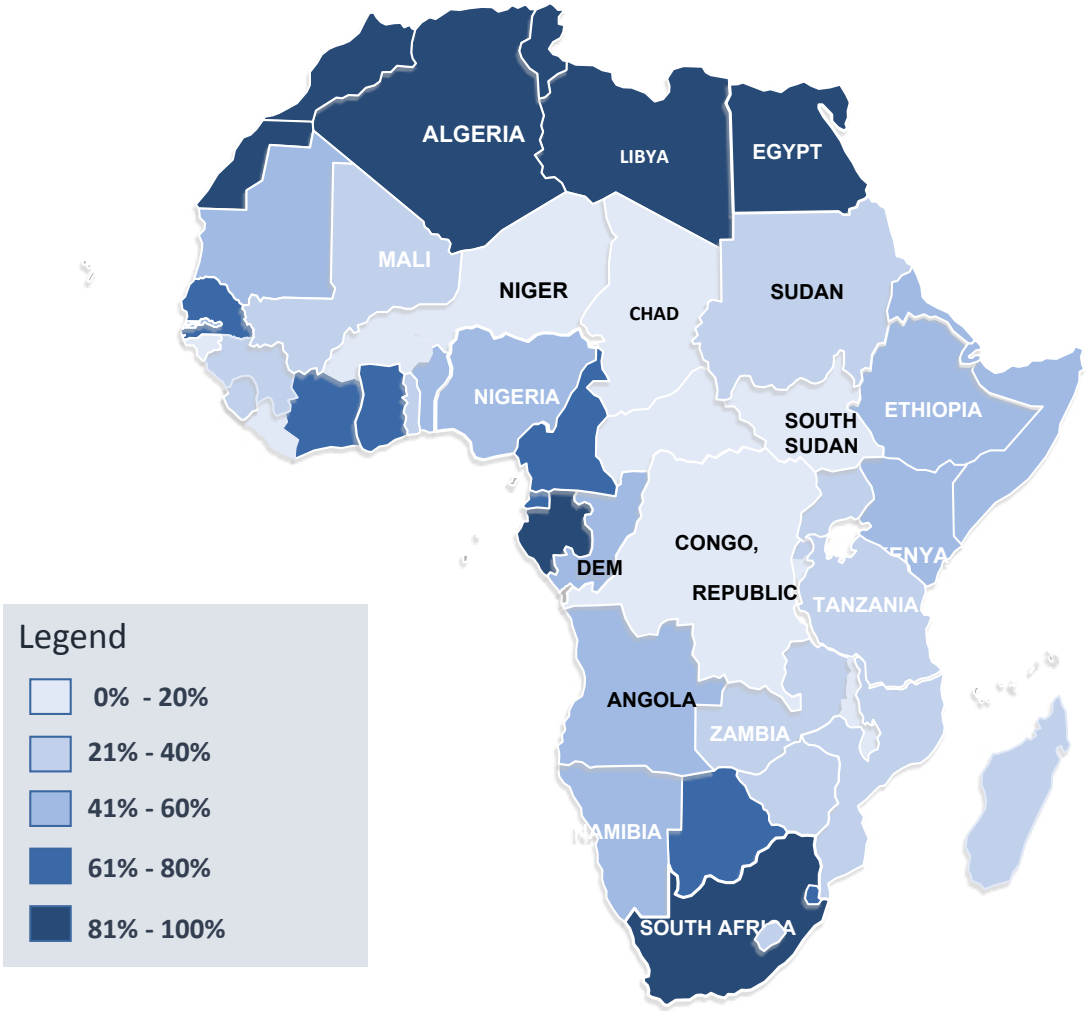
Electricity access remains a sticky challenge for most African countries, especially in sub-Saharan Africa where some 600 million people still lack an electricity connection (Figure 9). Insufficient supply in most of the continent has constrained economic growth for decades. To address the huge needs of expanding power systems to deliver electricity to homes and

[21] Brazil's transmission lines extend over 137,000 km, compared to 112,000 km in sub-Saharan Africa.

businesses across the continent, most countries have set ambitious electrification targets and plans to raise capital, whether in the form of national development strategies or in context of international initiatives such as the United Nations' Sustainable Energy for All and the AfDB's NDEA.

The preliminary purpose of 'standard model' reforms in the power sector was not to accelerate the creation of new electricity connections in under-electrified areas. Their main objectives are to enhance economic efficiency and performance in the sector by improving the performance of electricity supply companies and the investment landscape for local and international financing. The imagined products include well-performing, technically, and financially-sound utilities, an independent and effective regulatory system, economically-efficient least-cost expansion planning, and an influx of external investments to fund power system development. Of course, these intended products of reforms are powerful ingredients to catalyze power system expansion, boosting the utility's ability to extend the grid to previously unelectrified centers, build new connections, and ensure sufficient generation capacity to reliably supply its customers.

Figure 9—**Percentage household electricity**



Source: Study questionnaire and World Bank (2016).

Complementary policies, planning, funding, and purpose-built agencies for electrification all contribute to give direction to electricity sector reforms, guiding efforts to expand electrification, energy access, and affordability for poor households. These focused strategies are essential to accelerate electrification rates, for example with a dedicated rural electrification agency and policies.

Most African countries—almost 70 percent of study respondents—have established national agencies tasked with planning and policy-making for rural electrification, and with implementing rural electrification projects. Some countries have created separate funds or facilities whose job it is to receive and disburse funding for those projects. In others such as Ghana, exceptional electrification rates have been achieved

by targeted policy and collaboration between central government bodies and the electricity utility (without the establishment of a separate rural electrification agency).

Mini-grids and off-grid electricity supply models have become attractive and cost-competitive for countries with remote, under-electrified communities. Attention has been focused especially on systems that harness small modular renewable generation technologies. These consist of localized electricity networks connecting several customers in a community or village, often using locally available renewable resources such as solar Photovoltaic (PV), biomass, or small hydropower plants. Mini grids offer the opportunity to provide high-quality electricity to communities that would otherwise have had to wait for years to receive a connection to the main grid (see Box 4). Unlike individual solutions such as solar home systems, mini-grids can offer power not only for basic use but also for productive uses such as small commercial and industrial applications. They can develop and operate on a community-owned, privately-owned, or publicly-owned basis, depending on local policies, regulatory settings, and available financing models.

Box 4—**Electrification through off-grid and mini-grids in Tanzania**

Over 80 percent of Tanzania's rural population lacks an electricity connection (World Bank, 2016). To address the gap, the country's Rural Energy Agency (REA) has developed policies and projects since 2005 that encourage Small Power Producers (SPPs) to invest and provide electricity services to rural communities, targeting areas where extending the national grid would be costly and slow.

The country is now a regional leader in mini-grid development. Since the adoption of its innovative mini-grid policy and regulatory framework in 2008, the number of mini-grids in the country has doubled, and the rural electricity access rate has jumped by over 800 percent. Over 110 mini-grid systems now operate and sell electricity to rural customers. The mini-grids are owned by private business, local communities, the national utility (TANESCO), or non-profit organizations.

The success of Tanzania's mini-grid sector is partly thanks to the light-handed regulations developed by the national regulator, EWURA, which exempts developers from licensing requirements as well as tariff reviews under certain conditions. New projects must register with the REA but do not require an approval from EWURA. Half of existing projects have less than 100 kW of capacity, in which case they do not come under tariff regulations.

The burgeoning success of Tanzania's mini-grid sector has attracted international attention and funding. REA is working with development partners including the AfDB in the Green Mini-Grid Market Development Program to foster the development of renewable-powered mini-grids. Most mini-grid systems and capacity installed since 2008 use renewable technologies, including biomass, solar PV, small hydro, and hybrid systems (renewable sources with backup diesel generators). The Government of Tanzania, supported by development partners, has also offered financial mechanisms to ease access to financing during the project development process. The REA offered matching and performance grants to mini-grid projects (through a World Bank-supported facility).

Over half of study respondents—all in sub-Saharan Africa—report the existence of a mini-grid industry in the country. Some, like Zimbabwe which has almost 500 operating mini-grids, integrate the development of mini-grids through both private and public ownership models as a central tool of the national electrification strategy. Others such as Tanzania have adopted specific light-handed regulatory requirements for mini-grids as well as offering special financing pathways for mini-grid developers (Box 4).

2.5. Regional integration efforts: facilitating power trading and least-cost generation

Ongoing efforts for regional electricity interconnections remain an important tool for supporting optimal system performance. African countries can benefit from transmission interconnections to create economies of scale, especially where national power systems are not large enough to benefit from such economies. Interconnection creates opportunities for electricity trade, allowing partners to optimize their power costs, protect against fuel price shocks, and be relieved in case of generation shortfall. A recent AfDB-funded study, "Roadmap to the New Deal on Energy for Africa: An analysis of optimal expansion and investment requirements," predicts total investment needs of $ 8.9 billion USD in regional interconnectors from 2018 to 2030 to support a least-cost power investment and expansion plan across the continent (Multiconsult 2018).

Transmission investments make up a modest fraction of the final cost of electricity supply, with significant regional and country benefits. The same study

estimates such an investment in integration and power trading would allow annual cost reduction of $3.4 billion in generating costs, especially beneficial for smaller, isolated national power systems.

The African Union Programme for Infrastructure Development in Africa Priority Action Plan (PIDA-PAP) identified four major transmission interconnections needed in by 2020 and 2040 to transport low-cost electricity to buyers in Africa and further outside the continent (AfDB 2013). The Priority Action Plan (PAP) identified nine hydropower plants that would offer least-cost generation for the continent, and noted the regional integration investments needed to properly evacuate the resulting energy to countries that would benefit. The four transmission projects—the West Africa Power Transmission Corridor, the Central Africa Transmission interconnection, the North South Transmission Corridor, and the North Africa Transmission interconnection—range in estimated cost from $1.2 bn. to $10.5 bn (World Bank/PPIAF 2017).

Since the 1990s, the various power pools, common electricity grids, as well as binational electricity generation and transmission systems in Africa have provided avenues for regional-level planning, and cross-national policy-making in power. In many cases, establishing power pools has required countries to implement trade and regulatory reforms to allow adopting common rules and enforcement mechanisms. The Maghreb Electricity Committee (COMELEC) was established in 1989 between Morocco, Algeria, Tunisia, Libya, and Mauritania to promote energy exchange and interconnection between members. The first true power pool was founded through the Southern African Power Pool (SAPP) in 1995, with 16 members representing 13 countries. The West African Power Pool (WAPP) followed in 2000 between 14 countries. Seven countries make up the East African Power Pool (EAPP), and 10 are members of the Central African Power Pool. Shared generation initiatives include the Manantali Dam managed by the tripartite Mali-Mauritania-Senegal Société de gestion de l'energie de Manantali company, proof of multinational cooperation to plan cost-effective generation and transmission across borders since its creation in 1997.

Power trade in Africa in many cases lags behind the power pools' anticipated targets, many of which suffer from funding deficits and inadequate transmission investment and maintenance to allow the desired capacity of trade. DFIs are especially active in funding transmission interconnections. The AfDB has co-financed at various stages several major interconnections such as the Cote d'Ivoire-Liberia-Sierra Leone-Guinea interconnection, the Zambia-Zimbabwe interconnection, and the Zambia-Tanzania-Kenya interconnection with expected completion in 2021 (Olingo 2018a and 2018b). The World Bank is co-funding the interconnection between Kenya and Ethiopia (a 500kV high voltage DC line of over 1000 km), expected to be functional in 2019, and in 2018, announced funding of $455 million for an interconnection between Tanzania and Zambia. Outright privatization is not a clear solution for enhancing investment and maintenance of transmission assets in the context of small, centralized power systems. But other modes of PSP, such as PPP, can contribute positively to financing the expansion high-voltage networks, while maintaining public ownership. These schemes are being pursued in Kenya on selected lines.

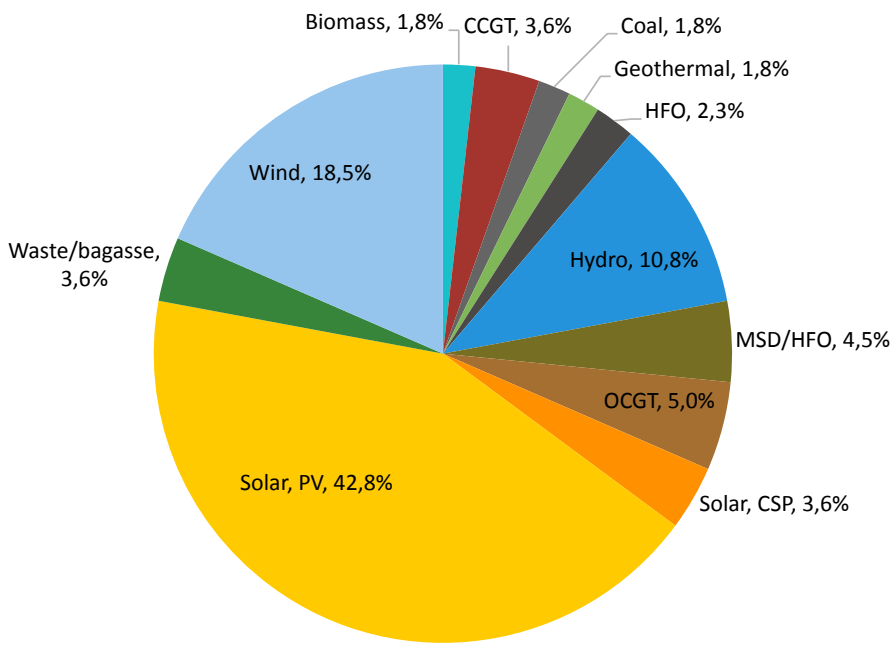
National and regional institutions need to coordinate to create common policies, regulations and enforcement mechanisms for actors participating in cross-border trade. National policies and regulations need to align with those at regional level to ensure that the market is coherent. Power pools need streamlined frameworks for organizing systems planning and operation, and to establish commercial rules for power trade (World Bank 2009). Contracts must be respected. The regional regulator or other appointed body need clear mandates for governing the market, including the trading arrangements, transmission pricing, and dispute resolutions. Responsibilities and powers should be clear for enforcing regulations and presenting advisory findings on disputes.

Political uncertainty and unstable relationships between neighboring countries undermine the trust needed to sustain cross-border markets. Parties must first establish a solid foundation of trust, based on realistic business cases. Questions of national sovereignty and energy security can complicate and unravel the relationships that underlie power trade. Countries are cautious about relying on a foreign country or a third party to provide their basic energy security, but they can be persuaded about the obvious shared benefits of regional cooperation. The continental agreement, at highest level around PIDA interconnection corridor projects, and the acceleration of efforts to establish regional energy markets in each power pool are compelling examples of existing political will.

