West Africa's Energy Sector Developments: Does the Sub-Regionalised approach to energy provision provide the optimal option towards the attainment of Energy Access and Security?

Submitted by:

KYEREMEH, Henry
(51-168230)

Supervisor:

Prof. ARIMA, Jun

Professor of Energy and Environmental Policy

Graduate School of Public Policy

University of Tokyo

THE UNIVERSITY OF TOKYO

Graduate School of Public Policy

Abstract

West Africa is acknowledged as energy-poor with close to 50% of citizens without access to modern forms of energy services. In this regard, two doctrines of domestic and regionalise approaches have been employed to address the energy access and security challenges. The two dogmas are not mutually exclusive, though the domestic approach is dominant with little emphasis on regionalism. We examine the impact of regionalism approach to energy security and access in the Economic Community of West African States (ECOWAS) by looking at West African Power Pool (WAPP). We employ rigorous review and analysis of power situation of ECOWAS before and after the establishment of WAPP and found that not much progress has been made especially in expanding energy access. In that regard, the ECOWAS goal of expanding energy access to all citizens by 2030 seems far from reach even for countries like Ghana where electricity access currently stands at 84%. We noted that none of the doctrines is panacea without the complement of the other. Reform of governance and administrative protocols that established WAPP to give it more autonomy would have a positive impact on the region's energy security efforts.

Keywords: Energy access, security, ECOWAS, Domestic approach, Regionalise approach

Dedication

I dedicate this piece of work to my adorable daughter, Kate Kyeremeh!

Acknowledgement

I wish to acknowledge the invaluable contribution of Prof. Arima Jun toward this work. Prof's insightful contributions, encouragement and support made the work much better. I remain grateful for the time he spent with me in making sure; I got the work right. Thank you! This is not to implicate Prof. Arima as all errors in this work are mine.

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Chapter One

1.0 Introduction

Developmental problems confronting humanity– poverty, inequality, warming climate, food insecurity, education and health– are inherently and inextricably linked to inaccessibility of sustainable, reliable and modern forms of energy (Bazilian. et al 2010; Hailu 2012). Intrinsically, increased access to modern energy services are central to addressing these global challenges. Advanced Countries achieved economic development and prosperity largely on the back of access to modern, high quality and reliable energy. Access to energy supported the provision of services such as lighting, transportation, heating, mechanical, and communication services which subsequently, impacted the quality of education, healthcare, and quality of life (IEA 2014, 441).

However, in developing countries provision of energy services have been lethargically slow (Iwayemi 2008); albeit sufficient evidence that contemporary energy remains a solid foundation of a new paradigm for development (Hailu 2012, 56). The barriers to the provision of modern energy services are resolvable. The benefits of access to modern energy are enormous (IEA 2014, 441). Nearly one-third of humanity is currently without access to modern energy services (Hailu 2012), and many are from developing countries, in particular, Sub-Sahara Africa.

The mitigating factors against global energy access are wide-ranging including the dysfunctional global energy governance system (Dubash and Florini 2011). Energy access matters are primarily transnational given the disproportional allocation of energy resources. However, the stark reality is that the global governance architecture is fragmented and conflictual, complexly diversified and composed of many actors. Individual Country interest is the foremost consideration in energy policymaking. Often, such interests are disjointed from the global governance institutional framework (Dubash and Florini 2011).

Despite the weak global energy governance, energy demand and consumption are on an upward trend. This is explained by the importance of energy as a catalyst for development. Other factors include global population increases, urbanisation and growing global income levels (Ouedraogo 2017). Global consumption is projected to continue to increase through the 2030's, 2040's and beyond (Dorian, Franssen, and Simbeck 2006, 1985). In 2015, global energy consumption was 575 quadrillions Btu. By 2030, consumption will be 663 quadrillions Btu (15% increase), and by 2040, it will be 736 quadrillions Btu (U.S. EIA 2017, 10). The jump in consumption will occur mostly in developing nations, where many citizens are currently without access. Industrialised countries, however, are expected to witness a decline in energy use. Between 2015 and 2040, non-OECD consumption of energy will increase by 41%, in contrast to a 9% increase in OCED (U.S. EIA 2017, 10).

Though energy consumption is projected to increase, still over 1.4 billion (18 percent) of the world's population would not have electricity (Dorian, Franssen, and Simbeck 2006, 1988) by 2030. Also, a whopping 2.7 billion people (40%) of the world's population will

also continue to use traditional bioenergy for cooking (IEA 2014, 73, 2017; Dubash and Florini 2011, 9). The energy mix is not also to change that much, as over 90 percent of the projected consumption increases is to come from fossil fuels, including oil, coal, and gas (Dorian, Franssen, and Simbeck 2006). Natural gas will also gain more prominence owing to their environmental friendliness and relative abundance. Renewables are also expected to expand from the current low ebb.

The increase in consumption, especially in developing economies would present additional energy-related challenges deserving attention from policymakers. These challenges include; oil scarcity, achieving energy security, combating environmental issues, and being able to adequately estimate the energy demand as well as meeting the growing demand of developing countries.

1.1 Sub-Sahara Africa and energy access

Energy access is viewed from the following perspective; households' access to electricity, access to clean cooking fuels, access to modern energy for productive activities and modern energy for public services. In this regard, the global energy situation appears gloom. However, the sub-Sahara Africa's situation is particularly gloomier, despite the abundant energy resources which far exceeds energy requirements (Ouedraogo 2017).

Undeniably, the debilitating energy situation has not escaped the attention of governments, development partners and the international community. Many positive efforts in the last two decades have led to steady increases in modern energy access, though limited (IEA 2014, 433, 2017, 75). Despite the efforts, the region which is home to about 14 percent of the world's population is the most energy-deprived of the world (Brew-Hammond and Kemausuor 2009; Quartey 2014), and share of global energy investment is at an abysmally low of 4% (IEA 2017, 76).

Few statistics will suffice here. By 2012, a total of 620 million people representing a two-thirds of the region's population did not have access to uninterrupted electricity (IEA 2014, 75; Avila et al. 2017; Ouedraogo 2017) and 730 million people depended on traditional biomass for cooking (IEA 2017, 433). About 70 percent of the population did have limited access to electricity with urban areas enjoying the larger share (Hailu 2012). Electricity per capita consumption is equally low at an average per year of 170 kW-hours (excluding South Africa) (Ouedraogo 2017).

