Regional Integration and Energy Sustainability in Africa: Exploring the Challenges and Prospects for ECOWAS

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Abstract
This study explores the strategic role of infrastructural development in supporting regional integration for sustainable development in Africa and assesses the effectiveness of regional integration in driving energy sustainability and vice versa. It had been argued that one of the strong pillars of regional integration for development is infrastructural development. Energy is also a key infrastructure for development of any economy and region as it is used to support household, commercial, and industrial activities. In strengthening the effectiveness of regional integration, regional energy integration should be considered as an important policy issue. It is therefore necessary to explore the extent to which regional integration can be a viable tool in driving energy sustainability in the Economic Community of West African States (ECOWAS) sub-region, which forms the motivation for this study. The study, thus, examines the existing opportunities and the attendant challenges for improved firms' productivity in the region through the appraisal of the ECOWAS West African Power Pool (WAPP). Using three measures of energy sustainability namely energy security, energy equity, and environmental sustainability; the study presents the performance of the ECOWAS sub-region in ensuring regional integration for energy sustainability. The findings from the study reveal, inter alia, that there are prospects and benefits for energy integration for sustainable development in the region. However, even though some progress had been made, there are many challenges ranging from weak institutions, insufficient technical infrastructure, low investment to inadequate unified macro policies. These challenges continue to act as constraints to achieving the objectives of the WAPP plan for energy integration. Also, where progress had been made, it is not uniform across the region, even though rising population and political instability could be responsible factors. It is recommended that the political economy surrounding regional energy integration should be given a priority among member states to ensure that there is positive political will for speedy achievement of set goals. Also, investment in human capital to manage the numerous projects and maintain the facilities cannot be overemphasised.

Keywords: ECOWAS, Energy, Green growth, Sustainable development, Regional Integration
JEL Code: F15; P28; Q43; R11; R58

Introduction

In the wake of the need for Africa to follow a new development trajectory, sustainable development continues to occupy a top priority in policy making. As a model of development, it emphasises a development strategy that integrates environmental concerns into economic and social objectives so as to ensure that future generation have sufficient resources for their development. It provides opportunity for economies to grow and develop while also using resources in a sustainable manner that does not pollute the atmosphere and create health concerns. There is no doubt that sustainable development is the most preferred approach for attaining development objectives and this is evident in the United Nations Sustainable Development Goals (SDGs).

The energy sector is one of the identified sectors that are strategic to achieving the targets of the SDGs. The importance of energy in sustainable development cannot be over-emphasised considering that energy is vital to providing an array of necessary services (Organisation for Economic Co-operation and Development-OECD, 2007). Energy is also an essential component in the development process of an economy considering that it serves as an important source of revenue for government (Akinyemi *et al.,* 2017a). Energy is equally identified as a defining infrastructure pillar for connecting Africa as documented in the African Union (AU)'s Agenda 2063. The energy sector in terms of production, supply and distribution, can advance sustainable development by producing and delivering secure and environmentally-friendly sources of energy while also increasing energy efficiency in use (OECD, 2007). This can occur by ensuring energy sustainability.

Energy sustainability emphasises the provision and availability of energy in a manner that it meets the demand of the present without affecting the capacity of the future to meet their own demand. Driving a sustainable energy framework has become important, among other things, to enhance firm productive and maximise overall welfare needed for sustainable development. This makes energy sustainability a key pillar of sustainable development as it integrates with environmental sustainability as activities of the energy sector contributes to greenhouse gas emission, and thus, ensuring sustainability in the sector can equally ensure sustainability of a cleaner environment. The channel through which energy sustainability helps to achieve sustainable development is basically through adoption of energy efficiency and renewable energy. This does not only enhance environmental quality, but also, there will be access to affordable, reliable, sustainable and modern sources of energy (Egbetokun,

Osabuohien & Akinbobola, 2018). Also, given that inclusive growth and development is a desirable status for many economies, energy sustainability becomes essential, as economic activities will be paralysed in the absence of reliable and sustainable supply of energy. Economies require uninterrupted supply of electricity to power industrial activities and improve quality of living.

