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Opinion paper

A policy perspective for an integrated regional power pool within the Africa Continental Free Trade Area

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ABSTRACT

The Africa Continental Free Trade Area presents an opportunity for the creation of a single continental electricity market in Africa. This market has the potential to promote the efficient development of electricity infrastructure and symbiotic electricity trading between members of Africa's five regional electric power pools. A framework is proposed to harness the opportunities presented by the African Continental Free Trade Area through the coordination of technical and commercial endeavors of the regional power pools in Africa. This includes fostering sharing mechanisms of best practices that support the development of national and international institutions, harmonizing regulations and grid codes, and promoting electricity trading opportunities that will catalyze the development of inter-regional infrastructure projects. In this paper, the authors propose a bilateral contract market that aligns with and complements the existing regional power pools without encumbering them with unnecessary bureaucracy. The paper's policy recommendations are designed to promote proactive adoption and compliance with the recommended best practices, market rules and regulations by market participants, motivated by their self-interests.

1. Introduction

The Africa Continental Free Trade Area (AfCFTA) is a flagship project of Agenda (2063), an initiative of the Africa Union for inclusive growth and sustainable development (The African Union Commission, 2063). The general objectives of the (AfCFTA) include (Secretariat, 2021):

- Create a single and liberalized market for goods and services.
- Facilitate free movement of persons and investment to deepen economic integration and promote sustainable and inclusive socio-economic development.
- Lay the foundation for a continental customs union.
- Promote industrial development and enhance competitiveness of the economies of member states.
- Resolve the challenges of multiple and overlapping memberships, and expedite the regional and continental integration processes.

The AfCFTA consist of fifty-four African states that have agreed to eliminate trade barriers, as outlined in the African Continental Free Trade Agreement (CFTA). The AfCFTA came into effect on the January 1, 2021 (African Union, 2021) and covers a market of over 1.3 billion consumers and a combined Gross Domestic Product (GDP) of more than $3.4 trillion US dollars. The main goal of the AfCFTA is the creation of a single continental market for goods and services, with its free movement of people and investments. AfCFTA is expected to eliminate trade barriers, promote competition, increase efficiency, and attract increased levels of foreign direct investment (Maliszewska and Ruta, 2020). In the past decades, African countries have leveraged regional social-economic cooperation and integration to eliminate trade barriers and attract investment into critical sectors of the economy such as the electricity sector. The AfCFTA provides a broader opportunity to increase access to electricity in Africa.

Cross-border electricity trade in Africa can reduce electricity costs, increase reliability and security of supply, promote greater consumer choice and increase the integration of renewable energy generation. Furthermore, the integration of electricity system investment and operation promotes new market opportunities, efficient use of existing infrastructure, facilitates the realization of economies of scale for capital investments, and broadens opportunities for local capital market actors and other service providers. Challenges to achieving these benefits

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include the current dissimilar regulatory frameworks of different countries, inadequate transmission capacity, non-alignment of national and regional investment strategies, limited financial resources, corruption, cost recovery challenges, lack of reliable technical and financial data, weak judicial system, varying levels of transparency in data and information dissemination, diverse rules and levels of transparency in the allocation of costs for infrastructure development, and the various national sovereignty and energy independence concerns (International Confederation of Energy Regulator (ICER), 2015; International Bank for Reconstruction and Development, 2015).

Globally, there are three dimensions to the integration of electricity systems and markets: (i) security of supply, (ii) sustainability and diversification of supply and (iii) competition in the supply of electric energy (International Bank for Reconstruction and Development, 2015). While all three dimensions are important, the dimension emphasized in each of the five regional power pools in Africa differs. The dimension each regional pool prioritizes is naturally influenced by the base level of development within the constituent countries. Since countries in each power pool are at different levels of infrastructure development and market liberalization, integration between their electricity markets varies considerably across the continent. With over 640 million Africans lacking access to electricity (Patel, 2021), the goal of most of the regional power pools is security, sustainability, and diversification of supply.

Africa needs to increase its investment in electricity generation from the current $30 billion to $120 billion US dollars annually to achieve universal access to electricity (African Development Bank Group, 2019). In consequence of this, several African countries have leveraged regional integration initiatives to attract new investment, diversify electricity generation fuel mix and increase reliability of electricity supply. However, integration efforts have faced issues such as pricing and wheeling charges, inconsistent reform objectives, and uncertainty in the expected outcomes of integration (Pineau, 2008). Despite these issues, regional integration has enjoyed some successes, especially where clear conditions for trading, well-established institutions, supportive political atmospheres, and practical timetables for reforms are present (Oseni and Pollitt, 2016; Gore et al., 2019; Mentis et al., 2017).

The advantages of regional power pools in Africa have been documented in recent research such as Remy et al., 2020 (Remy and Chattopadhyay, 2020), where the benefit of a "tight" integration in the Eastern Africa Power Pool (EAPP) was estimated at $18.6 billion in addition to 30% reduction in CO_2. Increased interconnection within the EAPP was also shown to reduce investment risks and promote diversification of the generation mix (Deloitte., 2021). Similarly, increased interconnection in the West Africa Power Pool (WAPP) can increase the potential for integration of renewable energy resources (Miketa and Merven), reliability and security of supply (Musati et al., 2017). In the light of this, an increased interconnection and trade within the regional power pools under the auspices of the AfCFTA is expected to result in significant efficiency gains, unlock power generation resources, and free up fossil fuel resources for other uses or export (Taliotis et al., 2016). A robust planning framework of the interconnection infrastructure is required for member countries to benefit from regional power pools. A review of the quantitative and qualitative planning and implementation approaches of forty-nine sub-Saharan African countries and four regional power pools in sub-Saharan Africa was carried out in (Trotter et al., 2017). Alova et al., 2021 (Alova et al., 2021) showed that ownership, direct foreign investment financing, project cost are factors that affected the completion of electricity projects in Africa and should be carefully considered when planning electricity projects in Africa.