However, by 2014, the situation had improved slightly with electrification efforts surpassing population growth for the first time (IEA 2017). People without access to electricity reduced to 590 million. On average, sub-Sahara Africa electricity consumers consumes 200 kWh of electricity and constitutes 12.5% of the average European Union figure of 1,600kwh (IEA 2017, 76). However, the number of people using traditional biomass for cooking increased to 740 million. Though the developments in electrification are encouraging, it is equally worrying in the sense that the 2030 projections of people without electricity access are to remain the same as today. With regards to clean cooking access, the situation could get worse with a projected 900 million people likely not to have access to clean cooking stoves. The worsen projection has arisen because of rapid

population growth projections in the sub-Sahara Africa, which outpaces investments in energy infrastructure (IEA 2017, 433).

On generation, as of 2012, the on-grid capacity of Africa was 90 GW, improvement on the year 2000 generation capacity of around 68 GW (IEA 2014, 454). Nearly half of this generation comes from South Africa (IEA 2014, 433). The generation comes mainly from coal (South Africa), hydro and oil and gas based. The identified challenges in the energy sector of Africa include generation shortfalls, limited and unreliable electrification, lower per person power consumption, unreliable services and high costs (The World Bank, n.d., 181).

From the rural and urban perspective, the energy situation is much more severe in rural communities. Approximately 90 percent of rural areas of Sub-Sahara Africa were not connected to the national power grid as of 2009 (Parshall et al. 2009, 2395). By 2016, 77% are still without electricity access, leaving many rural populations, educational centres, polyclinics, and many social amenities without access (IEA 2017, 114). Also, 783 million people (mainly rural) as of 2015 rely on traditional energy sources which are associated with different degrees of health, environment and economic impacts. By regional distribution, Central Africa has 91% of its population without access to clean cooking stoves. In East Africa, the number is 90% and West Africa, 87% (IEA 2017).

The frail energy access situation seems to have permeated and impacted critical facets of the economy of the various countries. For instance, the region's macroeconomic performance is no better when compared with the rest of the world. Gross Domestic Product (GDP) is the lowest in the world, though there have been significant improvements in the last three decades. Energy access has positive externality on many sectors including agriculture. Increase use of electricity for irrigation, and mechanisation potentially will improve crop yields and product quality. Such improvement in agriculture production and yields directly affects many sub-Sahara African economies since agriculture is the mainstay. It would also reduce the annual food import bill of $35 billion (IEA 2017, 99).

On top of these constraints is the uneven distribution of energy resources across the continent. Oil resources are found predominately on the western shores of the region. Coal reserves and uranium deposits are among the largest in the world and are found in the southern areas (Kebede, Kagochi, and Jolly 2010). Hydropower potential amounts to about 13 percent of the global hydro stock. Renewables such as wind and sunlight are in abundance owing to the region's closeness to the equator (Kebede, Kagochi, and Jolly 2010). The uneven nature of energy resources allocation in the region significantly inspired the establishment of many power pools three decades back. However, the bizarre energy access situation seems not to have attenuated even with their establishment (Ouedraogo 2017).

1.2 Why West Africa's energy situation is a concern

The West Africa, which has a population of 360 million people (population map attached as Appendix 1) has many of its people without access to sustainable, reliable and modern

forms of energy. The region has for the last two decades made significant strides in improving energy access situation. In 2000, the electrification rate was 33%, but by 2016, the rate has jumped to 52% (IEA 2017, 115). When compared with East Africa- 39% and Central Africa-25%, West Africa seems to be doing well (IEA 2017, 115). However, the absolute number of 175 million people without electricity access is worrying.

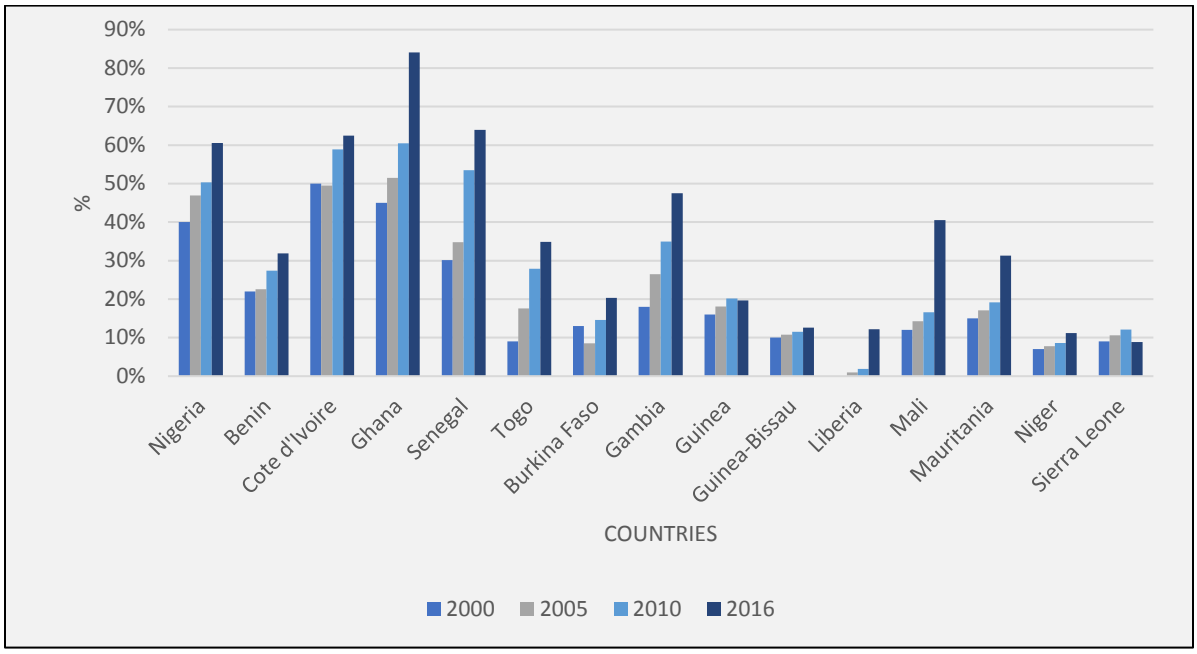
Also, when compared with South Africa and the developing non-OECD countries, and indeed, the rest of the world, West Africa shows up as energy poor. Currently, 30% of those without electricity in Sub-Sahara Africa are from West Africa (IEA 2017, 83). On the issue of access to a clean cooking stove, West Africa has not achieved much. In 2000, the share of the population without access was >95%. However, in 2015, the share has reduced to 87% with most of the improvements occurring at Cape Verde and Mali and Sao Tome and Principe (IEA 2017, 119).