2.6. Renewable energy and transition to green growth

Unprecedented breakthroughs in prices of solar and wind energy in the past decade have spurred African countries to take advantage of well-established variable renewable generation technologies. The survey shows that a law, policy or strategy to promote RE has been implemented in all the countries that were surveyed. Investing in expanding generation capacity through renewables offers Africa a head-start on the transition to green growth pathways and decarbonizing the energy sector, while also boosting countries' energy security by reducing their reliance on fuel imports. This creates an opportunity for countries to design and move to new power market arrangements that meet their needs to accelerate investment in clean power generation, whether through grid-based or off-grid delivery mechanisms.
Opening up a generation to private investment has been a major driver of renewable additions to national grids. The vast majority of new IPP procurements—83 percent of IPP projects that have reached financial close

Figure 10—**IPP additions since 2008, by technology type**



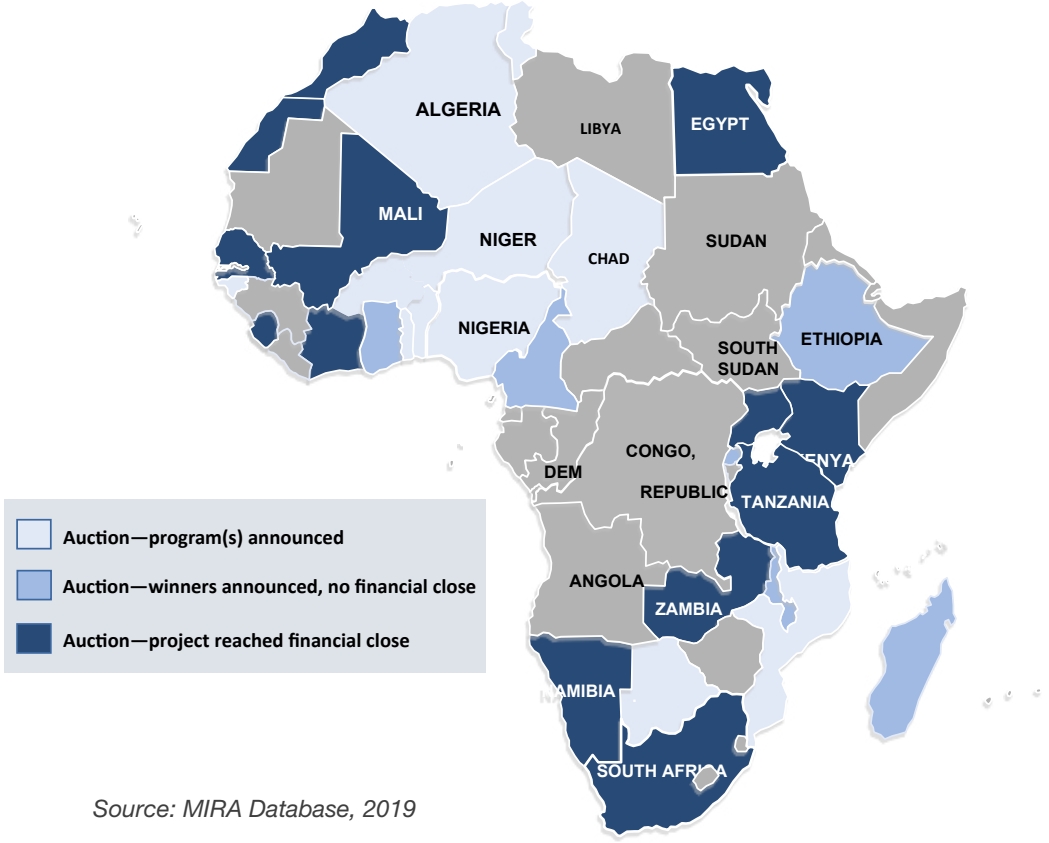
Source: MIRA database, 2019.

since 2008—are for RE: including solar, wind, biomass, hydro, bagasse, and geothermal technologies (see Figure 10) (MIRA database 2019). Allowing small project developers to participate in underserved areas, thanks to growing experience with new business models for rural electrification, has opened up a market to private operators that can provide decentralized electricity solutions using renewables, such as solar home systems and mini-grids (see Box 4). These can help utilities reach electrification goals, and may contribute to their RE targets, while avoiding the large capital costs of extending transmission systems to sparsely-populated areas.

Auctions or international competitive bidding programs are now a well-established trend to guarantee lowest prices for new RE projects. Procuring RE through auctions yields prices up to 80% cheaper than through direct negotiations in Africa (Kruger, Eberhard and Swartz 2018). Globally (excluding China), most new RE capacity is projected to be procured through auctions in future. Auctions provide a platform for developers to present their offering and qualifications to deliver new RE projects, while competition ensures the buyer of new energy receives the best prices. In South Africa, successive rounds of competitive tenders have catalyzed price reductions for wind and solar PV plants of over 75 percent (see Box 3). Cost reductions throughout the entire value chain contribute to cheaper auction prices. The well-established REIPPP program caused financing and development costs to fall rapidly. Engineering, Procurement and Construction (EPC) costs also progressively diminished thanks to a maturing market and larger production volumes. Solar PV and wind are now the cheapest new-build generation technologies in South Africa.

Over half of the study respondents report having hosted tenders for competitive procurement of IPPs (Figure 11). Most of them procured solar PV capacity, along with other technologies, including hydropower, wind, and thermal technologies. Competitive auctions in all corners of the continent have now produced prices for energy as low as 0.05 USD/kWh (5 U.S. cents), notably in Namibia, South Africa, Senegal, Ethiopia, Morocco, and Egypt. The procuring authority typically offers a PPA for a specified capacity of RE and for a specified period. Sometimes this includes a government guarantee to mitigate risks, and occasionally local content or other specific conditions.

Figure 11—**Progress of competitive tenders in Africa**



Source: MIRA Database, 2019

Box 5—**Renewable Energy (RE) approaches in Ghana**

Since the Renewable Energy Act passed in 2011, Ghana has adopted a suite of policies, regulations, and programs to promote RE. In addition to its existing large hydropower capacity, the RE Act requires Ghana to reach 20 percent of RE in its generation mix by 2020. It also provided for several regulatory tools to reach that goal:

- A FiT for RE technologies, published and updated regularly by the economic regulator, PURC,
- A net metering arrangement, to allow individual utility customers to sell energy generated via domestic solar PV panels to be sold back to the grid,
- A RE-Purchase Obligation (REPO), applying to large industries and bulk customers of the electricity utility, which would require them to purchase a certain share of their electricity consumption from RE.

In 2016, the ministry of energy and minerals planned the first competitive auction for energy to procure 20 MW of solar PV capacity. The winning bid, from a South African IPP, named a price of just around 0.11 USD/kWh. A change in government later the same year stalled the project negotiations for over 18 months.

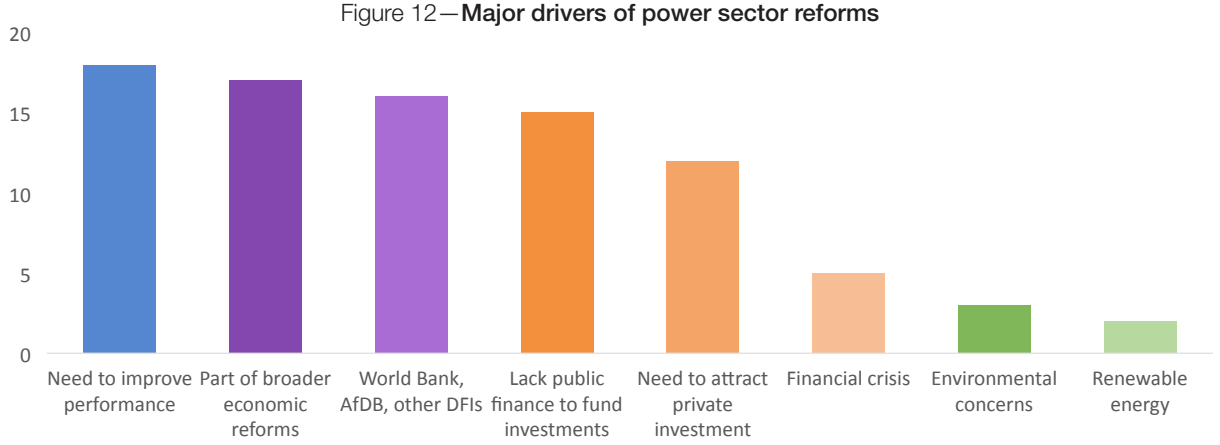
On-shore wind developments had previously received licences and PPAs with the main national utility, ECG, through direct negotiations. Stakeholders independent of the Government of Ghana—including a state-owned company managing a hydropower dam—also procured utility-scale solar PV under the RE law, for example to act as a hybrid generating arrangement with the hydro dam as storage capacity.

Expanding RE capacity beyond utility-scale investments relies on traditional targeted policies and financing mechanisms, such as FiTs, net metering, and RE targets or requirements. FiTs have been introduced in almost half of the questionnaire respondent countries, including Egypt, Ghana (see Box 5), Kenya, and Namibia. The international movements to transition to green economies and decarbonize industries have focused donor funding increasingly around renewables, including through technical support for national governments to implement RE laws and policies. Other green technologies—such as battery storage, to complement variable generation, and electric vehicles—are at a nascent stage in Africa (see section 4.2.1).

3. REFORMS IN THEIR POLITICAL-ECONOMIC CONTEXTS

Managing the complex political-economy of sector governance remains a challenge for many African countries. After 30 years of reform efforts, governments still struggle to catch up to the rest of the world in power sector development and institutional reform. Some of them have even fallen behind. Changing trends in finance and disruptive technologies—alongside a renewed focus on strategic reforms—now offer an opportunity to make up this difference. The design of these new reforms must be sure to account for and be informed by the political economy of the power sector in the target countries.

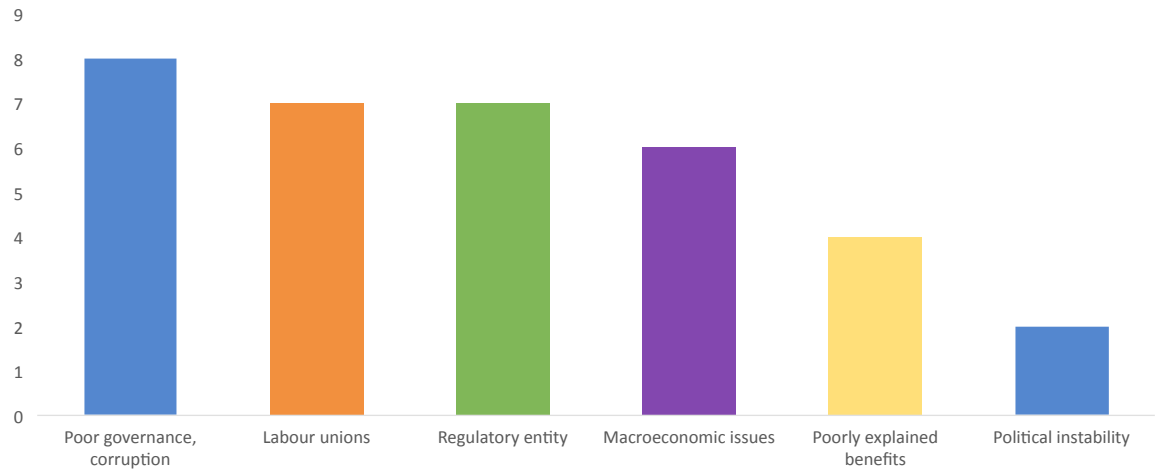
Figure 12—**Major drivers of power sector reforms**



Source: study questionnaire.

Rationales behind power sector reforms most commonly cite the need to improve performance, attract investment, and address financial shortage or crisis in the sector. In sub-Saharan Africa especially, infrastructure financing has been in short supply, and governments have often relied on donor aid since independence. International donors and DFIs feature in most responses as either driving or provoking reforms, or as facilitating them through technical assistance and financial resources. Respondents also cite political leadership, international trends and experiences, and a consensus around sector governance as determining factors to smooth the pathway to reform. Figure 12 shows the prevalence among questionnaire respondents of driving factors for reforms.

Figure 13—**Obstacles to reforms**



Source: study questionnaire.

Failures of governance and entrenched political interests are more likely to be cited as factors stalling the progress or success of reforms (see Figure 13). This section considers the political-economic and governance contexts and factors that have interacted with planning and implementing reforms, and how questionnaire responses engaged with and discussed these issues :

- Power sector finance, structure, and performance,
- Macro-economic circumstances: crisis, underdevelopment,
- Socio-political conditions: political instability, corruption and inequality, and
- Institutional environment: national institutions, political leadership, and international actors.

3.1. Power sector finance, structure, and performance

The power sector is central to the larger political economic systems of African countries, which makes it highly politicized, and creates a contested discussion around reforms. The sector has strategic importance and linkages with social and economic development, which reinforce its ideological weight as an engine of growth and industrialization. At the same time, its massive investment requirements are coupled with a dependence on external sources of technology and finance.

Financially unsustainable utilities and the lack of investments in the sector are a major component of the justification for reforms. Power sector financing is still closely tied to the national budget in African countries. Tariff and operating subsidies are near intractable in many contexts, and utility collections remain low, even though tariffs tend to be below cost recovery levels. Efforts towards cost reflective tariffs have sometimes proven futile even in cases of solid legislative or regulatory reforms, deepening the strain on utilities.

Few African countries have conceded the failures of the traditional reform model and its structural vulnerability to systemic corruption. Countries may believe that doing so could trigger a crisis of confidence in the state itself in the context of macroeconomic volatility and political transitions. The consolidation of power in a central utility has in many cases advocated strongly against any efforts to restructure the sector. In Zambia, «the national utility had overbearing influence on the regulator," so the regulator was unable to hold the utility accountable for its performance according to the conditions of tariff reviews.[22] Union opposition to reforms compounded this, further reducing chances to break up the monopoly.

Vested interests also share an interest maintaining the traditional industry model (or a hybrid). The vertically-integrated structure provides less transparency and more opportunities for rent-seeking. Interested parties include those who benefit from patronage, gained through connections, tenders, and jobs. Others receive subsidized electricity services or have been informally allowed to default on electricity bills. Obscure, shifting institutional structures in the sector also create space for actors to impose their vested interests.

3.2. Macro-economic circumstances: crisis, underdevelopment, international trends

Macroeconomic forces have shaped both the need and the results of reforms in African countries since they were first deployed in the 1990s. Almost 25 percent of the questionnaire respondents—including Egypt, Ghana, Guinea, Nigeria, Uganda, and Zambia—cited the impact of macroeconomic conditions as factors that hindered the successful implementation of reforms. High volatility of foreign exchange rates, cost of materials and fuel prices put African countries in a vulnerable position. High inflation rates and devaluation of many currencies eroded the tariff and other foreign currency denominated assets in the power sector. This affected the treasury's capacity to raise resources to support the power sector, and discouraged PSP (usually driven by profitability).

The designers of reforms often failed to pay close attention to the way that reforms would interact with the highly complex macroeconomic circumstances faced by most African countries. Those promoting the 'standard model' clearly understood the power sector's importance for economic growth and development. Reforms, as part of structural adjustment mechanisms tied to large development package loans, were inevitably interlinked with currency shocks, inflationary pressures, and fiscal crisis. This increased the transaction costs of implementing the reforms, while also increasing the risk (and disincentivizing) the type of competitive private investment that was central to the 'standard model.'

Early experiences of sector reform shaped attitudes to the processes, both within and outside of the countries for decades to come. In some countries, such as Uganda, 'standard model' reforms didn't immediately translate into inflows of private investment. At times, this extended supply side crises or required the government to take extraordinary measures to attract investment (such as a government-guaranteed return on investment). In other contexts, **private investment flowed in ahead of crises that threatened the reneging or renegotiation of private contracts**, hurting investors and the investment profile of these countries.

> *There was no well-defined and consolidated power reform program that explained the selection of reform measures, their sequence and coherency. On the other hand, the reform agenda was likely to meet donors' and lenders' requirements, rather than being a truly government-led national reform agenda. – Questionnaire respondent (Mozambique).*

In some cases, 'standard model' reforms have failed to explicitly link to national economic priorities, beyond economic growth. The advocates of reform did not make explicit links to job creation, provision of social services,

[22] Quote from questionnaire response, Zambia.

localization and industrialization, and the reform logics did not explain how they related to the ideological basis of those needs. For example, in Malawi, reforms were considered a threat to jobs in the power sector and to national sovereignty, rather than as an opportunity to improve the power sector's financial status and to harness external financing for development.