In accelerating progress towards meeting the targets of SDGs, regional integration is essential. Regional integration and co-operation is a major component of Africa's vision for its future (Africa Energy Outlook, 2014) as there are many regional externalities that can only be addressed through regional co-operation (Melo & Tsikata, 2014). It represents a key strategy that enables governments of African economies to enhance the transformation of their economies while also improving access to foreign technology, resources, ideas and investment (United Nations Economic Commission for Africa-UNECA, 2010; Ejemeyovwi, Osabuohien & Osabuohien, 2018). Programmes to cultivate transport, energy resources, communication networks and information technology would accelerate trade progress and transform Africa into a haven for investment (UNECA, 2010). There is however, usually a gap in the potential gains from regional integration and actual record of achievement in Sub-Saharan Africa-SSA (Africa Energy Outlook, 2014). Despite diverse efforts and initiatives, Africa's regional integration had not been impressive, as it has not brought significant improvements in intra-Regional Economic Community (REC) and intra-Africa trade (see UNECA, 2010; Olapade *et al.*, 2016). One of the reasons for this low performance is inadequate infrastructural development. Infrastructural development is usually one of the building blocks of economic progress. Cooperation arrangements through the Regional Economic Communities (RECs) are expected to foster African's integration with the various regional infrastructure Master Plans providing an added impetus for a more coherent approach to Integration (Africa Development Bank-AfDB, 2015).

As asserted by AfDB (2015), the support for regional infrastructural development is necessary for strong regional economic integration. Regional business infrastructure is a crucial component for the success of regional economic integration. The level of infrastructure has a direct bearing on the competitiveness of a region/country and by extension, its investment attraction (Rintaugu, 2016). Therefore, for regional integration to be effective in driving sustainable development and higher levels of economic progress, adequate infrastructural development is a priority as many indicators of development depends

on it. This is the overall objective of this study: it seeks to critically assess on one hand, the role of energy infrastructure in enhancing regional integration through energy sustainability, which will then improve the productivity of firms in the region. On the other hand, the study investigates the prospects and challenges of sustainable regional energy integration for the ECOWAS sub-region.

The experience of the European Union (EU) has shown that regional integration can be a useful tool to facilitate the adoption and implementation of renewable energy and energy efficiency that can promote energy security and sustainable development. This is where the motivation for this study lies. It seeks to investigate the extent to which regional integration is capable of being a viable tool for supporting sustainable energy development through improved energy supply. This is done with the case study of The West Africa Power Pool (WAPP). This is particularly interesting as the challenge of meeting rapidly growing electricity demand experienced in the West African region continues to play a key role in the low economic development rate of the region (Adeoye & Spataru, 2018). This makes regional energy systems integration a key factor in accelerated development. Energy integration across the borders can then be a channel for accelerating progress towards meeting the goal 7 of the Sustainable Development Goals. It can also be a major step towards relieving a number of the trans-border constraints on the energy sector development and further expand energy trade (Africa Energy Outlook, 2014). It aims towards supporting energy security for adequate access to reliable supply needed for expanded trade. Regional electricity integration and cooperation through grid interconnections and power cooling had recognised as a cost effective means of ensuring reliability of supply (Niyimbona, 2005).

Despite the laudable prospects of energy integration in the regions, lack of infrastructure continues to be a barrier (Africa Energy Outlook, 2014). It also remains one of the chief obstacles to intra-African trade, investment and private sector development (UNECA, 2010). There had been talks on having regional power pools such as the West African Power Pools (WAPP) and Southern African Power Pools (SAPP), among others that centre on plans to strengthen inter-connections, which optimises the use of installed capacities and also increases energy efficiency. There are also indications that regional integration can be used to address current energy crises in the region. The challenge of developing a harmonious energy policy that reflects common interest of countries in the sub-region, continues to hamper progress and implementation of a regional energy integration plan.

In the light of the above backdrops, the motivation for this study is important for two reasons. The establishment of a regional cooperative network/framework is needed to assist in human infrastructure development in the energy sector (AfDB, 2013) that can engender sustainable development in the region. Also, the adequate utilisation of the abundant energy resources in the region can enhance the export of surplus energy (particularly clean renewable energy) to support energy security and the transition to green economy in the SSA region (Akinyemi *et al.*, 2017b). The rest of the paper discusses the conceptual clarifications where the relevant concepts used in the paper were discussed. Energy resources endowment of the ECOWAS region, the regional power pool called WAPP with an appraisal of its performance in driving energy sustainability was also included in the other sections. The final part of the paper presents some policy implications, conclusion and recommendations.

Conceptual Clarifications

Regional integration can be viewed as an arrangement where countries of the same region enter into an agreement to enhance economic cooperation through agreed institutions and rules, focused on removing barriers to free trade, free movement of people and capital within the specific region (Rintaugu, 2016). As an economic arrangement, it seeks to enable freedom of movement of people, capital, goods and services across the borders while ensuring there are no barriers to trade. The countries unite to forge means of ensuring economic progress that will support sustainable development. The economic aim is to create larger and more attractive markets, link landlocked countries to international markets, and support intra-African trade (AfDB, 2015). It goes beyond ensuring free trade and removing barriers.