The negotiations of the first phase, covering good and service trade, are ongoing and the negotiation of phase two, encompassing protocols on investment, competition policy and intellectual property, is expected to commence soon. As member countries negotiate these protocols, there is a need for diverse perspective and research to support optimal negotiation outcomes. The goal of this paper is to contribute to the discussion by leveraging previous research on the regulatory and governance frameworks for electricity supply and security in the regional power pools and the potential application to a continent-wide framework under the auspices of the AfCFTA. A synopsis of the five regional markets in Africa is presented. The current states of the interconnection infrastructure, common regulatory framework, and organizational structure of the regional pools is assessed. The paper reviews examples of progress made in the regional power pools and how those successes can be leveraged to accelerate incremental AfCTA fostered market investment and integration. Finally, based on the successes enjoyed in regional power pools, a framework for a bilateral contract market between the continent's regions is proposed.

The paper is structured as follows: Section 2 discusses the CFTA; Section 3 provides a synopsis of the regional power pools in Africa; Section 4 and section 5 propose a framework under the AfCFTA for harmonizing the development endeavours of the regional power pools; Section 6 presents a policy framework for integrating the five regional power pools; and Section 7 summarizes the paper's conclusions.

2. Continental free trade agreement (CFTA)

The agreement establishing the AfCFTA entered into force on the 30th of May 2019 for the twenty-four countries that have deposited their instrument of ratification with the African Union Commission (AUC) (Williams and Cook, 2021). As of April 1, 2021 fifty-four Africa countries have signed the CFTA, thirty-eight have ratified it and thirty-six have deposited their instrument of ratification with the AUC (Secretariat, 2021; Tralac, 2021) as shown in Fig. 1. The AfCFTA will be governed by five operational instruments: (i) the rules of origin (ii) the on-line negotiating forum, (iii) the monitoring and elimination of non-tariff barriers, (iv) a digital payments system, and (iv) an African trade observatory (Sahel and West Africa Club, 2020).

Selected sections of the agreement expected to influence the integration of the electricity system in member countries and their implications are summarized in Table 1. The full implementation of AfCFTA is expected to complement ongoing efforts of the regional power pools in ensuring the security of electricity supply to Africans.

3. Regional Power Pools in Africa

Regional power pools are integrated power transmission grid and electricity market across countries within Africa regional economic communities with the purposes of creating and leveraging economic of scale in the generation and transmission of electricity. At least three conditions are required for a power pool to function. These are, interconnection between members, alignment between the legal and regulatory framework of members, and a multi-country organization to monitor system planning and cross-border market operations (Medinilla et al., 2019; Vanheukelom and Bertelsmann-Scott). Most African countries are members of at least one regional power pool. These pools are typically built on Regional Trade Agreements (RTAs) such as the Common Market for Eastern and Southern Africa (COMESA), Eastern Africa Community (EAC), Economic Community of West African States (ECOWAS), Southern African Development Community (SADC), Arab Maghreb Union (UMA), and Community of Sahel-Saharan States (CSSS). The five power pools in Africa are:

1. Comite Maghrebin de 1'Electricite (COMELEC)/North Africa Power Pool (NAPP).
2. The Eastern Africa Power Pool (EAPP).
3. The West African Power Pool (WAPP).
4. The Central African Power Pool or Pool Energetique d'Afrique Central (PEAC).
5. The Southern African Power Pool (SAPP).

Fig. 2 provides a pictorial layout of the power pools. Some countries

Fig. 1. Status of African countries with respect to the CFTA.

such as Libya, Democratic Republic of the Congo (DRC), Angola, and Tanzania are members of multiple regional systems. The socio-economic and electricity industry data in each of the regional power pools are estimated in Tables 2 and 3. A brief description of these regional power pools is presented next.

3.1. *Comite Maghre.bin de l'Electricite (COMELEC)/North African power pool*

COMELEC/NAPP was created on June 1974, and consist of five members, Societe tunisienne de 1'electricite et du gaz (Tunisia), Societe nationale de 1'electricite et du gaz (Algeria) and Office national d'electricite (Morocco), Societe Mauritanienne d'Electricite (Mauritania) and General Electric Company of Libya (Libya). The objective of the COMELEC is the integration of electricity systems and markets as well as the sustainability and diversification of supply and competition in electric energy supply. The installed generation capacity is approximately 43 GW as shown in Table 3.

3.1.1. *Interconnection infrastructure*

NAPP region has one of Africa's most developed electricity generation and transmission infrastructures. Over 98% of the citizens within the NAPP have access to electricity and the region is interconnected with Europe. There is no centralized transmission system operator within NAPP and about 5%-6% of total electricity generated within the region is traded between members based on established bilateral long-term sales agreements (Musan et al., 2017). There are ongoing efforts to expand the infrastructure, trade rules, sales clearance agreements, intergovernmental and utility agreements required to establish an electricity market by 2025.

3.1.2. *Common regulatory framework*

Common regulatory framework: Member countries do not have a common regulatory framework for the electricity industry as shown in Table 4. There is no established framework for dealing with transmission congestion and congestion revenue distribution.

Table 1
Sections of the CFTA expected to directly influence the electricity system in member countries.