International trends of electricity market liberalization gradually swept across other regions in the 1990s, showing successes in Europe and Latin America. Addressing financing crises through privatization became a worldwide norm. Competition reform offered a promising solution to African power sector challenges, especially given the successes elsewhere. Separating the off-taker from power producers seemed an obvious choice in some countries, to stimulate PSP and enjoy gains in technical and operational efficiency.

Many states opened the market to RE investment in response to unpredictable prices of imported fuels due to currency depreciation, as well as to rising electricity demand. The cost of thermal generation due to price volatility, combined with low hydropower availability due to droughts (an increasing effect of climate change) both incentivize the uptake of variable RE technologies.

3.3. Socio-political conditions: political instability, corruption and inequality

Socio-political systems of the 1990s were characterized by conflict, contestation, and uncertainty. Long periods of absolute leadership, civil unrest and ethnic conflict, and the ruins of imperialist proxy wars left many African countries in turmoil in the 1990s and 2000s. Addressing the financial problems and underdevelopment in the power sector has proven harder in countries suffering from political instability, interference, and general perceptions of a lack of rule of law.[23] Performance challenges sometimes stemmed from and often added to difficult macroeconomic circumstances. These worsened the ongoing ideological battles and social divisions. In Sudan, a political and financial embargo combined with protracted conflict "led some financiers to desist from funding projects,"[24] intensifying the financial deficits in the sector. Political stability was seldom cited in the questionnaires as contributing to successful reform programs, with exceptions such as Angola, Egypt (post-2014), and Kenya.

> *The political unrest and civil war up to 1986 left a dilapidated infrastructure with limited government resources to fund system expansion. This situation created a need to reform and refurbish the network as well as invest in generation expansion. Economic liberalisation ideology, prescribed by the IMF and World Bank, was a pre-condition for providing funding to the energy sector and for the national budget as a whole. – Questionnaire respondent (Uganda).*

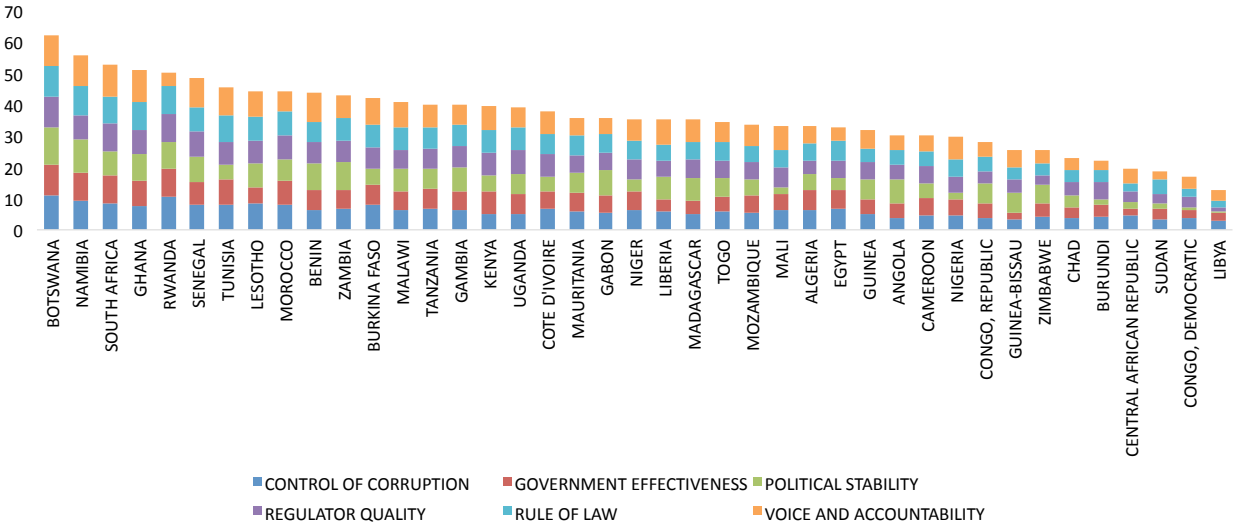
International donors used conditional loans and embargos to advance democratization, alongside structural adjustment programs, which often provoked resistance. In some cases, 'standard model' reforms challenged existing political settlements, or threatened fragile deals brokered towards democratization (often a balance between the interests of political leaders, clientelist networks and special alliances). In Senegal, powerful and politically connected labor unions used acts of sabotage to obstruct reforms at the end of the 1990s, leading to a 3-day national blackout. To maintain political control over a state-owned company, Kenya withstood years of embargo on power sector lending between 1992 and 1997, which contributed to a national supply side crisis.

Suspicions towards reforms are connected to relationships between ideas about the power sector, the political legitimacy of ruling elite, and the vested interests competing for state control. Core systems of ideas—socialist, liberal, or state-centered conceptions, and ideals of self-reliance—all combine in different ways with the strategic nature of the power sector. Forms of corruption, patronage or leveraging (for example by labor unions) can also be deployed in the sector. Political leaders often depend on power to subsidize social spending, maintain patronage networks, and fund elections. 'Standard model' reforms may not align with concerns of political leaders in these contexts, beyond the unreliable promise of investment, or the threat of aid and lending embargos.

Many countries have been politically unstable since the 1990s or earlier, creating a stumbling block for development and jeopardizing the long-term implementation of reforms. Even where reforms have been implemented, political moves for reversal may occur. Figure 14 shows global governance rankings of the countries studied from the Worldwide Governance Indicators.

[23] According to questionnaire responses.
[24] Quote from questionnaire response, Sudan.

Figure 14—**Governance rankings**



Source: Worldwide Governance Indicators, 2018.

Half of study respondents note the problems of poor governance and mismanagement, often compounded by corruption. These act both as an obstacle by impeding the implementation and sustainability of reforms, and as a driver by creating a need for reforms to remove the conflicts of interest and potential for interference in power sector decision-making. Weak governance and corruption are often cited as having driven away foreign investors, with negative consequences for the financial and commercial viability of the utility. In some countries, allegations of corruption and kick-backs to sector officials surrounded the question of privatizing state assets.

3.4. Institutional environment: national institutions, political leadership, and international actors

Reforms are difficult to implement in uncertain contexts of nascent or weak institutions that prevail in many African countries. Democratization and structural adjustment programs caused confusing shifts in institutional structures towards the end of the 20th century. With insufficient and under-resourced technical capacity, formal institutions were already weak and struggling to earn legitimacy in the eyes of the public. At the same time, informal institutions threatened to destabilize the delicate balance of economic and political power.

The government, including the Office of President and Cabinet, was also running a public reform programme in all the sectors of the economy of Malawi. – Questionnaire respondent (Malawi).

Strong political leadership from a leading coalition provides a necessary political impetus to push reforms through. Over one third of the respondents cited "political will" as a factor or precondition to allow reforms to succeed. Energy and finance ministries, as well as capable electricity regulators, are often considered to drive reforms, or to enhance their outcomes. For example, regulators incentivize improving performance by requiring utilities to meet conditions to receive tariff increases, or subsidies in the case of finance ministries. A key leader, such as a President, government minister, or regulatory commissioner, can spearhead reforms if they see them as a tool to recover the economy or stamp out corruption, or attract investors. In Kenya and Nigeria, presidential support carried reforms forward, creating political stability that fostered stable relationships to build trust between government and investors.

The logics and expected results of reforms need to be well conveyed to stakeholders and the public. The benefits of reforms in Zambia were not fully articulated, leading to proclamations that the utility would remain in public hands after reform. Similarly, in Mozambique, the power sector reform program lacked a clear indication of the benefits, structure, and sequence of reforms. This contributed to the sense that reforms were designed to align with donors' or other parties' needs, rather than being a national initiative to meet local needs within the country's context.

Restructuring of the utility solicits fears, among both workers and managers, surrounding job losses. Utility employees are often among the greatest opponents to reforms. In Nigeria, an overstaffed and under-skilled utilities workforce, through their union, refused to downsize or accept severance packages.

Weak existing legal frameworks, unclear enforcement mechanisms and lack of accountability can complicate the work of translating and applying reform policies into binding legislation. Even in countries where commitment to 'standard model' reforms exists, designing enforceable legislation and regulatory frameworks has presented a challenge to implementing reforms. The lack of independence, lack of capacity, or inexperience of the regulator hampers the progress of reform in some

countries. The selection of regulatory commissioners and chairmen remains a political decision in most countries, making full separation from politics impossible.

International institutions are frequently the first actors cited as provoking, as well as facilitating reforms. During periods of financial crisis, governments have depended on financial assistance from DFIs, which often arrive in structural adjustment packages. DFIs also provide support through technical assistance that can bolster recovery in the sector.

Successful reform implementation often requires major support from technical assistance and training for local institutions. Adequate funding allocations towards capacity building for government, statutory, and independent bodies are essential, as well as for ministries of energy and finance, sector regulator, utility, and other agencies affected in the power sector. Capacity building programs translate the ideas that underlie the reforms to the local stakeholders, while modernizing and strengthening the institutions established as a result of the reforms. It can also finance feasibility studies on reforms. Sector professionals can build skills and knowledge to act as local champions for reform measures, explaining their rationale and building support around the model's key arguments. For instance, in Kenya, study tours and training efforts were a key feature of the longer-term success of progressive reforms. The strong emphasis on local capacity building allowed the country to benefit from competitive procurement in generation. Similarly, some countries (including Malawi, Ghana, and Senegal) received grants of up to USD 600 million from the Millennium Challenge Corporation Fund, funded by the US government, which triggered the restructuring of the power market of the country.

A lack of clear political leadership can mire the power sector in 'false' reforms, where the country appears to adopt new policies or institutions without the accompanying implementation measures creating outright opposition. Embedded economic and political interests in the sector may use their ability to access positions of power to prevent institutional reform or development. Where media freedoms are limited, powerful actors can more easily mobilize broad-based public opposition to reforms on ideological grounds. Low levels of transparency and accountability reinforce the lack of political will to change the status quo.

4. REFORMS LOOKING FORWARD : OPPORTUNITIES AND CHALLENGES

Turning towards the horizon, we consider the ongoing weaknesses (section 4.1), pressing challenges, and trends (section 4.2) facing power sectors in Africa, in contexts of great financial insecurity, major demand growth, and disruptive technological and economic innovations.

4.1. African power sectors continue to face weaknesses and worries

The widespread challenges and weaknesses that trouble African power sectors combine to create a chronic energy security challenge for the continent. Operational, technical, financial, equity, and political quagmires continue to hamper utilities' performance, affecting their ability to deliver quality electricity services and to invest in developing and maintaining infrastructure. As a result, most utilities struggle with underdeveloped and poorly maintained infrastructure, eventually resulting in power outages, low access rates, low availability of electricity, and high levels of system losses. Utilities often manage their energy shortfalls with strategic load shedding, causing unpredictable blackouts to homes and businesses. Transmission infrastructure, a critical link for power delivery, has also suffered from underinvestment, unable to transport the needed energy from its generation sites to the millions of consumers who rely on it (World Bank/PPIAF 2017). These weaknesses increase overall system costs and also contribute to rampant poor quality and reliability of electricity supply in the continent¬, in general, except in selected few countries in SSA and most countries in North Africa that stand out with reliable systems.

African utilities, facing great technical and financial challenges, struggle to gain the confidence of customers and investors. Accessing finance is essential to develop new projects. The largest potential source of funds—the private sector—is easily deterred by the high risk of investing in a dysfunctional system. Meanwhile, the close to 650 million people who lack access to electricity represent most of the continent's poor and rural populations, raising the problem of equity among urban-rural and class divides. Equity problems are compounded by the high cost of power, commonplace corruption, and often opaque and unsustainable subsidies.

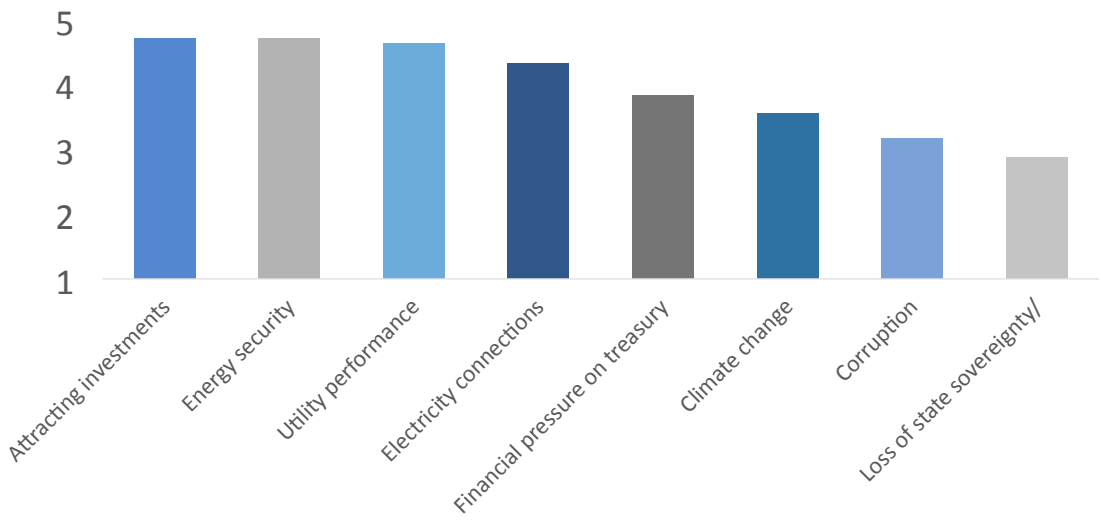
To sound out the prevailing opinions of energy sector professionals on the threats that they consider most urgent in their sector, the questionnaire respondents were asked to rate (on a scale from one to five) the relevance of various concerns that are likely to feature in different ways in the power sector :

- Attracting investments
- Utility performance
- Electricity connections
- Energy security
- Climate change
- Loss of sovereignty or control by the state
- Financial pressure on treasury
- Corruption.

The respondents almost universally report the greatest urgency surrounding attracting investments. Energy security and utility performance draw similar levels of concern across the sample. This highlights the still prominent need for reform mechanisms to improve access to finance, increase generation capacity and diversify the energy mix, and transform the operational, technical, and financial management of utilities.

With average electricity access rates lower than on any other continent, it is no wonder that questionnaire respondents rate electricity connections as another area of high concern (rating at 4.3 out of 5 overall). Here, a significant variation occurs between regional groups of respondents. West and North African countries report a high preoccupation for electricity connections (average rating of 4.7 out of 5), a little more than Southern African (at 4.2 on average). By contrast, East African respondents report only moderate level of concern in this matter (rating just 3.3 out of 5 on average).

