Prospects and Practice of Cross-border Electricity Pooling and Trading in West Africa

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i. Abstract

Cross-border electricity pooling and trading is increasingly modelled as a solution for overcoming the challenges of insufficiencies and inefficiencies in the electricity sector of many developing countries. Regional electricity pooling and trading can help lower energy costs, reduce power swings and shocks, alleviate shortages, speed up decarbonization, and create incentives for market expansion and integration. It is to this end that the West African Power Pool (WAPP) was formed in 2000 as a specialized agency of the (ECOWAS) to facilitate and govern important frameworks that could result in a more electricity integration and trading in West Africa. This study analyses the prospects, practice, and challenges of crossborder electricity pooling in the West African region. It concludes that although certain progress has been made to leverage the enormous opportunities in such cooperation, progress has been slow, incomplete, and uneven as a result of certain technical, economic and governance challenges.

ii. Abbrevations

ANARE – National Authority for the Regulation of the Electricity Sector.
ARSE – Electricity Regulatory Authority.
ASEAN – Association of Southeast Asian Nations
CEB – Communauté Electrique du Bénin
CEB – Communauté Electrique du Bénin
CEET – Compagnie Energie Electrique du Togo
CGC – Cenpower Generation Company Limited
CIE – Compagnie Ivoirienne d'Electricité
EAGB – Electricidade e Aguas da Guine-Bissau
EAGB – Electricidade e Aguas da Guine-Bissau.
ECG – Electricity Company of Ghana (ECG),
ECOWAS – Economic Community of West African States
ECREEE – Ecowas Centre for Renewable Energy and Energy Efficiency
EDG – Electricité de Guinée
EDG – Electricité de Guinée.
EDM -SA – Société Énergie du Mali SA
EDSA – Electricity Distribution and Supply Authority
ERERA – ECOWAS Regional Electricity Regulatory Authority
GRIDCO – Ghana Grid Company Ltd
LEC – Liberia Electricity Corporation
LERC – Liberia Electricity Regulatory Commission
MERPMEDER – Ministere de l'Energie, des Recherches Pétrolières et Minières, de l'Eau et du Développement des Energies Renouvelables.
NAWEC – National Water and Electricity Company
NBET – Nigerian Bulk Electricity Trading PLC
NEDC – Northern Electricity Distribution Company
NERC – Nigerian Electricity Regulatory Commission
NIGELEC – Nigerian Electricity Company
PURA – Public Utilities Regulatory Authority.
PURC – Public Utilities and Regulatory Commission.
SBEE – Société Béninoise d'Energie Electrique
SENELEC – Société nationale d'électricité du Sénégal
SOGEM – Societe de Gestion de l'Energie de Manantali
SONABEL – Die Société nationale d'électricité du Burkina
VRA – Volta River Authority
WAPP – West African Power Pool

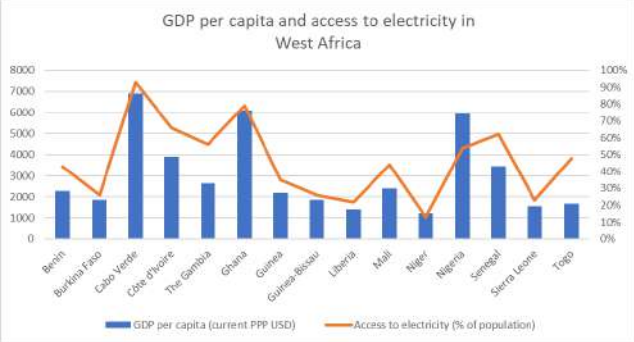
1. Background: The challenge of energy access in West Africa

West Africa, with its huge endowment of renewable and non-renewable energy sources, suffers from huge deficits in the generation, transmission, and distribution of electricity. individuals and businesses within the West African region are not only lacking in sufficient access to electricity supply but also have to pay significantly more than their contemporaries in other parts of Africa, for the limited supply.
According to the World Bank, only about half of its total population of 400 million people (200 million) have access to electricity, and those who do, pay among the highest prices in the world at $0.25 per kilowatt-hour (World Bank, 2021). The high cost of electricity increases the cost of efficient and productive economic activities, thus hindering sustainable and inclusive growth and development in the region. More specifically, it renders many industries and manufacturing sectors uncompetitive, hinders job creation, and slows annual GDP growth by between one and three percentage (Woolfrey, 2016). Furthermore, to cope with the deficit in energy access, many households and businesses especially within the most affected countries in the region, have resorted to more expensive alternative generation models, using costly, non-renewable, fuel-consuming generators, which also contribute significantly to environmental pollution. In addition, poor households lacking access to electricity and clean cooking facilities are constrained to embrace the use of traditional fuels that exacerbate air pollution and result in dire negative health consequences. Many stakeholders in the West African energy sector have come to realise that energy poverty in the region is closely connected to the grossly inadequate investment in national power systems and economic inequalities worsened by the absence of social safety nets (WAPP, 2020). Overall, these factors manifest in a self-reinforcing cycle of power supply deficit in the affected countries, notably characterized by low electricity access, shortage of electricty supply (relative to demand), high electricity supply cost, and transmission and distribution (T&D) losses. We discuss these factors and their manifestations in more details below.

1.1 Low electricity access and unmet demands

Due to limited fiscal resources coupled with competing demands, governments in many West African states have delayed in investing significant sums to connect all households and industrial clusters to the respective national grids. Therefore, as energy demand increases as the economy and the population grow, there is no corresponding growth in investment in electricity supply in each country across the region, leading to electricity supply deficits.
Table 1 below presents GDP per capita (PPP international dollars) and access to electricity (% of population) in each country. Cabo Verde, Ghana and Cote d'Ivoire are among the countries with the highest access to electricity, reaching 93%, 79% and 66%, respectively. This success suggests improvement in electricty sector policies, flow of investments and electricity sector efficiency in these particular countries, espeically in the recent years (World Bank 2022).