Agreement establishing the AfCFTA		
Section	Relevance of CFTA provisions (Africa Union, 2018)	Implication for the electricity sector
Part II, Article 3 -General Objective	Ensure a single market for goods, capital, services, and the free movement of labour.	It is hoped that this article will facilitate energy trading. investment, and exchange of energy systems expertise between member countries.
Part IV, Article 16 -Publication	Transparency of Information Sharing - requires that each member make public its laws, regulations, procedures, and administrative rulings on any trade matter covered under the agreement.	For investors and energy market operators, this article has the potential to foster transparency around international market operations, trade, and infrastructure investments.
AfCFTA protocol on trade		
Part II, Article 4 -Most-Favoured Nation Treatment	Preferential treatment must be extended to all state parties on a reciprocal and non-discriminatory basis.	This article prevents two or more states from excluding other member nations from concessions, privileges, immunities, or preferences granted in a trade agreement. This provision is expected to make multi-countries infrastructure development and electricity wheeling simpler.
Part II, Article 5 -National Treatment	State party shall accord equal treatment to domestic and imported products.	This article ensures that local and international goods, services, trademarks, copyrights, and patents within the market are treated equally, and equal treatment of local and foreign investment (Peterson, 2020).
Part II, Article 6 - Special and Differential Treatment.	State parties will accommodate the different levels of economic development in the implementation of the AfCFTA.	This provision in this article allows for flexibility in the implementation of market integration endeavours to accommodate the diverse level of regulation, governance, commercial and infrastructure development across Africa (Peterson, 2020).
Part III, Article 7 -Import Duties.	State parties shall eliminate charges on goods originating from local or member states.	The full implementation of AfCFTA is expected to complement ongoing efforts of the regional power pools to stimulate cross-border infrastructure development and energy trade within the free trade area.

3.1.3. Organizational structure

The NAPP is a supranational committee that constitute a steering committee and a secretariat general.

3.2. The Eastern Africa Power Pool (EAPP)

The objective of EAPP is to improve the security of supply by increasing interconnectivity between member states of the COMESA region. Members include Burundi, DRC, Egypt, Ethiopia, Kenya, Rwanda, Sudan, Tanzania, Libya, Djibouti and Uganda as shown in Fig. 2. The installed capacity within the EAPP is approximately 68 GW and electricity demand is expected to grow by 70% to 507 TWh by 2030, as shown in Table 3.

3.2.1. Interconnection infrastructure

Electricity trade among members is limited due to insufficient interconnections, weak alignment of developmental plans, and weak incentive for private participation (Infrastructure Consortium for Africa, 2016). The capacity of the current interconnection is approximately 474 MW. This is expected to increase with the completion of nine new transmission lines with a total capacity of 6100 MW which are expected to be available (latest) by 2025. (Analyses and Energinet, 2020; Carr, 2017). The 2300 km Zambia-Tanzania-Kenya transmission line will connect the EAPP to SAPP when completed in 2022.

3.2.2. Common regulatory framework

Most of the member countries excluding Burundi, Djibouti, DRC, and Libya have attained substantial levels of regulatory development with established independent regulatory bodies and market supportive regulatory frameworks in place. Most of these regulators however need to improve the technical and commercial quality of services regulation (Africa Development Bank, 2020). The structure of the electricity system in most of the member countries is vertically integrated except for Uganda and Kenya where the utilities are fully unbundled as shown in Table 5. The first Independent Power Producers (IPP) are under development in Burundi, and Djibouti. The current regulatory framework of the electricity industry of member countries is summarized in Table 5.

3.2.3. Organizational structure

The EAPP has four governing bodies: the council of ministers, the steering committee, the organization committees, and the general secretariat. The governance structure in most of the countries in the EAPP supports clarity of roles, independence, accountability, transparency, predictability, and open access to regulatory information. However, some of the institutions lack independence from government and politics (Africa Development Bank, 2020).

3.3. The West African Power Pool (WAPP)

The WAPP consists of fourteen member countries within the ECOWAS. Member countries of the WAPP are Benin, Burkina Faso, Ghana, Guinea, Guinea Bissau, Ivory Coast, Liberia, Mali, Niger, Nigeria, The Gambia, Togo, Senegal, and Sierra Leone as shown in Fig. 2. The main objective of WAPP is the security of electricity supply among members (West African Power Pool APL, 2020).

3.3.1. Interconnection infrastructure

The current installed generating capacity within the pool is 22,340 MW. Approximately 7% of available electricity in the region is traded via bilateral contracts between 10 interconnected countries (Musau et al., 2017; World Bank Group, 2020). Interconnection within WAPP is expected to increase with the completion of 28 high voltage transmission lines with a total approximate length of 22,932 km (West African Power Pool, 2019).

3.3.2. Common regulatory framework

The electricity industry structure among member countries varies from vertically integrated with little to no competition to fully unbundled with some level of competition and private participation in generation, transmission and distribution as shown in Table 6. The legal and institutional structures remain weak, hence, most members need to develop or update guidelines and methodologies for tariff setting and grid codes, simplify the licensing framework, design technology-specific power purchase agreements, build capacity in service regulation to expand the capacity of the regional market and attract private investment.

Fig. 2. Regional power pools in afiica.

Table 2
Estimated socio-economic data of member countries under the various power pools.

Power pool	Number of countries	Surface area (km^2) (World Bank Group, 2021a; Worldatlas, 2021)	Population ('000)(World Bank Group, 2021b; World Population Review, 2021)	GNI Billion PPP USD (2019) (World Bank Group, 2021c)	Average GDP (PPP) per capita USD (2019)(Miketa and Saadi) International Monetary Fund (IMF)
NAPP	5	5,773,641	102,530	1,051	3,972
EAPP	11	9,729,564	528,820	2,346	1,890
WAPP	14	5,028,940	386,360	1,632	1,133
PEAC	10	6,522,500	186,371	504	2,644
SAPP	12	9,083,436	332,490	1,438	2,676

Table 3
Estimated state of the electricity sector in each power pool.

Power pool	Installed capacity (GW)(USAID, 2021)	Electric power consumption (kWh per capita) (WorldData.info, 2021)	Electricity demand (TWh) (Miketa and Saadi),	Projected Energy demand (2030) (TWh) (Deloitte., 2021; Miketa and Saadi)
NAPP	43	1,529	400	960
EAPP	68	623	285	507
WAPP	22	121	130	228
PEAC	12	236	40	84
SAPP	78	862	409	580

3.3.3. *Organizational structure*

The WAPP management and governance structure comprise of the general assembly, the executive board, the organizational committees, and the secretariat. Recent organizational endeavours include: (i) the establishment of ECOWAS Regional Electricity Regulatory Authority (ERERA), (ii) WAPP market design and rules (West Africa Power Pool,

Table 4
Summary of electricity system in member countries of NAPP.