Figure 15—**Level of potential concerns (average of 26 responses)**



Source: study questionnaire

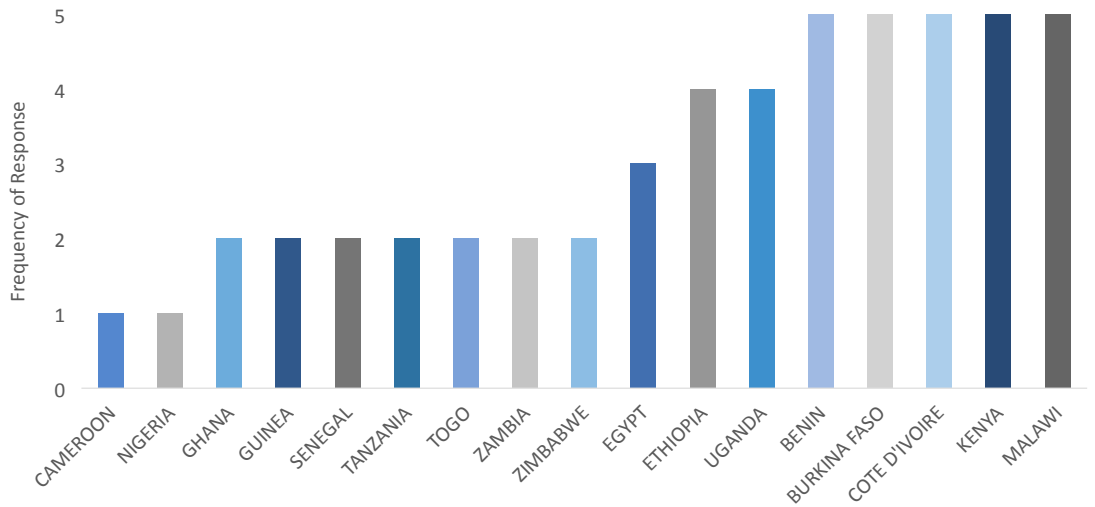
Stakeholders' preoccupations for the future center around the financing needs and operational responsibilities of the electricity utilities, which are tasked with meeting the country's energy security needs (Figure 15). Attracting investments represents a pathway to scale up electricity networks, connections, and supply of much-needed power. These gains will in turn bolster energy security for the country, and beyond to neighboring regions as regional interconnections continue to develop. Not surprisingly, improving utility performance remains a priority, since credit-worthy utilities are more likely to attract investment.

Future affairs of politics and governance elicit less concern or controversy for utility professionals. Respondents across regions tend to agree that both the prospects of diminishing state sovereignty over the power sector, as well as the risks of corruption, present moderate cause for concern. As such, resistance to regional cooperation, due to for sovereignty concerns and misaligned priorities would need more contextualization at project level.

Climate change features somewhat more prominently on the radar, when compared to governance and political questions, with probable links between rising global temperatures, increasing droughts, and reduced dam levels for hydro generation. But climate anxieties do not match the questions of sector investments, performance, and security. Investing in solar, wind, and other RE generation technologies already form a large part of the solution to the power crisis in African countries. The problems of decarbonizing industry or reducing carbon emissions in Africa are small in comparison to broader concerns for power sector development, and negligible in comparison to the decarbonization needs in other regions. The AfDB is taking the lead in this area, and has a Climate Change Action Plan (2017).

Most sector professionals surveyed have reservations about whether the institutions in their power sector are sufficiently prepared to tackle the upcoming challenges presented in the questionnaire (Figure 16). These respondents cite the need for additional capacity building, to strengthen organizational, operational, regulatory, and financial capacities. Policy support and new financial mechanisms are additional factors that respondents believe would facilitate institutions' ability to adopt new business models and manage upcoming challenges. However, most countries in the frameworks of global agreements on climate change made voluntary engagement toward reducing their carbon emissions, and they are supported in their efforts by DFI, as well as the AfDB, which has adopted ambitious targets to reduce carbon emission in all its operations.

Figure 16—**Are power sector institutions equipped to deal with these upcoming trends and challenges?**



Source: study questionnaire.

The anticipated impacts of upcoming trends are largely positive. Most respondents anticipate system costs and generation costs to lower as a result of competitive procurements, opening up opportunities to increase electricity access rates with knock-on effects for economic development and growth, especially in rural areas. Decentralization, distributed energy resources, energy efficiency technologies and mini-grids are a regulatory concern for tariff structures, also prompting the need for new utility business models. Utility performance—both technical and financial—is also considered a potential winner, thanks to introducing competitive tenders and mobile payment technologies. Capacitating power system operators is a major step to supporting utility performance while managing a decentralized grid with flexible resources, variable renewables, and bidirectional electricity flow.

4.2 Change, challenge, optimism define the next decade of reforms in Africa

Disruptive technologies are opening new opportunities and provoking the need for new regulatory, policy, and economic tools to harness them (section 4.2.1). The questionnaire respondents report high levels of awareness of these growing trends in African power sectors, and signs that sector decision-makers are sitting up and taking note of their imminent effects (section 4.2.2). These changes are triggering the need to reconsider the traditional business model and structure of electricity utilities, ushering in a new wave of reforms in the power sector (section 4.3).

4.2.1. Disruptive technologies are prompting a new wave of power sector reforms

The world of energy is changing profoundly and rapidly. Accelerated innovations in power technologies, services, and markets are shifting and upending relative prices and market shares, and the location and patterns of energy production and use. Electricity consumers are gradually becoming producers too, as digitalization, information and communication technologies, and infrastructure are used in more complex and decentralized ways, and as low cost, renewable and distributed energy, and storage resources become competitive.

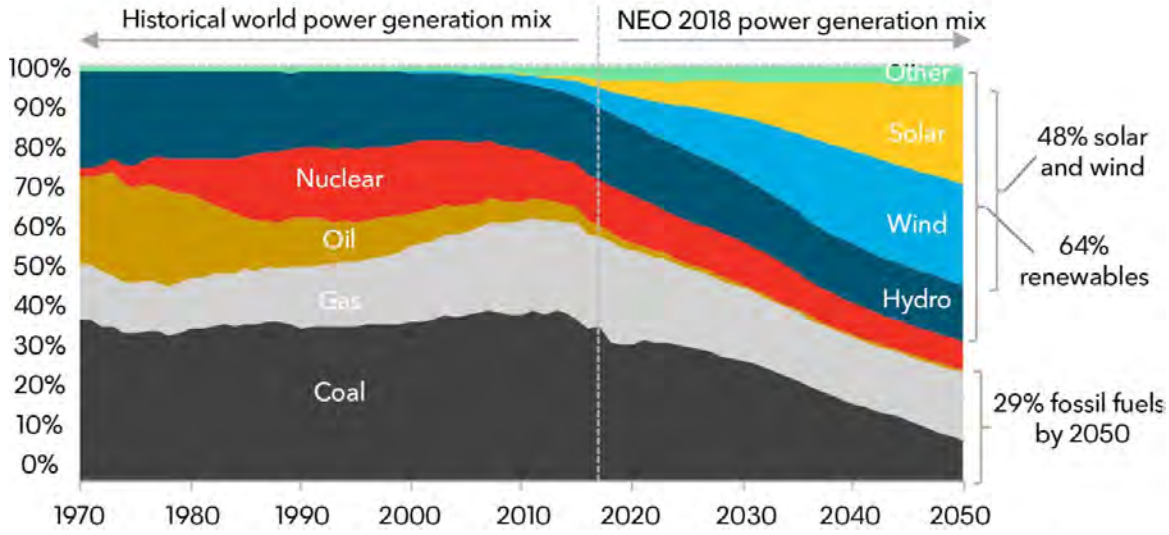
Capacity additions in Africa until 2030 will be dominated by hydropower resources, natural gas, solar, wind, geothermal, and biomass. This aligns with a sea of change in the global energy mix (Figure 17). Demand in Africa is forecasted to increase with a compound annual growth rate of 5.7% (Multiconsult 2018). Both increasing electricity access and GDP growth contribute to this increased demand, with some regions—notably West and East Africa—projected to increase demand by 10 percent and 11 percent yearly.

For the new generation of consumer-producers—or prosumers—electricity will flow in both directions. With real-time control over their electricity consumption and output, individuals will gain insight into their energy requirements and consumption, and gain the ability to control the energy sources they use and the end-user they sell on to. Smart devices and controls will complement smart meters, armed with machine learning and artificial intelligence to maximize comfort and economy.

Electricity distribution and payment systems could use distributed ledgers or blockchain technology for accounting purposes, even at a household-household level (Nsikak 2018). Blockchain, an online communication protocol that eliminates intermediaries, allows companies or individuals to create an auditable encrypted ledger that can record energy consumption and credit histories. These secure ledgers can facilitate energy trading between households.

Grids and power systems will transition to more radial structures with meshed patterns (Buljan 2018). Smart grids with new geometries will begin to emerge from a new landscape of traditional electricity networks interspersed with mini-grids, community grids, and distributed individual generation systems.[25] Modular RE technologies offer to bring generation closer to consumers, even as large low-cost sources of generation remain centralized and distant.

Figure 17—**The changing global power mix**



Source: Bloomberg New Energy Finance (2018), "New Energy Outlook (NEO) 2018", at https://bnef.turtl.co/story/neo2018.

Industrialized countries are experiencing the impacts of these innovations differently from developing countries. Developed wholesale and retail power markets are struggling to adjust to growing shares of competitive renewable energy. Zero or even negative pricing is an increasing phenomenon and stranded power assets are becoming commonplace. Incumbent service providers fear the classic utility death spiral, with declining sales and increased grid defections (O'Boyle 2017). Alternative utility models are emerging.

Industrialized country power market challenges are mostly absent in Africa. Nowhere are wholesale or retail power markets to be found. Most countries still have low levels of electrification and use. Nevertheless, their power systems have the potential to grow rapidly and could be shaped anew by innovative, disruptive technologies.

Solar and wind energy are also breaking through in Africa, facilitated by successful auctions, which are delivering cheap unsubsidized grid-connected power. Coupled with continued innovation in storage technologies, and growing experiences with new business models for mini-grids and off-grid solutions, many countries in the global South can leapfrog standard market reforms and have the opportunity to design and migrate to new power market arrangements which are appropriate for their needs for accelerating investment in power generation, both on- and off-grid. However, for grid-based generation, adequate baseload will be required to ensure stability.

African countries will have to revisit the power utility restructuring proposals that were commonly made in the 1990s to make the most of new technologies, to access private sector finance, and embrace new business models. Only a handful of countries in Africa structurally unbundled their utilities. Those that did so—such as Kenya and Uganda—benefitted from increased investment by IPPs. Challenges remain to extend reforms to more countries, extend regional interconnections, and capacitate independent transmission system and market operators (ISO) that can manage contracts for new variable renewable energy, plus flexible balancing and system security resources. This will open throughways to least-cost (and low-carbon) power. ISOs in Africa are likely to remain under public ownership, given the strategic status of the power grid and access issues in national development discourse and plans. Capacitating smart system and market operators to be able to respond with agility to these new markets will not be trivial.

Reforms need to open the space for mini-grid and off-grid solutions for countries that need to close the access gap, especially in rural areas. Decentralized RE generation technologies, battery storage systems, smart meters, and efficient appliances continue to plummet in price, catalyzing an explosion of new business models

[25] See http://fractal-grid.eu/.

that have identified innovative ways to bring solar home systems and mini-grids to remote regions at affordable costs. Mobile money linked with mobile telephony and pay-as-you go contracts are now widespread, particularly in East Africa. Industries and mines are also investing in their own mini-grids or self-generation with renewables, while residential energy communities are emerging, linked by embedded grids. Traditional utilities will need to decide whether they can and will enter those markets, or restrict their grid-connected customer base mainly to urban areas. Even there, customers are defecting from the grid due to poor service and increasing prices. New market design models will have to incorporate rules to ease entry for off-grid and mini-grid providers, and for PSP in distributed energy resources and distribution, to smoothen the transition and bolster access rates.

4.2.2. African utilities begin to anticipate the relevance, impact and timing of innovations in power technologies and markets

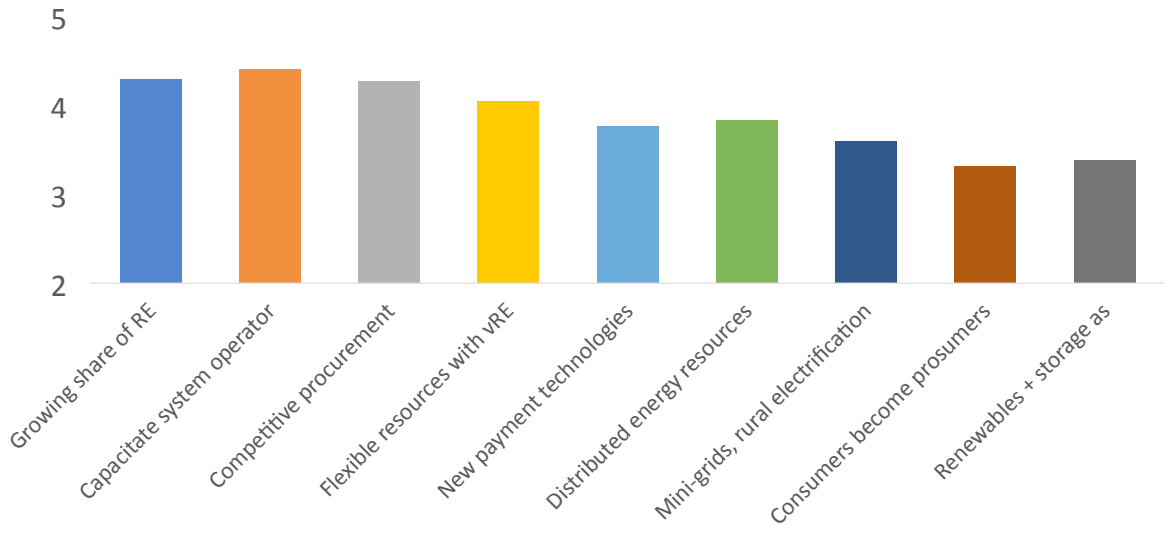
The questionnaire asked utility professionals and other power sector stakeholders to consider the relevance and potential impact of nine new technological and power market trends:

- The growing share of variable renewable energies in the power mix, due to falling prices compared to fossil-fuel technologies and environmental policies;
- Increased use of competitive procurement (auctions and tenders) for new power;
- Decentralization of power grids due to distributed generation with small renewable systems;
- More mini-grids providing power to rural and under-electrified communities;
- The need for flexible resources (e.g. gas turbines, storage, demand-side management) to support variable renewable technologies;
- The need for system operator to build capacity to integrate and manage the power system, due to increasing complexity (variable generation complemented by flexible and decentralized resources);
- Consumers becoming producers of electricity, power flowing both ways, net-metering, grids becoming more meshed;
- Mobile and/or blockchain payment technologies creating new consumer/provider relationships and dynamics; and
- Renewable energies becoming sufficient for base load generation, due to the rise/maturity of energy storage systems (batteries).

For each of the above nine trends, the respondents were asked to evaluate:

- How relevant is the trend in the power sector today?
- Do policy-makers recognize and discuss it at a political and regulatory level?

Figure 18—**Average ratings for relevance, impact, and recognition of new trends (out of 5)**



Source: Study questionnaire data.

Power sector stakeholders—utilities in particular—seem to recognize that renewable energy technologies, such as solar PV and wind energy, are breaking through. Increasingly, these technologies are being procured competitively through reverse auctions rather than directly negotiated deals or feed-in tariffs. As the share of these variable energy technologies grows, and the role and function of system operators becomes more complex, there will be a need to build their capabilities to adequately balance national power systems through procuring and dispatching flexible, complementary resources, including technologies which can provide adequate system strength, inertia, reactive power, and other required auxiliary services to maintain system reliability and quality.