According to UNDP (2011), regional economic integration is much broader than simply liberalising trade. It encompasses investments in regional infrastructure, harmonisation of regulations and standards, adopting common approaches to macroeconomic policy, management of shared natural resources and greater labour mobility. Harmonising policies and having a common approach to management of natural resources serves as part of the objectives for regional integration. The major rationale for regional integration is premised on the assertion that there is strength in numbers and in unity, thus, this strength can speed up the rate of development while also enhancing security (Chingono & Nakana, 2009). For regional integration to succeed, it has to be based on effective national growth and development strategies, including a normative convergence on the issues of democratisation

and promotion of human rights (Qobo, 2007).

In the past, regional integration had been embraced in Africa as an important component of their development strategies with a large number of the Regional Integration Arrangements (RIAs) having membership overlap (Hartzenberg, 2011). These RIAs exists in the West, East and South of Sub-Saharan Africa (SSA). There is the Southern Africa Development Community (SADC), Common Market for Eastern and Southern Africa (COMESA), East African Community (EAC) and the ECOWAS. Despite their laudable efforts at enhancing trade in their regions, they are however, often confronted with some challenges. Chingono and Nakana (2009) highlighted some of the challenges of regional integration in Southern Africa, for example, to include lack of infrastructure, incompatible economic and political systems, uneven benefits of integration, institutional incapacity, poor economic and political governance, amongst others.

Several assessments of Africa's regional integration efforts have concluded that while there has been some progress, achievements have not however, matched ambitions as it has failed to yield satisfying fruits (Qobo, 2007; AfDB, 2015). Dinka and Kennes (2007) attributed this low performance of the regional integration initiatives to two groups of problems; on one hand is the problem surrounding the degree of political commitments and organisational coherence within government, as well as the strength of National consensus in support of regional integration. On the other hand is the broad idea of supply side constraints.

In spite of Africa's determination to dismantle trade restrictions to create a common market following the framework of regional and sub-regional agreements, at the intra-regional level, a number of barriers to economic community trade development still exist (UNECA, 2010)[1]. These ranges from lack of adequate infrastructure (transport, energy, communication), weak institutional and regulatory framework to diversified policies. Apart from infrastructural barriers, there is also the issue of underdevelopment of the payment and insurance system, which delays the flow of trade on the continent (UNECA, 2010). Effective trade facilitation measures are what help traders in terms of reduction in costs and minimal delay in the movement of goods across countries. It increases the efficiency level of businesses and the generation of revenue by government (UNECA, 2010). As part of their responsibilities,

[1] With the Launch of the African Continental Free Trade Area (AfCFTA) in March 2018 in Kigali, Rwanda, this pattern may change; however, it will take time to assess its impact, which is beyond the scope of this study.

Regional Economic Communities (RECs) develop programmes and measures that simplify and harmonise trade procedures required for a smooth flow of movement of goods and services.

The importance of infrastructure for economic development in general and intra-Africa trade in particular cannot be over-emphasised. Efficient transport, communications, energy infrastructure and other related services are crucial for trade and the pursuit of Africa's development goals (UNECA, 2010). Integrating physical infrastructure is a necessary though insufficient condition for achieving deeper regional integration and increased trade among African countries (UNECA, 2010). Emphasising the role of regional integration in electricity sustainability in Southern Africa, Montmasson-Clair and Deonarain (2017) opined that three key factors are important in using regional integration to contribute to improved electricity sustainability in the SADC region. These factors include harmonised policies and regulatory frameworks, adequate common institutions and technical infrastructure, and co-ordinated implementation. In addition, there is also the existence of Power Pools.

Power pools have been viewed as the best and most effective strategy in tackling Africa's energy problems (Niyimbona, 2005) and also maximise Africa's evenly distributed energy resources. There are five regional power pools in Africa namely Southern Africa Power Pool (SAPP), West Africa Power Pool (WAPP), Central Africa Power Pool (CAPP/PEAC), East Africa Power Pool (EAPP) and *Comite Maghrebin de l'Electricite* (COMELEC) which is the North Africa region. So majorly four power pools in Sub-Saharan Africa (SSA). A power pool is defined as a group of organisations that operate their power systems jointly for mutual benefits (UNECA, 2010). According to Avila *et al.* (2017), regional co-operation, which is enhanced by power pools and cross border transmission networks, will be critical to closing the electricity gap in SSA. Its benefits ranges from economies of scale to reliable and secure supply of energy, optimisation of resources, energy cost differential, rationalising investment and increasing the volume of electricity trade, among others. It can also reduce dependence on fossil fuel imports by enabling large concentrated renewable resources to be shared (Avila *et al.*, 2017). Paradoxically, intra-Africa trade in oil and gas is limited as even the non-oil producing countries imports oil from outside the continent (UNESA, 2010). Many rather trade with the industrialised economies of America and the European Union.