Fig 1: GDP per capita and access to electricity in West Africa



Source: Author's calculation based on Table 1

Table 1 shows the GDP per capita and access to electricity in West African countries, which vary significantly across countries. GDP per capita in the region ranges between USD 1,217 (Niger) and USD 6,913 (Cabo Verde), with access to electricity also varying from 13% (Niger) and 93% (Cabo Verde). As revealed in Figure 1, there is also a trend of correlation between GDP per capita and access to electricity in the region. Generally, this correlation shows that increase in GDP per capital, which is an indicator of fiscal resources for investments, significantly affects access to electricity in the countries. In this observation, however, the case of Togo and Nigeria are outliers.

In the case of Togo with a GDP per capita of $1671, a lower electricity access would have been expected; while in the case of Nigeria with GDP per capita of $5942, a higher electricity access would have been expected. This outlying observation suggests the influence of other external factors of institutional quality, sector efficiency, security and flow of domestic and foreign direct investments (Adeoye & Spataru, 2018; Odetayo & Walsh, 2021).

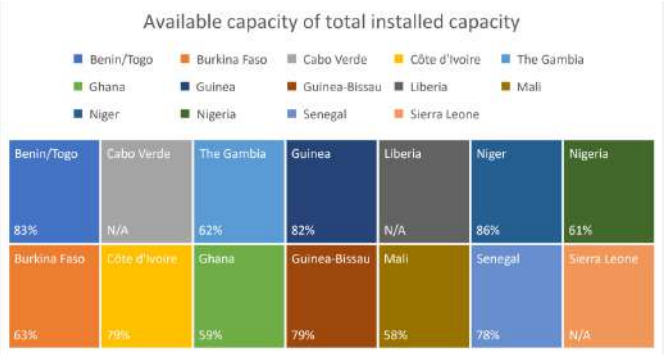
1.2 High electricity supply costs and technical losses

With low purchasing power, the cost of electricity supply remains high for many households across West Africa. The resulting inability to pay electricity tariffs results in low tariff collections by utility companies operating within the region which makes lending and investment in the electricity companies unattractive. Meanwhile, affordability is a keydeterminant of whether utilities will be able to meet demand and expand access. Majority of households cannot afford connection fees and the tariffs charged hence it limits the access. Without investments, the generation and distribution systems are not adequately maintained to assure improved power supply, leading to technical losses. The current combined installed electricity capacity in West Africa is 10,640MW, of which a mere 60% is in operation (ca. 6,500MW) (ERERA, 2019). Meanwhile, overall electricity demand in the region, fuelled by rapid urbanisation and population increase is estimated at 22,000MW (ERERA, 2019).

Table 2 below shows the transmission losses in West African countries, where available. Niger and Nigeria record the highest losses in total transmitted electricity in the region.

Figure 2 below also shows the percentage of available capacity out of total generated electricity for each country in the West African region, where available. It shows more utilization of generated electricity in Niger, Benin/Togo and Guinea; while Ghana, Mali, Gambia, Burkina Faso and Nigeria record the lowest utilization of generated electricity in the region.

Figure 2: Available capacity out of total installed capacity



Source: Author's calculation from WAPP, 2018

2. Rationale and opportunities of cross-border electricity pooling and trading in West Africa

In recognition of the potential and challenges of the region's electricity system, the Economic Community of West African states (ECOWAS) introduced a means of integrating the energy resources of member states through cross border electricity pooling and trading among west African countries under the umbrella of the West African Power Pool (WAPP). Cross-border electricity trading, within the context of the WAPP, was designed to connect electricity generating entities in one country with electricity consumers in another country within the region, thereby establishing a regional electricity market. The framework for the regional supply relies on the delivery of electricity, using the transmission network and cross-border interconnection by which the seller is committed to transfer the volume of electricity agreed to the buyer within the prescribed interval or intervals and at an agreed price. It is envisaged that through the WAPP, citizens and residents within the ECOWAS region will benefit, in the medium and long term, from the supply of regular and reliable energy at competitive prices, across borders. Greater cross-border trade in electric power is a potentially cost-effective way of connecting excess capacity in one country or region with demand peaks in another. Across the region, the economic benefits of the regional power market are evaluated at up to US$665 million per year, with the average cost of electricity generation expected to fall by between a quarter and a third (World Bank 2021).

Table 1: GDP per capita and access to electricity in West Africa

Countries	GDP per capita (constant 2017 PPP USD)	Access to electricity (% of population, 2018)
Benin	2287	43%
Burkina Faso	1867	26%
Cape Verde	6913	93%
Côte d'Ivoire	3902	66%
The Gambia	2642	56%
Ghana	6099	79%
Guinea	2189	35%
Guinea-Bissau	1865	26%
Liberia	1405	22%
Mali	2384	44%
Niger	1217	13%
Nigeria	5942	54%
Senegal	3459	62%
Sierra Leone	1561	23%
Togo	1671	48%

Source: World Bank, 2022 (Calculated in approximates).

Over the past 10 years, the World Bank has financed close to US$2.3 billion of investments in transmission infrastructure, and institutional capacity in support of the WAPP (World Bank 2021). Through expert interviews and document analysis, this paper identifies opportunities for creating the regional power pool. By creating a regional power market, regional energy cooperation allows countries to:

2.1 Maximize capacity through market balancing, reduced cost and greater efficiency

Cross-border electricity trading within the WAPP improves the connection between supply and demand for electricity by expanding the geographical reach of the energy markets. It allows participating countries to reduce the cost of electricity generation through its offering of a robust energy supply mix from the different participating countries. The pooling of energy resources and the interconnection of isolated electric power systems allows for trading and utilization of electricity based on reduced cost as a result of the optimal use of available energy and fiscal resources.

