Briefing note: Unbundling practices and opportunities for private sector engagement in energy transmission in Africa

12 **September 2019**

1. Rationale

The Coverage: Energy Team in the DBSA requested KMR to conduct desktop research on examples of unbundling in the energy sector across Africa, particularly in Kenya and Nigeria. This brief also includes Ghana and Uganda. The team's request is due to an interest in the practice across the continent in order to garner lessons learned for the potential Eskom unbundling process mooted recently. This briefing note explores various methods of unbundling and then goes into more detail on a number of African countries' experiences with their unbundling process. Finally, the report documents opportunities in three power pools in Africa, namely the Central African Power Pool, the East African Power Pool (EAPP), the Southern African Power Pool and, the West African Power Pool (WAPP). The report will provide the team with information and sufficient knowledge to engage in debates on the future of Eskom and various options open to the utility.

2. Background

The energy sector in Africa has evolved over time with generation, transmission and distribution costs being shared by the public and the private sectors. However, there is also a call for smaller energy projects, renewable energy and off-grid solutions.[1] This report covers some of these recommendations that provide opportunities for more private sector involvement.

The electricity sector has witnessed many reforms, which have entailed the unbundling of state-owned vertically integrated electricity utilities and been driven primarily by their failure to deliver services (Politt, 2007 in Mburu, 2017). Both developing and developed countries have undertaken energy-related service sector reforms since the early 1980s. Across the world, market liberalization has become the cornerstone of energy policies (Bonneville & Rialhe, 2005 in Mburu, 2017). This has led to a significant change in the structure of the energy market as state monopolies are dismantled due to privatization and liberalization, and an emergence of services activities. In the energy sector, liberalization may take one or a combination of the following forms: privatization of energy assets owned by the state utility firm, changes to the organization structure of energy sectors to bring in competition, and the establishment of an independent regulator for the sector (Mburu, 2017, 15).

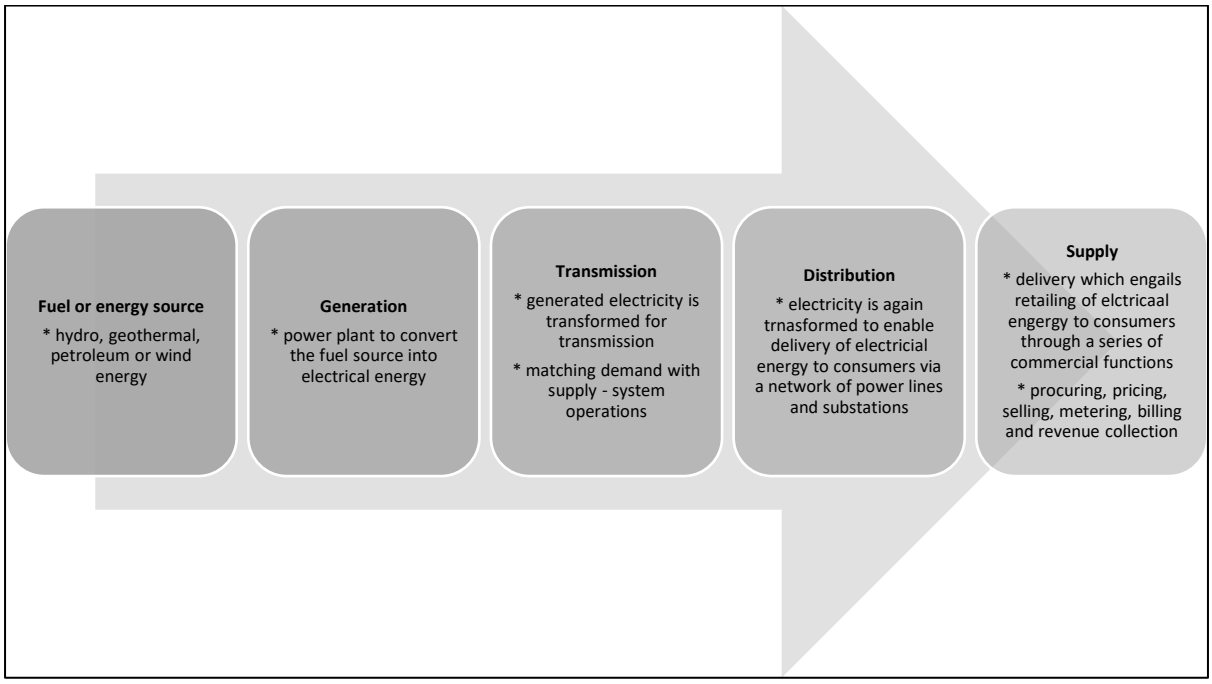
In most developing and developed countries, the privatization and liberalization of vertically integrated state-owned electric utilities brought about the dismantling of the utilities into a number of different entities either partially or fully state-owned or fully privatized. The vertically integrated state-owned monopoly is unbundled into four main activities, namely generation, transmission, distribution and supply. In this vertical restructuring of the

[1] World Bank, 2019. Mini Grids for half a billion people: Market outlook and handbook for decision makers.

monopolies, there is clear separation of production into the transmission and distribution activities, and the generation and supply activities, and all parts are competitive (Evans, 2006; Melly, 2003 in Mburu 2017:20).

As shown in Figure 1, traditionally in most countries, the electricity industry was comprised of one large monopoly provider that was responsible for the four components of the electric power value chain, namely generation, transmission, distribution and supply. In addition, it was believed that network bound systems were assets of national strategic interest and hence, it was more economical to have a sole entity because of their nature of production and operation of the transmission grids (Cameron, 2007; Selivanova, 2014 in Mburu, 2017).

Figure 1: Electricity sector value chain



Source: Mburu, 2017

Technological advances and, in some instances, the failure of utilities to deliver an efficient service at a transparent tariff, have been instrumental in changing these views as most governments concluded that a sole provider is no longer a prerequisite but that there is need to introduce competition in some segments of the value chain such as generation and retail supply that would lead to more efficiency. However, the transmission and distribution segments remain under government control as these are considered natural monopolies and it would not be necessary to have competing grids (Cali et al., 2008; OECD, 2005; Melly, 2003 in Mburu 2017:25).

3. Methods of Unbundling

A modest form of unbundling might simply be functional and/or accounting unbundling. For example, Eskom has a separate Transmission Division. The utility could also create a separate Transmission business unit, with its own accounts (e.g Eskom a few years ago before its

accounting units were centralized). These examples do not fundamentally change the power sector.

Meaningful unbundling of a vertically-integrated utility (VIU), to separate transmission/system operation from generation and distribution, involves establishment of a legally unbundled transmission and system operator (LTSO), or an independent transmission and system operator (ITSO), or an independent system operator (ISO) on its own (Boulle, 2017:2).

Table 1: Different categories of unbundling

VIU	VIU/F	VIU/A	LTSO	ITSO	ISO	ITO
Vertically integrated Utility	**Functional unbundling**	**Accounting unbundling**	**Legal unbundling**	**Ownership unbundling**	**System operator**	**Transmission operator**
Generation, transmission and distribution integrated in a single company	Generation, transmission and distribution in separate divisions within VIU	Generation, transmission and distribution have separate accounts within VIU	Transmission and system operator in separate subsidiary company of VIU	Transmission and system operator in separately owned company	System operator in separate company	Transmission in separate company

Source: Boulle, 2019:2

VIUs refer to cases where one entity is responsible for generation, transmission, distribution and retail. A LTSO is a company that operates the transmission grid and system operator but is a subsidiary of a parent company that owns other parts of electricity supply chain such as generation, distribution and retail. In the case of an ITSO, an independent company is responsible for ownership and operation of the transmission grid and is independent from any other players in the electricity market. The state may still own an ITSO. An ISO, on the other hand, is responsible only for system operation (i.e. balancing demand and supply in real time) while a separate transmission company (ITO) owns, operates and maintains the transmission grid (Chawla & Pollitt, 2013 in Boulle, 2017).

One of the primary reasons for separating transmission from other components of the electricity supply industry is to remove conflicts of interest that may occur in state-owned VIUs, where it is generating its own power while also being a single-buyer from independent power producers. In many cases, this has caused a departure from least-cost power planning and procurement. Establishing an independent transmission grid and system operator can facilitate competition by allowing also the entry of privately funded generators. This makes sense where the incumbent VIU struggles to raise capital for new investments and where alternative power generators might be cost competitive. The following section documents the extent and nature of Transmission and System Operation unbundling globally. Some countries have established combined Transmission and System Operator Companies (ITSOs). Others have independent System Operators (ISOs), also with independent Transmission Companies (ITOs). Boulle, 2017:3)

Eberhard and Godinho (2017:2) identify a World Bank devised 'standard model' of power sector reform, which includes the following steps:

- The corporatization and commercialization of national utilities
- The introduction of competition through restructuring, privatization and allowing for the entry of private power producers and distributors
- The establishment of independent regulatory institutions and transparent regulation
- The creation of power markets (importation of services)

The authors explain that in sub-Saharan Africa (SSA), a 'single buyer' model dominates where State-Owned Utilities aggregate demand, while often still building and operating publically owned generation capacity. Kapika and Eberhard (2013:4)[2] explain that the World Bank's standard model set up countries for funding based on 'a clear commitment to improving sector performance in line with these principles'.