In the sub-ECOWAS region, Heads of State and Government to integrate the National power systems of member countries in a unified regional electricity market established the WAPP in 1999. This is with the expectation that such mechanism would ensure that citizens of member state have a stable and reliable electricity supply at competitive prices (Adeyemo, 2014). The intended mission is geared towards the development of power generation and transmission infrastructure while also ensuring the coordination of electric power exchanges. UNECA (2010) stated that the level of electricity supply in the WAPP plan only meets 54 percent of estimated demand in the region with Nigeria being the largest supplier and consumer of electricity. In recent times, as part of measures in strengthening the capacity of the region to provide reliable and sustainable modern energy, there have been calls to integrate renewable sources of energy to the energy mix plan. This involves incorporating hydropower, wind and solar energy to electricity generation programmes. Developing a multi-region economic dispatch model with hourly stimulations, Adeoye and Spataru (2018) evaluated the impacts of increased integration of grid connected solar PV plants to the interconnected West Africa electricity network in year 2025. Their results showed a reduction in the supply-demand gap in the region from 10 percent to 5 percent where this solar energy integration in the West African electricity market network significantly meets growing energy demand and reduces load shedding and generation costs.

As with the regional integration plans, the power pool arrangements are also confronted with some barriers that prevent them from performing optimally and achieving their set objectives. According to Niyimbona (2005), many of the regional power pools in Africa do not meet the requirements necessary to make them operational daily. Some of these requirements include having fairly developed grid interconnections, adequate generating capacity to meet demand of the pool, legal framework for cross-border electricity exchange, trust and mutual confidence among pool members and regional regulation for dispute resolution. As identified by Avila *et al.* (2017), political and economic challenges continues to hinder the effectiveness of regional energy integration in fulfilling many of their objectives.

Energy Resources in ECOWAS Region

Africa is endowed with diversity of energy resources for electricity generation that are unevenly distributed (Niyimbona, 2005; UNECA, 2006), the ECOWAS region inclusive. ECOWAS, which was established in 1975 and with an estimated population of about 327 million people (2016 figures) is also blessed with significant renewable energy resources.

Even though it is highly dependent on fossil fuels (Vilar, 2012). The region holds a third of Africa's proven fossil fuel reserves (Cheto & Brooks, 2013). It is a region with abundance of fossil and renewable energy sources (Avila *et al.*, 2017) but the challenge remains capacity to utilise the resources to meet future electricity supply (Miketa & Merven, 2012). It is among the African regions with the most energy production potential both from non-renewable (oil, gas, uranium) and renewable sources such as solar, wind energy and hydroelectric power (Karaki, 2017). As Pineau (2008) had mentioned, electricity consumption per capita for ECOWAS countries was 128 kWh with installed capacity of 10,000 MW (Adeyemo, 2014). Also, available generating capacity stood at 12GW and an estimated peak demand of 25.6 GW (Adeoye & Spataru. 2018). There is also proven oil and natural gas reserves with solid infrastructure for transmission across the region. This helps to enhance the free flow of trade for economic progress. One of the several oil and gas pipelines under development to further intra-Africa trade in energy is the West Africa Gas Pipeline (WAGP) of 678km to supply gas from Nigeria to Benin, Togo and Ghana (UNECA, 2010).

In terms of electricity generation mix in the West Africa region, hydropower, thermal and fossil fuels are commonly used. Cheto and Brooks (2013) asserted that fossil fuels, predominantly gas, accounts for about 64 percent of power generation closely followed by 31 percent hydropower production and 5 percent from other sources. This hydropower generation is primarily supplied by Nigeria (43.4 percent) and Ghana (40.9 percent) while the remaining production is shared by Burkina Faso, Cote d'Ivoire, Guinea and Mali (Cheto & Brooks, 2013). In an attempt to boost electricity supply in the region, there have been significant investments in projects financed and supported by international organisations such as the EU among others. Some have been completed; others are on-going or awaiting approval. Despite these efforts, demand for electricity in the region (mainly due to growing population) is yet to match supply.

The West Africa region has long experienced deficits in the supply and distribution of energy (Karaki, 2017). The abundance of energy resources had not helped in alleviating the energy access situation of the region (Miketa & Merven, 2012), which is one of the notable missions of the regional power pool. Reliable data on electricity access in the region is scarce and where available, there are conflicting figures. For example, Cheto and Brooks (2013) estimates average access rates in the ECOWAS region to be at about 40 percent while Adeyemo (2014) puts average electricity access to about 70 percent. When disaggregated, the

World Development Indicators (WDI) of the World Bank show access to electricity as percentage of population to be as high as 79 percent for Ghana, 59 percent for Nigeria, 64 percent for Senegal and14 percent, 16 percent and 19 percent for low access countries such as Guinea-Bissau, Niger and Burkina Faso respectively (see Figure 1). This inadequate supply of power continues to constrain private sector and manufacturing activities development that deprive the region of critical investment capital (Chambers *et al.*, 2012). West Africa has a very low per capita electricity use and this situation can change rapidly in future through renewable energy initiative (Miketa & Merven, 2012). The gap between electricity demand and supply resulted to increased use of petrol and diesel powered generators for household, commercial and industrial use. There is however, increased use of renewable energy such as solar power in recent times to support conventional power.