In this paper, the Economic Community of West Africa States (ECOWAS) which is an organisation of fifteen West African States is the focus of discussion concerning energy access and security. More so that regionalism has become the de facto leveraging tool of ECOWAS for ameliorating the energy situation of the region. In specifics, the reasons for discussing ECOWAS energy security and access are as follows.

Firstly, the prolonged energy insecurity of the region and the wide variability in energy access among ECOWAS countries requires understanding. The ECOWAS has only 52 percent of electrification, and only 28 percent of the rural population have access (IEA 2017, 115). The figure which is at par with the African average is higher than the Sub-Sahara Africa's rate of 43% (IEA 2017, 11) but way below the South Africa average of 86%. When compared with the developing nations of Asia, and the North Africa, the West Africa's situation becomes precarious as electrification has been on an upward trend since the 2000s in those regions. India, for instance, as of 2000 had electrification rate of 67% and in 2016, the rate is 89% (IEA 2017, 11). The average electrification of developing countries was 64% in 2000, and in 2016, it has risen to 86%. Evidently, the ECOWAS energy situation is not encouraging.

The country-by-country analysis further indicates a dire energy situation and wide variability among the individual countries. Niger, for instance, has only 11 percent of electrification as of 2016 with rural areas access of less than 1%. Only 3% of rural Liberia and 6% of Sierra Leone do have access to electricity (IEA 2017). The national access rate for Liberia is 12%, and Sierra Leone is about 9%. In Senegal, the electricity access rate in 2012 was just above 50% (IEA 2014, 445). By 2016, the situation improved and the current rate of access is 63% (IEA 2017, 83). Nigeria as of 2016 had 61% of its population with access to electricity from a low of 40% in 2000. Of this number, 80% do have backup generators because of the unreliability of the national grid system. Ghana is the only successful country within the West Africa to have expanded access from a low of 45% in 2000 to 84% in 2016 and very much on course to achieve universal access by 2020 (IEA 2017, 83, 2014, 446). The percentage of citizens having access to electricity across the individual countries of ECOWAS is illustrated in the figure below (figure 1.).

FIGURE 1: ELECTRICITY ACCESS IN ECOWAS



Source: Author with data from IEA

At the same time, the three countries of Ghana, Nigeria and Côte d'Ivoire out of the fifteen (15) countries of ECOWAS account for about 80 percent of electricity generation and consumption (Smart Villages 2014). This is a clear case of wide variability in energy access in the region. Many of the citizens of ECOWAS do not have access to improved cooking stoves and other forms of modern fuels (Brew-Hammond 2010). They rely on solid fuels, such as dung, wood, and charcoal for most of the energy needs including cooking and heating (Ouedraogo 2017).

Secondly, the demand for energy for commercial and household use is expected to increase, going into the future (Avila et al. 2017) especially in countries where current connectivity is below 30% and also, in Nigeria. Reasons such as urbanisation coupled with rural-urban drift, increasing population and improvements in the economic wellbeing of ECOWAS citizens are likely to push the energy demand further. The drift in demand will have an impact on the climate at the local, regional and global stage (Dorian, Franssen, and Simbeck 2006).

On the other hand, supply is constrained to the extent that existing consumers are unable to get steady electricity supply whiles potential consumers do not get access at all. Supply constraints largely have come about because of years of disinvestments in the sector. Also, lack of generation capacity, a rundown of existing stock and limited transmission and distribution infrastructure (IEA 2014, 439) are the other constraints. To address the mismatch and ensure supply meets the demand would require substantial investments in various facets of the energy sector. For instance, under the IEA's new Policy scenario, commutative investments (2017-2030) under the current energy sector arrangements only constitutes one-fifth of investments required to ensure universal

access in Sub-Sahara Africa. An additional investment of $370 billion on top of initially estimated $80 billion is required (IEA 2017, 90&91). Legitimately, the investment required would not come easy. Hence, the need to interrogate the matter with the aim of finding alternative supply solutions.

Thirdly, the energy access gap between countries in the region requires closing up (Avila et al. 2017). Currently, national access rate ranges from a low of 9% in Sierra Leone to a high of 84% in Ghana. To close this gap require a combination of interventions to be pursued. Two chief energy expansion dogmas (country-specific policy and regionalised approaches) are the standard practice, with the former being the dominant strategy. The relevance of energy to growth and development requires of individual nations or regional grouping to adopt policy approach(es) that optimises energy policy gains. The approaches – sovereignty approach and regionalised approach have proved not sufficient panacea (Ouedraogo 2017) especially when they are pursued in isolation and without the complement of the other. However, finding the balance between the two doctrines has not been smooth as many of the countries envision energy as a matter of national security. Moreover, also because of the fragmented and conflictual global energy governance regimes (Dubash and Florini 2011).

Fourthly, the role of renewables in the ECOWAS is essential given the unlimited potential in the region and the impact it will have on energy generation cost. The ECOWAS has enormous renewable energy potential consisting of 5,871 MW in mini hydro, 281.4 CSP TWh and about 1,038.01 in solar PV TWh (Merem et al. 2017). Modern biomass potential is about 19,867 MV and wind; 46,624 MV. In the renewables, the comparative advantage is with Nigeria and Niger. Evolving discussions about the renewables in the context of the regionalised platform is more critical than ever giving the disproportional allocation of such resources and the impact it would have on the high cost of the current oil-based generation mix. The corollary of bringing renewables on stream will increase energy security and reduce the dependence on imported fuels, and ultimately, impact the power mix and cost.

Finally, the ambitious goal of ECOWAS of having a 100 percent energy access to all its citizens by 2030 makes the discourse much more critical and timeous (ECREEE, n.d., 31). Within the next decade or so, the ECOWAS decree seeks to ensure full citizens access to electricity, clean cooking stoves, and modern fuels. The path to 100 percent energy access requires the ECOWAS to evolve arrangement(s) which guarantees adequate mobilisation of the needed financial and technical resources (domestic or external) for the provision of the needed energy infrastructure. It is estimated that a total investment of $52.1 billion is required to ensure energy for all of West Africa by the year 2030, (Brew-Hammond 2010). Equal importance has been the efforts at stimulating innovations in the energy sector.