Table 1—**Detailed relevance and impact scores for new trends**

Salience (1-5)	Relevance of trend	Popularity in power sector	Recognized by poli-cy-makers	Future policy/ regn concern	Impact/ importance	Helpful for country	Mean salience of trend
Growing share of RE	4.3	4.3	4.3	4.1	4.3	4.4	4.3
Capacitate system operator	4.5	4.3	4.2	4.4	4.7	4.4	4.4
Competitive procurement	4.5	4.1	4.3	3.8	4.2	4.6	4.3
Flexible resources with VRE	4.0	4.0	3.8	4.0	4.2	4.2	4.0
New payment technologies	3.9	3.6	3.3	3.8	4.1	4.0	3.8
Distributed energy resources	3.9	3.7	3.7	3.8	4.0	4.0	3.8
Mini-grids, rural electrification models	3.8	3.5	3.4	3.1	3.9	4.0	3.6
Consumers become prosumers	3.2	3.1	3.0	3.6	3.7	3.6	3.4
RE + storage as baseload	3.2	3.5	3.1	3.6	3.8	3.7	3.5

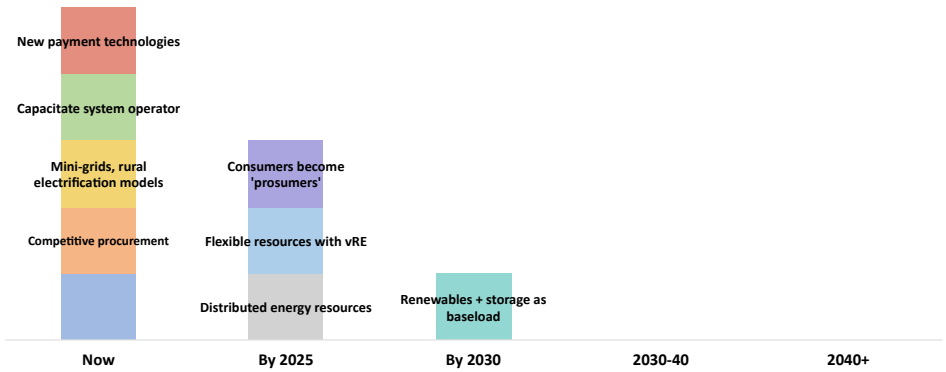
Source: Study questionnaire data.

Respondents also recognize that power systems are becoming more decentralized alongside a future proliferation of mini-grids and off-grid systems. The likelihood that many consumers will also become producers of electricity remains less widely accepted, along with the upcoming changes in the nature and shape of grids, metering and payment systems, and the extent of digitalization. The idea that renewable energy with storage could displace current baseload power generation technologies was the least accepted (yet even here, a mean salience rating of 3 out of 5 was recorded).

The survey generally reveals a relatively high level of awareness of these new technology and power market trends, and their potential impacts. The results report that the consciousness of these questions by policy-makers and regulators only slightly lags behind that of other power sector stakeholders.

Most utilities also believe that the impacts of these trends are being felt within the next 2 years, especially the breakthrough of renewable energy technologies, increased use of competitive tenders and auctions, and increased investments in distributed energy resources and business models (see Figure 19). The issue of system operators procuring flexible resources to complement the variability of solar and wind, was seen to be relevant only from 2020 or later, and significant growth in "prosumers" from 2025 onwards.

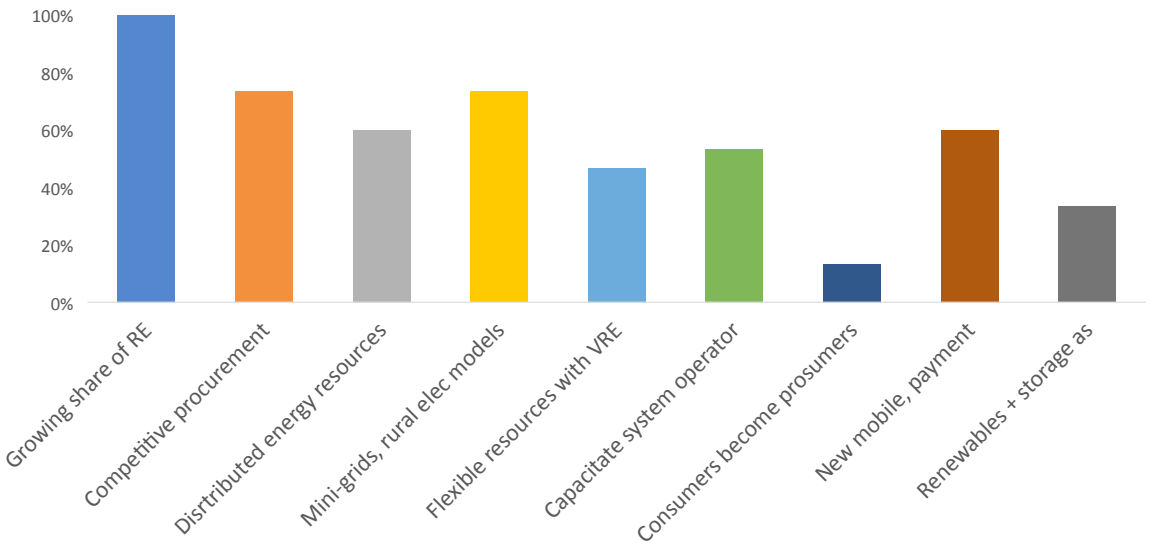
Figure 19—**In what timeframe will the impact of new trends will be felt? (average response)**



Source: Study questionnaire data.

Countries and utilities are beginning to frame responses to many of these disruptive technologies and new power market trends (Figure 20). The move to more competitive procurement systems is an indicator of this, as well as with reverse auctions for solar and wind energy, to lower prices and increase investment and transparency. Policy, legal, and regulatory frameworks are creating the space for distributed energy resources, which have the effect of improving grid-stability as well as, of course, access to electricity, as do new business models for off-grid power using pay-as-you go mobile money systems. Fewer countries have yet to confront the need to build the capabilities of their system operators to procure and manage flexible resources that could adequately complement a growing share of variable renewable energy and secure required system strength and quality. Likewise, few countries are anticipating how the nature of utilities, might be revolutionized by more consumers also becoming producers of electricity, with local energy community grids emerging, meshed in different ways with urban, regional or national grids, although there is some awareness that these trends could impact negatively on utility revenues unless they change their business models.

Figure 20—**Share of countries that have adopted policy or regulatory response to trends**



Source: Study questionnaire data.

4.2.3. Utilities of the future will emerge

Africa has the opportunity to embrace innovations in enabling technologies, business models, system operation, and market designs. Enabling technologies and new business models will include a growing share of low-cost renewable energy that is complemented by both utility-scale and distributed batteries, electric vehicle smart charging, strengthened grid interconnectors, and renewable-based mini-grids, demand-side management and virtual power plants, energy communities with embedded grids and peer-to-peer trading, community-shared ownership, pay-as- you go and, eventually, perhaps even distributed ledger systems.

There will be a new impetus to unbundle transmission systems to create independent system and market operators. These will be responsible for managing variability, flexibility, reliability and system strength, and quality. They will have to operate hydro and other resources in more complex and responsive ways. System operations will also need to integrate advanced renewable energy generation forecasting. Distributed system operators in metropolitan areas might emerge, with the added complexity of integration with national control centers.

Market and regulatory reforms will be essential to respond to these transformations. These reforms will be designed to free up markets for willing buyer/seller arrangements, wheeling across the grid, and smart metering. Tariff structures will need to include charges reflecting time differentiation in energy costs (showing when it is cheaper or more expensive to produce or consume electricity). Tariff reform will also introduce peak-coincidental capacity charges for networks, flexible resources, and reliability services (to complement their own-generation).

In the medium- and long-term, the digitalization of the electricity system will be transformational for every aspect of system operations, planning, and maintenance. An explosion of new data sources will change how system operators work, and how customers engage with, consume, and manage their consumption. In addition to smart meters and Geographic Information Systems (GISs), for example, "5G" data networks, social media, mobile apps, cloud apps and storage, sensor data, Global Positioning Systems (GPS), drones, critical infrastructure data, Enterprise Resource Planning (ERP), and block-chain data transfer will be harnessed for decision support through virtual and augmented reality, artificial intelligence or machine learning, and cognitive intelligence. These have vast consequences for control and automation in power trading, remote switching, and automated operations.

4.3. Implementing a sustainable utility transformation agenda

It is widely acknowledged that transforming the power utilities and the sector is now an imperative on the continent. While many solutions have been imagined and advanced to transform the sector, the AfDB contends that five action areas should emerge as priorities. These are: 1) to strengthen the least cost integrated resource planning in utilities; 2) to improve sector governance and management; 3) to achieve efficiency in human capital management in the sector; 4) to support sector reform and achieve the financial sustainability of utilities; and 5) to foster smart partnerships (with DFIs, investors, technology providers, and service providers). These action areas constitute a recipe for sustainable transformation of the power sector. Utilities will then be able to operate within an investment-driven policy, legal, and regulatory framework with greater corporate efficiency and private sector participation.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5. POLICY IMPLICATIONS FOR DESIGNING AND IMPLEMENTING THE NEXT WAVE OF REFORMS

The prescriptive approach of the 'standard model' has not been the expected panacea for power sector challenges in African countries. No single African country has adopted, word for word, the full suite of policy prescriptions from the 'standard model' of power sector reforms. In some cases, this was formally decided in policy, in others it was due to the high transaction costs, political economy challenges, or other hurdles to implementation. Measures to establish an independent regulator have been the most common reform across the continent, alongside rules to allow the entry of IPPs in generation (Victor and Heller 2007; Gratwick and Eberhard 2008). True wholesale and retail power markets are not yet functioning in Africa.

Power sector reform and development have been slow and demanding processes. Public outcry and political backlash have too often derailed reforms in protest of empty promises associated with reform outcomes—especially about promised inflows of private investment, lower tariffs, and widened access.

Almost thirty years of applying 'standard model' reforms in Africa yields a collection of practical lessons and policy implications, both from direct local experiences as well as global literature. Lessons from past reforms can inform the future of power sector decision-making in African countries. This section offers a set of strategies for successfully implementing reforms adapted from 'standard model' approaches (section 7); recommendations for adapting today's power sectors to meet new and existing challenges (section 5.2); and some additional implications for policy-makers to put into action (section 5.3).

5.1. Adapted elements of 'standard model' reforms are still relevant for boosting sector performance

Separate and clarify roles and responsibilities between government and utilities, especially through regulatory reform. Improving governance is a clear signal for attracting investment and enabling reform and development efforts. Good governance paves the way for long-term, credible policy, improving regulatory capacity, increasing transparency in competitive bidding for IPPs, and enforcing resource, generation and distribution contracts (Williams and Ghanadan 2006). Governments are sometimes reluctant to step away from direct governance in state-owned power companies by giving regulators a suitable degree of autonomy, often compromising utility financial sustainability. Where regulators (and laws) respond to such difficult political-economy conditions by engaging with political actors and managing vested interests, sector governance can immediately benefit.

Establish and strengthen independent power sector regulators with a legal mandate to make effective, transparent, and fair licensing and tariff decisions. Regulators need to be able to enforce contracts and consistent licensing rules to foster PSP in the sector on a sustainable basis. Regulatory reform is successful when stakeholders can trust that a regulatory decision is made through a transparent, rules-based process, and that it will withstand political interference. In Kenya, for example, the independence of the regulator helps reforms to be implemented with positive outcomes. Equally importantly, regulations should be fairly defined and applied, taking into account social welfare and equity concerns, while balancing the toll on regulated entities to lighten regulatory burdens. Light-handed regulatory requirements have helped mini-grid and off-grid industries to flourish to provide electricity services to poor rural communities in many countries, including Zimbabwe, Tanzania, and further afield.

Create robust provisions for budgetary and decision-making "independence" for the regulator. The framework must ensure the regulator's operational and financial independence from politics, while minimizing political involvement in appointing or constituting regulatory commissioners and chairpersons. Building the regulator's financial and operational capacity helps to ensure a smooth transition to cost-reflective tariffs, if balanced with social equity priorities. Regulatory bodies' dependence on the political process and government has hampered the success of reforms in other situations, like Cameroon, Guinea, and Zambia.

Make tariffs predictable and cost-reflective (as well as enforceable). This creates a foundation of financial sustainability for the utility, helping to attract new investment that relies on a bankable off-taker. Nigeria—a cautionary example—has implemented many standard model reforms, but still lacks cost reflective tariffs. Introducing metering regulations that ensure adequate roll-out of meters to electricity consumers will reduce widespread illegal connection, bill estimation method, and electricity theft, which will in turn improve reliability, operational efficiency, and financial viability of the utility.

Encourage PSP, especially in generation investments, under a clear legal and regulatory framework. Investment from the private sector and international sources is vital to allow any country to meet its power sector development targets. Network expansion and maintenance can also greatly benefit from private capital inflows under the right arrangements. These investments

can only be possible in an appropriate environment that fairly balances national and public interests and interests of investors. At the same time, contracts, concessions, and investments have often been a source of political controversy. Mitigating this risk means ensuring that respected, mature regulatory bodies are in place before allowing PSP in the market. Strategic, timely sequencing of reform interventions is key in this regard.

Build capacity for least-cost power sector planning across the value chain. This area of the power sector is too often under-resourced, and countries rely on grants from donors and work by consultants to update their power master plans. Planning divisions need to regularly update plans to reflect latest demand and cost data, and to inform the timing of new generation procurement, as well as demand-side initiatives—energy efficiency investment remains one of the least-cost ways to meet demand. Documents produced by external advisers should serve as living, up-to-date maps for investing and maintaining the power system.

Adopt competitive procurement processes for new power generation. Competitive tenders have allowed prices for generation projects to fall dramatically in recent years, especially, for example, in the case of renewable sources (solar and wind) of electricity. Established data shows that competitive tenders and auctions deliver lower prices than feed-in tariffs or unsolicited, directly negotiated projects.

Improve incentives and structures for improved utility governance, management, and systems to underpin their technical and financial performance. Regulation, PSP, unbundling, and competitive procurement are important, but not necessarily sufficient to ensure utility sustainability. Establishing well-aligned incentives to improve performance is key. Performance contracts between shareholders and utility boards, and between boards and management should include rewards and penalties linked to actual medium-to-long term performance. Building capacities of utility shareholders, government ministries, state-owned enterprises, and regulators is key to allow performance contracts to be adequately monitored. Additional interventions are also often essential to strengthen core utility functions, supported by necessary investments in new technologies and operational systems.

5.2. Facing the future requires proactive policy, regulatory, market, and institutional reforms

The transformations overtaking the power sector call for a framework of policy, regulatory, market, and institutional reforms that :

- Are flexible to respond to the uncertain changes already occurring,
- Will allow an efficient portfolio of both centralized and decentralized energy projects to emerge, and
- Will structure the electricity sector to minimize potential conflicts of interest.

Unbundle generation from transmission to create independent transmission, system and market operators, and remove potential conflicts of interest (especially in medium–large systems, typically beyond 1000 MW installed capacity). Single buyer systems often create conflicts of interest: State-owned utilities must invest in their own generation while being required to buy power from IPPs, following power system planning. Separating the functions of system and grid operation, and buyer, from those of generation investment and operation creates a platform to plan, procure, and contract least-cost power transparently and competitively. The planning, procurement, contracting, and dispatch roles of ISOs for managing the grid and power markets will become crucial as new low-cost energy technologies break through. Central grid operators or ISOs will need to build capacity in multiple areas, including :

- To run effective auctions for new energy capacity, as well as for flexible and distributed resources, including batteries, to complement and balance cheap variable solar and wind energy technologies,
- To manage variability, flexibility, reliability and system stability, and quality through responsive dispatch of generation and ancillary services, and
- To plan extension of the grid, and to interconnect with localized systems and mini-grids where economically feasible.