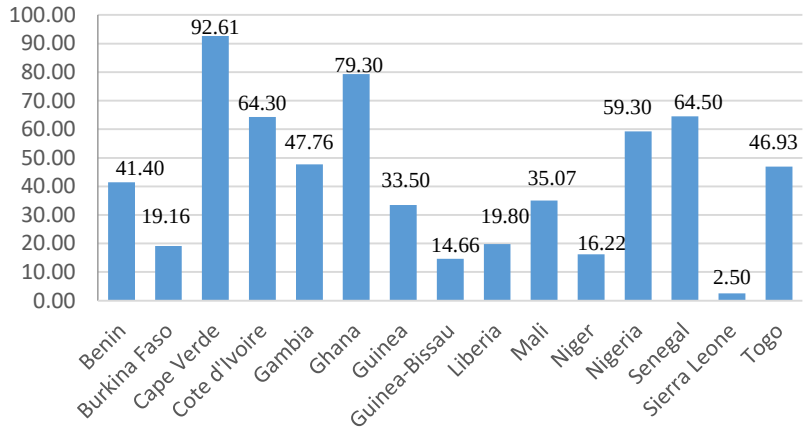

Figure 1: Access to Electricity-ECOWAS
Source: The Authors' using data from the World Development Indicators (World Bank, 2017)

Among the efforts towards enhancing energy security and promoting regional energy trade in the region was the establishment of the West African Power Pool in 1999 and the ECOWAS Energy Protocol in 2003. The next section discusses the West African Power Pool.

The West African Power Pool (WAPP)

One of the key objectives of ECOWAS is the promotion of integration in all fields of economic activity such as infrastructure (in which energy is part of it). In accelerating the pace of economic progress in the region, the West African Power Pool (WAPP) was established by ECOWAS in 1999, which was officially started in 2000, to build regional power plants and interconnected transmission infrastructures among the countries (Adeoye & Spataru, 2018). It was revised (the Master Plan) in 2003 and was designed to integrate the national power systems of member countries. It consists of 14 countries, namely: Benin,

Burkina Faso, Ivory Coast (Cote d'Ivoire), The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo. It was borne out of the desire of 14 of the 15 member states to pool together the efforts of their respective national electricity companies (Cheto & Brooks, 2013). As recorded in Adeyemo (2014), the vision of WAPP is to integrate the National power systems into a unified regional electricity market, with the expectation that such mechanism would over the medium to long term, ensure the citizens of member states have reliable and uninterrupted electricity supply at competitive costs.

WAPP was set up to address the inadequate power supply that was affecting the productivity of the industrial and manufacturing sectors. It was also to create a unified regional electricity market. The goal was to create a more robust regional power systems with the potential of lowering capital investment and systems operational costs that will eventually increase electricity supply and access in the ECOWAS region (Cheto & Brooks, 2013). The regional energy plan of WAPP currently focuses on integrating the huge water, coal, oil and gas resources of the region for electricity generation. However, as pointed out by Adeoye and Spataru (2018), impact of drought, climate change and vandalism constitute major hindrances to the plan. Therefore, it is necessary to incorporate a solar energy model into the plan for sustainability of the WAPP plan. According to Avila *et al.* (2017), WAPP is still under development and is not yet operational.

The WAPP project master plan is a document that is based on a thorough technical study of the power sector of the countries involved (Pineau, 2008). Two zones were defined given the large territory covered by the region. Zone A covers Benin, Burkina Faso, Cote d'Ivoire, Ghana, Niger, Nigeria and Togo. Zone B on the other hand, consists of Gambia, Guinea, Guinea-Bissau, Liberia, Mali, Senegal, and Sierra Leone. The main aims of the WAPP plans is increase regional generation capacity by 2.4 GW and interconnect the 15 countries with 6109km of high voltage transmission lines by 2025 (Adeoye &Spataru, 2018). It was envisaged under the plan that there will be a maximum demand of almost 22,500 MW for the target year of 2020. Though Cheto and Brooks (2013) argues that this may just be a conservative estimate as Nigeria alone that consumes about two thirds of the energy in the region, has a demand of 10,000 to 12,000 MW (2013 figures).