In the context of the factors above that this research paper proceeds, we postulate that ECOWAS is unlikely to meet the goal of having all her citizens have access to energy by 2030; but, there is a potential to improve energy access with the right approach to regionalisation. We hold the notion that expanding the frontiers of ECOWAS

regionalised arrangement to cover energy domains not currently covered by individual state government could boost the relevance of the sub-regional power pool. The efforts at renewables would significantly improve the power generation situation within the ECOWAS region within the medium to long-term.

The study, therefore, concentrates on the energy situation of West Africa, delving into the various approaches being used to achieve the ECOWAS objective of 100 percent energy access by 2030. We further explore alternatives that potentially could quicken energy supply and try to explore the possible militating factors which could affect the policies. We also hope this provides the empirical grounding for energy policymakers in developing nations, notably ECOWAS, concerning Energy Access.

Chapter Two

2.0 Energy situation of West Africa

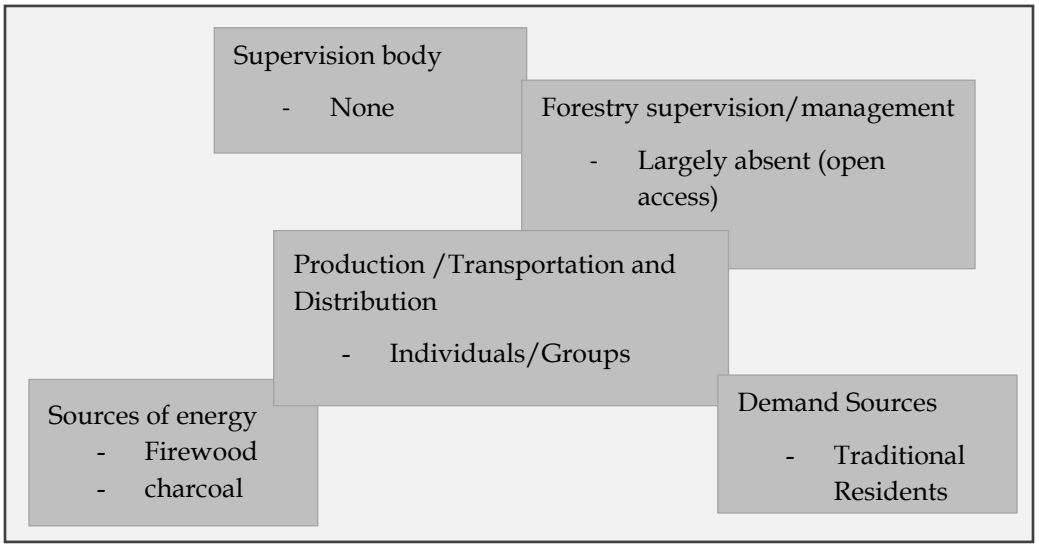
West Africa's energy mix comes from three primary sources of wood fuel (firewood and charcoal), petroleum and electricity (Kebede, Kagochi, and Jolly 2010). Wood fuels account for about 70 percent, with petroleum constituting about 23 percent and electricity, about 7 percent (Kebede, Kagochi, and Jolly 2010).

2.0.1 Bioenergy source

Wood fuel, though a significant share of energy consumption, they are largely primitive and mostly informal and inefficient. Bioenergy sources primarily are used for cooking and heating. Production of contemporary energy from bioenergy sources are still infinitesimal. As of 2015, about 87% (which translates into 308 million people) of West Africans had no access to clean cooking and relied on traditional wood fuels for cooking and heating. The number though astonishingly high, represent an improvement on the 2000 share of >95% (IEA 2017, 119).

The dependence on bioenergy or wood fuels is due to the sheer abundance of biomass resources (IEA 2014, 470) and also the fact that other forms of energy are beyond the reach of many especially the poor. Under the new policy scenario of IEA, bioenergy is projected to continue to be the number one energy source for sub-Sahara Africa as well as West Africa (IEA 2017). Tellingly, West Africa's energy mix is expected to remain constant way into 2030 with wood fuels as the primary source. Population growth and sluggish economic growth explains the continued dependence on bioenergy into the future. However, under the Energy for all Case of IEA, with an annualised investment of $1.7 billion on top of the required $77 billion, the situation gets much better. The share of biomass reduces to 62% in 2030 and gets replaced with more advanced biomass cooking stoves. The share of LPG and gas, and electricity will also become more prominent (IEA 2017, 96). The structure of wood fuel arrangement is illustrated below in figure 2.

