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

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Abstract

This study explores 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 of Africa, and vice versa. It examines the existing opportunities and the attendant challenges for improved firms' productivity in the sub-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. Though some progress has been made, there are many challenges. Also, where progress has been made, it is not uniform across the sub-region, though factors such as rising population and political instability could be responsible. It is recommended that the political economy surrounding regional energy integration should be given a priority among the Member States to ensure that there is positive political will for speedy achievement of set goals. Also, investment in human capital to manage the different projects and maintain the facilities cannot be overemphasised.

Keywords: ECOWAS, Energy, Green growth, Sustainable development, Regional Integration

JEL Code: F15; P28; Q43; R11; R58

1. 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 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 as encapsulated in the Sustainable Development Goals (SDGs) of the United Nations.

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 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 maximise 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, 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 the 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, *et al.*, 2018).

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 & Osabohien, 2018). 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 (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 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 or 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 assesses the role of energy infrastructure in enhancing regional integration and energy sustainability in the ECOWAS sub-region. It also examines the prospects and challenges of sustainable regional energy integration in the sub-region as this can support firm productivity in member countries. 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 sub-region continues to play a key role in the low economic development rate of the sub-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 SDGs. 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). Regional electricity integration and cooperation through grid interconnections and power cooling had been recognised as a cost-effective means of ensuring reliability of supply

(Niyimbona, 2005).

Despite the laudable prospects of energy integration in the sub-region, 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 West Africa sub-region. However, 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 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 and infrastructure development in the energy sector (AfDB, 2013) that can engender sustainable development in the sub-region. Also, the adequate utilisation of the abundant energy resources in the sub-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 sub-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.

2. Some Conceptual Clarifications

Regional integration can be viewed as an arrangement where countries of the same sub-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; Osabuohien *et al.,* 2019). 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 economic aim is to create larger and more attractive markets, link landlocked countries to international markets, and support intra-African trade (AfDB, 2015; Osabuohien *et al.,* 2019). 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).

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 overlaps (Hartzenberg, 2011). These RIAs exist in the West, East and South of Sub-Saharan Africa. 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 sub-regions, they are, however, often confronted with some challenges. Chingono and Nakana (2009) highlighted some of the challenges of regional integration in Southern Africa, these include lack of infrastructure, incompatible economic and political systems, uneven benefits of integration, institutional incapacity, poor economic and political governance, among 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). Dinkaand 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 range 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 especially in SSA (UNECA, 2010; Akinyemi *et al.,* 2019).

Integrating physical infrastructure is a necessary though insufficient condition for achieving deeper regional integration and increased trade among

[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.

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 sub-region. These factors include harmonised policies and regulatory frameworks, adequate common institutions and technical infrastructure, and co-ordinated implementation (Akinyemi *et al.,* 2019). 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 unevenly 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 *ComiteMaghrebin de l'Electricite* (COMELEC) which is the North Africa sub-region. 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 is limited as many rather trade with the industrialised economies of America and the European Union.

In an attempt to integrate the National power systems of member countries to form a unified regional electricity market, Heads of State and Government in the ECOWAS sub-region established the WAPP in 1999. This is with the expectation that such mechanism would ensure that citizens of member

states have a stable and reliable electricity supply at competitive prices (Adeyemo, 2014). Also, the growing energy deficit in the sub-region made it necessary to mainstream renewable energy into national energy policies (Ikeonu, 2018). 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 sub-region with Nigeria being the largest supplier and consumer of electricity. In recent times, as part of measures in strengthening the capacity of the sub-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 sub-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. In conclusion, regional integration plans through power pool arrangements are unable to achieve set objectives due to a number of economic and political challenges, which equally prevent them from been fully operational.