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Table 2: Transmission losses in West African countries

Countries	Access to electricity (% of population, 2018)
Benin	5.4%
Burkina Faso	2.3%
Cape Verde	N/A
Côte d'Ivoire	6.0%
The Gambia	N/A
Ghana	4.4%
Guinea	N/A
Guinea-Bissau	N/A
Liberia	N/A
Mali	N/A
Niger	12.7%
Nigeria	8.4%
Senegal	2.8%
Sierra Leone	N/A
Togo	5.8%

Source: ERERA, 2019

2.2 Increase electricity access, stimulate economic growth and reduce social inequality

Another benefit of the WAPP is that grid interconnections amongst the member states allows for the accelerated electrification of regions and areas that previously lacked electricity access, especially along the corridors of the borders between interconnecting countries. The resulting improvement in electricity access creates new economic frontiers and boosts productivity in already existing economic clusters, leading to an overall growth in both local and regional economy. Increased electricity supply also enhances socio-economic productivity within the local economy by enhancing storage of farm produce, reducing the amount of hours expended on household tasks and reducing the cost of operating small businesses, among others. Further, new and/or better access to electricity for communities often means improved access to educational opportunities, health care services, sanitation and other social amenities which contributes to overall social-economic development and wellbeing.

2.3 Improve Infrastructure investment and economies of scale

In the updated Regional Power Generation and Transmission Infrastructure 2019-2033 (Master Plan), ECOWAS recognized that increasing regional electricity sector integration requires a solid investment in infrastructure. A major benefit of cross border electricity pooling and trading is that it has created a framework, incentive and opportunity for investments, also from the private sector. Private sector investments and involvement in cross-border electricity projects will ease the financing constraints and will lead to better application of technical skills in project implementation and operation as well as in organizational and financial discipline. Further, cross-border electricity trading creates opportunity for investors to benefit from economies of scale in energy development within West African countries. It also reduces risks of investment by spreading the risk of affordability and capacity-to-pay.

2.4 Increase regional and inter-country cooperation, and trade-away conflict

A major benefit of WAPP is that it creates a regional electricity market that furthers intercountry and inter-regional cooperation through electricity trading. The experience establishing frameworks and legal apparatus for intra-regional electricity trading will also shape further and future inter-country and inter-regional exchanges in other sectors of the regional economy. Furthermore, the development of a regional markets through interconnected power systems and cooperation has the potential to contribute to reducing tendencies for political, economic or social conflicts and increase resilience particularly in fragile states, through regional cooperation.

2.5 Increase adoption of renewable energies and environmental sustainability

Cross-border electricity trading provides opportunities for tapping into the vast renewable energies in the region, particularly hydropower. West Africa remains a veritable ground for investment in hydropower, which has ample potentials to provide access to cheap and sustainable energy.

Figure 3: Opportunities of cross-border electricity pooling and trading in West Africa