The 'standard model' is a 'series of steps that move vertically integrated utilities towards competition, and generally include the following activities: corporatization, commercialization, passage of the requisite legislation, establishment of an independent regulator, introduction of IPPs, restructuring/unbundling, divestiture of generation and distribution assets and introduction of competition' (Meyer et al, 2018:76).

Table 2: Standard model of power-sector reform

Milestone	Description
Corporatization	Transforming the power utility company into a separate legal entity (separate from the ministry or government), with all the associated rights and obligations including governance structures, managing budgets, borrowing procurement, labour employment, payment of taxes and dividends.
Commercialization	Introducing cost-recovery pricing and improvements in metering, billing and revenue collection, adopting internationally accepted accounting practices, and accounting for all subsidies
Requisite legislation	Passing legislation that provides a legal mandate for restructuring and allows private as well as foreign participation and ownership in the sector
Independent regulator/s	Establishing regulatory bodies that are able to ensure efficiency, transparency and fairness in the management of the sector as well as to prevent anti-competitive activity, incentivize appropriate investment and protect consumers
Sector restructuring	Unbundling incumbent (state-owned) utilities vertically and/or horizontally into separate generation, transmission and distribution companies in readiness for privatization of (profitable) assets and the introduction of competition
Independent power producers	Securing new, private investment in generation, anchored by long-term power-purchase agreements
Divesture of generation assets	Divesting state ownership (in part or in full) of generation assets to the private sector
Divesture of distribution assets	Divesting state ownership (in part or in full) of distribution assets to the private sector
Competition	Introducing wholesale and retail markets

Source: Kapika and Eberhard, 2013:5

In sub-Sahara Africa, only 10 out of 48 countries have vertically unbundled utilities (Eberhard & Godinho, 2017). Examples of African countries undergoing unbundling include:

- Algeria (SONELGAZ)
- Kenya (KPLC & KETRACO)
- Egypt (Egyptian Electricity Transmission Company)

[2] https://www.gsb.uct.ac.za/files/Power-sector_reform_and_regulation_in_Africa-Entire_eBook.pdf

- Nigeria (Transmission Company of Nigeria)
- Ghana (Ghana Grid Company of Ghana, Ltd)
- Angola (Rede Nacional de Transporte de Electricidade (RNT)
- Sudan (Sudanese Transmission Co Ltd)
- Uganda (Uganda Electricity Transmission Company Limited, UETCL)
- Ethiopia (Ethiopian Electric Power)

Table 3: Power structures in Sub-Saharan Africa

Group 1 Vertically Integrated with no PSP		
Benin Burkina Faso Burundi CAR Chad Comoros DRC Equatorial Guinea Eritrea	Guinea-Bissau Liberia Malawi Mauritania Seychelles Somalia South Sudan The Gambia	Republic of Congo Niger
Group 2 Vertically integrated with PSP		
Botswana Cape Verde Guinea Madagascar Mauritius Rwanda	Senegal Sao Tome and Principe Swaziland Tanzania Togo	Cameroon Cote d'Ivoire Gabon Mali
Namibia South Africa	Mozambique	Zambia
Group 3: Vertically unbundled		

Without PSP		**With PSP**		
Ethiopia	Lesotho	Angola	Ghana	Kenya
Sierra Leone	Sudan	Nigeria	Uganda	Zimbabwe

4. Country examples

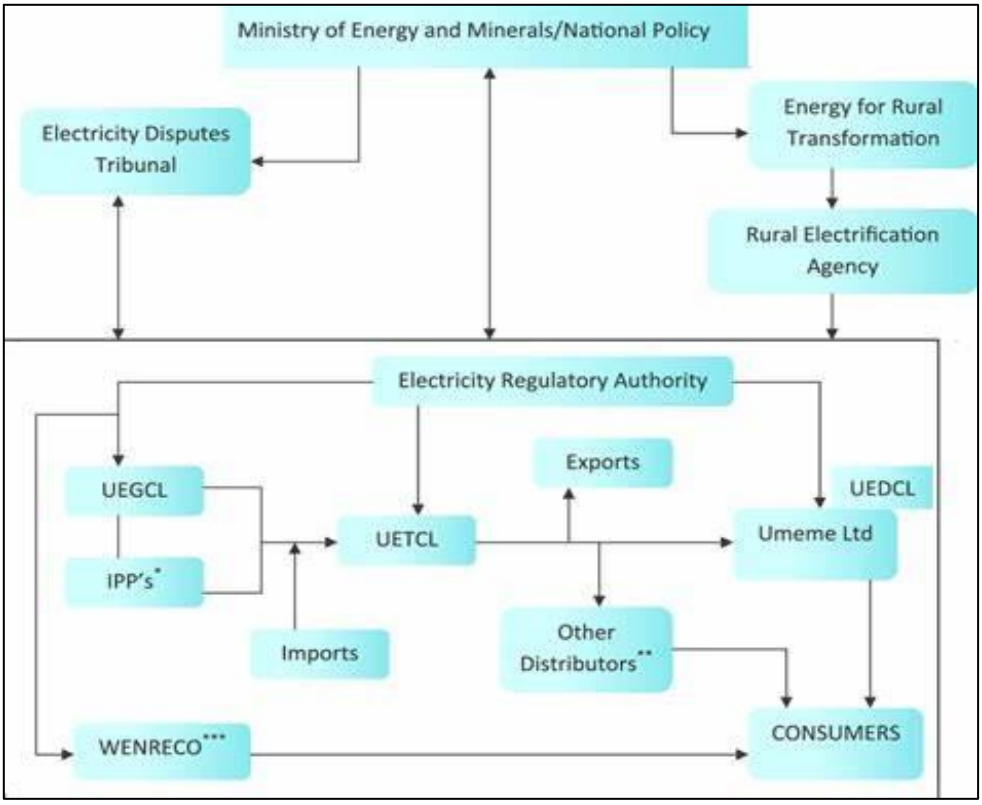
The next section provides an overview of the unbundling programmes key countries have embarked. The countries covered are Uganda, Kenya, Ghana and Nigeria.

4.1 Uganda[3] - brave new reform and new growth

In the late 1990s, Uganda was the first country to unbundle its generation, transmission and distribution utilities and offer private concessions for power generation and distribution. The main reason behind the change was insufficient public funds for new generation and decades of poor performance by state-run utilities. African countries adopted the 'standard model' for power systems influenced by the US, the UK, Chile and Norway

The state-owned Uganda Electricity Generation Company Ltd (UEGCL) has retained ownership of the Kiira and Nalubaale power stations but these are managed by Eskom Uganda under a concession agreement. The operational work is through the 100% state-owned Uganda Electricity Transmission Company (UETCL), which owns and operates the transmission grid. The Uganda Electricity Distribution Company Ltd (UEDCL) owns the distribution network but distribution and consumer services are managed and operated by Umeme Ltd, a private firm operating under a concession agreement.

Figure 2: The structure of Uganda's power sector



Source: Mawejje[4], see also *Meyer et al, 2018:79*

[3] Meyer, R., Eberhard, A. and Gratwick K. (2018). Uganda's power sector reform: There and back again? *Energy for Sustainable Development* (43), pp75-89. http://www.gsb.uct.ac.za/files/UgandasPowerSectorReform.pdf

[4] https://www.researchgate.net/profile/Joseph_Mawejje/publication/279591521/figure/download/fig1/AS:391608064331786@1470378046588/The-Uganda-Electricity-market-structure.png

The Uganda Power Sector Restructuring and Privatisation: New Strategy Plan and Implementation Plan (government of Uganda, 1999) included the following:

- Generation – to be facilitated through international competitive bidding by the private sector on an IPP basis but the power stations would continue to be owned by government with co-generation encouraged.
- Transmission – a separate transmission company would be established and responsible for network maintenance, system operations and dispatch, planning and bulk purchase, and the supply of electricity. Bulk purchase and supply would be undertaken by a ring-fenced unit operating within the transmission company. Initially the transmission company would be state-owned and run but it would be let out to the private sector under a concession arrangement in the medium term.
- Distribution – it was proposed that a number of financially viable distribution companies be created out of the UEB's existing distribution structures.
- Rural electrification – the private sector participation would be encouraged in this sector that would drive access to electricity through national grid or isolated power networks.
- Regulation – it was proposed that an authority be established to perform the regulatory function independent of political influence.