3. Energy Resources in ECOWAS Sub-region

Africa is endowed with diversity of energy resources for electricity generation that are unevenly distributed (Niyimbona, 2005; UNECA, 2006; Agbodo*et al.*, 2017; Ikeonu, 2018), the ECOWAS sub-region inclusive. ECOWAS, which was

established in 1975 and with an estimated population of about 360.34 million people (2017 figures by IMF World Economic Outlook) is also blessed with significant renewable energy resources, even though it is highly dependent on fossil fuels (Vilar, 2012). It is a sub-region with abundance of fossil and renewable energy sources (Avila *et al.,* 2017), holding a third of Africa's proven fossil fuel reserves (Cheto & Brooks, 2013); however, the challenge remains capacity to utilise the resources to meet future electricity supply (Miketa & Merven, 2012). It has not been able to convert these huge potentials to sufficient electricity capacity for its teeming population as average electricity consumption per capita is about 118kWh (Ikeonu, 2018). Also, with an installed capacity of 10,000 MW, available generating capacity stood at 12GW and an estimated peak demand of 25.6 GW (Adeyemo, 2014; Adeoye & Spataru. 2018). It is among the sub-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).

In terms of electricity generation mix in the West Africa sub-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). The West Africa sub-region has long experienced deficits in the supply and distribution of energy (Karaki, 2017). The abundance of energy resources has not helped in alleviating the energy access situation of the sub-region (Miketa & Merven, 2012), which is one of the notable missions of the regional power pool. Reliable data on electricity access in the sub-region is also scarce and where available, there are

conflicting figures.

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 sub-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.

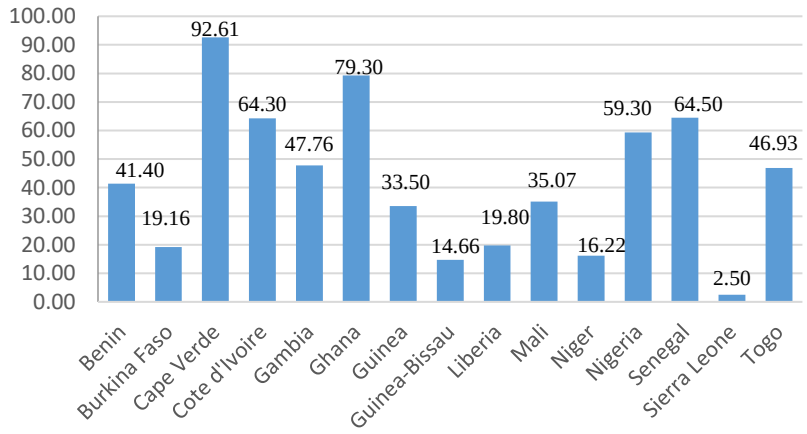

Figure 1: Access to Electricity-ECOWAS
Source: Authors' Computation using data from the World Development Indicators (World Bank, 2018)

Among the efforts towards enhancing energy security and promoting regional energy trade in the sub-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.

4. 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 sub-region, the West African Power Pool (WAPP) was established by ECOWAS in 1999, which officially started in 2000, to build regional power plants and interconnected transmission infrastructures among the countries (Adeoye &S pataru, 2018). It consists of 14 member 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) and the WAPP Business Plan 2015-2019, the vision of WAPP is to integrate the National power systems of member countries 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, and to create a unified regional electricity market. This regional electricity market was launched in June 29, 2018 in Cotonou, Benin Republic. 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 sub-region (Cheto & Brooks,

2013). The regional energy plan of WAPP currently focuses on integrating the huge water, coal, oil and gas resources of the sub-region for electricity generation. As pointed out by Adeoye and Spataru (2018), the impact of drought, climate change and vandalism constitute major hindrances to the plan. Therefore, it is necessary to incorporate a renewable energy model such as solar energy into the plan for sustainability of the WAPP plan. 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 sub-region. 'Zone A' covers Benin, Burkina Faso, Cote d'Ivoire, Ghana, Niger, Nigeria and Togo while 'Zone B' consists of Gambia, Guinea, Guinea-Bissau, Liberia, Mali, Senegal, and Sierra Leone. The main aims of the WAPP plans is to increase regional generation capacity by 2.4 GW and interconnect the 15 countries with 6,109 km 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 sub-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)

5. Regional Integration and Energy Sustainability

In line with the first objective of the study, this section discusses the relationship between regional integration and energy sustainability. The sustainability of energy is accessed from three dimensions as defined in the literature (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.