Embrace innovations in enabling technologies and business models, including investment in local R&D, and manufacturing of energy products. The growing share of low-cost renewable energy will need to be complemented by both utility-scale and distributed batteries as well as a range of distributed energy resources. These will make power systems more efficient and expand generation capacity, while integrating variable renewables and catalyzing the transition to green growth. Appropriate incentives to invest in capacity building and local manufacturing centers for these technologies will ensure that African countries make the most benefit from these innovations.

Free up markets for distributed energy resources through forward-looking policy and regulations. Countries need to make innovation and investment easier in small-scale distributed energy systems through exempting or simplifying licensing and registration requirements for small-scale electricity generation, including mini-grid and off-grid systems. Utilities also need to embrace new business models to enter these new markets or, at a minimum, to interface efficiently with them, including through joint ventures and offering of energy efficiency services. Policy and regulatory frameworks need to adjust to allow individuals and businesses to choose how and when to control their energy services, suppliers, and customers.

Develop more complex and efficient system metering and billing systems and capacities, to interact with consumers who increasingly also become producers

of energy (or 'prosumers'). Distribution and retail of electricity will require advanced metering and payment systems. Regulated charges will need to reflect time differentiation in energy costs such as peak/off peak capacity, and energy charges for networks, flexible resources, and reliability services.

Design tariff, smart subsidies, policy, and market reforms to incentivize investment in distributed energy resources and energy efficiency. Allow markets to emerge for willing buyer/seller arrangements, wheeling power across the grid, and smart metering to incentivize low-cost capacity additions through distributed energy resources. Lighten duties on energy efficiency materials and technologies to incentivize investment in energy-saving. Innovative tariff structures need to accompany these markets to enable utilities to expand their product offerings.

Invest in transmission interconnections and associated institutional capacities (power pools, regional planning, regulation, and system operation). Power pools can create economies of scale, improved efficiencies, and security of supply in the right regulatory and commercial frameworks. Transmission networks and generation plants need sufficient capacity to support cross-border trade, including with coordinated investment for maintenance and expansion. Special entities need to be created or appointed to coordinate and oversee cross-border trading.

Create common policies, rules, and enforcement mechanisms among members of a power pool participating in cross-border trade. National policies and regulations need to align with those at regional level to ensure the market is coherent. Power pools need streamlined frameworks for organizing systems planning, project development, construction and operation, and to establish commercial rules for power trade, including for the participation of IPPs (World Bank 2009). Contracts must be respected to ensure trust and energy supply security. The regional regulator or other appointed body need clear mandates for governing the market, including the trading arrangements, transmission pricing, and dispute resolutions. Responsibilities and powers for enforcing regulations and presenting advisory findings on disputes should be clear.

5.3. Successful power sector reforms require careful consideration of political-economic factors and processes

This study shows that reforms are successful in the context of enabling political factors, including good governance and stability. Key actors in the sector need to clearly see and integrate the benefits of reforms, and good governance at all levels is essential for reform to take hold. Countries that have implemented the standard model of reforms to a greater degree (Uganda, Kenya, and Nigeria) benefitted from leadership of key actors, such as the head of state, energy and/or finance minister. The enabling environment of political stability creates private sector confidence in the sector. In this context, introducing competition or PSP in reforms is more likely to result in additional capacity investments.

Consult and include key members of the general public, civil society, power sector stakeholders, political actors and groups, and the private sector when designing reform strategies (Besant-Jones 2006). Closed policy processes have in the past undermined the political, social and techno-economic feasibility of implementing reforms by discounting the importance of broad-based support and perceptions of legitimacy from key actors and groups, especially parliament, judiciary, and employee unions. The logics and desired outcomes of reform need to be clearly explained to stakeholders in the power sector and beyond. Stakeholder engagements, staff training and public awareness campaigns can help to clearly communicate the goals, benefits, structure, and sequence of reform across the value chain of the power sector. Inadequate communication of goals and expected outcomes has often hampered reform processes, for instance, in Kenya, Zambia, and Mozambique, this posed challenges in community engagement and land access issues.

Pay attention to the dynamics of entrenched political and economic power, especially in societies with high levels of inequality. Weak formal institutions and low economic development, combined with a high dependence on international investment, pose major constraints on reform processes. Reform planners and advocates can underestimate the reach of particular interest groups to affect political, economic, regulatory, and physical processes. This can result in plans backfiring, with public backlash, spectacular failure or even reversals following soon after (such as in Gabon, South Africa, or Mali).

Consider national contextual features at each stage of reform program through realistic, transparent, and open process. The program should set realistic objectives and timelines, choose appropriate measures and reform steps, and identify politically feasible paths to reform. 'One-size fits all' approaches do not exist for power sector development. Reforms should be based in reality, paying attention to the starting conditions of the power sector, the nuances of its political economy, and the broader macro-economic and social conditions in the country (Williams and Ghanadan 2006). Prioritizing public benefits—such as to increase access—can bolster public support and increase the chance of positive outcomes.

Evaluate each reform proposal against the chance that it will help to meet the country's objectives in the sector (Besant-Jones 2006). Focusing on 'standard model' steps and outcomes has sometimes led to neglecting important contextual differences, such as the local resource base, economic structure, and even national objectives like electrification targets. In many cases, constraining and enabling factors have been unmapped and poorly understood, leaving reform outcomes and progress at the mercy of global macro-economic and geopolitical conditions (particularly small island states

and landlocked countries.

Account for macroeconomic problems and other exogenous risks when designing and planning for reforms. Local currency fluctuation and inflation often impede performance and disincentivize private sector investment, regardless of the implementation of competition and PSP in reforms. Political, climate, and technological changes also pose risks to the expected development of a reform policy or regulation. Evaluating these factors and designing measures to mitigate these risks throughout the implementation phase is essential to planning reforms.

Consider power sector development as a combination of best-fit approaches, rather than a choice between market-based or state-led approaches. Human, financial, technical, and organizational resources are limited in many contexts, especially in African economies. Countries need to harness all the capacity that exists across the private and public sectors (Hudson and Leftwich 2014). In the development practice community, the 'governance' or 'good governance' agenda considers how to achieve this, focusing on the distribution of and constraints on power. Good governance also looks at bureaucratic, legal and regulatory institutions, including their capacity, independence and the extent to which they are respected, as well as corruption, and socio-political stability (World Bank 1989).

Monitor and evaluate processes, activities and outcomes post reforms. An independent electricity regulator can be an effective force to keep track and assess the progress of new reforms, as well as to check that new institutions and stakeholders meet their performance agreements. In the case of Nigeria, power sector reforms disappointed expectations, with few gains in operational efficiency and power generation expansion. Many of the private sector actors that acquired the previously state-owned assets did not fully comply with their performance agreements—failing to reduce losses and expand the utilities as expected—in part due to their own financial incapacity, and the prevailing non-cost reflective tariffs that was to be addressed by the government.

Plan reform programs to be flexible as well as durable, suitably paced and sequenced, paying attention to the transition period (Jamasb, Nepal and Timilsina 2015). Seeing reforms through to complete implementation often takes longer than expected. It is important to plan for sustaining the momentum of the program and manage expectations. Regular forums for open discussion among sector stakeholders can help shape up-to-date policy and reaffirm commitment to reform. Including the public and stakeholders in policy processes, can help bring legitimacy to reform programs by adding transparency and good governance practices. Selecting strategic reform measures to keep up the momentum of sector reforms—for example, introducing rounds of competitive procurement of IPPs—can help mitigate the uncertainty of consultation processes (Bhattacharyya 2007; Besant-Jones 2006; Jamasb, Nepal and Timilsina 2015; Williams and Ghanadan 2006).

Forge institutional norms for data collection on the power sector across African countries, at a national and regional level and through international learning centers. 'Knowledge is power' is not only a cliché, but also a reality that shapes the world. Tracking up-to-date information on the power sector gives policy-makers, planners, regulators, and investors valuable knowledge to carry out their functions and make sound decisions. Data collection should be institutionalized and standardized at national and utility levels. AfDB recently launched the Africa Energy Portal, a platform to make available important power sector statistics from across the continent. Researching the power sectors in 42 African countries revealed many lessons, but also showed how complicated it remains to access standard, current data to help inform future decisions. [26] A longer research project examining the track record, outcomes, and future of reforms, would allow African countries to keep track and gain valuable information for designing and managing their power sectors.

5.4. The next wave of power sector reforms is imminent

Important progress to improve African power sectors has occurred over the last 20 years, though the reform models proposed by DFIs have not been fully implemented. Most countries have created independent regulators, there is a general movement towards more transparent tariff setting, and few have adopted more cost reflective tariffs. PSP is becoming increasingly common, especially through investment in IPPs. Some countries have also introduced private concessions and leases of utilities, as well as for transmission and distribution systems. Only a handful of countries have unbundled generation, transmission, and distribution services. But such restructuring will become more important as utilities face the challenges of the future.

Accelerated innovations in power technologies, services, and markets are changing energy markets and patterns of energy production and use. Electricity consumers in Africa will gradually become producers too when digitalization, smart information, and communication technologies and infrastructure become widespread, and low prices for renewable and distributed energy and storage resources more available. It is expected that physical grid structures will transform as a result of these changes.

Some African countries will likely skip the step of shifting to full wholesale and retail power markets, which are the norm in OECD countries. African countries can instead embrace various technology, business, market, and regulatory innovations, which offer the potential to leapfrog to a more climate resilient and sustainable electricity future.

[26] Of the 55 utility members of the APUA that were contacted to request data for this study, only 23 (less than half) engaged with our messages, while only 17 provided a response to the questionnaire (less than a third).

Given the pace of innovation, the next wave of power sector reforms in Africa is imminent. African countries should not try to closely anticipate the future, but instead create a framework of proactive policy, regulatory, market, and institutional reforms that :

- Are flexible in response to uncertain changes already underway,
- Can facilitate the growth of an efficient portfolio of both centralized and decentralized energy resources,
- Re-evaluate the structure of the electricity sector to minimize potential conflicts of interest.

Countries' reform priorities and programs must pay close attention to political economy dynamics when designing and carrying them out. Integrating an understanding of stakeholders' needs, enrolling the public for broad-based support, and considering patterns of existing interest groups are essential to allow durable, effective, and equitable reforms.

Annex

Annex

Annex 1
Methodology—Questionnaire

The questionnaire is designed as a comprehensive data collection tool that collects specific information on country experiences and utility perspectives about power sector reforms. These data serve to map the historic contextual factors, events, and outcomes of reforms, as well as the future trends and perceptions in respondent countries, to form a larger picture of the successes and challenges in power sector reforms as well as the ongoing needs to respond to future trends.
The questionnaire is structured in four parts :

- Timeline of reform events and sector structure. Collects data related to different aspects of reform (including policy, law, regulation, competition, restructuring, and private participation), specifying the dates relevant to each reform event or initiative,
- Context of reforms: drivers, enablers, and obstacles. Asks respondents to identify the various drivers (motivating factors, conditions, and actors that led to reforms), enablers (contextual settings or actors that facilitated or encouraged the implementation of reforms), and obstacles (conditions and actors that prevented or deterred reforms) relevant to power sector reforms in the country,
- Effects of reforms. Gathers data to create a snapshot of the current situation in the power sector, pointing to any outcome or impacts of reforms. Notably, the questionnaire requests data on: investments and expansion of the power system; financial performance and technical performance of utilities; electricity access levels; affordability for consumers; level of competition; and corruption,
- Upcoming trends and concerns. Surveys country respondents' perceptions and predictions about the relevance and potential impacts of various forward-looking changes occurring or likely to occur in the power sector.

Annex 2
Questionnaire Respondents

The following table presents the entities that participated in the study, or the professional affiliation of individual respondents. In total, 30 responses were received to the questionnaire from 26 countries. Two-thirds of responses (20) are from electricity utilities or utility officials, six responses are from officials working for national electricity regulators or in government and policy-making positions, and four from independent experts in the power sector. The effectiveness of the questionnaire as a data collection tool depends on engagement with knowledgeable in-country respondents who are well-placed to respond to its detailed questions with high quality, frank answers.

Table 2—**Questionnaire respondents**

Country	Name of respondent organization (or affiliation)	description
Angola	Rede Nacional de Transporte de Electricidade (RNT)	Public transmission utility
Benin	Société Béninoise d'Energie Electrique (SBEE)	Public, vertically integrated utility
Burkina Faso	Société Nationale d'électricité du Burkina Faso (Sonabel)	Public, vertically integrated utility
Cameroon	Eneo Cameroun SA	Public, vertically integrated utility
Cote d'Ivoire	Côte-d'Ivoire ENERGIES (CI-ENERGIES)	Public, vertically integrated utility
Cote d'Ivoire	Compagnie Ivoirienne de Production d'Electricité (CIPREL)	Independent power producer
Egypt	Egyptian Electricity Holding Company (EEHC)	Public, vertically integrated utility holding company
Ethiopia	Ministry of Water and Energy	Government ministry in charge of energy (independent respondent)
Ghana	Independent consultant	Energy sector consulting advisers
Guinea	Electricité de Guinée (EDG)	Public, vertically integrated utility
Kenya	Kenya Electricity Generating Company PLC (KenGen)	Public generation utility
Liberia	Liberia Electricity Corporation (LEC)	Public, vertically integrated utility
Malawi	Malawi Energy Regulatory Authority (MERA)	Energy sector regulator (independent respondent)
Malawi	Independent consultant	Energy sector consulting adviser
Mali	Énergie du Mali SA (EDM)	Public, vertically integrated utility
Morocco	Office National de l'Electricité et de l'Eau Potable (ONEE)	Public, vertically integrated utility
	Autoridade Reguladora de Energia (ARENE)	Energy sector regulator (independent respondent)
	Ministry of Mineral Resources and Energy (MIREME)	Government ministry in charge of energy (independent respondent)
Namibia	NamPower	Public, vertically integrated utility
Nigeria	Government adviser	Energy sector adviser (independent respondent)
Rwanda	Ministry of Infrastructures (MININFRA)	Government ministry in charge of energy
Senegal	Société nationale d'électricité du Sénégal (Senelec)	Public, vertically integrated utility
South Africa	Eskom	Public, vertically integrated utility
South Africa	Independent consultant	Energy sector researcher
Sudan	Sudanese Electricity Holding Co.	Public, vertically integrated utility
Togo	Compagnie Energie Electrique du Togo (CEET)	Public, vertically integrated utility
Tunisia	Société tunisienne de l'électricité et du gaz (STEG)	Public, vertically integrated utility
Uganda	Umeme Limited	Public distribution utility (concessionaire)
Zambia	Independent consultant	Energy sector consulting adviser
Zimbabwe	Zimbabwe Electricity Transmission and Distribution Company (ZETDC)	Public transmission and distribution subsidiary of vertically integrated utility

Annex 3

List of Countries Covered by Reform and Performance Index

Table 3 shows, for each country, where data availability allowed the calculation of scores for the Reform Index and the Performance Index. The first column shows, for each country, whether enough data was identified to complete all four indicators that make up the Reform Index ("Yes"). The column notes where data is missing to form a complete Reform Index score (in the case of Sudan, insufficient data was available on the status of regulatory reform).

The second column shows, for each country, whether sufficient data was available to complete the five indicators that make up the Performance Index ("Yes"). For the cases where some data is lacking to complete the overall Performance Index score, the column lists which of the five indicators have sufficient data available to compose a sub-score for the indicator.