By 2016, Uganda's energy sector seemed to have moved beyond the most demanding phase of its transition and be sufficiently prepared for future challenges. By 2012, Umeme, the utility listed its shares on the Ugandan stock exchange and with the funds reduced the company's interest-bearing debt and enabled Umeme to secure additional commercial debt over the next few years to finance its expansion strategy. The power sector's success factor is built on its planning, which is evident in Uganda's experiences where it has clarity of the structures in its power sector structure. IPPs contract directly with its transmission company. It has one of the few financially sustainable electricity sectors in SSA, in which tariffs are cost reflective and do not require government subsidies. An independent regulator has also been integral to attracting IPPs and sustaining the sector. In 2019, USAID's Power Africa programme supports Uganda's electricity sector. Its support targets innovation in last mile market entry and development and innovation in payment modalities.[5]

Meyer et al (2018:86) express concerns that despite the reforms in the electricity sector, Uganda's relatively small power system constrains its ability to procure reasonably priced IPP capacity. Uganda's plan to export power into the east African region could be hampered by its neighbours increasing their own power generation and by the introduction of Ethiopia's hydropower into the East African Power Pool. The supply-demand mismatches in the Ugandan power sector could lead to government providing more subsidies for energy generated by the IPPs because the energy is not being used. The Ugandan power sector reforms have provided opportunities for the private sector to become players in the generation, transmission and distribution sectors but insufficient planning and poor phasing have had a negative impact on the sector as a whole (Meyer et al, 2018:86).

Uganda's power sector remains small and there is some question about unbundling small power systems. However, reforms have led to improved levels of professionalism and financial transparency in the sector; privatization has seen an increase in productivity and an improvement in the debt levels incurred for capital expansion programmes under the Uganda Electricity Board (UEB) (Kapika and Eberhard, 2013: 120).

[5] https://www.export.gov/article?id=Uganda-Energy

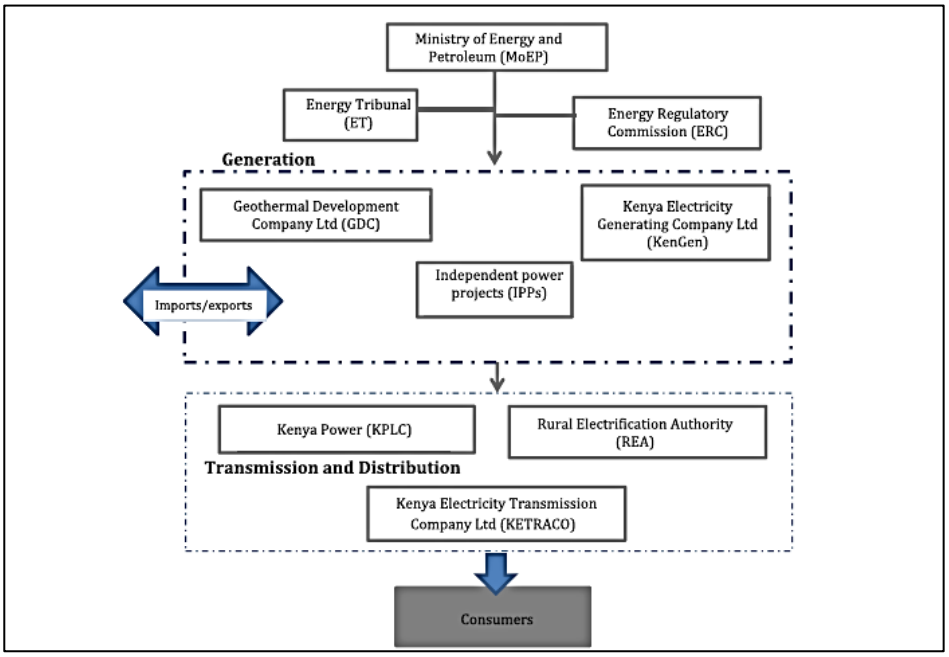
4.2 Kenya – enabling private-sector participation in electricity generation

In 1996, the government initiated reforms in the electricity sector in Kenya with the dismantling of the state-owned power utility and the creation of an independent regulatory body, the Electricity Board of Kenya, which became operational in 1997. The Electric Power Act of 1997 led to the unbundling of the vertically integrated electricity supply company into two, namely the Kenya Generating Company Limited (KenGen) which is concerned with generation of electricity, and Kenya Power and Lighting Company (KPLC), which handles the transmission, distribution and supply of electricity. Eberhard et al (2018) argues that unbundling is a 'useful way of removing potential conflicts between the aspirations of state-owned generators to continue investing in new power capacity and the need to close the funding gap by also procuring IPPs' (2018:46).

The Kenyan government set policy and strategic direction for the energy sector. In this way, the generation aspect of the value chain was liberalized whereas other sections were privatized (Mburu, 2017:18). The Kenyan model is based on Independent Power Producers (IPPs) gaining access to the market. The country has significant experience with IPPs that account for 28 percent of installed generation and 23 percent of production (Eberhard et al. 2018).[6] IPPs fall under the generation sector in Kenya, which provides the private sector with a competitive market structure.

Kapika and Eberhard (2013), provide the following schematic of Kenya's electricity sector. The private sector is involved in the development of the industry and the provision of IPPs. The electricity sector reforms have improved the tariffs and supply of electricity in Kenya, and could be used as an example for other countries in Africa (Kapika and Eberhard, 2013:47).

Figure 3: Overview of Kenya's electricity sector



Source: Eberhard et al, 2018

[6] http://www.gsb.uct.ac.za/files/KenyasLessonsFromTwoDecades.pdf

KETRACO was established in 2008 to overcome the difficulties of KPLC's mixed ownership structure (public and private) created in relation to the government's plans for the development of the electricity grid. Mixed ownership had made the entity more cost effective, improved its operations and enhanced the profitability of the sector, however, partial private ownership restricted its ability to raise public and donor funds for the transmission grid. KETRACO's role is to design construct, operate and maintain new high-voltage electricity transmission lines (Kapika and Eberhard 2013:26).

KPLC and KenGen were listed on the stock exchange and were partially privatized but are obliged to adhere to governance and reporting requirements of the stock exchange. KenGen manages the energy mix of the country and negotiates with IPPs on their contributions to the power sector.

Finally, the Energy Regulatory Commission (ERC) handles the regulatory frameworks in the country. The ERC constituted the Least Cost Power Developing Planning committee in 2009 that developed the Least Cost Power Development Plan to guide the energy sector in Kenya. Kapika and Eberhard (2013:46) recommend that the ERC should strengthen its role and be more active in Kenya. They need to improve their planning capacity, communicate more effectively and be less dependent on government for strategic direction. To strengthen the energy sector, in 2018, the Kenyan government published The Electricity Sector Investment Prospectus, which outlined $14.8 bn of investment opportunities in the country up to 2022. The government has amended the Energy Act that was ratified early in 2019 and a Renewable Energy Auctions policy has been approved to complement the Feed-in-Tariff programme.[7]

Eberhard et al (2018:46) conclude by saying that reforms are important in Kenya but 'equally relevant are the issues of least-cost power planning linked to the timely procurement of new capacity and effective contracting capabilities'. Least cost planning, allocation of new-build opportunities between the state and the private sector, competitive procurement and risk mitigation will continue to be important in Kenya's electricity sector.

[7] https://www.abiq.io/kenya-power-sector-q2-2019/

4.3 Ghana – pursuing the standard model for power sector reform

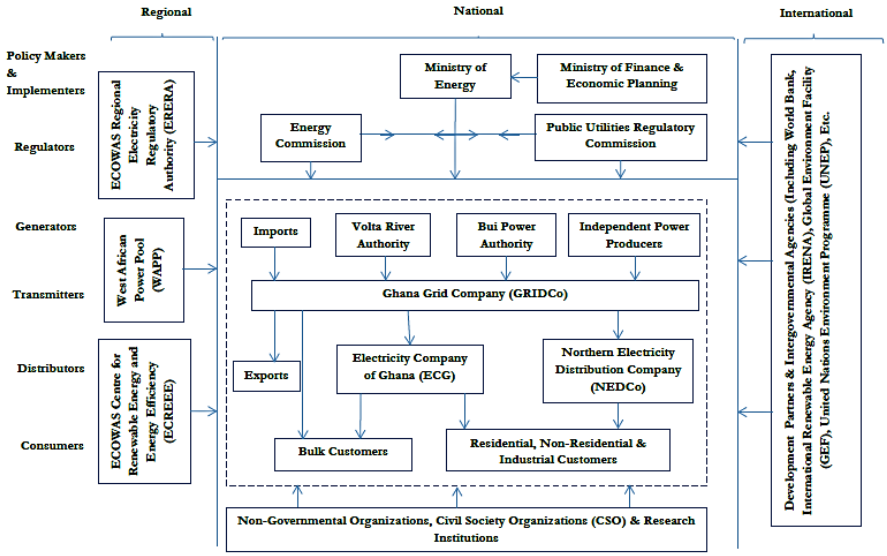
Ghana's energy policy has focused on renewable energy that only accounts for 5 percent of the country's energy mix. In order to succeed in its reform processes, Ghana will need to diversify its mix and reduce the delivery risks of each of the options and will need to improve its energy infrastructure to increase supply frequency and reliability.[8] Kumi[9] explains that despite Ghana increasing its generation capacity over the past decade, supply challenges continue. Electricity reforms have improved the situation somewhat but infrastructure, energy mix and losses in the distribution system hamper the growth of the sector.