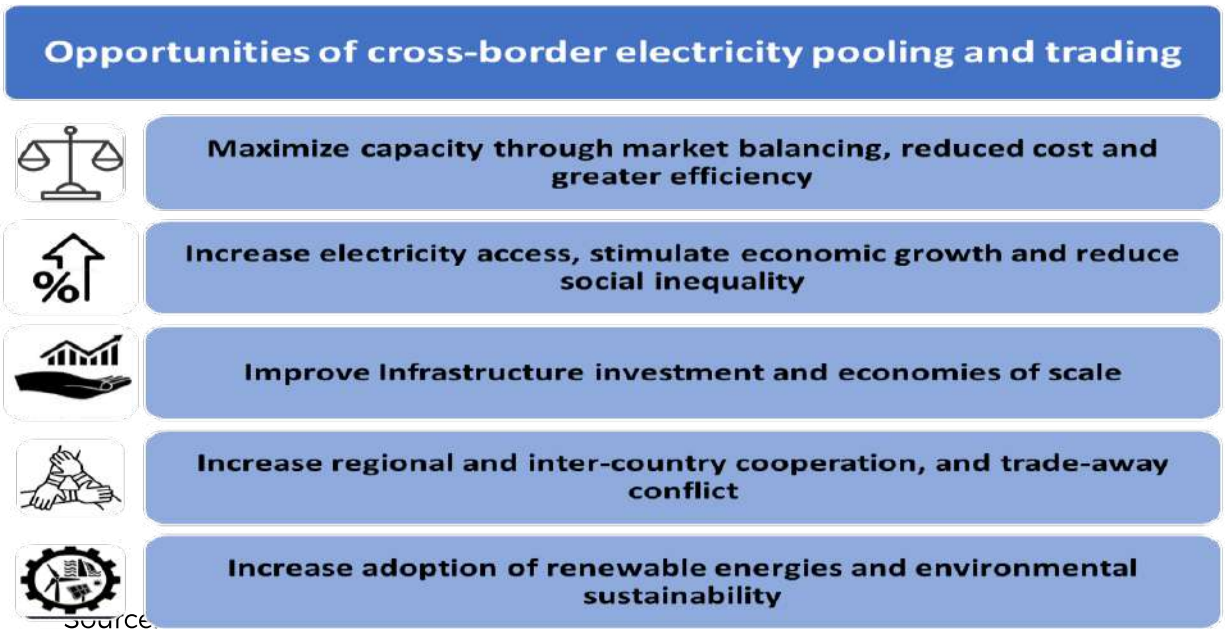

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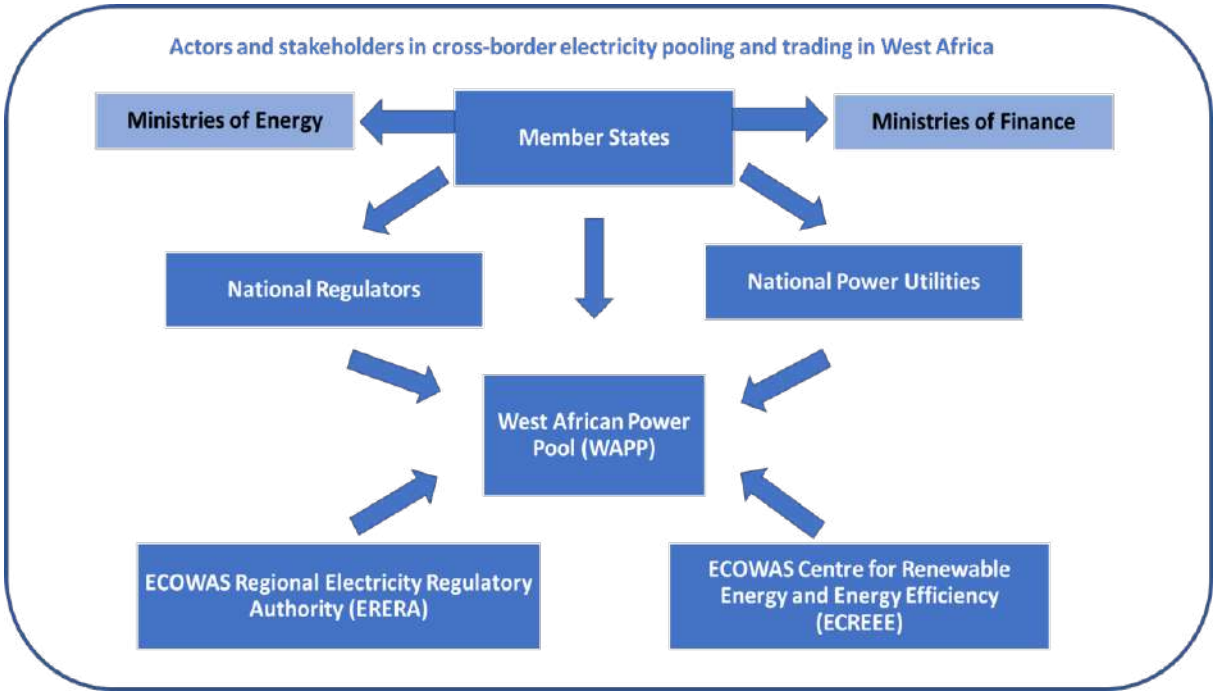
Figure 4: Actors and stakeholders in the cross-border electricity pooling and trading in West Africa



Source: Author's illustration

3. Actors and stakeholders in the cross-border electricity pooling and trading in West Africa

Governing actors and market stakeholders in cross border electricity pooling and trading include the following: (1) the West African Power Pool (WAPP) (2) the Member States through their Ministries of Finance and Energy; (3) National Power Utilities of Member States; (4) National Regulators of Member States; (5) the ECOWAS Regional Electricity Regulatory Authority (ERERA); and (6) the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE). Figure 4 below illustrates the actors and their connections in crossborder electricity pooling and trading in West Africa. The actors and their roles are further explained in the following sub-sections.

3.1 The West African Power Pool

The West Africa Power Pool (WAPP) was established by Article 1 of Decision A/DEC.5/12/99 of the Twenty-Second Summit of the ECOWAS Authority of Heads of State and Government. Article 2 of Decision A/DEC.5/12/99 provides that it shall be coordinated by a body composed of the meeting of the Ministers in Charge of Energy and the committee of Directors-Generals of electricity companies in member states. The functions of the body are as follows. (i) Prepare and establish an appropriate framework for the development of the West African Power Pool. (ii) Formulate recommendations on the financing and execution of projects selected within the framework of the West African Power Pool. (iii) Prepare a detailed financing plan and an implementation schedule for the master plan on the development of energy production facilities and the interconnection of electricity grids; and define to that end, the important phases, and the modalities for the coordination of the different segments of the West African Power Pool. (iv) Prepare a donors' meeting in collaboration with financial institutions. In line with the various instruments highlighted above, the WAPP presently exists and operates as an international body overseeing the operation of a bulk electricity transmission system for enhancing energy supply reliability within the West African region. To achieve its primary goal of integrating the power systems of its member countries for the purpose of operating a regional electricity market, the WAPP connects several private and public stakeholders in the generation, transmission and distribution segments of the electricity value chain in each of the countries that constitute the WAPP.

The WAPP Secretariat is located at PK6, Zone des Ambassades, Akpakpa, Cotonou in the Republic of Benin.