Considering the extent of productivity of the manufacturing sector in ECOWAS countries and 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 percentage of merchandise exports, while other countries such as Nigeria and Sierra Leone had manufacturing export of about 2.16 percent and 3.32 percent respectively. Compared to the value in total SSA region, which is about 27 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 sub-region is disproportionate, there is still substantial opportunity for countries in the ECOWAS sub-region to experience increasing benefit from regional integration, in terms of manufacturing export.

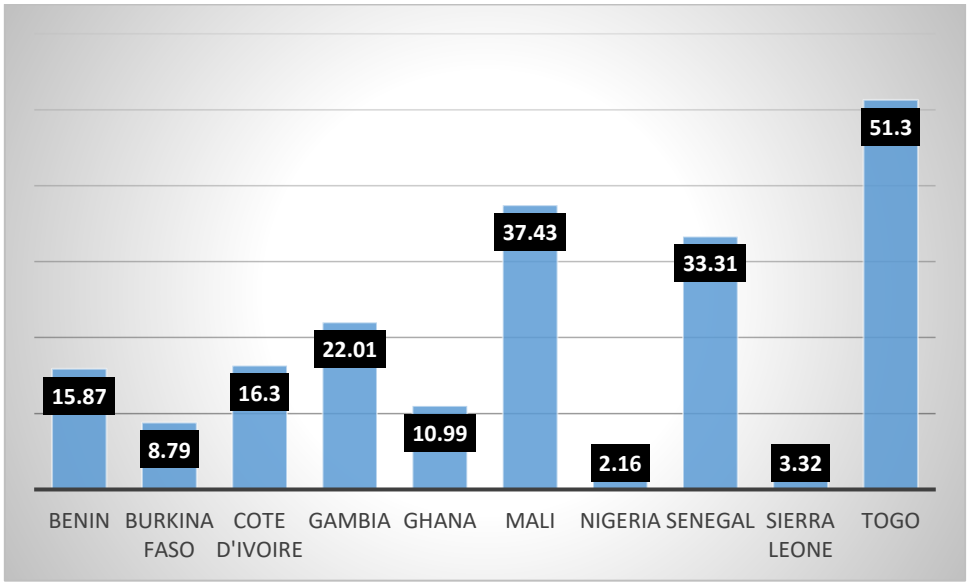

Figure 2: Manufacturing Exports (% of Merchandise Exports-2017 figures)
Source: Authors' Computation using data from the World Development Indicators (World Bank, 2018)

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 Figure 3, 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 Togo that had about 94 percent of firms having such experience. Similar occurrences are observed in Guinea, Mali, Niger, Nigeria, Senegal, and Cote d'Ivoire.