Ghana pursued the standard model for power-sector reform. By doing this they proposed the following:

- The state-owned generation and transmission company, the Volta River Authority (VRA) was to be unbundled into separate generation and transmission entities;
- Independent power producers would be allowed to enter the market;
- The state-owned distribution company, the Electricity Company of Ghana (ECG) was to be horizontally unbundled and its successors privatized; and
- An independent regulator was to be established (Kapika and Eberhard, 2013:195).

In the Ugandan model, the state-owned VRA, GridCo and ECG dominate the sector. The VRA is a power-generation company but it carries out limited distribution functions through its subsidiary, the Northern Electricity Distribution Company (NEDCo); GridCo is responsible for transmission and system operations; and ECG is the national distribution utility. Ghana has two separate bodies for regulatory oversight of the sector, namely the Public Utilities Regulatory Commission (PURC) and the Energy Commission (EC). Like Namibia, Ghana does not have a specialist agency for rural electrification. The VRA was the first to initiate cross-border electricity trade in West Africa. In addition to the institutions mentioned above, the other key institutions are various state-owned and independent power producers.

Figure 4: Stakeholders in Ghana's electricity sector



Source: Kumi, 2017:15

[8] https://energsustainsoc.biomedcentral.com/articles/10.1186/s13705-016-0075-y
[9] https://www.cgdev.org/sites/default/files/electricity-situation-ghana-challenges-and-opportunities.pdf

The structure illustrated in Figure 3 came after failed attempts to reform the energy sector. When the World Bank was assisting Ghana with the development of the Takoradi thermal plant, the Bank insisted on reforms.

Ghana unbundled the VRA in 2008 when the continent was opting for new models of reform. The separation of VRA's system operations and transmission functions has created a 'level playing field' for IPs. The Ministry of Energy remains responsible for policy formulation, implementation monitoring and evaluation. The reform has led to power purchase agreements that should be subject to competitive bidding. Reforms also include the government's decision to renegotiate the timelines for the commencement of generation of power.

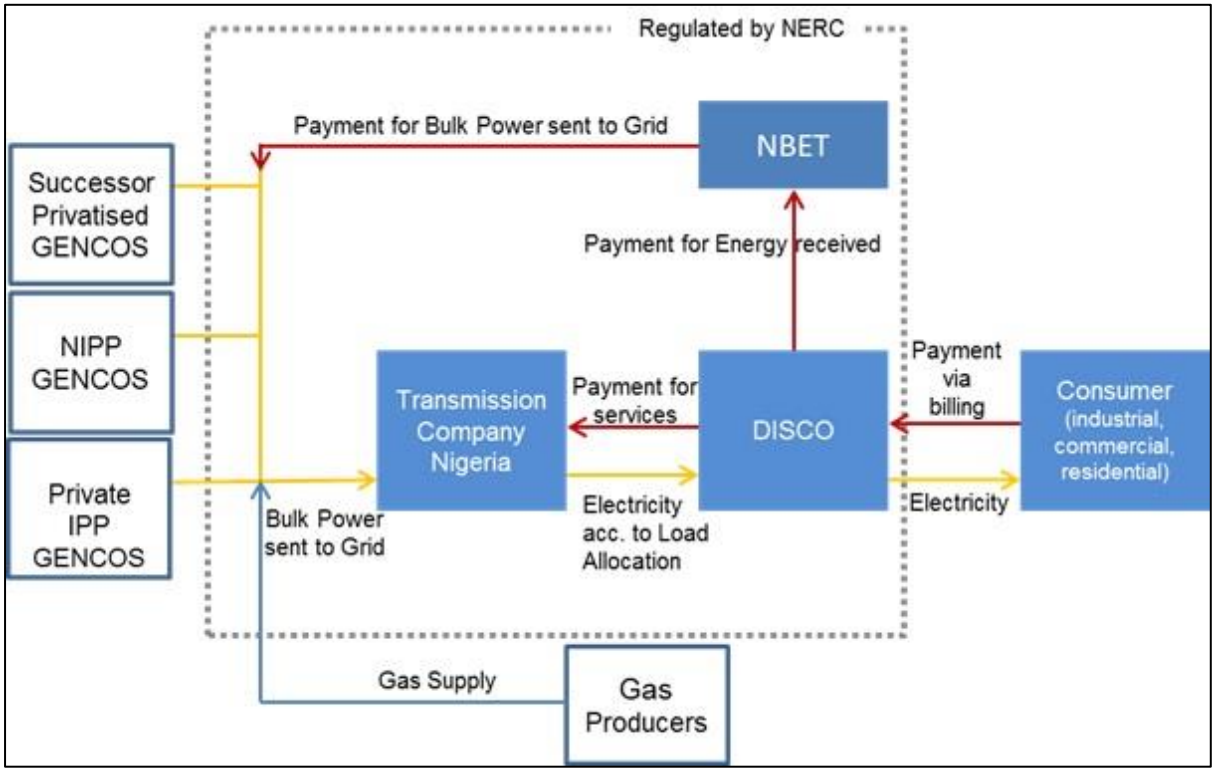
Despite the reforms in the sector, Ghana needs to ensure that its mix of energy sources is diversified and the losses through poor infrastructure are controlled. Reform alone will not improve the electricity sector.

4.4 Nigeria – embedded generation

The African Development Bank's Economic and Power Sector Reform Programme (EPSERP) was prepared in June 2009 and is aimed at providing access to affordable and reliable electricity to 'encourage diversification of the economy, sustain growth, create jobs and alleviate poverty'.[10] The programme also attempts to improve the electricity system and business environment for active private sector financing in the medium term. Oladipo et al (2018)[11] state that the deregulation of the Nigerian electricity sector has created opportunities for government and business to improve power capacity, reliability and availability in the country. Nigeria has moved from centrally generated power to a concept of 'embedded generation' (EG) or 'distributed' generation, which 'refers to any electric power production technology that is integrated within distribution systems, close to the point of use, and these generators are connected to the medium or low voltage grid' (Oladipo, 2018:1).

In 2005, the National Electric Power Authority (NEPA) was unbundled and renamed the Power Holding Company of Nigeria (PHCN). The Electric Power Sector Reform (EPSR) Act was signed into law in the same year, which enabled private companies to participate in generation, transmission and distribution. The government unbundled PHCN into eleven electricity distribution companies (Discos), six generating companies (GenCos), and a transmission company (TCN). The Act also created the Nigerian Electricity Regulatory Commission (NERC).

Figure 5: Nigeria's power sector



Source: https://energypedia.info/wiki/Nigeria_Energy_Situation

[10] https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Nigeria_-_The_Economic_and_Power_Sector_Reform_Program_EPSERP_-_Appraisal_Report.pdf

[11] Oladipo et al 2018. https://iopscience.iop.org/article/10.1088/1757-899X/413/1/012037/pdf

The Federal Government divested from 7 GenCos and sold 60% of its shares in eleven DisCos to private operators while the TCN still remains under government ownership. NERC has licenced private Independent Power Producers (IPPs), enacted the Bulk Procurement Guidelines and developed regulations on embedded generation. These reforms have provided a window for investors, communities, state and local governments to generate and sell or utilize power without going through the transmission grid. DisCos will also be able to increase the amount of power available to sell while eliminating the transmission cost component of the tariff. Nigerian Bulk Electricity Trading PLC (NBET) purchases power generated by the GenCos and IPPs at agreed prices stated in PPAs and resells to the DisCos who deliver the power to the end consumer.[12]

The generation sector is driven by privatized generation companies, IPPs and the generation stations under the National Integrated Power Project (NIPP). The embedded generation model has been adopted to by-pass some of the infrastructure problems in the energy sector and to ensure continued supply to communities and the economy. Embedded generation improves the efficiency of the power grid by having multiple micro-sources added to the system. NERC allows IPPs to integrate power with the network of the local distribution company without going through the trouble of connecting to the transmission network.

This model has also improved payment systems as power generation is closer to the communities who have a more constant quality supply and are willing to pay cost reflective tariffs as a result of the changes.