3.2 Member states through their Ministries of Finance and Energy

Cross-border electricity pooling and trading in West Africa consists of 14 of the 15 member states of the ECOWAS. The member states are Benin, Burkina Faso, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo. Cape Verde is the only member of ECOWAS who does not officially participate in the West African cross-border electricity pooling and trading under the WAPP. These states are officially represented through their ministries of Energy and Finance. The relevant roles of the market stakeholders are further laid down in Article 4 of Directive C/DIR.2/12/18 of the WAPP as follows:

3.2.1 Ministries of Energy

As noted in Article 4 of Directive C/DIR.2/12/18, the main role of the ministries of energy in the power pool is to manage and control the business of power generation, transmission and distribution, by doing the following. (i) Undertaking, publishing and officially adopting sound least cost power generation procurement plans that consider the availability of domestic and regional options for meeting national energy demands and is updated regularly. (ii) Adopting and ensuring follow-up of an appropriate procurement framework for the regular, competitive, and timely implementation of domestic power generation, transmission, distribution projects and power imports that is linked to the national least cost power generation plan. iii) Adopting a transparent policy regarding domestic energy security considerations that caps the domestic energy security premium at a reasonable level. (iv) Establishing a sound regulatory framework for the regular revision of the revenue requirement of the power utility based on evolving costs; and (v) Ensuring that revenue requirement of the sector is met primarily through tariff adjustments, or by an equivalent distribution of tariff adjustments and compensatory subsidies.

3.2.2 Ministries of Finance

As noted in Article 4 of Directive C/DIR.2/12/18, the main role of the ministry of finance in the power pool is to ensure that power utilities receive the necessary revenue required to deliver on their service obligations, by: (i) supporting the institutions to ensure that the electricity bills of all public sector institutions are paid in a timely manner and on a regular basis, through making appropriate budgetary provision for them and, if necessary, adopting prepayment mechanisms to support payment. (ii) adopting escrow accounts that ring fence utility revenues, accompanied with cascade or waterfall payment mechanisms that clarify the priority of payment of electricity creditors in situations of cash shortfall. (iii) budgeting and transferring in a timely manner any compensatory fiscal subsidies that may be required to meet the revenue requirements of power utilities if electricity tariffs are not set at cost recovery levels. (iv) introducing mechanisms of payment guarantees with the involvement of the technical and financial partners for the benefit of the electricity supplier; and (v) adopting a framework for recording, monitoring and making adequate fiscal provisions for energy related contingent liabilities, including those related to independent power projects and power imports.

3.3 National Power Utilities of member states

The main role of power utilities within the cross-border electricity exchanges is to maximize the efficiency of power distribution, by taking the following actions: (i) Adopting measures to enhance the full recovery of revenues from customers billed for electricity consumption. (ii) Adopting measures to reduce technical and non-technical losses on the transmission and distribution systems; and (iii) Complying with the terms of bilateral contracts for cross border power trade, whether as importers or exporters, in accordance with the requirements established by the ECOWAS Regional Electricity Regulatory Authority (ERERA).

The national power utilities in the ECOWAS member countries participate in cross-border electricity pooling and trading in the region, except for Cape Verde and Mauritania. Table 3 below presents the participating power utilities of member states.

3.4 National Regulators of member states

The main role of the National Power Sector Regulatory Authority is to establish the level of the revenue requirements of the power utilities and to determine the combination of tariffs and compensatory subsidies needed to cover these requirements. To ensure the smooth operation of the regional market, Member States are mandated to establish an independent regulatory authority where none exists. The majority of ECOWAS Member States have created national regulators to supervise the national power market in order to ensure transparent operation and financial viability of the sector through tariff regulation. The powers of the national regulators are presently limited to their national territories through issuing licences, tariffs, arbitration etc. All ECOWAS member state's regulators participate in the cross-border electricity trading and pooling, except Cape Verde and Mauritania. Table 4 below presents the participating national regulators of member states.

3.5 The ECOWAS Regional Electricity Regulatory Authority (ERERA)

ERERA was established in January, 2008 by Supplementary Act A/SA.2/1/08, as a specialized institution of ECOWAS, to carry out the function of a regional regulator for cross-border electricity interconnections in West Africa. In this regard, ERERA's general mission is to regulate cross-border electricity exchanges between ECOWAS Member States, while overseeing the implementation of the necessary conditions to ensure rationalization and reliability and contributing to setting up a regulatory and economic environment suitable for the development of the regional electricity market.

ERERA's mandate allows it to set rules for both the technical and economic regulation of all cross-border electricity trading within the ECOWAS region. Additionally, ERERA is responsible for ensuring the development and monitoring of the regional electricity market and is equally vested with quasi-judicial powers to resolve disputes amongst market participants. In addition to its role on the regional market, ERERA also has powers to, upon request, assist member States as well as National Regulators on technical issues with respect to domestic regulation.

To attract investments for the development of the market, ERERA prepared market directive for necessary reforms of the regional electricity market which addressed the following issues: Market Design; Structure of national electricity markets; Regional transmission network operators; Harmonization of contracts; Strengthening of national regulatory authorities; Tariff methodology; and Support for implementation of directives.

3.6 The ECOWAS Centre for Renewable Energy and Energy Efficiency

The Ecowas Centre for Renewable Energy and Energy Efficiency (ECREEE) is a specialized centre of the ECOWAS saddled with the mandate to promote regional renewable energy and energy efficiency markets in West Africa, as part of measures to address the energy supply deficit in the region. In 2008, the 61st Session of ECOWAS Council of Ministers adopted the regulation C/REG.23/11/08 and gave the Centre a legal basis. It commenced operation in 2010 with support of ECOWAS, the Governments of Austria and Spain and key technical assistance of the United Nations Industrial Development Organization.

4. Current status of cross-border electricity pooling and trading in West Africa

Given the rationale, the opportunity and frameworks, cross-border electricity pooling and trading is already underway in the West African region, albeit with some challenges. This section presents the current status of the different synchronous blocks of the WAPP, which were established on high voltage interconnections, and through which electricity trading and transmission takes place within the regional electricity market. Sub-section 4.1 explains the different blocks and their integration; sub-section 4.2 discusses the status of electricity trading within the regional power pool; while sub-section 4.3 presents the current priority projects of the power pool.