FIGURE 2 TRADITIONAL WOOD FUEL STRUCTURE



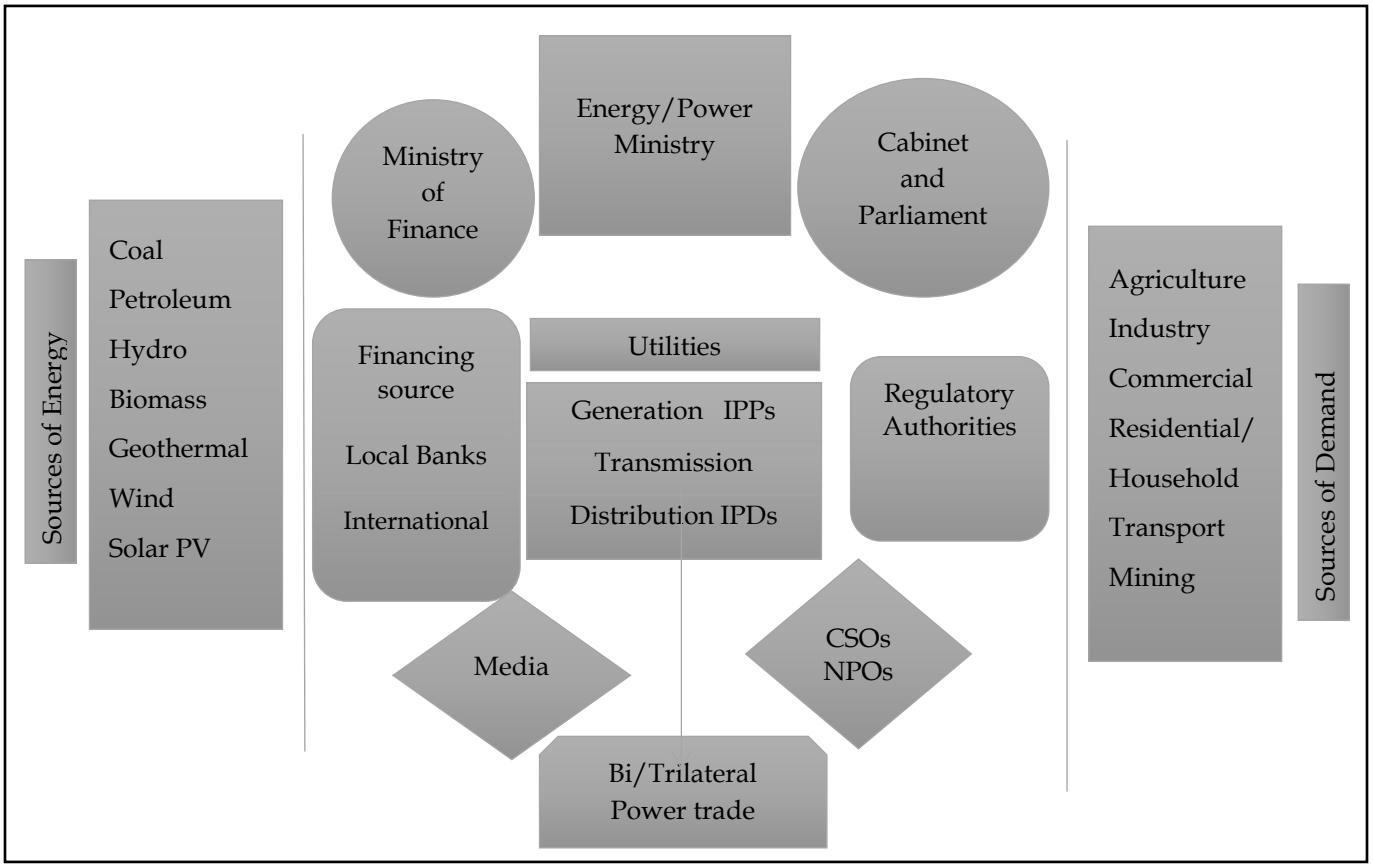
Source: Author

2.0.2 Electricity and Petroleum

Petroleum and electricity, which are the other two energy sources, are considered the non-traditional and improved energy sources. They are essential, as they are used across the entire economy. Petroleum products of gasoline, diesel and kerosene are used in all forms of transportation, including aviation, road and marine. Many ECOWAS countries do not have petroleum resources and rely on imported products for domestic consumption. Countries with petroleum resources, some produce and refine portions in-country while others produce and export the crude. Petroleum exportation has been a significant source of revenue for many of the petroleum exporting countries in ECOWAS.

With regards to electricity, it is a vital energy source for Industries, Commercial and Residential/Households. Lack/inadequate electricity supply is identified as one critical challenge to Sub-Sahara Africa's industrialisation(AREI 2015, 12). To effectively increase energy access and ensure energy security requires that the energy mix must drastically change by increasing the share of electricity. However, electricity generation, transmission and distribution constraints coupled with the economic position of many West African countries shows the shift might not occur sooner as required despite the vital role that electricity plays in economic development. Below is a generic institutional structure of improved energy sources of electricity and the petroleum sector [Figure 3].

FIGURE 3: INSTITUTIONAL STRUCTURE OF IMPROVED ENERGY SOURCES IN ECOWAS



Source: Author

2.1 Key matters on West Africa's energy situation

The rest of the discussion on the energy situation in West Africa is examined from four perspectives including energy poverty, energy security, climate change and management framework.

2.1.1 Energy poverty

Energy access, especially modern energy types, continues to be a significant challenge for the member countries of the ECOWAS. Moreover, without deliberate investments in both energy generation, transmission and distribution, the ECOWAS is most likely to wear the tag "energy poor" far beyond 2030 (ECREEE 2015). The impact on member countries' economies and society could be dire. However, the impact will be much more severe in countries which depend almost wholly on imported fuels for power generation.

The price of energy in West Africa is significantly high[1] and giving the high levels of income inequality; many people spend high proportions of their income on poor quality energy services. Despite the high charges, many countries still provide subsidies as the tariffs are below the production cost. Traditional biomass is still a dominant energy source for most rural folks for cooking and lighting. The dependence on biomass and the slower migration to other energy forms such as electricity is due in part to the limited ability and willingness to pay and also high electricity cost (ECREEE 2015, 25).

Urban areas use higher energy such as electricity and petroleum products for most of their needs. LPG which is much more efficient and clean has been promoted especially in urban areas, yet charcoal continues to be the most preferred fuel. About 87% of most of the citizens of ECOWAS depend on firewood and charcoal, a situation which is having a debilitating impact on flora and fauna.

2.1.2 Energy security

Scholarly discourse on energy security has been daunting, owing to the distinctiveness of the subject matter- sovereignty, robustness and resilience- that form the core. These three perspectives fall under different disciplines of political science, engineering and economics (Cherp and Jewell 2011). Previously, energy security theorising focused on oil supplies. However, a harmonised approach where all perspectives get reflected has become a preferred approach in recent times albeit challenges of transparency and vigorousness (Cherp and Jewell 2011).

Energy security is defined as the uninterrupted availability of energy sources at an affordable price (Jewell 2011, 9). It concerns about the management of inherent risk in the supply chain, from production through to the final user. West African sub-region, undeniably, is challenged in energy security, from physical supply- availability and accessibility, economic- affordability and environmental sustainability- acceptability. There is a growing gap between energy demand, supply capacities and increasingly