The implementation strategy of the WAPP priority project follows the mobilisation of resources for preparation of the projects, ensuring preparation for financing, assembling resources for implementation and coordination/monitoring of the implementation process (Adeyemo, 2014). Table 1 presents the revised master plan of the ECOWAS WAPP projects, which is to run from 2012 to 2025. It shows costs and number of projects to be undertaken under the time frame as it relates to hydropower, thermal power, transmission lines and renewable energy projects. These projects require a total investment of US$26.416 billion.

Table 1: Projects under the Revised WAPP Master Plan

Projects	Number	Costs (US$ million)
Hydropower Projects (7,092 MW)	24	13,803
Thermal Power Projects (2,375 MW)	5	4,263
Renewable Energy Projects (800 MW)	4	1,893
Transmission Line Projects (16,000 km)	26	6,457

Source: Adeyemo (2014)

The Prospects and Challenges for ECOWAS Region

Avila *et al.* (2017) asserted that filling the electricity gap with renewable energy resources would involve economic and environmental trade-offs because of the region's unique combination of challenges and opportunities. They further suggested regional power pools as a promising way to facilitate filling the electricity gap. This enables countries to aggregate resources and extend grid across national borders, while capitalising on regional diversity in resources and demand (Avila *et al.*, 2017).

Other benefits of Power Pools as highlighted by Niyimbona (2005) include improved power system reliability with reserve sharing, optimisation of generation resources with large units, reduction in capital and operating costs through improve coordination among power utilities, enhanced security of supply through mutual assistance, improved investment climate through pooling risks, coordination of generation and transmission expansion, development of a regional electricity market, and increase in inter-country electricity exchanges.

There exists four major power pools in Africa, however; only about 7 percent of electricity is traded across international borders, mostly through the South Africa Power Pool (Avila *et al.*, 2017). An improved integration or use of the four power pools could save more than US$50

billion in capital investments in the power sector (Avila *et al.*, 2017). Power pools can equally facilitate additional strategies to incorporate large amounts of variable renewable generation such as deployment of novel chemical and mechanical storage technologies, use of existing reservoir hydropower to provide storage, and the adoption of widespread demand response programmes across the region (Avila *et al.*, 2017).

Despite the laudable prospects and intended objectives of WAPP for improved economic and trade integration, it is yet to perform at optimal capacity and yield substantial outcomes. The success had been mixed (Cheto & Brooks, 2013; Adeoye & Spataru, 2018). After over a decade since its inception, the WAPP agreement has had a limited impact on electricity supply in the region and persistent challenges implies that the region's aim of energy security hangs in the balance (Cheto & Brooks, 2013). In 2012, the updates provided by WAPP showed that available capacity was around 10,000 MW as against the installed capacity of 14,091 MW and if demand is expected to rise to around 22,500 MW; then more needs to be done for it to enhance regional trade integration. Also, out of the 23-generation and transmission projects planned, only two had been successfully executed with ten at implementation stage and 11 awaiting financing (Cheto & Brooks, 2013). As identified by Avila *et al.* (2017), political and economic challenges continues to hinder the effectiveness of regional energy integration in fulfilling many of their objectives. There is also the problem of lack of trust and confidence among pool members, difficulties in mobilising investment for power projects, weak legal framework for electricity trading, underdeveloped transmission networks, lack of rules on mechanism for accessing the transmission grid, among others. In the case of the West African Power Pool, initial constraints relates to weak national transmission network, lack of funding, limited interconnection for cross-border electricity, among others (Adeyemo, 2014). The author also stated the following as challenges confronting the West African Power Pool:

a. Transition to a regional electricity market;
b. Having a market governance structure in place;
c. Appointment of a system market operator for implementation of a regional electricity market;
d. Construction of communication and data communication infrastructure;
e. Improved reliability of WAPP interconnected network; and
f. Capacity building in pool operation and real-time electricity trading

Considering the extent of productivity of the manufacturing sector in ECOWAS countries, in keeping with the objective of regional integration, Figure 2 shows that manufacturing export is relatively lower in the sub-region. Togo has the highest percentage of manufacturing export to total merchandise export, while other countries like Nigeria and Niger had manufacturing export to total merchandise export of about 1.13 and 9.40 percent. Compared to the value in total SSA region, which is about 24 percent in the same period, most SSA countries had values higher than the SSA average. Considering that the distribution of the manufacturing performance in the ECOWAS region is disproportionate, there is still substantial opportunity for countries in the ECOWAS region to experience increasing benefit from regional integration, in terms of manufacturing export.