Oladipo et al (2018:11) argue that despite the reforms, the Nigerian power sector has not improved much even with continued government subsidies for some users. Their article lists a number of embedded generation benefits:

- A wide variety of EG technologies offers the opportunity of selecting the right energy solution at the right location.
- It may offer efficiency gains for on-site applications by avoiding line losses
- Its flexibility of operation because of small modular units enables savings on electricity rates by self-generating during high-cost peak power periods and adopting relatively low cost interruptible power rates.
- Environmental quality may be boosted by EG's preference for renewable energy sources
- EG limits capital exposure and risk because of the size, siting flexibility, and rapid installation time
- Unnecessary capital expenditure can be prevented by closely matching capacity increases to growth in demand.
- EG avoids major investments in transmission and distribution system upgrades by siting new generation near the customer.
- It offers a relatively low-cost entry point into a new and competitive market
- Opens markets in remote areas without transmission and distribution systems and areas without power because of environmental concerns
- Establishes new industry worth billions of dollars in sales and hundreds of thousands of jobs and enhances productivity through improved reliability and quality of power delivered, valued at billions of dollars per year.

Nigeria has had some tensions with the World Bank related to their slow pace of reform in the energy sector. However, in April 2019, they were in negotiations with the World Bank for a $1 billion loan for

[12] This paragraph has been informed by Oladipo et al 2018.

the development of the power sector. At these meetings, Nigeria committed fully implement their Economic Recovery and Growth Plan (EGRP) for 2017 – 2020, which includes the expansion of energy infrastructure capacities in power and petroleum.[13] Nigeria has also been faced with 'persistent shortfalls in payments for electricity'.[14] The Black Rhino and Nigerian National Petroleum Corporation's $1 billion Qua Iboe Power Plant has been put on hold due to the difficulties experienced with the 460 megawatt Azura-Edo plant, Nigeria's first privately-financed power project. The Nigerian Bulk Electricity Trading company (NBET) buys power from generators to sell on to distributors. The difference between the two amounts is then subsided from an emergency central bank loan fund created to support the sector and paid to the generators. Under current fiscal conditions, this is not a tenable situation therefore the Qua Iboe plant has been delayed.

4.5 Zambia[15]

Zambia's ZESCO supplies electricity nationwide and supplies the Copperbelt Energy Corporation (CEC). CEC, set up as a Public-Private Partnership, has a license to generate, transmit and sell energy to a number of designated end users in the Copperbelt region (Hatch/DBSA 2016). CEC requires ZESCO's grid capacity for the import of power from neighbouring countries and the Southern African Power Pool. ZESCO is responsible for about 90% of generation capacity in Zambia.

The Office for the Promotion of Private Power Investment (OPPPI) promotes private-sector investment in generation and transmission. CEC and ZESCO have transmission licenses with CEC ensuring funds were raised for expansion of the Zambian Transmission System through its balance sheet. The Maamba IPP project obtained permission to construct a 57km 330kV transmission line to connect to the ZESCO network on a BT basis. Lunsemfwa Hydro Power Corporation (LHPC) and ZESCO have been given permission to construct a 132 kV line to supply power from the power station to the Mkushi Copper JV mine and to communities in the area. ZESCO will be responsible for operations and after 8 years will own the line under a BT agreement.

Under the Electricity Act there is no guaranteed third party access to the ZESCO or CEC transmission grids and licensees provide access on terms agreed to with applications. Recourse can be sought with the energy Regulatory Board and the Minister responsible for energy. Legislation is enabling towards further transmission licensees.

ZESCO and CEC plan their own transmission expansion programme and fund this through mining companies' fees for access and through International Development Banks (IDBs). Traditionally the utilities financed their own expansion plans but due to Zambia's fiscal constraints, they have opened up to financing from the private sector. The current energy framework allows for PPPs and concessions through the Public Private Partnership Act (2009).

The PPP framework has since been used in the energy sector in the development of the Kabompo mini-hydro, Kalungwishi mini-hydro and Mombututu mini-hydro. Maamba and Lunsemfwa have also used the framework in recent years, but specifically for generation. LHPC, an operator of hydropower

[13] https://www.proshareng.com/news/NIGERIA%20ECONOMY/The-EGRP-Articulates-Up-To-60-Interventions-and-Initiatives-That-Must-be-Executed-and-Completed-/34337 See also https://africa-energy-portal.org/news/nigeria-govt-seeks-us1-billion-world-bank-loan-power-sector

[14] https://www.reuters.com/article/us-nigeria-power-exclusive/exclusive-nigerian-energy-sectors-crippling-debts-delay-next-power-plant-idUSKCN1OK1IQ

[15] This section has been sourced from the Hatch/DBSA Report – A Framework for Private Investment in Electricity Grid Infrastructure, 29 February 2016.

plants, and ZESCO are jointly overseeing the construction and development of USD6.8 million transmission line in Mkushi. A 72km 132 kV transmission line from Lunsemfwa Hydro to the Mkushi Copper Joint Venture mine. The transmission line will involve the construction of two substations 132-66/33kV in Chimsoro Farms and Mkushi Mine respectively.

Revenue and tariffs for PPPs are determined by ZESCO's non-regulated tariff system where the tariff is negotiated prior to entering into a contract and applied to bulk supply to mining companies and export to neighboring countries through high-voltage lines and the Southern African Power Pool (SAPP).

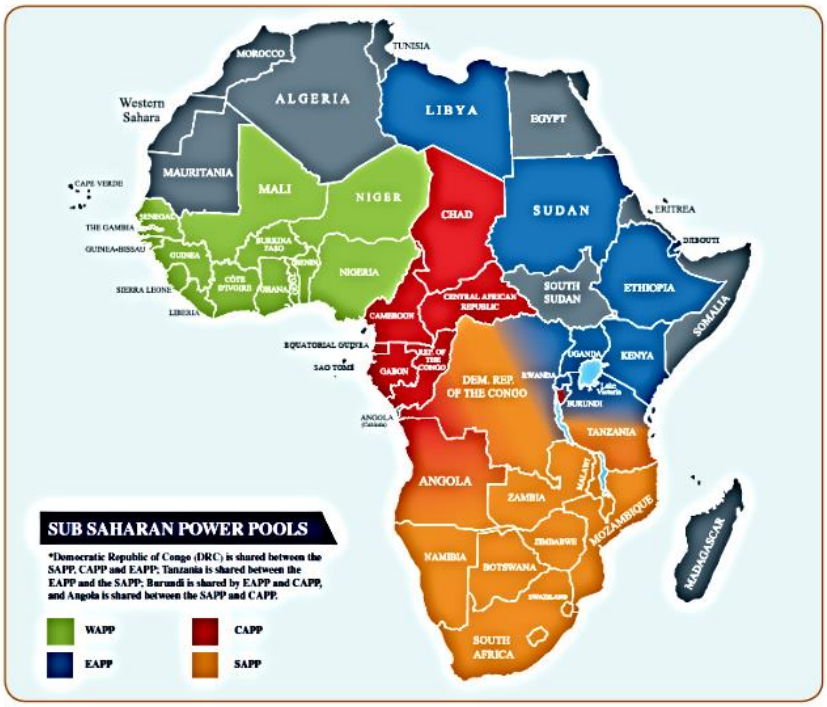
The Hatch/DBSA report concludes the Zambian overview with the following observation:

> 'Funding of new capital will put undue strain on future tariffs and will cause significant price increases in the absence of subsidies from government. Since tariffs to large end users are normally on negotiated terms, funding for expansion of the transmission system to connect these users is often provided by the users through a Build-Transfer (BT) arrangement'.

5. Power Pool Transmission Plans

The power pools in Africa occupy an important role in the electricity generation and transmission sector. The costs are enormous and will require collaboration with the private sector. Regional bodies have undertaken to reform their electricity sectors but a few issues need to be resolved in the process, such as governance, capacity to deliver, payment schemes and providing the right type of electricity for each region.

Figure 6: Sub-Saharan Power Pools[16]



[16] https://www.esi-africa.com/industry-sectors/finance-and-policy/power-pools-enabling-ssas-transmission-corridors/

Table 4 below, illustrates the following cost implications for the power pools between 2015 and 2030.[17]

Table 4: IRENA's estimated funding needs for Africa 2015 - 2030

Region	USD Billion			
	All generation	Large hydro	Other renewables	T&D
North Africa	342	2	218	186
West Africa	89	36	31	52
Central Africa	32	13	17	14
East Africa	72	36	21	49
Southern Africa	145	18	94	74
Total	681	106	381	375

5.1 Central African Power Pool (CAPP) [18]

CAPP services 10 members-states, namely, Angola, Burundi, Cameroon, Central Africa Republic, Congo, DRC, Gabon, Equatorial Guinea, Rwanda, and Sao Tomé and Principe. The regional power pool was established in 2003 but remains the least developed power pool in Africa with 75% of the regional population lacking access to electricity. CAPP member-states engage in minimal trading due to limited transmission interconnector infrastructure.[19] The problem facing this region include lack of a regional framework for electricity trading, lack of regional regulations for dispute management, difficulty in gathering investment, and low interconnection. Table 5 lists three priority projects, see Table 5 below.