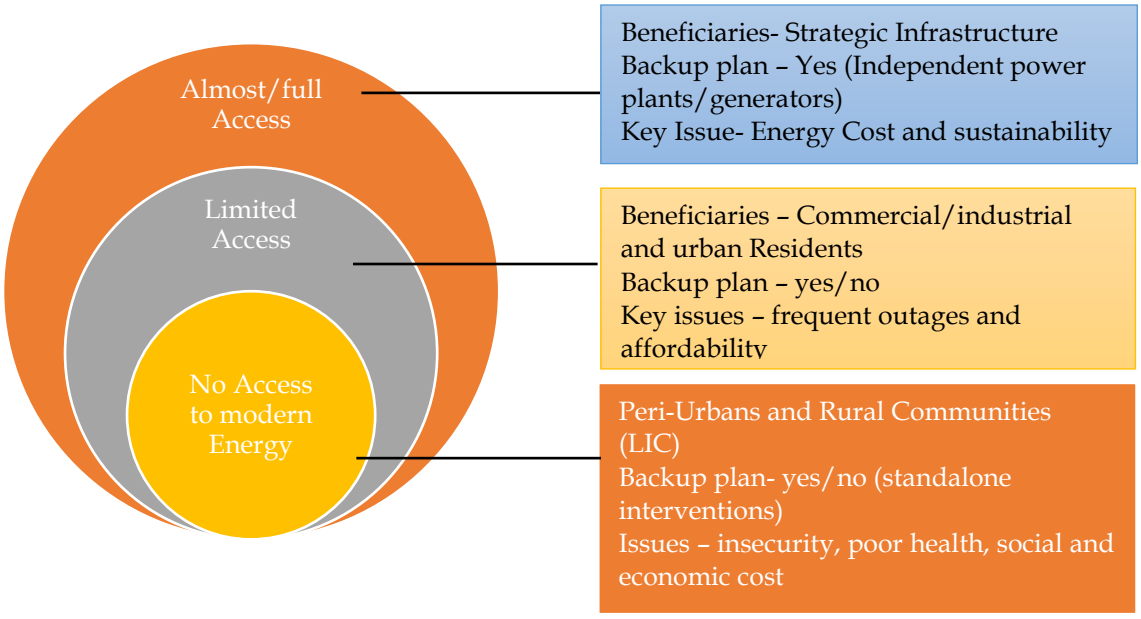
[1] For instance, average effective electricity tariff of Africa in 2010 was $0.14 per kWh and average production at the same period was $0.18 per kWh. Around the same time, the average tariff for South Asia was $0.04/kWh, while that for East Asia was $0.07/kWh. (https://www.afdb.org/en/blogs/afdb-championing-inclusive-growth-across-africa/post/the-high-cost-of-electricity-generation-in-africa-11496/)

limited capital investments (ECREEE 2015). The blip in capital investment is exacerbating the demand and supply gap, and they are not ephemeral but persistent. To improve the energy security within the region will require a full understanding of the four R's–the problem (Review), and using less energy (Reduce). The rest are shifting to other sources (Replace) and also limiting new demand to secure sources (restrict) -(Hughes 2009, 2461).

Currently, the grid capacity of ECOWAS is estimated at 20 GW (IEA 2014, 477) and a target of 35 GW in 2040. About 50 percent of this capacity is from oil and gas generation (mostly from Nigeria), 30 percent from oil distillates and 20 percent from hydropower (Avila et al. 2017). Not long, until the 1990s, hydropower sources were the most significant share of the generation capacity. The challenge with the oil and gas led generation mix has been about price fluctuation. For countries who depend on expensive diesel and heavy fuel-fired power generation, they face double energy squeeze - a higher price for traditional and imported energy. For instance, in 2012, average generation cost within the sub-region was about $140 per MWh (IEA 2014, 477; Avila et al. 2017).

Oil price increases and fluctuation are without a doubt, contributing to the plummeting economic growth of the region and slow levels of electricity grid connection. Of equal concern is the high energy intensity as well as colossal technical and system losses during generation, transmission and distribution. There are regular power outages and load shedding in the region, which have severe social and economic cost. Below is a generic modern energy security/access map of a typical ECOWAS country.

FIGURE 4: MODERN ENERGY ACCESS MAP



Source: Author

Key messages from the map are as follows;

- the transition between the "no access" and "limited access" is highly blurry and depends on individual's income level and availability of power.
- "No access" have direct impact including health, social and economic cost, whiles "limited access "have indirect psychological impact such as damage to gadgets due to frequent outages
- Many interventions are highly biased towards the "almost/full access" and "limited access" group
- Stand-alone interventions such as small solar projects work better on the "no Access" group

Author

Another feature of West Africa's energy security has to do with the tariff structure. Average consumer tariff is about 13.6 c€/kWh(Avila et al. 2017) and is high. The high tariffs are explained by the rising dependence on imported fuel-based energy generation and a myriad of inefficiencies. Though energy generation cost is high, many of the countries of West Africa are unable to pass down the full cost to the various segments of customers (residential, commercial and industrial) because of the low-income levels. The situation is much pronounced in countries without a fully deregulated power market and where inefficiencies are pervasive. In effect, massive subsidies are often provided to cover the uncovered cost of generation (ECREEE 2015) because tariffs are high when compared with the rest of the world (IEA 2014, 453). The spasm associated with subsidy programmes have, however, become a chief concern for national budgets.

2.1.3 Climate change

Climate change has become an inescapable trap that many developing countries must deal with in the provision of energy. Already, the impact of a warming climate is felt in many parts of West Africa through prolong droughts and changing river flow patterns (ECREEE 2015, 26). Erratic precipitation patterns are impacting the reliability of hydropower resources which constitute a second most significant source of power generation in West Africa (Avila et al. 2017, 8). Many forced outages have been necessitated by the unpredictable rainfall patterns which make hydro stations unreliable. Also, biomass capacity to naturally regenerate itself is constrained by extreme climate change.

Though the region is one of the least contributors to climate change, it is vulnerable to climate change impacts such as reduced agricultural yields and droughts and dwindling biomass potential (Yekini et al. 2013; ECREEE 2015; Avila et al. 2017). The integration of climate change mitigation and adaptation cost into energy pricing is escalating energy cost. Moreover, the situation is putting energy security and access in a dilemma (ECREEE 2015). The only caveat, though, is that "no action" on climate change could prove to be

costlier than the fractional cost due to climate mitigation and adaptation measures. Also, the region has still substantial unexplored opportunities with abundant renewables which do not exacerbate climate (Avila et al. 2017, 17).

2.1.4 Management framework

Management capacity of many of the utilities in West Africa is relatively weak, and almost all the utilities are state-owned with political interference as a widespread occurrence. The weak management capacity coupled with political interference, have led to significant inefficiencies in many of the utilities. The operational inefficiencies have also compromised the financial viability of many of the utilities. Many of the energy sector SOEs, are effectively in operation because the central government bear their explicit and implicit liabilities. The reason for the predicament of these companies is the result of persistent under-capitalisation and their inability to access adequate funding either from local or international capital market.