4.1 Blocks of electricity pooling within the WAPP

The different blocks that currently make up the WAPP are :

- **Block A:** Burkina Faso, Ghana, Côte d'Ivoire, part of Mali (up to Bamako) and part of
- Togo/Benin.
- **Block B:** Senegal, Mauritania, and parts of Mali (up to Bamako).
- **Block C:** Nigeria, Niger, and parts of Togo/Benin. Other countries of the WAPP which are not connected to each other through the High Voltage (HV) grid but which trade in isolation are Guinea, Guinea Bissau, The Gambia, Liberia and Sierra Leone.

Taken together, Côte d'Ivoire and Ghana have a surplus of installed electricity capacity in comparison to their neighbours in Block A and C. The challenges with frequency control and operating limits of the electricity transmission network in Nigeria have impaired the ability to synchronise Blocks A and C, connecting Ghana through Togo and Benin and to Nigeria. Compared to other countries within Blocks A and C, Nigeria has a significantly larger land mass and invariably requires more investment to optimize the operations of its national grid to minimize frequency deviations. However, until the concerns with operational stability of the grid in Nigeria have been addressed, the frequency challenges will continue to impact the operations and integration of the WAPP Blocks A and C. Further, although Mali is connected to both Côte d'Ivoire and to Senegal in Blocks A and B, it does not import electricity synchronously from both countries, as a result of technical inadequacies leading to low voltages and the deactivation of grid protection systems. Notwithstanding the increasing penetration of wind and solar electricity in the grid in Senegal and Mauritania (Block B), integrating generated electricity from these renewable energy sources have proven to be problematic due to operational problems in maintaining the frequency and voltage criteria, as a result of lack of reserves in the system. There is zcurrently no interconnected network in Cape Verde, given the prevalence of decentralized and fragmented transmission and distribution networks in the island country.

4.2 Electricity trading within the WAPP

11 of the 14 members of the WAPP are currently involved in electricity trade in the West African region as shown in Table 5 below. Benin, Burkina Faso, Mali, Niger, Senegal and Togo are net importers, while Nigeria, Côte d'Ivoire, and Ghana are net exporters, all with significant volumes of cross-border trade.

Table 3: Participating Power Utilities of Member States

Member States	Participating Power Utilities of Member States
Benin	Société Béninoise d'Energie Electrique (SBEE), Communauté Electrique du Bénin (CEB)
Burkina Faso	Die Société nationale d'électricité du Burkina (SONABEL)
Côte d'Ivoire	Côte-d'Ivoire Energies (CI-ENERGIES), Compagnie Ivoirienne d'Electricité (CIE)
The Gambia	National Water and Electricity Company (NAWEC)
Ghana	Volta River Authority (VRA), Northern Electricity Distribution Company (NEDC), karpowership Ghana Company LTD (KARPOWERSHIP), GTS Engineering Services (GTS), Ghana Grid Company Ltd (GRIDCO), Electricity Company of Ghana (ECG), Cenpower Generation Company Limited (CENPOWER/CGC), CENIT Energy Ghana (CENIT), GTG Energy LTD (GTG)
Guinea	National Water and Electricity Company (NAWEC)
Guinea-Bissau	Electricidade e Aguas da Guine-Bissau (EAGB)*
Liberia	Liberia Electricity Corporation (LEC)
Mali	Societe de Gestion de l'Energie de Manantali (SOGEM), Société Énergie du Mali SA (EDM-SA)
Niger	Nigerian Electricity Company (NIGELEC)
Nigeria	TCN, Nigerian Bulk Electricity Trading PLC (NBET), Mainstream Energy Solutions Limited (MAINSTREAM)
Senegal	Société nationale d'électricité du Sénégal (SENELEC)
Sierra Leone	Electricity Distribution and Supply Authority (EDSA)
Togo	Contour Global Togo (CONTOURGLOBAL), Compagnie Energie Electrique du Togo (CEET), Communauté Electrique du Bénin (CEB)

*Government-owned
Source: Author's compilation

Electricity is currently been planned to be traded in all the 33 regions of the WAPP. So far, electricity is been traded in only few of the regions. The 33 regions as shown in Figure 6 below, represent the interconnection nodes in each country, with 25 transmission interconnectors between them. 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 (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 after the implementation of the priority projects (WAPP, 2021)

4.3 Current priority projects within the WAPP

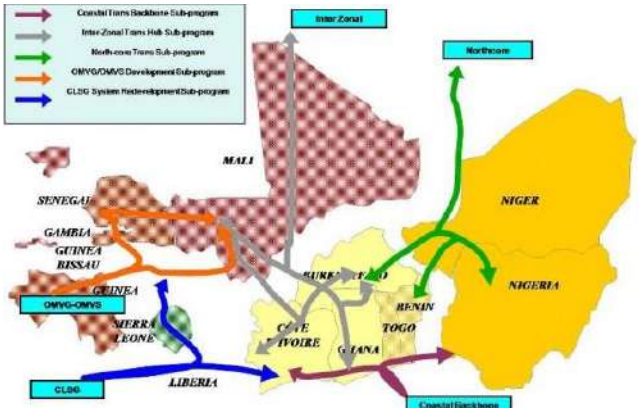
The following are some of the major priority projects that are currently underway and their expected commission dates (WAPP, 2020):

330 kV Nigeria - Benin Interconnection Reinforcement Project

- Pre-investment studies financed by NEPAD-IPPF, USAID, GIZ and beneficiary utilities (CEB and TCN) are being finalized. These studies are experiencing delays partly because of the COVID-19 related health crisis.
- Estimated cost of works is 115.1 million Euros.

- First Donors' Roundtable held on 19th November 2020. 120.59 million Euros of funding pledges were made.
- Expected to be commissioned in 2023.