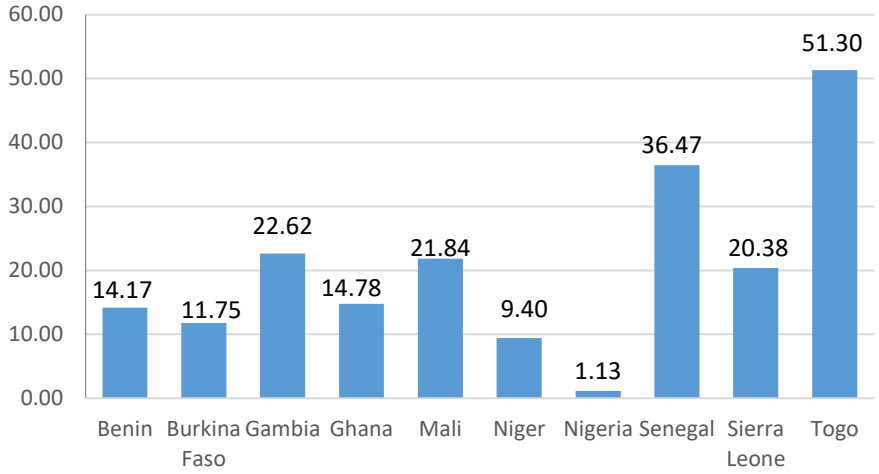

Figure 2: Manufacturing Exports as Percentage of Total Merchandise
Source: The Authors' using data from the World Development Indicators (World Bank, 2017)

Among the factors responsible for the low output from the manufacturing export in the ECOWAS sub-region is low infrastructural input. As mentioned earlier, energy is a key input in production and thus, a vital infrastructure for development. If electricity supply to power production in the industrial and manufacturing sector is low, there will be low output. Also, given that many of the firms will have to depend on alternative source of power (e.g. diesel which may be more expensive), this will increase overhead cost. For instance, taking the percentage of firms that experience electric outages in the ECOWAS sub-region as reported in Table 2, it is shown that there is a substantial fraction of firms with high electric outages. In Benin for instance, about 96 percent of the firms experience electric outages, which is similar to the experience in Cote d'Ivoire that had about 79 percent of firms having such experience. Similar occurrence is seen in Guinea, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo.

Table 2: Percentage of Firms Experiencing Electric Outages

Country Name	2013	2014	2016	2017
Benin	na	na	95.6	na
Cote d'Ivoire	na	na	78.8	na
Ghana	20.1	na	na	na
Guinea	na	na	84.2	na
Liberia	na	na	na	44.3
Mali	na	na	86.6	na
Niger	na	na	na	78
Nigeria	na	77.6	na	na
Senegal	na	83.7	na	na
Sierra Leone	na	na	na	71.8
Togo	na	na	93.8	na

Source: The Authors' using data from the World Development Indicators (World Bank, 2017)
*na: data not available in the database for the countries for the particular year

The use of renewable energy could be an important policy option for SSA countries to boost energy supply for manufacturing and industrial sector. However, the extent to which SSA countries can effectively pursue this policy option is slim considering the enormous resources required for engaging renewable energy option for energy supply. Clearly, very few countries like Togo, Sierra Leone, and Ghana can actually pursue this option considering that they have over half of their total electricity output from renewable energy. This statistics shows that pursuing the use of renewable energy for the entire ECOWAS countries may be viable, but only very few ECOWAS countries are on course with achieving such agenda.

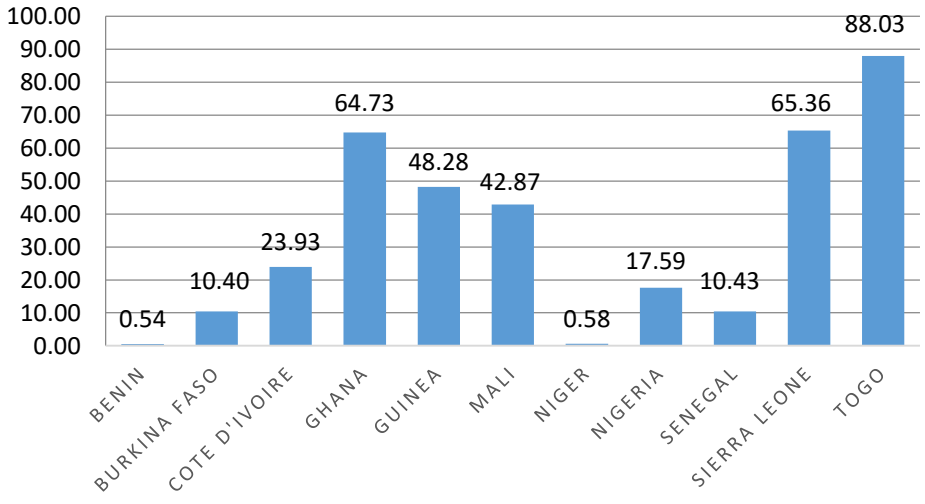

Figure 3: Renewable Electricity Output (% of Total electricity Output)
Source: The Authors' using data from the World Development Indicators (World Bank, 2017)
*Countries selected were based on availability of data