Table 5: Central African Power Pool Transmission Projects

Project name	Country(ies)	Est Cost $m	Est readiness
Inga – Calabar interconnection	DRC, Congo, Gabon, Equatorial Guinea, Cameroon, Nigeria	Studies: 3.0 Implementation 1770	Studies $14 m available in AfDB, Studies on Inga 3 ongoing (Westcor project); Pref. on Grand Inga conduction
Inga – Cabinda – Pointe Noire interconnection	DRC, Angola, Congo	Studies: 1.0 Implementation: 97.3	Draft TOR of studies ready ; Draft Legal Memorandum of Understanding ready
Chad – Cameroon interconnection	Chad, Cameroon	Studies: 0.3 Implementation: unknown	Prefeasibility study already conducted

(no date is attached to this information)

[17] Update of the ECOWAS revised master plan for the development of power generation and transmission of electrical energy. Volume 5: Priority investment program and implementation strategy (page 160) http://www.ecowapp.org/sites/default/files/volume_5.pdf Tractebel Engineering.

[18] Central Africa Power Pool Session 3: Overview https://www.powershow.com/view/4a90-Mjg4N/Central_Africa_Power_Pool_CAPP_powerpoint_ppt_presentation?varnishcache=1

[19] https://www.esi-africa.com/industry-sectors/finance-and-policy/power-pools-enabling-ssas-transmission-corridors/

The lack of electricity development in this region presents an opportunity to the DBSA.

5.2 East African Power Pool (EAPP)[20]

The EAPP is best by institutional weakness, lack of regulatory coordination and frameworks, delays in financial contributions from members to the EAPP, financial constraints and challenges to finance power at the utility level and a lack of harmony in the network operation, planning and design processes despite the existence of an EAPP Grid Code. Their priorities remain the development of power infrastructure and the Regional Power Market, and achieving excellence in operational activities.

Table 6: Estimated budget for regional transmission lines by 2020

Interconnection between	Distance (km)	Type	Capacity (MW)	Estimated costs (USD m)
Sudan – Ethiopia	550	500 kV AC	1600	373
Egypt – Sudan	775	500 kV AC	500	233
Rwanda – Tanzania	115	220 kV AC	200	30
Uganda – South Sudan	200	400 kV AC	600	77
Libya – Egypt	163	220 kV AC	200	38
Kenya – Uganda	254	200/220 kV AC	300	44
Total by 2025	2057		3400	795

These six transmission lines have been identified by the 2011 and 2014 regional master plan as urgent to be implemented during the 2016 – 2026 strategic plan.

5.3 Southern African Power Pool (SAPP)

The SAPP Pool Plan (2017:3) is the latest document that provides information on regional generation and transmission plans. The objectives of the Plan are to

> 'identify a core set of generation and transmission investments of regional significance that can provide adequate electricity supply to the region under different scenarios, in an efficient and economically, environmentally and socially sustainable manner and support enhanced integration and power trade in the SAPP region'.

The Pool Plan identifies three components in its study:

- Component A/Benchmark Case – this is a combination of country-by-country expansion plans based on national mater plans extended to 2040. The results are driven by the assumption that a large proportion of the generation options are defined by the countries as committed, and trade is limited by the only new transmission interconnections allowed being those already under construction.
- Component B/Full integration Case – the region is treated as though it is a single country and a least cost sequence of generation and transmission expansion projects is derived.
- Component C/Realistic Integration Case – this is an intermediate integration case, whereby certain constraints are applied to Component B to ensure that each country should have sufficient installed or firm imported capacity to be able to meet its maximum demand and

[20] http://eappool.org/strategic-and-coporate-plans/

reserve obligations, and large thermal plans should operate at or above minimum capacity factor levels.

The SAPP programme compares the different components in terms of cost and GW differences and in terms of percentage differences (see Table 7 and Table 8 below).

Table 7: Cost differences between the Components

$b/GW differences	Component					
	A	B	C	B<>A	C<>A	C<>B
Investment costs	155	117	121	-38.1	-34.3	3.8
Of which Generation	154.2	113.5	117.1	-40.6	-36.5	4.1
Transmission	1.1	3.6	3.3	2.5	2.2	-0.3
Short-term operational costs ($b)	128	123	125	-4.1	-2.9	1.2
Unserved energy (UE) costs ($b)	12	13	13	1.7	1.5	-0.3
Installed generation capacity (GW)	143	127	130	-17	-14	3
SAPP w/o UE ($b)	283	241	246	-42.2	-37.2	5.0
SAPP with UE ($b)	294	254	259	-40.5	-35.7	4.8

Table 8: Percentage differences between the Component options

% differences	Component					
	A	B	C	B<>A	C<>A	C<>B
Investment costs	155	117	121	-25%	-22%	3%
Of which Generation	154.2	113.5	117.1	-26%	-24%	4%
Transmission	1.1	3.6	3.3	228%	198%	-9%
Short-term operational costs ($b)	128	123	125	-3%	-2%	1%
Unserved energy (UE) costs ($b)	12	13	13	15%	13%	-2%
Installed generation capacity (GW)	143	127	130	-12%	10%	2%

SAPP w/o UE ($b)	283	241	246	-15%	-13%	2%
SAPP with UE ($b)	294	254	259	-14%	-12%	2%

The Pool Plan concludes that Component C is the best option as the installed capacity and the costs associated with Component C overcome the small differences with Component B and definitely supersede Component A.

The Pool Plan has identified 9 existing projects and proposes three additional developments:

- **Existing projects:** Inga, Cambambe, Caculo Cabaça, Lauca, Batoka Gorge, Devil's Gorge, Cahora Bassa, Mphanda Nkuwa and Stiegler's Gorge.
- **New proposed developments**: N'Zeto/Angola – Inga/DR Congo, Cahama/Angola – Kunene/Namibia and Matambo/Mozambique-Phombeya/Malawi.

Table 9: Transmission projects in SAPP

Transmission Line	Characteristics	Component B	Component C	Utilization in 2040
Inga-Angola	3 x 400 kV HVAC	1,100 MW in 2023 (i.e. two lines) 1,600 MW in 2033 (with third line)	1,100 MW in 2020 (i.e. 2 lines) 1,600 MW in 2034 (with third line	14 TWh (full load)
Inga-Luano (Zambia)	500 kV HVDC	2,000 MW in 2030	2,000 MW in 2029	10.7 TWh (61%)
Inga-Limpopo (Gauteng)	600 kV HVDC	3,000 MW in 2033	3,000 MW in 2032	26.4 TWh (full load)
Kabwe (Za) – Mbeya (Tz)	500 kV HVDC	1,500 MW in 2030		
STE (Mozambique)	1 x 400 kV HVAC north to central 1 x 400 kV HVAC Central to South 500 kV HVDC bi-pole line, first stage only on converters	In 2023, to cover local demand in Beira In 2027, providing 400 MW capacity north to south In 2027, 1,325 MW	In 2023, to cover local demand in Beira In 2028, 400 MW capacity north to south In 2028 1,325 MW	

5.4 West African Power Pool (ECOWAPP)[21]

The ECOWAPP Master Plan was revised in December 2018 and provides information about the region's plans for generation and transmission of electrical energy. The ECOWAS region includes 15

[21] Update of the ECOWAS revised master plan for the development of power generation and transmission of electrical energy. Volume 5: Priority investment program and implementation strategy. http://www.ecowapp.org/sites/default/files/volume_5.pdf

member countries: Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, The Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Niger, Nigeria, Sierra Leone, Senegal and Togo. The ECOWAPP was established in 2006 to promote the integration of national power systems of the fourteen inland countries into a unified regional electricity market. The objective of the ECOWAPP is to provide regular and reliable energy at competitive cost to the region. In 2012, 59 priority projects were identified for the sub-region.

As illustrated in Table 4 (page 14), the interconnections for the region only represent a small part (10 million on 52) of the necessary investments at national and regional levels to meet the National Determined Contribution to the ECOWAPP. The Tractebel report states that the strengthening of national transmission and distribution networks and rural electrification represent major issues that are under the responsibility of national authorities and are therefore not included in the list of Regional Projects. WAPP is also looking into developing battery-storage infrastructure in the region. The priority projects are listed in Appendix 4.