Figure 5: Blocks of electricity pooling with the WAPP



Source: WAPP/IRENA (2013)

330 kV WAPP Median Core Interconnection Project

This project is the first segment of the East-West Transversal Backbone (Nigeria-Senegal). The project is expected to link Nigeria, Benin, Togo, Ghana, and Côte d'Ivoire.

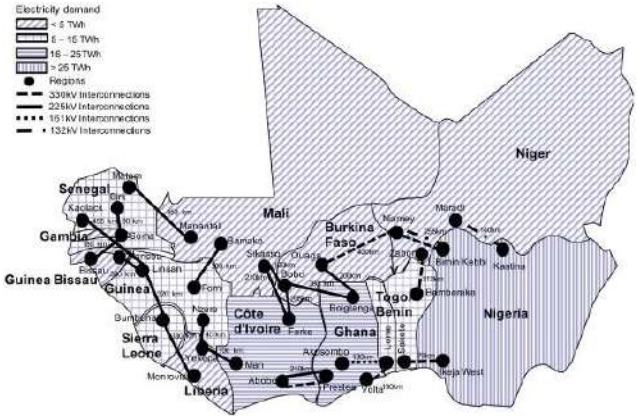
- Funding of pre-investment studies in the amount of 6.8 million USD by the World Bank.
- Terms of Reference (ToR) for studies are finalized.
- Recruitment of Consultants for the pre-investment studies are being finalized.
- Expected to be commissioned in 2025.

Côte d'Ivoire – Guinea Interconnection Project

- Funding for the pre-investment studies is being sought.
- Estimated amount US $5.44 million presented to the Technical and Financial Partners (TFPs) at the December 2020 round-table.
- Term of Reference (ToR) for pre-investment studies are being finalized
- Expected to be commissioned in 2025.

The map below illustrates the expected development of the West African power system by 2033 to meet this growing demand. The dark blue lines are the current transmission lines;the light blue lines are the transmission lines that are close to commissioning, under construction, or projects that has reach financial closure; dotted red lines are the future planned transmission lines (World Bank, 2021).

Figure 6: Existing and proposed interconnections in West Africa by 2023



Source: WAPP (2015) in Adeoye and Spataru (2018)

5. Challenges of cross-border electricity pooling and trading in West Africa

Cross-border electricity pooling in West Africa is not yet optimal as a result of several factors. They include: Market Disparity, weak legal and institutional frameworks; technical, network and interconnection deficiencies; overlapping functions and bureaucratic delays; and insufficient capital and investments. These factors are further discussed in the below sub-sections.

5.1 Market Disparity, weak legal and institutional frameworks

The creation of a regional market consisting of countries with varying and wide differences in the status of their national markets has been a major challenge in the setting up of the ECOWAS regional electricity market. The 14 countries involved in the West African Power Pool range from very small countries with vertically integrated state-owned utilities to partially unbundled systems and on to countries such as Nigeria that have fully unbundled and privatized the erstwhile state-owned power companies. Whereas some of the power sectors in some West African countries are fully unbundled and privatized, there are other countries that do not have any form of private sector participation (see Table 6 below). The resulting disparity in the status of the various national markets with regards to the reform and operations of the individual domestic markets similarly creates a mismatch of policies that lead to different reactions of the different participants to market stimuli within the WAPP.

Table 4: Participating National Regulators of member states

Member States	Participating Power Utilities of Member States
Benin/Togo	Ministere de l'Energie, des Recherches Pétrolières et Minières, de l'Eau et du Développement des Energies Renouvelables (MERPMEDER).
Burkina Faso	Electricity Regulatory Authority (ARSE)
Côte d'Ivoire	National Authority for the Regulation of the Electricity Sector (ANARE)
The Gambia	Public Utilities Regulatory Authority (PURA).
Ghana	The Ghanaian Energy Commission; and the Public Utilities and Regulatory Commission (PURC).
Guinea	Electricité de Guinée (EDG)
Guinea-Bissau	Electricidade e Aguas da Guine-Bissau (EAGB)*
Liberia	Liberia Electricity Regulatory Commission (LERC)
Mali	Electricity and Water Regulatory Commission (CREE).
Niger	Authority for the Energy Sector (ARSE)
Nigeria	The Nigerian Electricity Regulatory Commission (NERC)
Senegal	Electricity Sector Regulating Committee (CRSE)
Sierra Leone	Electricity and Water Regulatory Commission

*Government-owned
Source: Author's compilation

Figure 7: Current and planned priority projects within the WAPP

Source: The World Bank (2021)

Furthermore, although the harmonisation of technical specifications (known as 'grid codes'), operating procedures and standards, and legal and regulatory frameworks are key requirements for the safe and reliable operation of grids in cross-border power trade, most of the countries in the region do not have yet (see Table 6 below).

5.2 Technical deficiencies

Inadequate cross-border transmission capacities and domestic infrastructure issues hinder large-scale electricity trade. Across the WAPP, it is observed that many countries encounter voltage problems on their grid. This observation is especially true in the north of the coastal countries like Ghana, Côte d'Ivoire, Togo, Benin. In these countries, most of the generation and large load centres are located along the coast while few generators exist inland to control the voltage profiles. Furthermore, many countries currently experience load shedding needs due to insufficient generation capacities especially at peak demand (evening times). Other causes of load shedding include problems such as the lack of reserves, frequency, and voltage deviations. The distribution grids of many west African countries are also relatively old and need to be maintained. The development and maintenance of these distribution grids are of importance in order to reduce the high losses on the distribution network.