Member countries	Independent regulator (Africa Development Bank, 2021)	Market structure (Attia and Shirley, 2021)	Grid code	Private sector participation (USAID, 2021; Attia and Shirley, 2021)		
				Gen?	Trans?	Dist?
Algeria	Yes	Vertically-integrated	Yes	Yes	No	No
Libya	No	Vertically-integrated	No	No	No	No
Mauritania	Yes	Vertically-integrated	Yes	No	No	No
Morocco	Yes	Vertically-integrated	Yes	Yes	No	No
Tunisia	No	Vertically-integrated	Yes	Yes	No	No

[a] Gen. = Generation.
[b] Trans. = Transmission.
[c] Dist. = Distribution.

2020), and (iii) the establishment of a WAPP Information and Coordination Centre.

3.4. The Central African Power Pool or pool energetique d'Afrique Centrale (PEAC)

The PEAC is a special agency of the ECCAS responsible for implementing energy policies to increase regional electricity supply security and reliability. Member countries include Angola, Burundi, Cameroon, Republic of the Congo (Congo), Central Africa Republic (CAR), Chad, DRC, Gabon, Equatorial Guinea (E.Guinea), and Sao Tome and Principe (ST&P) as shown in Fig. 2.

3.4.1. Interconnection infrastructure

There is currently one operating interconnection, the 220 kV Congo - DRC interconnection, within the PEAC. There are ongoing regional integration infrastructure developments such as the 220 kV DRC-Burundi transmission line. The single cross border market is based on bilateral arrangements and there is no established framework for transmission congestion management or congestion revenue distribution.

Table 5
Summary of electricity system in member countries of EAPP.

Member countries	Independent regulator (Africa Development Bank, 2021)	Market structure (Attia and Shirley, 2021)	Grid code (USAID, 2021)	Private sector participation (Attia and Shirley, 2021; Eberhard et al., 2016)		
				Gen?	Trans?	Dist?
Burundi	No	Vertically-integrated	No	Yes	No	No
Djibouti	No	Vertically-integrate d	No	Yes	No	No
DRC	No	Vertically-integrated	No	No	No	No
Egypt	Yes	Vertically-integrated	Yes	Yes	No	No
Ethiopia	Yes	Unbundled (G & T, D)	No	Yes	No	No
Kenya	Yes	Unbundled	Yes	Yes	No	No
Libya	No	Vertically-integrated	No	No	No	No
Rwanda	Yes	Vertically-integrated	Yes	Yes	No	No
Sudan	Yes	Vertically- integrated	No	No	No	No
Tanzania	Yes	Vertically- integrated	Yes	Yes	No	No
Uganda	Yes	Unbundled	Yes	Yes	No	No

[a] Gen. = Generation.
[b] Trans. = Transmission.
[c] Dist. = Distribution.

Table 6
Summary of electricity system in member countries of WAPP.

Member countries	Independent regulator (Africa Development Bank, 2021)	Market structure (Attia and Shirley, 2021)	Grid code	Private sector participation (USAID, 2021; Attia and Shirley, 2021; Eberhard et al., 2016)		
				Gen?	Trans.[b]	Dist.[c]
Benin	Yes	Vertically-integrated	No	No	No	No
Burkina Faso	Yes	Vertically-integrated	No	Yes	No	No
Ghana	Yes	Unbundled	Yes	Yes	No	Yes
Guinea	Yes	Vertically-integrated	No	Yes	Yes	Yes
Guinea Bissau	No	Vertically-integrated	No	Yes	No	No
Ivory Coast	Yes	Vertically-integrated	No	Yes	Yes	Yes
Liberia	No	Vertically-integrated	No	No	No	No
Niger	Yes	Vertically-integrated	No	No	No	No
Nigeria	Yes	Unbundled	Yes	Yes	No	Yes
The Gambia	No	Vertically-integrated	No	Yes	No	No
Togo	Yes	Vertically-integrated	Yes	Yes	No	No
Senegal	Yes	Vertically-integrated	Yes	Yes	No	No
Sierra Leone	Yes	Vertically-integrated	Yes	Yes	No	No

[a] Gen. = Generation.
[b] Trans. = Transmission.
[c] Dist. = Distribution.

3.4.2. Common regulatory framework

In most of the member counties of the PEAC, excluding Cameroon, there are few or no elements of a supportive regulatory framework in place. The electricity industry structure in member countries are verti cally integrated as shown in Table 7. There are either insufficient or complete absence of legal and institutional structures for the establish ment of an independent regulator (Africa Development Bank, 2020).

3.4.3. Organizational structure

The PEAC is made up of Council of Ministers, Executive Committee, Regulatory Body, Management Committee, Conciliation body and Expert Committee, Permanent Secretariat, Planning, Operation, and Environmental Sub-committees and the Control centre (Central African Power Poo, 2020).

3.5. The Southern African Power Pool (SAPP)

SAPP is composed of twelve countries, Angola, Botswana, DRC, Lesotho, Mozambique, Malawi, Namibia, South Africa, Swaziland, Tanzania, Zambia, and Zimbabwe as shown in Fig. 2.

3.5.1. Interconnection infrastructure

Nine of the 12 member countries are interconnected. Interconnec tion is expected to improve upon the completion of several high voltage and High Voltage Direct Current (HVDC) transmission lines. Markets include a Day-Ahead Market (DAM), an Intra-Day Market (IDM), a Forward Physical Monthly Market (FPM-M) and a Forward Physical Weekly Market (FPW-W) (Southern African Power Pool, 2020).

3.5.2. Common regulatory framework

The SAPP is regulated by the Regional Electricity Regulators Asso ciation of Southern Africa (RERA), a platform for effective cooperation between the regulators of the member counties of the SADC. In addition, RERA harmonizes regulating policies, legislation, standards, practices, and guidelines for cross-border electricity trades and investments within the SADC. A summary of the regulatory framework in member countries is presented in Table 8. Some of the member countries have achieved a substantial level of regulatory development and have established most elements of a market supporting regulatory framework. The market structure of most member countries is vertically integrated except for Malawi and Zimbabwe where the systems have been unbundled.