Chapter Three

3.0 Energy access approaches

Here, the discussion focuses on the modern energy -electricity and petroleum. The bias here is as a result of the fact that regionalisation concept is much applicable to the electricity market and the fact that there is less of regionalism in bioenergy. We, however, acknowledge the importance of modern bioenergy to the broader ECOWAS energy strategy. We are aware of the many innovations and evolutions taking place in the traditional energy source and its attendant positive implications on climate change, on individual country's economy as well as on poverty, health and disease reduction. For instance, the efforts at modernising bioenergy (traditional through to improved and ultimately modern energy) are acknowledged. They are important micro events we do not lose sight of.

Until the last two decades, the dogma employed by many countries concerning energy access were country-specific with occasional bilateral and trilateral engagements. Many countries treated energy as a strategic national asset and as such a national security asset. Energy resources were, therefore, harness for the exclusive economic use of individual countries. Countries with an abundance of it leveraged it for economic gains and superiority in the international economy of nations. Exploitation exclusivity and denial of other people from use were the guiding principles. Given the importance countries attached to energy, cooperation was rare and seldom. Though Karim Karaki in his paper opined that regional cooperation in West Africa started circa, 1960's (Karaki 2017, 5), the evidence suggests that those cooperations were bilateral or trilateral (ECA 2004, 24) and were defined by energy resources ownership commonalities.

However, with the uneven distribution of energy resources, growing connectedness of humanity and higher benefits from cooperation, transnational approaches have become prominent and desirable for the enhancement of energy access and security.

The rest of this chapter is, therefore, devoted to the two main approaches; a.) country level and b.) sub or regionalisation approaches.

3.1 Country level approach to energy access and security

The countries of ECOWAS all have individual country level energy policies. Each policy reflects their energy situation, required resources, policy actions under implementation and the bottlenecks.

The objective and vision vary from country to country. For instance, Nigeria's energy policy objective among others is to "…ensure the development of Nigeria's energy resources, with diversified energy resources option, for the achievement of national energy security[2] and an efficient energy delivery system with an optimal energy resource mix" (Energy Commission of Nigeria 2003, 8). Also, Ghana's vision is to "...develop an "Energy Economy" that would ensure, secure a reliable supply of high-quality energy

[2] Though Nigeria remains an important country as far as energy independence of the ECOWAS sub-region is concern, her National energy policy is domestic focused and ensuring domestic energy security is paramount.

services for all sectors of the Ghanaian economy, and to become a net exporter of oil and power[3] by 2012 and 2015, respectively"(Republic of Ghana 2010, 8).

For Sierra Leone, the primary objective among others is to "…provide reliable and affordable power supplies to stimulate the economic development of Sierra Leone, through the consolidation, improvement and expansion of existing power supply infrastructure" (Ministry of Energy and Water Resources 2009, 7). For Burkina Faso, the main objective is to "...to increase the use of national energy resources and improve the efficiency of energy consumption"(ECREEE, n.d., 59). Niger's objective is to "… contribute to poverty reduction through sustainable access to modern energy services in all socio-economic sectors"(ECREEE, n.d., 64).

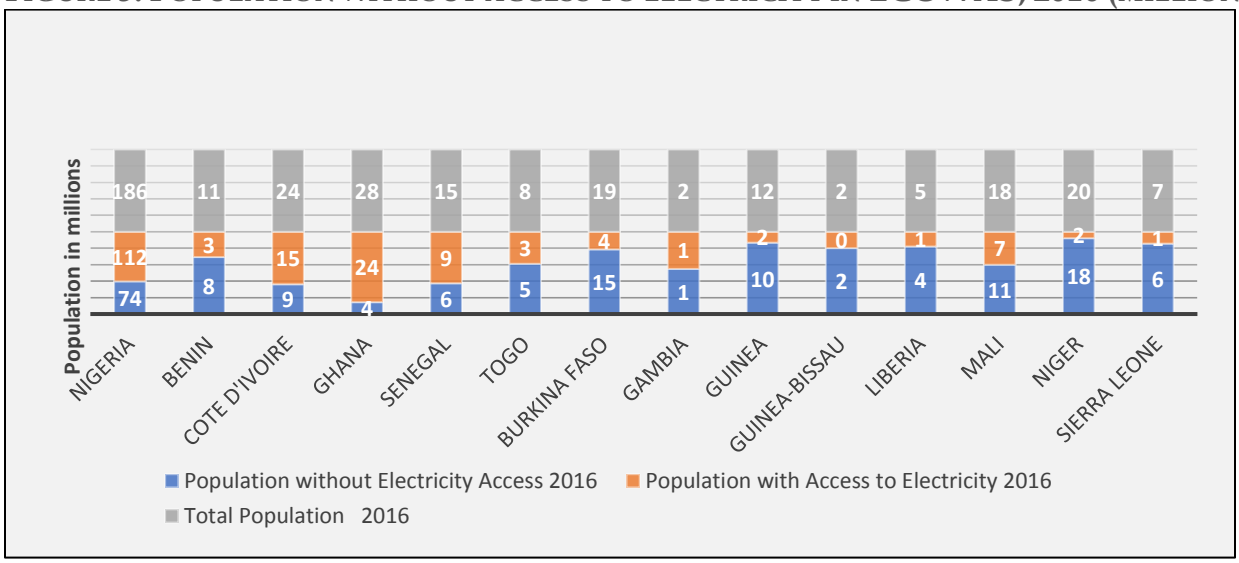
Though some of the countries reflected regionalisation and transnational coordination in their national energy policies, the majority still approach energy matters from the domestic viewpoint. Even for countries where bi or trilateral agreements exist, energy policies are envisioned on country-specific needs. The emphases on the domestication of energy policy pose challenges for the transnational efforts which are aimed at attenuating the dire energy situation collectively. What, however, is significant in many of the country-specific efforts is the integration of renewables into such policies, albeit slow pace of developments, integration and implementation.

Another critical feature of the country-level approach is that the energy sector utilities are State Owned Enterprises (SoEs). Private sector investments in the energy sector of Africa is about 1% of all such investment in developing regions. South Asia has 34%, and Latin America, 26% (Saghir 2015). In many countries, the generation, transmission and distribution are solely the functions of SoEs created for such purpose. However, in recent, there has been increasing private sector participation, especially at the generation-Independent Power Producer and distribution-Independent Power Distributors-level. Independent regulatory bodies are also being formed to regulate the sector. For instance, Ghana's Energy Commission and the Public Utilities and Regulatory Authority are examples.