6. WAY FORWARD

The countries cited in this brief (Uganda, Kenya, Ghana and Nigeria) have all implemented unbundling in their energy sectors, with varied outcomes. South Africa is currently undergoing a review process of Eskom. In July 2019, Minister Mboweni stated there was no timeline for the Eskom restructuring. A team of officials led by the Directors-General of National Treasury and Public Enterprises have 'considered a number of options as a solution to the company's debt challenge in order to ensure its sustainability, and the most viable of these will be communicated in due course' and that the Chief Restructuring Officer (CRO) 'will be mandated to test these options with the ratings agencies to establish what impact each will have on the fiscus and recommend the appropriate one for implementation' (RMB Financial Markets, 24 July 2019).

In his speech to the National Assembly (23 July 2019), on the Special Appropriation Bill to provide additional financial support to Eskom for the current and next financial year, Minister Mboweni stated that the restructuring of Eskom into three entities, namely, generation, transmission and distribution will have numerous benefit such as:

- Allowing strong parts of the business to raise funding more cheaply;
- Creating higher transparency across the value chain and reduce opportunities for fraud, corruption and rent-seeking;
- Creating clear performance incentives in each business;
- Reducing systemic risk South Africa faces by having one very large entity, where problems in one part of the electricity value chain now affect the entire value chain. Instead, it will isolate problems and deal with them where they arise, without compromising the entire system;
- Positioning the electricity sector to embrace clean technology, distributed generation and respond to other industry changes;
- Reducing support required from the government in the form of capital outlays and sovereign guarantees, mainly due to increased private sector participation and funding over time;
- Generating competition in the electricity market that is expected to drive improvements in efficiency and put downward pressure on prices;
- Providing open access to the grid and remove conflicts of interest to the procurement of power, both conventional and renewable, from IPPs;

- Diversifying the generation of electricity across a multitude of power producers, thereby reducing the country's reliance on a single supplier; and
- Providing a stable platform for transparently contract least-cost and most secure power.

However, the lessons learned from other unbundling processes in Africa have shown that sector reform is not a sufficient requirement for success. All the other factors ranging from private sector environment to infrastructure availability to the independence of the regulator could impact the outcome of the reform process.

The DBSA will need to look at country indebtedness and the regulatory frameworks within each of the countries they wish to engage on private sector opportunities. The unbundling processes have been undertaken but there are underlying issues such as governance, infrastructure capacity, payment history and the regulatory frameworks that need to be considered carefully. This is a desk-top brief that has made extensive use of reports in the public space.

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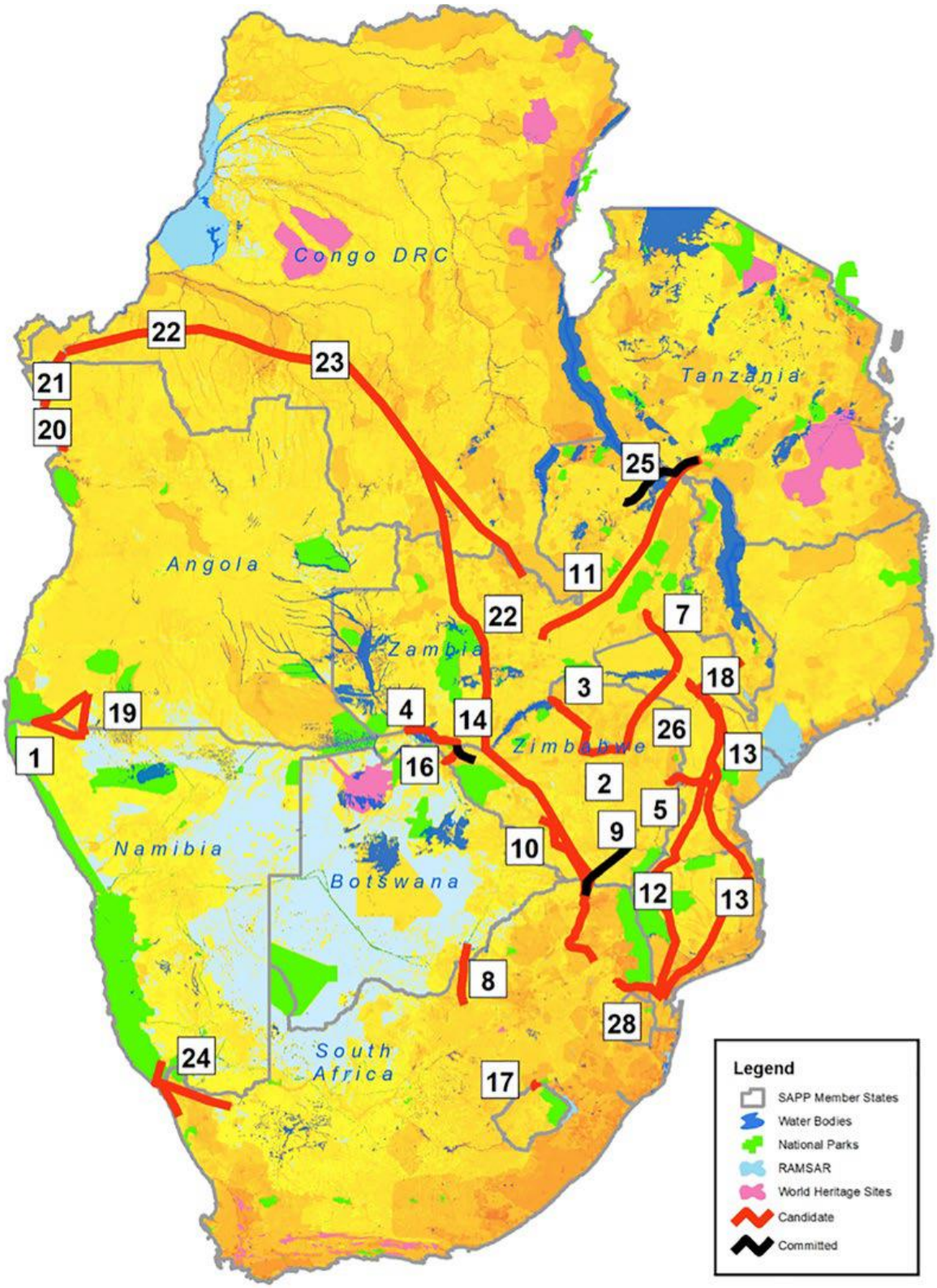
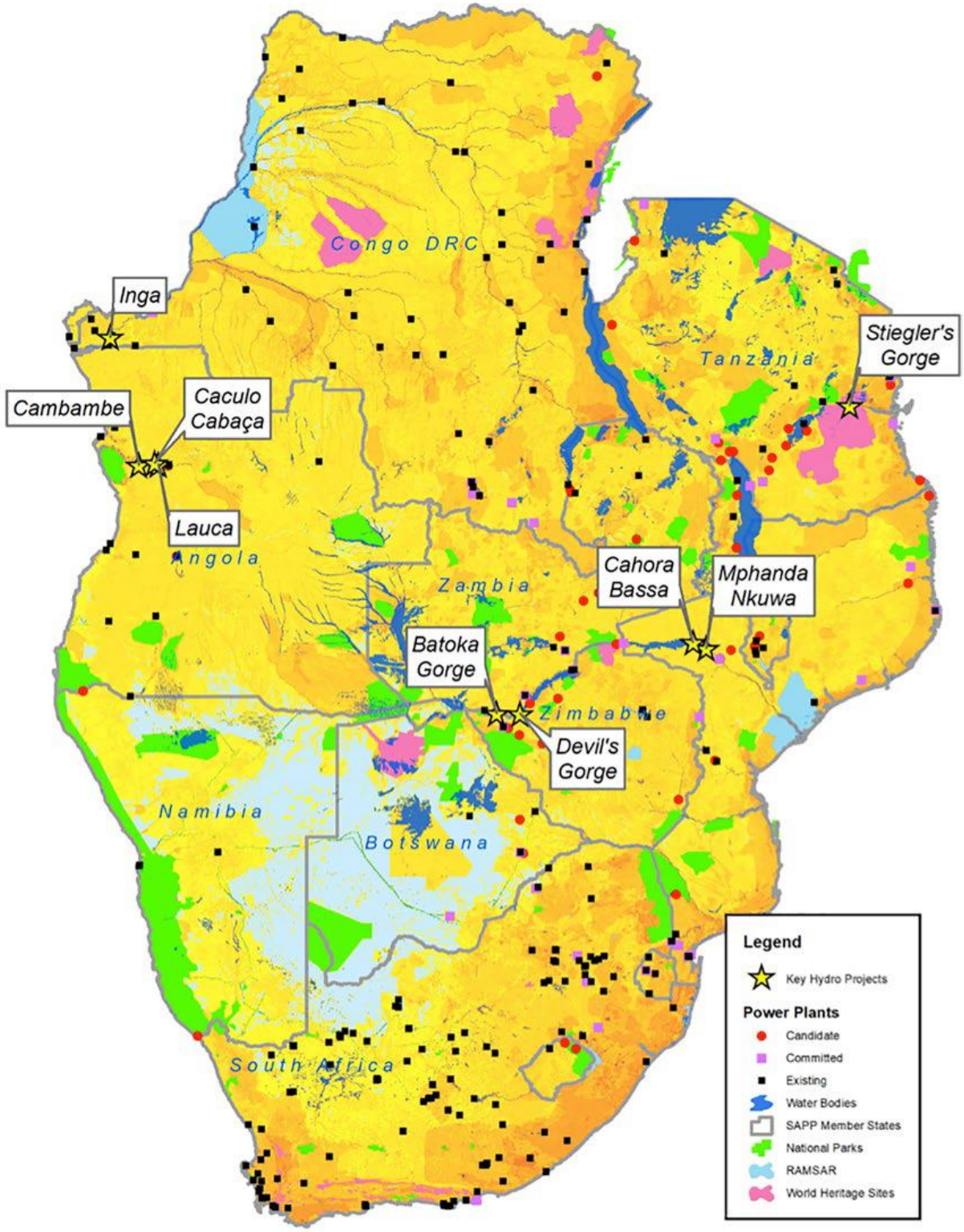
Appendix 1