Table 7
Summary of electricity system in member countries of PEAC.

Member countries	Independent regulator (Africa Development Bank, 2021)	Market structure (Attia and Shirley, 2021)	Grid code	Private sector participation (Attia and Shirley, 2021; Eberhard et al., 2016)		
				Gen.[a]	Trans.[b]	Dist.[c]
Angola	Yes	Vertically-integrated	Yes	Yes	No	No
Burundi	No	Vertically-integrated	No	No	No	No
Cameroon	Yes	Vertically-integrated	No	Yes	No	Yes
Congo	No	Vertically-integrated	Yes	No	No	No
CAR	No	Vertically-integrated	No	No	No	No
Chad	No	Vertically-integrated	No	No	No	No
DRC	No	Vertically-integrated	No	No	No	No
Gabon	No	Vertically-integrated	No	Yes	Yes	Yes
E.Guinea	No	Vertically-integrated	No	No	No	No
ST&P	No	Vertically-integrated	Yes	Yes	Yes	Yes

[a] Gen. = Generation.
[b] Trans. = Transmission.
[c] Dist. = Distribution.

3.5.3. Organizational structure

The governance of SAPP has five levels: a Directorate of infrastruc ture and services; Executive Committee; Management Committee; Environmental, Market, Operations and Planning Sub-Committee; and Co-Ordination Centre (Southern African Power Pool, 2020). The governance structure within the SAPP is highly developed, with mem bers having laws that guide the electricity industry; the roles of the regulator are clearly defined (Africa Development Bank, 2020).

4. The case for a continent-wide power pool design underneath the AfCFTA

The regional pools have stimulated investment in interconnection infrastructure and the reform of regulatory and governance frameworks. Continent-wide measures can enhance the regional successes and bolster the business case for greater investment in the sector by expanding the potential market for generators, as well as transmission and distribution companies. The ten largest African economies, accounting for three-quarters of the continent's GDP, are scattered across different regional pools. These are Algeria, and Morocco in NAPP; Egypt, Ethiopia, and Kenya in EAPP; Ghana and Nigeria in WAPP; Angola in PEAC; and South Africa, and Tanzania in SAPP. Without a continent-wide framework, electric infrastructure investment will remain constricted by regional boundaries and balkanized design, operations and investment rules.

4.1. Benefit of integrating existing power pools

Integrating the regional power pools has the potential to increase energy security, improve the reliability of national electricity systems, increase the utilization of infrastructure, incent new investment, realize economies of scale for new investment, diversify the fuel mix of elec tricity supply, facilitate renewable energy integration, and, importantly, lower the cost of electricity for consumers.

4.2. Challenges of integrating existing power pools

The foundation for integrating national electricity systems has been laid already by the various regional power pools. Nevertheless, chal lenges remain and will have to be resolved for a continent-wide market to thrive. These challenges include:

1. Prioritizing resources and investments amongst competing national, regional, and continent-wide alternatives.
2. Resolving disputes around the allocation of cost-sharing.
3. Harmonizing regulatory and environment frameworks among member countries.
4. Accommodating divergent political ideologies and economic struc ture of different member countries.
5. Managing potential and perceived effects at the state level of external market on national champions, state-owned utilities, sovereignty, and energy independence.

The AfCFTA, being a new framework, presents an opportunity for all stakeholders to leverage the successes of the regional power pools while avoiding some their historic challenges.

5. Proposed continent wide market design framework underneath the AfCFTA

The AfCFTA presents Africa with an opportunity to develop a continent-wide framework that can promote the free movement of

Table 8
Summary of electricity system in member countries of SAPP.

Member countries	Independent regulator (Africa Development Bank, 2021)	Market structure (Attia and Shirley, 2021)	Grid code	Private sector participation (USAID, 2021; Attia and Shirley, 2021; Eberhard et al., 2016)		
				Gen.[a]	Trans.[b]	Dist.[c]
Angola	Yes	Vertically-integrated	Yes	Yes	No	No
Botswana	Yes	Vertically-integrated	Yes	Yes	No	No
DRC	No	Vertically-integrated	No	No	No	No
Lesotho	Yes	Vertically-integrated	Yes	No	No	No
Mozambique	Yes	Vertically-integrated	No	No	No	No
Malawi	Yes	Unbundled (G, T&D)	Yes	Yes	No	No
Namibia	Yes	Vertically-integrated	Yes	No	No	Yes
South Africa	Yes	Vertically-integrated	Yes	Yes	No	Yes
Swaziland	Yes	Vertically-integrated	No	No	No	No
Tanzania	Yes	Vertically-integrated	Yes	Yes	No	No
Zambia	Yes	Vertically-integrated	Yes	Yes	Yes	Yes
Zimbabwe	Yes	Unbundled (G, T&D)	Yes	Yes	No	No

[a] Gen. = Generation.
[b] Trans. = Transmission.
[c] Dist. = Distribution.

capital and skills for the design, development, financing, construction, and operation of electric infrastructure across Africa. The design of implementation steps should be cognizant of lessons learned from the experiences of regional markets in and outside Africa. Lessons include:

1. African countries and regional pools are at different stages of reforms, development, financial capabilities, private sector participation, environmental and social consciousness. Hence, the frameworks under the AfCFTA must be flexible enough to accommodate these developmental variations.
2. To achieve market integrations, the current national and regional institutions in the electricity sector will need to adopt common rules, regulations, and practices. The common regulations will need to be coordinated with existing regional institutions to minimize disruption and alleviate the fear of wholesale change and potential negative consequences, such as employment dislocation.
3. Regulatory, legal, technical and operational standards and structures need to be harmonized, within the regional markets and between member countries within the AfCFTA in order to promote improved reliability and facilitate electricity trading. It is recommended to build individual standards and structures off those of the most advanced pool (International Bank for Reconstruction and Development, 2015), which will frequently be those of SAPP.
4. Similarly, the harmonization of technical standards and regulatory frameworks in member countries will expand the breadth and depth of activities of financiers and investors in Africa's electricity sector if the perceived riskiness of the sector declines.
5. Finally, lessons learned from the successes in the various regional power pools within the continent suggest that reform must be organic and bespoke to the unique circumstances of each country if it is to be successful and enduring. Reforms need to be carefully designed and staged to accommodate the diversity in regulatory, legal, technical, commercial, and operational developments, and the politics of member countries, while at the same time remain focused upon the end goals.