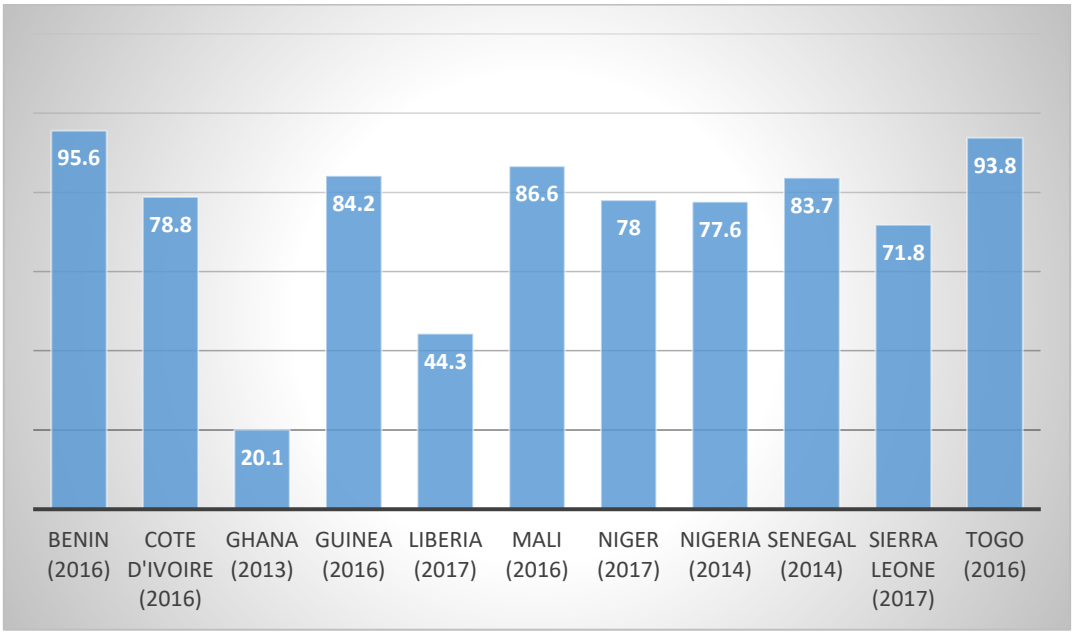

Figure 3: Electric Power Transmission and Distribution Losses (% of Output)
Source: Authors' Computation using data from the World Development Indicators (World Bank, 2018)

The use of renewable energy could be an important policy option for ECOWAS countries to boost energy supply for manufacturing and industrial sector. However, the extent to which ECOWAS countries can effectively

pursue this policy option is slim considering the enormous resources required for engaging renewable energy option for energy supply. Clearly, from Figure 4, very few countries such as Guinea, Togo, Ghana and Sierra Leone can actually pursue this option considering that they have over half of their total electricity output from renewable energy. The statistics show that pursuing the use of renewable energy for the entire ECOWAS countries may be viable, but only very few countries are on course with achieving such agenda.

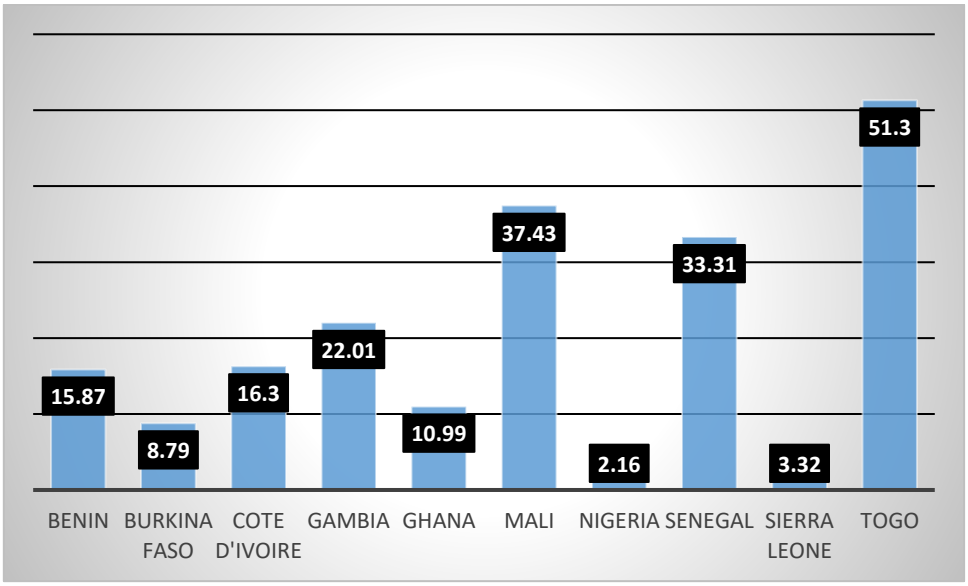

Figure 4: Renewable Electricity Output (% of Total electricity Output-2015)
Source: Authors' Computation using data from the World Development Indicators (World Bank, 2018)
*Countries selected were based on availability of data