Table 3—**Availability of data to construct Reform Index and Performance Index**

Country	Reform Index	Performance Index*	Questionnaire
Algeria	Yes	Yes	No
Angola	Yes	3/5 indicators: IA, RS, EA	Yes
Benin	Yes	Yes	Yes
Botswana	Yes	Yes	No
Burkina Faso	Yes	Yes	Yes
Burundi	Yes	Yes	No
Cameroon	Yes	Yes	Yes
Central African Republic	Yes	4/5 indicators: IA, EA, OE, FV	No
Chad	Yes	3/5 indicators: IA, RS, EA	No
Congo, Democratic Republic	Yes	4/5 indicators: IA, RS, EA, OE	No
Congo, Republic	Yes	4/5 indicators: IA, EA, OE, FV	No
Côte D'Ivoire	Yes	Yes	Yes
Egypt	Yes	Yes	Yes
Ethiopia	Yes	Yes	Yes
Gabon	Yes	Yes	No
Gambia	Yes	Yes	No
Ghana	Yes	Yes	Yes
Guinea	Yes	Yes	Yes
Guinea-Bissau	Yes	3/5 indicators: IA, EA, OE	No
Kenya	Yes	Yes	Yes
Lesotho	Yes	Yes	No
Liberia	Yes	Yes	Yes
Libya	Yes	4/5 indicators: IA, RS, EA, OE	No
Madagascar	Yes	Yes	No
Malawi	Yes	Yes	Yes
Mali	Yes	Yes	Yes
Mauritania	Yes	Yes	No
Morocco	Yes	4/5 indicators: IA, RS, EA, OE	Yes
Mozambique	Yes	Yes	Yes
Namibia	Yes	Yes	Yes
Niger	Yes	4/5 indicators: IA, EA, OE, FV	No

Nigeria	Yes	Yes	Yes
Rwanda	Yes	Yes	Yes
Senegal	Yes	Yes	Yes
South Africa	Yes	Yes	Yes
Sudan	Incomplete data on RR*	3/5 indicators: IA, EA, OE	Yes
Tanzania	Yes	Yes	No
Togo	Yes	Yes	Yes
Tunisia	Yes	3/5 indicators: IA, RS, EA	Yes
Uganda	Yes	Yes	Yes
Zambia	Yes	Yes	Yes
Zimbabwe	Yes	Yes	Yes

** Abbreviations to comment on data availability :*

- RR = Regulatory Reform indicator
- IA = Improving Access indicator
- RS = Reliability of Supply indicator
- EA = Electricity Affordability indicator
- OE = Operational Efficiency indicator
- FV = Financial Viability indicator

Annex 4
Methodology—Reform and Performance indices

One of the study's aims is to evaluate the current status and outcomes of reforms. Beyond determining whether a reform was fully implemented and carried through, evaluating its effects implies testing whether a relationship exists between a successfully-implemented reform and the performance outcomes or status of the power sector following those reforms.

We designed an indexing methodology that allows us to create a simple ranking along two dimensions, performance and reforms, based on several key variables of a power sector. This index methodology allows us to propose simple comparisons of power systems of greatly differing sizes, technologies, performance characteristics, commercial structures, and other reform characteristics. It also allows us to test, in a preliminary and tentative manner, the ways that reform measures have correlated, or not, with performance characteristics of a power system.

Through quantifying and processing a significant volume of data using a well-defined methodology, creating these indices allows us to propose some ideas of how implementing different kinds of reforms could have affected, or interplayed with, the various performance dimensions of power systems. However, these simple formulas—which account for only few variables of the many that could be at play—are unable to propose any definitive causes, diagnoses, or relationships between these two dimensions.

Below, we describe the methodologies behind our power sector RI and the PI.

Reform Index (RI)

The RI is a numerical ranking showing the extent of different types of reforms implemented in the African countries included in the study. This methodology draws on the World Bank's recent global study assessing power sector reforms across the developing world (Foster et al 2017); and the AfDB's recent study on extent of electricity regulatory reform in Africa (AfDB 2018). We use data from REN 21 (REEEP) country profiles (REN 21/Renewable Energy and Energy Efficiency Partnership 2015), the lead author's previous publications,[27] as well as desk research for current data.

We score the overall extent of power sector reform in selected African countries' using four parallel dimensions of power sector reform: regulation, restructuring, competition, and PSP (see Table 4). For each country, we determine the degree of each dimension of reform currently in place, and score over 100. The average (mean) of the four scores gives an overall index out of 100.

[27] Oxford policy management's Energy and Economic Growth knowledge series conducted by the Managing Infrastructure Investment Reform and Regulation in Africa (MIRA) research group based at the University of Cape Town Graduate School of Business.

Table 4—**Score distribution for Reform Index**

1 Regulation	No regulator	Regulator exists	One category (independent / mature / legal mandate)	Two categories (independent / mature / legal mandate)	All three: independent + mature + legal mandate
	0	10	max. 40	max. 70	max. 100
2 Restructuring	Vertically integrated	Partial vertical unbundling		Full vertical unbundling	Vertical and horizontal unbundling
	0	33		67	100
3 Competition	Monopoly	IPPs operate	Single buyer model	Bilateral Contracts	Competitive market
	0	25	50	75	100
4 PSP	Full public ownership		PSP in Generation or Distribution		PSP in Distribution and Transmission
	0		50		100

***OVERALL REFORM INDEX** – average of the four scores (out of 100)*

Below, we define each of the four dimensions of reform and explain the index scoring parameters.

Regulatory reform

Regulatory reform refers to the formal creation of an independent entity with statutory responsibilities to make regulatory determinations and possibly define regulatory policy for commercial, and in some cases technical, aspects of power sector activities. In addition to being established by law or statutory decree, it is important for the regulatory body to be independent in practice from political influence, to allow the regulator appropriate impartiality in its decision-making and its relationships to regulated entities (including, for example, power utilities).

We determine the degree of regulatory reform using the following sub-indicators :

- No regulator. No separate authority or statutory entity exists to conduct regulation in the power sector; regulation is achieved through policy and law, implemented by a government department.
- Regulator exists. A regulatory entity exists, but may lack other characteristics required to fully comply with regulatory reforms, such as a legal mandate to carry out regulatory functions, or operational and financial independence from government/political authorities.
- Regulator has one or a combination of characteristics that meet best practice requirements for regulatory reforms. As defined below, the regulatory entity enjoys one or more of: a legal mandate to carry out functions; institutional maturity; operational and financial independence.

For the purposes of the Regulatory Reform Indicator (RRI), we define and score the regulatory entity according to its degree of maturity, legal mandate, and independence, as follows :

- Legal mandate. This implies that the regulator is established by legislation (electricity law and regulatory act), rather than an electricity law alone or by presidential decree. This should protect against the possibility that changing government or leadership would create drastic or unpredictable changes in regulatory policy. Regulatory entities established through electricity sector laws and regulatory acts encourage adherence to the regulatory framework, to a greater degree than those established by presidential decree. A regulator established by legislation augments its credibility and confidence from investors.
- Maturity. In principle, a matured regulator has better experience and capacity to carry out financial and technical regulation, such as equitable tariff and rate setting; setting technical codes and rules; and licensing prospective players in the sector. We assign points to regulators based on the institutional maturity as follows:

Table 5—**Score distribution for regulatory maturity**

Time since established (years)	Score—Maturity
Up to 3	0
4 to 7	5
8 to 11	10
12 to 15	15
16 to 19	20
20 to 23	25
23+	30

Independence. This implies that the regulator has operational and financial (budgetary) independence. Regulator independence limits conflict of interests that could occur between political authorities and the regulator. Operational independence relates to the rules and processes surrounding the appointment and conduct of regulatory commissioners or board members, including rules surrounding appointees' professional and financial relationships to regulated entities and utilities. A regulator's financial independence is based on the degree of dependence of the regulator's budget on government contributions.

We assign points to regulators based on their level of independence as follows:

Table 6—**Score distribution for regulatory independence**

Independence of regulator	Score—independence
Operational (max. 15)	
Appointing regulatory officials relies not only on government decision, but also industry bodies or civil society	15
Financial (max. 15)	
Budget relies fully on government allocation	0
Budget relies on licensing fees, levies, grants, and government allocation	7.5
Budget relies on licensing fees, and portion of utility turnover	15

Restructuring reform

Restructuring reform refers to the—usually incremental—transition of the power sector from a vertically integrated national monopoly utility along two dimensions :

- Full vertical unbundling, which consists of separating generation, transmission, and distribution services to distinct entities,
- Horizontal unbundling, which consists of allowing multiple companies to operate in parallel and compete for business in the generation and distribution sub-sectors.

Countries tend to introduce restructuring measures to drive competition in the power sector. Restructuring reforms typically follow a sequence in four stages, from vertically integrated to full vertical and horizontal unbundling :

- Vertically integrated. Generation, transmission, and distribution services are carried out by a single, vertically integrated entity,
- Partial vertical unbundling. Either generation has been separated from transmission and distribution services (which remain combined), or distribution has been separated from transmission (while generation and transmission remain combined),
- Full vertical unbundling. Generation, transmission, and distribution activities have been separated from each other to function as commercially and legally distinct operators,
- Full vertical and horizontal unbundling. Beyond full vertical unbundling, generation, and distribution are further disaggregated into multiple entities that are allowed to compete in the marketplace.

Competition reform

Competition reform refers to the movement of power sector services along a continuum, from a monopoly service provider to full retail competition. The aim of competition reform is to drive efficiency and innovation in the sector through optimizing service providers' operations, through the logic that competition helps to drive costs down to efficient levels. Natural monopolies have often been considered more efficient in the power sector due to the economies of scale entailed; the rise of economically efficient, small-scale renewable technologies is now changing that perception. The movement through competition reform can be distinguished in four stages :

- Monopoly. A single company has responsibility for generation, transmission, distribution, and retail sales.
- Independent Power Producers (IPPs). As shown above, with the addition of PSP in power generation. IPPs are allowed to compete for the right to build and operate new power plants, with the support of a bankable off-taker.
- PPA with the monopoly utility.
- Single buyer model. A single buyer entity buys power from all generation companies and may then sell power to distribution or retail companies and any large wholesale customers, such as industrial or commercial companies. The single buyer may be either a transmission entity, a distribution entity, or a combined transmission, distribution (and possibly retail) entity; it cannot have generation activities (for instance, this would follow from full vertical unbundling or separation of generation from transmission and distribution activities). In essence, the single buyer has a monopoly on power sales to

the end users.

- Bilateral contracting with third party access. A transmission company, or other entity, operates as a single buyer of power for a portfolio of retail customers; at the same time, large customers such as distribution companies or industries can purchase power directly from generation companies by wheeling power through the grid on a non-discriminatory third-party access basis. This stage requires a full vertical unbundling of the power sector to be in place.
- Wholesale market competition. A power market of multiple generation companies that sell directly to multiple distribution companies and other large eligible customers, with support from an independent system and market operator. This level of competition allows both spot purchases and longer-term contracts, and may include markets for ancillary services. Small customers are allowed to purchase only from their local distribution company.
- Retail market competition. The demand-side of the power market is opened to all customers. It is not restricted to distribution companies and large customers, which is the case for wholesale market competition. This stage requires vertical unbundling of distribution and retail companies, where distribution companies provide open access wheeling services to numerous power retailers.

Reforms for PSP

PSP is strongly tied to the other dimensions of reform. Introducing PSP creates incentives for efficiency and allows businesses to be run according to commercial principles, typically before a competitive market is possible. Here, we briefly distinguish the different degrees of PSP in the power sector :

- Public ownership. All generation and distribution companies are under public ownership and control.
- Some degree of PSP in one segment :

  a. Generation: at least one generation company has been privatized, or there is at least one public-private partnership for power generation (typically, an IPP).
  b. Distribution: at least one distribution company has been privatized, or there is at least one public-private partnership for power distribution (typically, a management contract or concession).

- Some PSP in both generation and distribution. At least one generation and one Distribution Company have been privatized or have some form of PSP.

Performance Index (PI)

Data used in this section draws on a database made available by the World Bank from the African Renewable Energy Access Program-funded project, “Making Power Affordable for Africa and Viable for Its Utilities,” supported by the World Bank’s Energy Sector Management Assistance Program (ESMAP) (Kojima and Trimble 2016). Other sources of data include the World Bank’s Sustainable Energy for All (SE4ALL) database, the World Economic Forum Global Competitive Index data set, as well as desk research for updated data.

According to the World Bank, power utility performance can be described through five dimensions: access to electricity, quality of service, affordability (of connection and services), financial viability of power utilities, and energy mix (Trimble 2018). Similarly, our PI integrates five indicators into a single score composed of five dimensions: access, reliability of supply, affordability, operational efficiency and financial viability. Table 7 shows these five dimensions of the power sector PI, alongside the indicators used to compose the weighted score in each dimension. For each country, we assign a score out of 100 to each indicator of performance based on available data. The average (mean) of the five aggregated performance indicator scores gives a total score over 100.

Table 7—**Score distribution for power sector PI**

Dimension	Indicator		Maximum
Electricity Access	Total electricity access (share of households)	50	100
	Improvement in electricity access (2007 to 2016)	50	
Supply Reliability	Quality of electricity supply		100
Affordability	Cost of electricity (proportion of income per capita)		100
Operational Efficiency, composed of :	Technical losses (inverse %)	50	100
	composed of:	50	
Financial viability	Cost recovery of utility (proportion of revenues)		100

OVERALL INDEX— *average of five scores (out of 100)*

Improving Access

Access is almost universally measured to reflect the performance of a power sector. Here, in alignment with many power sector actors, we define access as the percentage of (rural and urban) household electricity connections in a specified region or set of settlements.
The indicator for Improving Access combines two sub-indicators: the actual electricity access rate in the country (as of 2016), and the degree of improvement in access rates achieved in the country in about a decade (from 2007 to 2016). The weighted score for electricity access is indexed with respect to the African country (included in this study) with the best electricity access score and rate of improvement.

Reliability of Supply

We use data on the quality of electricity supply to quantify the reliability of electricity supply in the systems studied, since data on system reliability is scarce. Across most African power sectors, the standard reliability data, System Average Interruption Duration Index (SAIDI) and System average Interruption Frequency Index (SAIFI), are disaggregated and are not commonly recorded.[28] Instead, we use data recording the quality of electricity supply as an index from 1 to 7 to represent the Reliability of Supply indicator, based on the annual frequency and magnitude of power interruptions and voltage fluctuations (where 1 implies a completely unreliable system and 7 an extremely reliable one). We index the Reliability of Supply score for each country studied with respect to the score for a very reliable system (with score of 7).

Electricity Affordability

Electricity should be affordable to end users, in addition to being accessible and reliable. Tariff data, classes and structure are highly specific and variable across African power sectors. Electricity affordability is roughly calculated as the cost of electricity in relation to the economy's income per capita.[29]

We use the World Bank's Doing Business data set to index Electricity Affordability (World Bank 2018). The weighted score for Electricity Affordability is indexed with respect to the African utility (in this study) with the most affordable electricity.

Operational Efficiency

Eliminating operational inefficiencies improves a utility's sustainability and ability to attract new investments in the power sector. Operational efficiency can be broken down into losses (technical and non-technical) and overstaffing.
This study only considers technical and non-technical losses. Data discussing overstaffing is scarce. Moreover, the little data available on overstaffing did not reveal clear or coherent trends. For instance, data seemed to show that the larger the power sector (measured as installed capacity per capita), the higher the overstaffing factor.

The index measures Operational Efficiency through technical losses as transmission and distribution losses. To score technical efficiency: for technical losses below 10 percent (that is, technical efficiency of above 90 percent), the system receives a perfect score of 50; for technical losses above 10 percent, the score is set in proportion to a perfect score for technical losses. Non-technical losses include losses due to theft and billing inefficiencies; this sub-indicator is indexed with respect to a 100 percent collection rate.