Full electricity market integration takes decades to achieve, however, every individual stage of integration, investment and operational coordination offers tangible and worthwhile benefits.

5.7. *Market integration under the Auspice of AfCFTA*

The electricity sector of the member countries of the AfCFTA, and existing power pools in Africa are at different levels of development. Therefore, plans to integrate these markets for the security of electricity supply for Africans must be flexible, allowing each country and regional power to develop at its own pace. However, developments must be coordinated as a divergent development approach can put the harmonization of infrastructure development, commercial and legal frameworks and transparent information dissemination in disarray. Nevertheless, success in the leading countries will encourage the straggler nations to keep up to avoid missing out on potential benefits of lower electricity costs, skills development, and greater inbound investment. Considering that most member countries lack the infrastructure required to support a fully liberalized electricity market, institutions within the AfCFTA should align with regional pools to strengthen frameworks and infrastructure for bilateral contract markets.

5.2. *Proposed implementation steps for a continent-wide electricity market*

Regional electricity market integration typically evolves in four stages (International Bank for Reconstruction and Development, 2015). First, the transitional market focuses on identifying barriers to expanding electricity trade opportunities and the contestability of the supply and demand sides of the market. Second, wholesale competition is introduced into regional markets anchored by bilateral contracts. Third, wholesale market competition is expanded using standardized contracts while concurrently developing the rules and frameworks for the trading of ancillary product markets. Fourth and final, the market rules and frameworks evolve through a series of redesigns to become fully integrated, interconnected and synchronized markets across the region. With most of Africa lacking the infrastructure to meet local electricity demand, the rest of this paper focuses on the first stage of regional electricity market integration.

5.3. *Organization and functions of the AfCFTA bilateral contract transitional market*

The underlining philosophy for the organization of the proposed initial transitional phase of the AfCFTA bilateral contract market is to establish a framework that addresses the following principles.

1. Adoption of contract and terms that function within the prevailing structures of the current regional pools.
2. Ensure the contractual terms are vetted by regional lenders and investors and therefore deemed "bankable" from a lender's point of view.

3. Provide a bridging mechanism or forum to facilitate bilateral trades between countries in different regional power pools, and to identify and resolve any concerns raised by market stakeholders.

A key philosophical tenet of this paper is that any new undertakings towards an AfCFTA wide electricity market should not create over lapping bureaucracy with the operations of the regional power pool or the current market mechanisms. Rather, new undertakings should complement the status quo and facilitate evolutionary steps towards a common long-term vision. Adoption of a shared vision is an important early step and objective for an AfCFTA electricity market endeavour, and the initial transition phase described above is a concrete and pragmatic milestone to reinforce participants' commitments to the shared vision.

5.4. Roles and responsibilities at each organization level of the proposed AfCFTA bilateral contract transitional market

Similar to the organization structure of the regional power pools, the organization structure of the proposed bilateral contract transitional market will constitute (i) Conference of AfCFTA ministers, (ii) AfCFTA Executive committee, (iii) AfCFTA Management committee and sub committees, and (iv) The AfCFTA secretariat. The proposed organiza tion structure relative to the structure of the regional pools is shown in Fig. 3. Each level of the structure is explained in the following paragraphs.

1. The Conference of Ministers of member countries is required to ensure the alignment of the national and regional policies within AfCFTA. This includes harmonizing policy recommendations from the AfCFTA executive committee and driving national reforms. Re forms, such as the unbundling of generation, transmission, and possibly distribution systems, are necessary to facilitate non-discriminatory access to the transmission system by non-incumbent parties. In addition, the Conference of Ministers can bolster the po litical will to promote the harmonization of the grid codes, drive consent on the assessment of cross-border transmission capacity and transmission loss calculations, as well as promote adoption of other mechanisms underpinning transmission operations within the free trade area. Reforms such as these are immensely valuable for sup porting an atmosphere for attracting private and public investments towards the proposed AfCFTA bilateral contract market.
2. The AfCFTA executive committee: The executive committee will typically constitute the Chief Executive Officers of the power pools. This committee is responsible for bringing policy issues and recom mendations to the attention of ministers especially those limiting bilateral trades. In addition, the executive committee is responsible for promoting policy changes for developing new trading opportunities.
3. The AfCFTA management and subcommittees: Similar to the man- agement committees in established regional pools, the AfCFTA management committees will be responsible for reviewing and updating standards and procedures for planning, operations and the bilateral electricity trading structure within the Africa Free Trade Area. The management committee collaborates with the sub committees to translate trade opportunities identified by the AfCFTA executive committee into workable plans.