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 (Efobi*et al*, 2019). Countries such as Cote d'Ivoire, Nigeria and Senegal all have CO_2 emissions that are higher than 30 percent of total fuel combustion (Figures are for 2014 which are latest available). Compared to the SSA region average for environmental pollution – in terms of CO_2 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 sub-region.

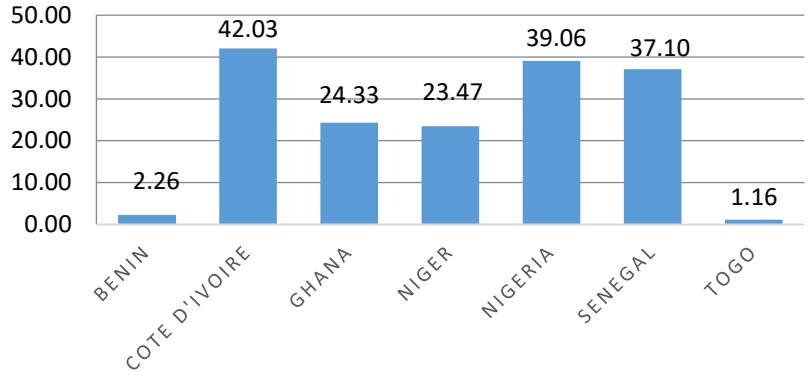

Figure 5: CO_2 Emissions from Electricity and heat Production (% of total fuel combustion)
Source: Authors' Computation using data from the World Development Indicators (World Bank, 2018)

6. The Prospects and Challengesfor ECOWAS Sub-region

There are opportunities for energy sustainability in the sub-region through its integration, however, there are also challenges slowing down progress in harnessing these opportunities. The uneven distribution of energy resources in the sub-region makes its integration necessary to tackle inadequate access to electricity and outages. This is the basis of having an integrated electricity market with renewable energy as an important element of the energy mix. Avila *et al.* (2017) asserted that filling the electricity gap with renewable energy resources would involve economic and environmental trade-offs because of the sub-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). The opportunities that regional integration presents for energy sustainability and

the challenges are discussed in this section.

6.1. The Prospects

The integration of the energy systems of member states in the sub-region through power pools will improve electricity generation capacity through the aggregation of resources. 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 sub-region (Avila *et al.*, 2017). There exist 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). Additionally, it will lead to efficiency gains, exploit economies of scale and reduce the thickness of borders due to the isolated characteristics of many of the economies (De Melo & Tsikata, 2014). 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 improved 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.

Furthermore, if these opportunities are adequately harnessed, it can support sustainable growth and development through cleaner environment from the production of energy with renewables and increase in firm productivity and welfare as a result of stable supply of electricity. Irregular supply of electricity

to power industrial operation made many companies relocate and, in some cases, close down as relying on diesel generators was increasing the cost of production. The desire to have improved standard of living and economic prosperity in the sub-region is the basis for the establishment of WAPP. Despite some progress made by WAPP, there is still need to strengthen capacity further and this is reflected in the updated ECOWAS master plan for the development of regional power generation and transmission infrastructure 2019-2033.

6.2. The Challenges

As the West African energy sector provides opportunities for energy transition and transformation in the sub-region, there are also some challenges especially due to its evolving nature. After over a decade since its inception, the WAPP agreement has had a limited impact on electricity supply in the sub-region and persistent challenges implies that the sub-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. In the second quarter of 2018, available capacity stated by WAPP was 11,982 MW.