Table 5 – Cross-border electricity trade in West Africa in 2018

Countries	Cross-border electricity exports (GWh)	Cross-border electricity imports (GWh)	Net import of electricity (imports – export) (GWh)
Benin	0	1299	1299
Burkina Faso	0	783	783
Cabo Verde	0	0	0
Côte d'Ivoire	1,078	16	-1,062
The Gambia	0	11	11
Ghana	740	140	-600
Guinea	N/A	N/A	N/A
Guinea-Bissau	N/A	N/A	N/A
Liberia	0	0.01	0.01
Mali	0	459	459
Niger	0	964	964.3
Nigeria	2802	0	-2802
Senegal	11	321	310.3
Sierra Leone	0	0	0
Togo	4.6	1532	1449

Source: WAPP (2018) and ERERA (2019)

5.3 Network and interconnection deficiencies

The networking and interconnection of grids for cross-border electricity pooling and trading face many difficulties, including weakness of network codes, absence or weakness of the rotating reserve, and manual dispatching of electricity.

These weaknesses result in frequent and long interruptions since the reenergization must be done manually in most cases. This factor also limits the possibility of integrating of intermittent renewables to the grid. Furthermore, many countries in the region lack the technical skills required to optimally and effectively dispatch electricity at the national level. These inefficiencies in dispatching as well as in the monitoring of national flow of electricity in dispatch centres hamper the process of gathering data and modelling electricity distribution for cross-border trading forecasting.

5.4 Overlapping functions and bureaucratic delays

Due to overlapping functions, the roles of responsibilities for most of the actors and stakeholders in cross-border electricity trading in the region are sometimes unclear and, in some cases, overlaps. Countries like Ghana, where 2 different regulators (PURC and Energy Commission) exist with similar roles and responsibilities in monitoring of contracts in the power pool, is an example of such complexities. Furthermore, in countries like Nigeria and Ghana where there are many actors and stakeholders involved in the electricity sector, there are often bureaucratic delays and difficulties in reaching agreements and financial close for the development of new projects for cross-border electricity trading in the region.

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5.5 Insufficient capital and investments

One of the biggest challenges in cross-border electricity pooling and trading in the region remain the inadequate mobilisation of affordable financing for inter-connection infrastructure projects, which are often perceived as a high-risk investment due to identified technical, commercial and collection losses. In Nigeria and other countries where the generation segment of the electricity value chain has been privatized, there has been a notable rise in the level of investment in electricity generation.

This rise in investment in the generation subsector is often met with a corresponding lack of investment in transmission and distribution sub-sectors, which remains mainly controlled by the government in most countries (see Table 6). The development of the transmission lines in various countries within the West African region is without a doubt sine-qua-non to the success of the WAPP, as it is critical to attracting more private sector investment in electricity generation and distribution as well as in reducing technical losses through improved maintenance.

Table 6 – Electricity systems in member countries in cross-border electricity pooling and trading under the WAPP

Countries	Market structure	Independent regulator	Grid code	PSP* in Gen*	PSP* in Trans*	PSP* in Dist*
Benin	Vertically-integrated	Yes	No	No	No	No
Burkina Faso	Vertically-integrated	Yes	No	Yes	No	No
Côte d'Ivoire	Vertically-integrated	Yes	No	Yes	Yes	Yes
The Gambia	Vertically-integrated	No	No	Yes	No	No
Ghana	Unbundled	Yes	Yes	Yes	No	Yes
Guinea	Vertically-integrated	Yes	No	Yes	Yes	Yes
Guinea-Bissau	Vertically-integrated	No	No	Yes	No	No
Liberia	Vertically-integrated	No	No	No	No	No
Mali	Vertically-integrated	Yes	No	No	No	No
Niger	Vertically-integrated	Yes	No	No	No	No
Nigeria	Unbundled	Yes	Yes	Yes	No	Yes
Senegal	Vertically-integrated	Yes	Yes	Yes	No	No
Sierra Leone	Vertically-integrated	Yes	Yes	Yes	No	No
Togo	Vertically-integrated	Yes	Yes	Yes	No	No

*Private Sector Participation
*Generation
*Transmission

6. Conclusion

This study draws out the prospects, practices and challenges of cross-border pooling and trading in West Africa. While the case for power pools is strong and promising, it will take time and incremental gains for countries to put their trust in an inherently flexible, yet less predictable model for regional energy trade. Although the framework for cross-border electricity pooling and trading in the West Africa region was set up under the West African Power Pool (WAPP) to leverage the enormous opportunities in such cooperation, progress has been incomplete and uneven as a result of certain challenges. Power pools depend on a critical mass of surplus capacity, which is not yet sufficiently available across the region.

At the same time, in some country cases where there are surplus generation capacities, there is the risk of countries ending up with capacity they cannot use as they are not able to trade in the power pool as result of inefficiencies in grids and interconnections. Such structural deficit in many of the countries regions does not make a strong case for expensive interconnection investments or to make use of short-term market mechanisms. Although these challenges to achieving functioning power pools in the region are mainly technical and economical, they also have political dimensions. Power pooling requires strong willingness, trust and a strong alignment of interests between the region's member states, between the region (and/or member states) and the national private sector, and between external partners and member states.

While efforts are ongoing to rectify these challenges in the short and medium term through regional cooperation, it is equally important to keep the momentum around longer-term planning going. There is the need for more in-depth research in evaluating benefits and costs, which would help to attract both public and private investors. Frequent dialogue and knowledge exchange among stakeholders are required to ensure coordination of interventions and techno-economic improvements in the electricity pool. Furthermore,
lessons and best practice can also be drawn from more mature regional power markets, such as those in Europe and the Association of Southeast Asian Nations (ASEAN).

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