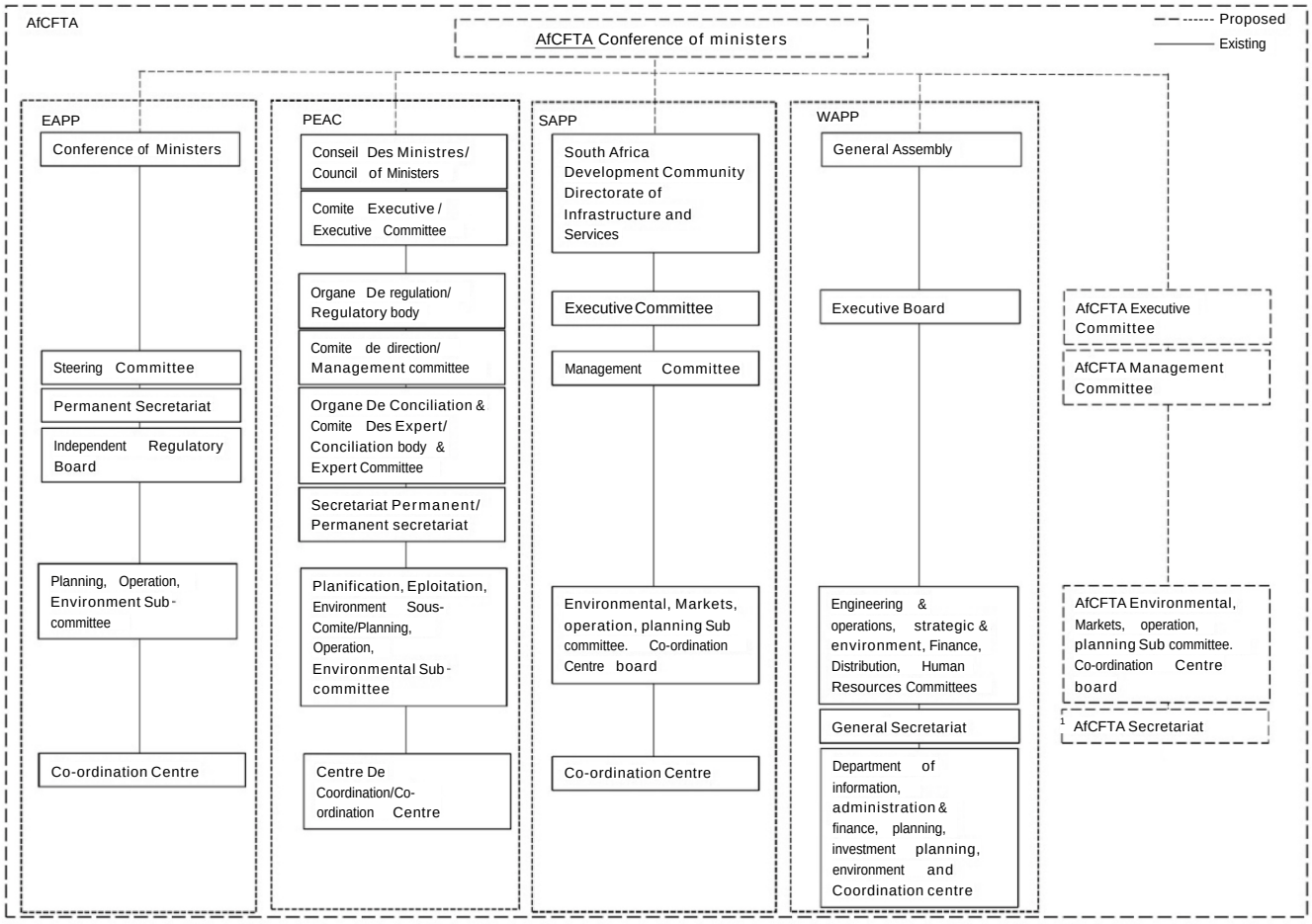

Fig. 3. Current organization structure of regional power pools in Africa and the proposed structure under AfCFTA.

4. The AfCFTA secretariat: The secretariat is ultimately responsible for the practical design and implementation of concrete steps to enact the AfCFTA continental electricity marketplace vision. In collaboration with the regional pools, the secretariat will coordinate and monitor the implementation of the inter-regional bilateral contract market and maintain comprehensive and up-to-date information on member countries' electricity infrastructure investment and development plans. The secretariat, with help from the regional power pools, will coordinate the harmonization of rules and regulations governing the transmission operations, system reliability standards, and settlement of electric power exchange across borders. The secretariat will provide guidance on the preparation of incremental electricity market trading mechanisms such as transmission tariffs and the auction of cross-border transmission capacity.

It is important that the design, implementation, and coordination of the bilateral contract market is sufficiently attractive to promote proactive participation. The secretariat will be responsible for designing mechanisms where the net benefits of participation in the market are attractive, and where the cost of breaking the rules are concrete and enforceable. For example, participants may be required to pool collateral (in a manner similar to arrangements undertaken by futures exchanges) as a precondition to market participation. If a market participant does not abide by certain rules, such as not contracting for sufficient ancillary services to ensure grid reliability, those services would be procured by (or for) the affected grid and paid for from the collateral account. Trust in participants' compliance with reliability standards and other operational codes is a necessary pre-condition to the development of a successful market. The implementation of the bilateral market standards does not have to be simultaneous across the continent but can allow for different integration pacing by region. Slower integrating regions will benefit from the experiences of the early adopters, while at the same time be prompted to take steps to secure the benefits for themselves from market participation. These contrasting forces can promote a healthy balance when managed appropriately. Finally, the bilateral market is expected to coexist with regional markets hence, the market operation processes need to be standardized for easy information exchange. In addition, processes should be streamlined to minimize the duplications of responsibilities between the regional and the continent wide markets. Table 9 highlights the responsibilities of the AfCFTA Secretariat and the responsibilities of their regional power pool counterparts.

5.5. *Potential limitations to the proposed continent-wide electricity market*

Challenges and limitations to the continent-wide electricity market include:

1. Limited transmission interconnection between countries and regions.
2. Inadequate generation capacity.
3. Challenges around revenue collection and subsequent impact upon investment mobilization.
4. Adverse effect of fuel and energy subsidies on investment landscape.
5. Weak and/or corrupt regulatory and organization institutions.
6. Interference of local politics on regulations.
7. Weak framework for electricity trading.
8. Limited trust and confidence by member countries in a continent-wide electricity market.
9. Potential conflicts between the interest of regional power pools and a continent-wide market.
10. Weak rules for accessing and wheeling energy across multi border transmission system.
11. Weak mechanisms for dispute resolution.

Table 9
Responsibilities of the AfCFTA secretariat/cooidination centre and the regional power pool secretariat/coordination centers.