Financial Viability

Financial viability or sustainability is critical to allow the utility to maintain existing assets, fund expansion of electricity access, and improve service delivery. Strong financial viability improves the utility's credit worthiness, which in turn allows it to attract new investments to the sector thanks to greater surety of return on investment. We measure the Financial Viability indicator as a percentage of the ratio of the revenue-expenditure gap to the revenue of the power utility. It is indexed with respect to the most financially viable African utility included in this study.

[28] SAIDI: the annual average duration of power outages for each customer served; SAIDI: the average number of interruptions that a customer would experience in a year.
[29] The cost component includes all the fees and costs associated with completing the procedures to connect a facility to electricity, excluding value-added tax. These include the related costs of obtaining government permits, applying for connection, site and internal wiring inspection, buying materials, securing actual connection works, and paying the applicable security deposit.

Annex 5
Additional data on IPPs in Africa

This section contains charts drawn from MIRA's database, with additional information on IPPs in Africa in 2019.

Figure 21—**Number of IPPs Per Country**

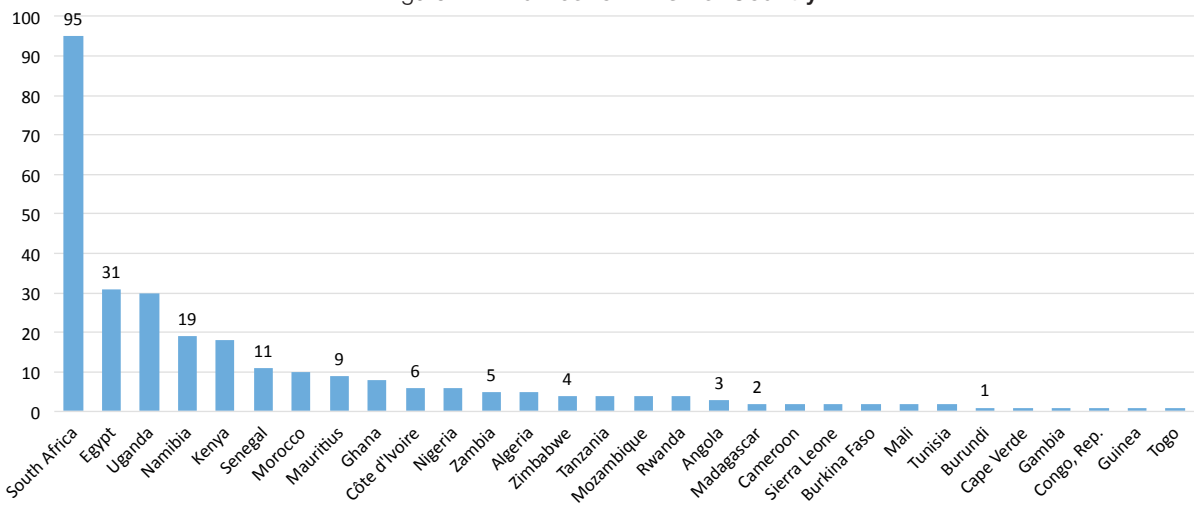


Figure 22—**Total IPP investments par country**

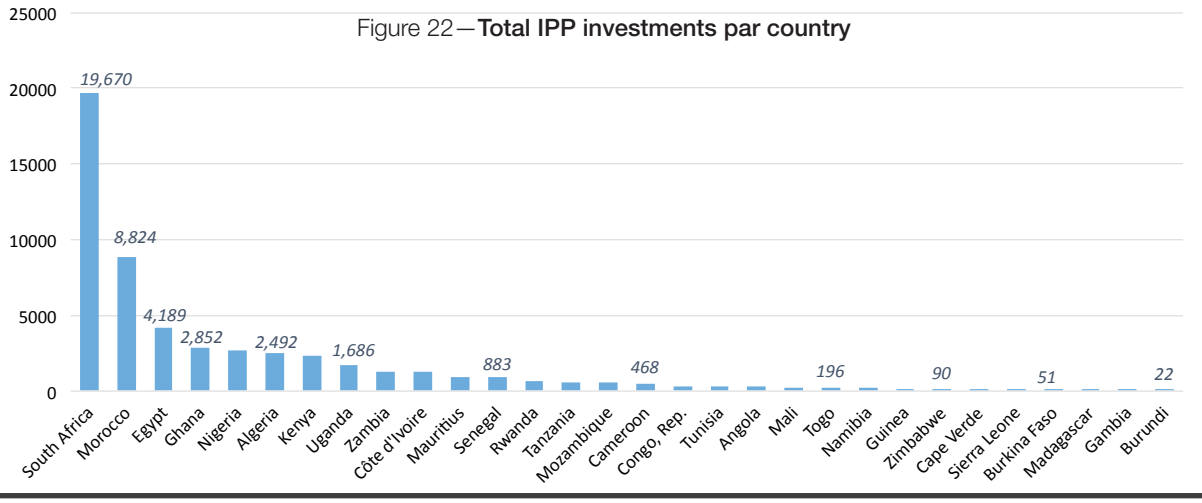
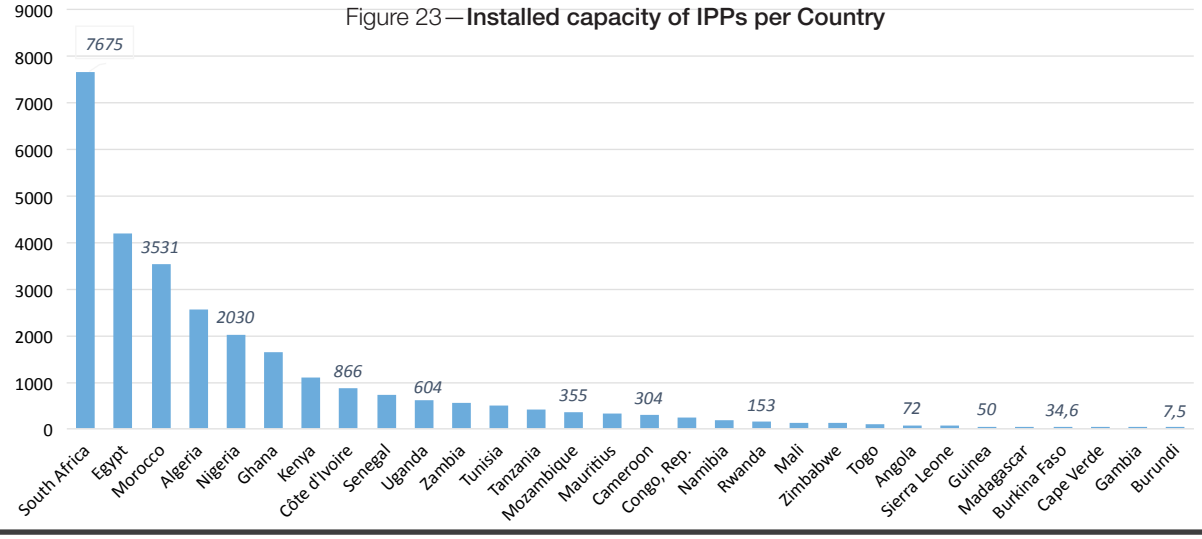


Figure 23—**Installed capacity of IPPs per Country**



Annex 6
References

Africa Intelligence, *Veolia's SEEG ejection: Libreville picks arbitrator at last*, last modified January 2019, https://www.africaintelligence.com/aem/consultants/2019/01/15/veolia-s-seeg-ejection-libreville-picks-arbitrator-at-last,108340285-bre

African Development Bank, *Interconnecting, integrating and transforming a continent*, Programme for Infrastructure Development in Africa, 2013, https://www.afdb.org/fileadmin/uploads/afdb/ Documents/Project-and-Operations/ PIDA%20 note%20English%20for%20web%200208.pdf

African Development Bank: Power, Energy, Climate Change and Green Growth Complex, Electricity Regulatory Index for Africa, 2018. https://www.afdb.org/fileadmin/uploads/afdb/Documents/Generic-Documents/Electricity_ Regulatory_Index_2018.pdf

Baako, Abdul, "Local content law …engine of growth for Ghanaian enterprises," GhanaWeb, last modified February 2014. https://www.ghanaweb.com/GhanaHomePage/NewsArchive/Local-content-law-engine-of-growth-for-Ghanaian-enterprises-301693

Besant-Jones, John E. 2006. *Reforming power markets in developing countries: what have we learned?* Energy and Mining Sector Board discussion paper 19. Washington, DC: World Bank. http://documents.worldbank.org/curated/en/483161468313819882/Reforming-power-markets-in-developing-countries-what-have-we-learned

Bhattacharyya, Subhes, "Power sector reform in South Asia: Why slow and limited so far?" *Energy Planning, Policy and Economy*, 2007, 35(1)

Buljan, Adrijana. *Offshore wind and meshed offshore grid(s) to benefit energy security in EU*, offshorewind.biz, last modified in October 2018. https://www.offshorewind.biz/2018/10/19/offshore-wind-and-meshed-offshore-grids-to-benefit-energy-security-in-eu/

Eberhard, Anton and Catrina Godinho, "A Review and Exploration of the Status, Context and Political Economy of Power Sector Reforms in Sub-Saharan Africa, South Asia and Latin America," Management of Infrastructure Investment and Reforms in Africa (MIRA) Program Working Paper, University of Cape Town Graduate School of Business, 2017. http://www.gsb.uct.ac.za/files/Eberhard_Godinho_2017.pdf

Foster, Vivien, Samantha Witte, Sudeshna Ghosh Banerjee, Alejandro Moreno, *Charting the Diffusion of Power Sector Reforms across the Developing World*, Policy Research Working Paper 8235, Washington, DC: World Bank Group, 2017. https://openknowledge.worldbank.org/bitstream/handle/10986/28853/WPS8235.pdf?sequence=1&isAllowed=y

Global Transmission Report, "Update on Brazilian power sector: Key highlights of 2017," 8 January 2018. https://www.globaltransmission.info/archive.php?id=32000

Gore, C.D., J. N. Brass, E. Baldwin, and L. M. MacLean. "Political autonomy and resistance in electricity sector liberalization in Africa." *World Development*, 2018. doi:10.1016/j.worlddev.2018.03.003

Gratwick, Katharine N. and Anton Eberhard. "Demise of the standard model for power sector reform and the emergence of hybrid power markets," *Energy Policy*, 36(10), 2008

Hudson, David and Adrian Leftwich. "From Political Economy to Political Analysis," *DLP Research Paper*, 2014.

IRENA. *The socio-economic benefits of solar and wind energy*, 2014. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2014/Socioeconomic_benefits_solar_wind.pdf

Jamasb, Tooraj, R. Nepal, R., G. Timilsina. "A Quarter Century Effort Yet to Come of Age: A Survey of Power Sector Reforms in Developing Countries," *World Bank Policy Research Working Paper*, 2015, https://openknowledge.worldbank.org/handle/10986/22211

Kapika, Joseph and Anton Eberhard. *Power-Sector Reform and Regulation in Africa: Lessons from Kenya, Tanzania, Uganda, Zambia, Namibia and Ghana*. Human Sciences Research Council Press, Cape Town, 2013

Kaufmann, Daniel, Aart Kraay, and Massimo Mastruzzi. “The Worldwide Governance Indicators: Methodology and Analytical Issues,”*World Bank Policy Research Working Paper No. 5430*. 2010

Kojima, Masami and Chris Trimble. *Making Power Affordable for Africa and Viable for Its Utilities*, ESMAP/World Bank Group, 2016

Kruger, Wikus, Anton Eberhard, and Kyle Swartz. “Renewable Energy Auctions: A Global Overview,” *Report for Energy and Economic Growth Research Programme*, 2018

Mbodiam, Brice R. “A 10 years’ extension on public service concession on electricity in Cameroon was granted to Actis,” Business in Cameroon, last modified October 2017. https://www.businessincameroon.com/electricity/0510-7447-a-10-years-extension-on-public-service-concession-on-electricity-in-cameroon-was-granted-to-actis

Multiconsult “Roadmap to the New Deal on Energy for Africa: An analysis of optimal expansion and investment requirements,” *Report to the African Development Bank*, 2018

Nsikak, John. “Blockchain can revolutionise the energy industry in Africa,” World Economic Forum, last modified November 2018. https://www.weforum.org/agenda/2018/11/blockchain-will-change-the-face-of-renewable-energy-in-africa-here-s-how/.

O’Boyle, Mike. “Three ways electric utilities can avoid a death spiral,” Forbes.com, last modified September 2017. https://www.forbes.com/sites/energyinnovation/2017/09/25/three-ways-electric-utilities-can-avoid-a-death-spiral/#4f4904f2758d

OECD (2015), «Local-content requirements in the solar- and wind-energy global value chains», in Overcoming Barriers to International Investment in Clean Energy, OECD Publishing, Paris. https://www.oecd-ilibrary.org/environment/overcoming-barriers-to-international-investment-in-clean-energy/local-content-requirements-in-the-solar-and-wind-energy-global-value-chains_9789264227064-6-en.

Olingo, Allan. “Boost for East Africa power pool project as Dar, Nairobi secure $600m,” The East African, last modified July 2018. https://www.theeastafrican.co.ke/business/Boost-for-East-Africa-power-pool-project/2560-4642124-tgp4b6/index.html

Olingo, Allan. “Phase one of regional power pool project set for completion by mid-2019,” The East African, last modified August 2018. http://www.theeastafrican.co.ke/business/Phase-One-of-regional-power-pool-project-set-for-completion/2560-4699790-g706gj/index.html.

Power Futures Lab/Managing Infrastructure Investment and Regulation in Africa Programme. Internal database. University of Cape Town Graduate School of Business.

REN 21 and Renewable Energy and Energy Efficiency Partnership (REEEP). “Country Profiles,” reegle, 2015, https://www.reegle.info/countries/.

Thomson Reuters. “Gabon accuses France’s Veolia of polluting amid concession dispute,” last modified February 2018, https://www.reuters.com/article/us-gabon-veolia-environ/gabon-accuses-frances-veolia-of-polluting-amid-concession-dispute-idUSKCN1GB2OO.

Trimble, Chris. “The performance of power utilities in Africa,” presentation. World Bank Group, 2018.

Victor, David, and Thomas Heller (Eds.). (2007). The Political Economy of Power Sector Reform: The Experiences of Five Major Developing Countries. Cambridge: Cambridge University Press.

Williams, J. H., R. Ghanadan, “Electricity reform in developing and transition countries: A reappraisal,” Energy 31, 2006.

World Bank. *World Development Report 1989: Financial Systems and Development*, Oxford University Press. © World Bank, 1989. https://openknowledge.worldbank.org/handle/10986/5972

World Bank. *International Experience with Cross-border Power Trading. Washington*, DC, 2009

World Bank/Public-Private Infrastructure Advisory Fund. Linking Up: Public-Private Partnerships in Power

Transmission in Africa, 2017, https://openknowledge.worldbank.org/bitstream/handle/10986/26842/LinkingUp.pdf?sequence=3&isAllowed=y.

World Bank. *Worldwide Governance Indicators*, 2018, © World Bank Group. Accessed at http://info.worldbank.org/governance/wgi/index.aspx#home

World Bank: Doing Business, “Getting Electricity: Cost % of income per capita,” 2018, http://www.doingbusiness.org/en/data

World Bank Indicators, «Manufacturing, value added (% of GDP)», 2019. https://data.worldbank.org/indicator/NV.IND.MANF.ZS?name_desc=false

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