Some of the challenges are briefly highlighted as follows:

Economic Challenges: Many of the utility companies engaged in transmission and distribution in the power pool do not have access to adequate funding to cover the capital-intensive structure of their operations. This affects their service delivery and result in poor power quality and inability to meet growing electricity demand (Agbodo *et al.,* 2017). The low mobilisation rate of electricity tariff and ineffective revenue collection in many of the member countries are contributing factors to this. There is also the issue of low

investment funding in the sector and difficulties in mobilising investment for power projects, even though there are indications of improvements in this area, more still needs to be done. For example, the World Bank in 2017 provided International Development Assistance (IDA) grant of US$22.66 million equivalent to the Republic of Liberia for a WAPP-Cote D'Ivoire, Sierra Leon, Liberia and Guinea power interconnection project. There was also an additional IDA grant of US$17.5 million equivalent to WAPP for the WAPP Interconnector Project and Integration and Technical Assistance Project. These projects are expected to minimise cost of electricity supply for Liberia and Sierra Leon and also support the technical integration of the WAPP network. Another economic issue is lack of a single currency which continues to impede efforts at regional integration. This equally impacts on energy integration abilities in terms of energy trading across countries. There is no harmonisation of electricity tariffs and pricing in the sub-region.

Technical Challenges: There are also technical challenges limiting the ability of WAPP to ensure reliable supply of electricity that includes underdeveloped transmission networks. Many of the member utilities are confronted with operation inefficiencies and low technical skills to handle most of the operations. They often have to rely on foreign technical assistance. Also, inequality between the countries' electricity systems are significant; about 96 percent of all power generated in the sub-region is between Nigeria, Ghana, Cote d'Ivoire and Senegal (Agbodo *et al*, 2017). As the objective is to increase the share of renewable energy in total energy mix, climate change impacts such as flooding and drought affects renewable energy resources.

Political and Security Challenges: Political and security challenges continue to hinder the effectiveness of regional energy integration in fulfilling many of their objectives. Unsatisfactory political environment can constrain greater cooperation in the power sector as it is difficult for commercial trading to

occur in war zones (Avila *et al.,* 2017; Agbodo *et al*, 2017). The activities of extremist groups in the sub-region such as Boko Haram in Lake Chad and Mujao in Mali present threats for energy integration. The impact of geo-politics continues to be a central focus for energy and security analysts.

Institutional and Regulatory Challenges: There is also the problem of lack of trust and confidence among pool members, weak legal framework for electricity trading, lack of rules on mechanism for accessing the transmission grid, weak institutional frameworks, weak national transmission network, limited interconnection for cross-border electricity. Other challenges as indicated in Adeyemo (2014) confronting the West African Power Pool relates to areas of:

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

There is also the issue of cultural and language differences. The countries, except Cape Verde, in the sub-region are mainly divided into Anglophone (the English speaking side) and Francophone (the French speaking side), coupled with the diverse cultures they have, contribute to the challenges facing the smooth integration of their energy systems. Also, the belief system, norms and traditions of the individual countries often come to bear during negotiations which often affects implementation plans. It is, however, important to note that despite these challenges confronting the ability of the sub-region to adequately integrate its energy systems for energy

sustainability, there is strong commitment by Head of States to put in place measures to address these challenges. This is reflected in the launch of the ECOWAS Energy Governance Programme in West Africa on May 22nd, 2018 in Abuja, Nigeria. This will allow the sub-region to tackle all the challenges that hamper universal access to energy and a sustainable energy mix in West Africa.

7. Summary of 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. 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 sub-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.

8. 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 (SDGs), the sub-region has to develop feasible model of energy integration that can improve energy security to boast sustainable economic growth and development. This is believed to be a viable channel for accelerating progress in the sub-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 sub-region in ensuring energy sustainability through a content method of analysis. Findings revealed that there are opportunities for energy integration in the sub-region and the challenges have implications for the smooth integration of the national energy systems. 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 various projects and resources; and maintain the facilities cannot be overemphasised.

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