SAPP Pool Plan Main Transmission Lines



Appendix 2
SAPP Pool Plan – Key Hydro Projects



Appendix 3

Summary results for each country (SAPP Pool Plan 2017)

Country	Transmission Developments
Angola	Interconnection at 400 kV DRC- Angola & Angola-Namibia to export surplus in early years and import in later years. Second North-South 400 kV line required by 2025; and third line in the 2030s to strengthen internal grid (highly dependent on domestic load growth as well as exports)
Botswana	National network has radial 40 kV where further studies are required to confirm if loss of load and reactive compensation are acceptable when there are faults To meet minimum capacity requirements, Botswana becomes a net exporter which requires a strengthening of the interconnection to South Africa (Isang-Watershed).
DRC	The 220 kV Katanga network is a bottleneck for transfer of power between the DRC and Zambia. Beyond 2020 a second Inga HVDC link, terminating in Zambia, plus extra generation in the Katanga region required. Interconnections to Angola (400 kV), Zambia and RSA (both HVDC) are necessary to evacuate power if Inga 3 and 4 are developed according to recommended least-cost regional plan. Multi-terminal Inga-Zambia-RSA link is not recommended for the 5000 MW transfer proposed due to high risk blackouts for major faults. Two separate HVDC schemes provide better stability. EAPP market needs further study to establish if Inga-Tanzania interconnection would be viable.
Lesotho	Least cost generation options are to be a net importer for the planning horizon. An additional 132 kV link to RSA is required by 2022
Malawi	Without interconnections it is necessary to upgrade and expand the existing 132 kV and 400 kV system. Least cost plan is to connect to Mozambique – more viable than some internal generation projects. Additional interconnections that may include Zambia and Tanzania should be subject of further studies. These could also be used to export surplus hydropower during high flow seasons.
Mozambique	Key transmission developments needed are connections to Malawi and building the STE grid from Tete area to Maputo to evacuate power from Mphanda Nkuwa identified as part of the least cost plan. Reinforcing 400 kV links to RSA and Zimbabwe may become viable later.
Namibia	Additional interconnections required as system relies on imports in early years. Connection to Angola already highlighted but studies needed with better hydro plant data to decide if one or two lines are needed. Recommended regional plan includes Kudu and Baynes projects by mid to late 2020s which requires second 400 kV line to RSA. Strengthening the link to Zambia including the HVDC to Caprivi may also be beneficial.
South Africa	Rsa is net exporter until the mid to late 2020s, supported by the Nzhelele-Triangle line added early on In the least cost regional plan, additional cross border reinforcements are needed from 2030 onwards when RSA becomes a net importer. Trade with SAPP is through Namibia in the west, Botswana and Zimbabwe in the north and Mozambique and eSwatini in the east in addition to an HVDC from DRC.

eSwatini	Least-cost plan has eSwatini as a net importer except for the last two years of the study horizon
Tanzania	Tanzania is assumed interconnected to SAPP through Zambia but the level of trade on this is limited to 200MW by market uncertainties and voltage constraints in the Zambia-Tanzania border areas. Further studies needed to establish if higher transfer capacity can be justified for transfer of surplus hydro power during high inflow seasons.
Zambia	Suggestion for EAPP-SAPP link to be back-to-back AC-DC-AC to deal with the relatively weak link between Zambia and Tanzania where it is difficult to economically justify the proposed 2000 MW link. Regional interconnection projects of major impact to Zambia are linked to the integration of Inga to Zambia and SA. Interconnections to Malawi and Mozambique are more of local rather than regional benefit.
Zimbabwe	Main impact of regional developments is the reinforcement of the Zimbabwe grid to allow more north-south power flows linked to developments in Inga and in Tete area of Mozambique. Further studies needed on viability of alternative routes for reinforcement of Mozambique-Zimbabwe-South Africa interconnections, taking account of the timing of the STE grid.
Total SAPP (RM relative to coincident peak)	Interconnections of non-operating members – Angola (to DRC and Namibia), Malawi (to Mozambique) and Tanzania (to Zambia) – recommended within the next 4 – 5 years.

Appendix 4

West African Power Pool Priority Projects

Line	Level voltage KV	Length (km)	Estimated cost (USD m)	Date of commissioning
Short term projects				
Coastal backbone project: interconnection Volta (Ghana) – Lomé (Togo) – Sakété (Benin)	330	340	122	2019
Laboa-Boundiali – Ferkessedougou (Côte d'Ivoire)	225	310	115	2019
Line Kayes (Mali) – Tambacounda (senegal) (part of the Manantali II project of OMVS)	225	288	94	2020
Interconnection CLSG (Côte d'Ivoire – Liberia – Sierra Leone – Guinea	225	1303	517	2020
OMVG Loop (Senegal-The Gambia-Guinea Bissau-Guinea)	225	1677	722	2020
Manantali – Bamako line in Mali (part of the Manantali II project of the OMVS)	225	317	85	2021
Interconnecion Guinea – Mali	225	1074	436	2021
Project North Core (interconnection Nigeria – Niger – Benin /Togo – Burkina Faso)	330	832	541	2022
Kayes Line (Mali) – Kiffa (Mauritania) (part of the Manantali II project of the OMVS)	225	420	184	2022
Second circuit of the CLSG interconnection to be commissioned at the same time as the first circuit	225	1303	131	2022
Line Bolgatanga (Ghana) – Bobo (Burkina Faso) – Sikasso (Mali)	330	555	341	2022 recommended
Total short-term		**8419 km**	**USD 3288 m**	
Medium-term projects				
Line Manantali (Mali) – Boureya (Guinea) – Koukoutamba (Guinea) – Linsan (Guinea) (part of the Manantali II project of the OMVS)	225	462	166	2024
Line Buchanan (Liberia) – San Pedro (Côte d'Ivoire)	225	520	129	2028
Strengthening interconnection Côte d'ivoire – Ghana	330	387	156	2029
Line Boundiali (Côte d'Ivoire) – Tenrgela (Côte d'Ivoire) – Syama (Mali) – Bougouni (Mali)	225	330	96	2029

Line Fomi (Guinea) – Boundiali (Côte d'ivoire)	225	380	96	2025 recommended
Median Backbone (Nigeria – Benin – Togo – Ghana – Côte d'Ivoire)	330	1350	813	2025 recommended
Strengthening the coastal Backbone First Phase Nigeria-Benin 2nd Phase Benin – Togo – Ghana	225	400	281	First phase: 2025 recommended Second phase: 2028 Recommended
Line Labé- Koukoutamba In Guinea	225	115	50	2024 recommended
Connection Segou Bamako	225	290	105	2025 recommended
Total medium-term		**4234 km**	**USD 1892 m**	
Long-term projects				
Western Backbone (Senegal – The Gambia – Guinea Bissau – Guinea – Mali) to reach Ghana – Burkina – Mali	330	1600	912	2033 recommended
Link Bobo (Burkina Faso) – Ferke (Côte d'Ivoire) to connect the Western Backbone to the Median	330	213	126	2033 recommended
Reinforcement of the Western section of the OMVG loop	225	800	301	2030 recommended
Strengthening Niger – Nigeria Interconnection	330	510	332	2033 recommended
Second north-south axis in Ghana	330	750	426	2030 recommended
Eastern Backbone in Nigeria	330	1856	966	2033
Interconnection WAPP (Senegal/OMVS) – Northern Africa through Morocco		1250	615	2033
Interconnection WAPP (Nigeria) – CAPP (Inga)		3300	1622	2033
Total long-term		**10279**	**USD 5300 m**	
Grand total		**22932 km**	**USD 10480 m**	