The importance of pursuing the use of renewable energy for energy generation is such that there could be sustainable development that reduces the likelihood of environmental pollution, which is an emerging issue in the sub-region. Countries like Nigeria, Senegal and Cote d'Ivoire all have CO2 emissions that are higher than 30 percent of total fuel combustion. Compared to the SSA region average for environmental pollution – in terms of CO2 emission of 54.77 percent – ECOWAS countries are still fair in environmental pollution. However, once these issues are not efficiently controlled, and infrastructure fixed, the prospect for increasing environmental pollution will be looming considering the rising industrial activities in this region.

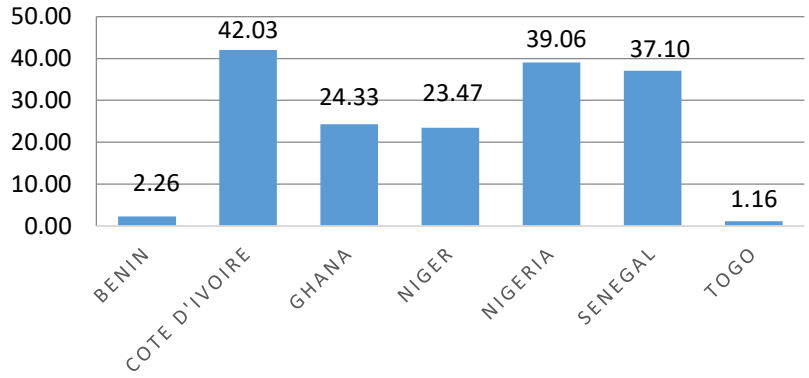

Figure 4: CO2 Emissions from Electricity and heat Production (% of total fuel combustion)
Source: The Authors' using data from the World Development Indicators (World Bank, 2017)
*Countries selected were based on availability of data

Key Findings and Policy Implications

Energy sustainability is a core component of sustainable development and an integral ingredient for infrastructural development for stronger regional integration. The sustainability of energy is accessed from three dimensions as defined in the literature (e.g. Montmasson-Clair & Deonarain, 2017), namely: energy security, energy equity and environmental sustainability. Electricity security is concerned with issues relating to reliable supply of electricity to meet household, commercial and industrial demand. Electricity equity on the other hand, assess performance in terms of the percentage of the population that is able to access affordable modern energy sources. That is, the composition of the urban and rural area with access to modern energy. Environmental sustainability becomes essential in view of the polluting nature of some energy sources which then makes it necessary to ensure that energy production, transmission and distribution follows a low-carbon path. These three factors are complementary and regional integration can be a viable policy mechanism for improving their performance through better integration of energy resources of member countries.

Regional integration can strengthen the energy sector through three main channels. This includes through human capital development, adoption of common infrastructural network and institutions, and finally, a harmonised policy and regulatory framework for a smooth integration across the member countries. Using the sub-ECOWAS West African Power Pool as a case study, evidence suggests that even though some progress had been recorded for this regional pool in these three areas for enhanced energy sustainability, there are still lots of room for improvements in meeting the targets set in the WAPP master plan. Assessing the extent of regional integration for energy sustainability is crucial for supporting firm productivity in a green or low-carbon model so as to equally increase the level of intra-regional trade flows. Inadequate energy supply continues to constrain manufacturing and industrial output in the region which in turn affects volume of trade internationally. This has implications for trade and energy policy. Therefore, effective collaboration, mutual trust, sufficient investment in human capital and technical expertise and creation of international frameworks to govern technical and legal issues of interconnections are crucial components in the success of regional integration for ensuring regional energy sustainability.

Conclusion and Recommendations

This paper has investigated the role of regional integration in enhancing energy sustainability as a key infrastructure for development. In meeting the Goal-7 of United Nations Sustainable Development Goals, the region have to develop feasible model of energy integration that can improve energy security to boast economic growth and development. This is believed to be a viable channel for accelerating progress in the region in particular, and the continent in general. There are efforts and initiatives put in place to enhance the integration of energy systems and resources; however, barriers ranging from political to economic continues to hamper implementation. Using three measures of energy sustainability namely energy security, energy equity and environmental sustainability; the study presented the performance of the region in ensuring energy sustainability through a content method of analysis. Findings revealed that there are prospects and benefits for energy integration in the region. It is recommended that the political economy surrounding regional energy integration should be given a priority among member states to ensure that there is positive political will for speedy achievement of set goals. Also, investment in human capital to manage the numerous projects and resources; and maintain the facilities cannot be overemphasised.

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