Regional Level	Continental Level
Perform annual demand and generation resources assessment and balancing.	Perform long-term inter-regional transmission capacity assessment and planning.
Audit the state of readiness of members, owners and operators based on continent-wide standards.	Develop and coordinate the compliance of participating regional pools with the standards and regulation of the inter-regional bilateral market.
Coordinate regional transmission and generation expansion planning.	Enforce transmission reliability standards via penalties and/or exclusion from participation in the inter-regional market.
Set regional operation policies and limits.	Set inter-regional operation policies and limits.
Train operators, schedulers and dispatchers on regional and inter-regional operation standards.	Train inter and intra regional transmission system operators on continent wide operational standards.
Conduct reliability assessment and events review within the pool.	Conduct reliability assessment of transmission events.
Ensure compliance within the regional power pool.	Monitor all compliance issues relating to inter-regional interconnection.
Monitor regional bulk power system transmission and trading.	Monitor inter-regional bulk power transmission and trading.
Coordination of intra-regional project development initiatives.	Coordination of inter-regional project development initiatives.
Coordination of intra-regional settlement systems-physical and financial.	Coordination of inter-regional settlement systems-physical and financial.
Develop and enforce intra-regional reliability and standards operational codes.	Develop and enforce inter-regional reliability and standards operational codes.

6. Proposed implementation steps for AfCFTA bilateral contract transitional market

In the early stages of implementing the AfCFTA bilateral contract transitional market, the focus should be on developing documentation for the governance of the market and building regional institutions required for the successful operation of the market. It is important to implement these steps with minimum interference with the regional power pools or financial burdens to member countries. Two temporary committees and the secretariat, which are described below, should to lead the efforts pending the establishment of other formal entity described in subsection 5.4.

1. A regulatory advisory committee responsible for:
   - Keeping a comprehensive list of countries that have ratified the AfCFTA.
   - Preparing and coordinating the signing of the AfCFTA electricity market agreement by countries that have ratified the AfCFTA.
   - Harmonizing national/regional grid codes aimed at developing the grid code for the Africa Free Trade Area.
2. A transmission system operation committee tasked with identifying opportunities for expanding, reinforcing, upgrading and optimizing electric power generation capacity and cross-border interconnections.
3. A secretariat coordinating the implementation of technical, commercial and legal procedures for electricity infrastructure planning, development, operation, optimization and trading between countries in different regional power pools.

The committees and secretariat should be constituted upon submission of the protocol on trade of goods and services, rules, and procedures on settlement of dispute, competition policy, intellectual property, and investment to the Africa Union Assembly. It is important to constitute these committees and secretariat early in the design of the free trade area because of the importance of the electricity sector to the development of the continent and the attainment of the United Nation

Sustainable Development goal 7 (SDG 7) i.e. access to affordable, reliable, sustainable and modern energy for Africans.

7. Conclusion and policy implications

The African Continental Free Trade Agreement (AfCFTA) is expected to stimulate the efficient movement of capital, information, and products within Africa. However, legal, commercial, operational, and technical issues must be coordinated if the full potential benefits of the AfCFTA inspired electricity market are to be realized. Coordination of standards and physical elements of electricity generation, transportation, and consumption are precursors to efficient, reliable and sustainable electricity trade. Unlike most goods that can be stored inexpensively, electricity requires virtually instantaneous coordination of supply and demand. Additionally, electricity markets require the coordination of multiple layers of ancillary product markets and communications protocols to ensure a continuous state of contingency and preparedness to prevent power outages, safety incidents or other emergency events. Rules of origin, schedules of tariffs, schedules of concessions and other barriers to entering the electricity industry are issues that need to be addressed if truly contestable electricity market places are to be achieved. In addition to these issues, legal provisions relating to cost allocation for multi-border projects and for stranded costs, electricity market design, transmission capacity allocation for host utilities, congestion pricing, harmonization wheeling charges, safety, and environmental regulations, and coordination between Transmission Facility Operators (TFO) will have to be negotiated amongst market participants and market regulators. Negotiations of terms are complex and must account for national energy security constraints and concerns.

Due to the sheer size of investment required in Africa's power industry, there is a need for private investment in the sector. Most countries are likely to support arrangements that can help attract needed investment and expertise into new power stations and transmission lines conditioned upon member states not comprising their national energy security. The security concerns can be managed with a collection of policies such as ensuring a minimum utilization of indigenous generation or energy resources and prioritization of transmission capacity to serve priority local electricity needs. In addition, the AfCFTA will need to encourage reforms that increase governance and financial independence of regulators in member states, define and distinguish the roles of the national and regional TFOs, stipulate inter-TFO compensation mechanisms, ensure cross-border coordination of market design and operations, and promote the design of incentive-based trading models that, among other things, promote non-discriminatory network charges and allocate transmission congestion charges and revenues. Although the scope of negotiation is broad and crosses multiple specialities, the AfCFTA can leverage progress made by the regional power pool's current frameworks and their historic efforts to synchronise most of these areas amongst their member states.

In conclusion, this paper proposes a bilateral contract market under the auspices of the African Continental Free Trade Agreement (AfCFTA) to facilitate a truly contestable electricity marketplace within the African Continental Free Trade Area. The paper proposes a hybrid institutional framework that leverage the market, regulatory, and governance structures of the five regional power pools to foster electricity trade amongst these pools. The proposed bilateral contract market complements the structure of the regional power pools without encumbering them with unnecessary bureaucracy. Importantly, the bilateral contract market should be structured to ensure it stimulates investments as well as compliance with the market rules. Market participation benefits should clearly outweigh the costs. Non-compliance with the rules must carry penalties or expulsion from market participation that entails material costs. If implemented effectively, the bilateral contract market has the potential to stimulate new electric generation and transmission infrastructure developments among African countries scattered across the five regional power pools and consequently, improve the efficient supply of electricity on the continent.

CRediT authorship contribution statement

Babatunde Odetayo: Conceptualization, Methodology, Investigation, Writing - original draft, Writing - review & editing. **Michael Walsh:** Conceptualization, Methodology, Writing - review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

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