The country-specific approach has not been that successful, owing to the lewd level of power access among ECOWAS as seen from the figure 5. Significant to the low trend has been the low capital investment in the sector, weak governance, low capacity and performance, political patronage and corruption, and irrational subsidy programmes. These and many more have militated against the ECOWAS countries thereby impacting power generation, transmission and distribution.

[3] Ghana however, reflects regional power trade in her policy, perhaps because Ghana already has somewhat good infrastructure for electricity trade.

FIGURE 5: POPULATION WITHOUT ACCESS TO ELECTRICITY IN ECOWAS, 2016 (MILLION)



Source: Author with data from IEA

Given the challenges above, it appears that relying solely on country-specific efforts to solve energy access challenges appears not sound and lasting especially for countries with lower resources endowment. The situation requires something else, and hence, we turn our attention to sub-regional efforts.

3.2 Regionalise approach to energy access and security

Energy cross-border trade and system interconnections have been promoted as one way of solving the problem of power supply reliability, efficiency, low cost and system security. Theoretically, such trade and interconnectedness must result in increased reliability of energy service, improved energy security among countries, reduced power production cost and offer grounds for development. The regionalised approach is not new to Africa. In the early 1950s, the Maghreb Countries of Tunisia and Algeria established the first "emergency power exchange networks"(ECA 2004). Congo and Zambia, in 1958, also constructed another grid connection between the two countries. In West Africa, the first country-to-country power connectivity occurred in 1960 between Ghana and Togo-Benin after the construction of the Akosombo Hydropower station (ECA 2004; Karaki 2017).

What is clear is that the earlier grid connectivity agreements were bi/trilateral. Many of the agreements were purposely for hydropower because they were cheap (ECA 2004). They were done either to aid extraction of minerals (Firm energy sale) as in the case of Congo-Zambia. Alternatively, many arrangements of such were undertaken because the hydro resources were trans-national (compensation exchange made in kind). An example is the Akosombo Dam in Ghana. However, many of the bi/trilateral agreements of this kind did not envision the need for capacity expansion and so over time, installed capacity of many of the systems were no longer capable of meeting the conditions of the supply agreements as domestic demand increased. In that regards, many of the power exchange

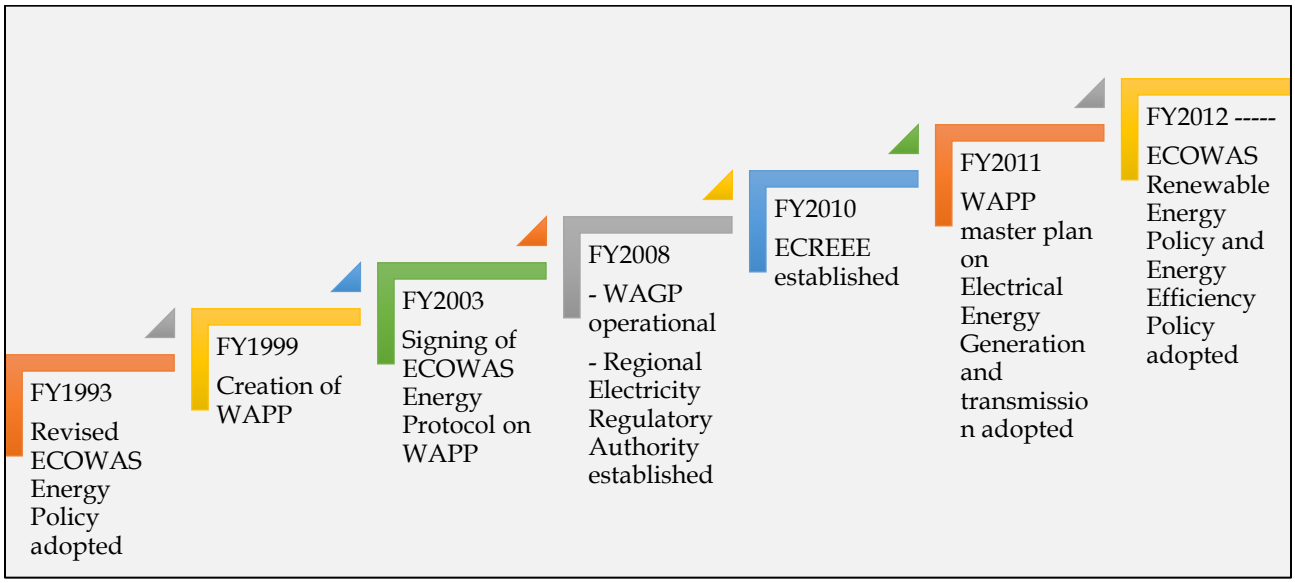
contractual agreements suffered breaches and export obligations were not met (ECA 2004).

Given the limitations in bi/trilateral arrangements, comprehensive power pooling, multi-country arrangements became more attractive. Such an approach was seen as one that potentially could enhance greater integration in power generation, planning, and transmission. They offered much security and reliability to member countries than the bi/trilateral arrangements. The first of such regionalised approach was the Southern Africa Power Pool (SAPP) of the Southern Africa Development Community (SADC) (ECA 2004). Subsequently, the ECOWAS learning from SAPP established the West Africa Power Pool (WAPP). The East and Central Africa subsequently established their regional Power pools.

3.2.1 Establishment of WAPP

The WAPP is one of the three critical pillars created by the ECOWAS Energy Policy of 1982- revised in 1983. The other two are; the West Africa Gas Pipeline in 2003 and the Energy Centre for Renewable Energy and Energy Efficiency (ECREEE) in 2010 (Karaki 2017). The ECOWAS Energy Policy envisioned the need for member countries to harmonise and coordinate their energy policies to promote greater integration and collective energy autonomy. The creation of WAPP in 1999 and the subsequent signing of the ECOWAS Energy Protocol in 2003 ("Ecowas Energy," n.d.; Karaki 2017), gave impetus and an indication of the seriousness of the Region to solve its protracted energy crises.

FIGURE 6: EVOLUTION OF ECOWAS ENERGY COOPERATION AND INTEGRATION



Source: Author

The WAPP aims to connect the power infrastructure of all the 14 participating ECOWAS countries thereby creating flexibilities that enable power exchanges among member countries. In specific, WAPP promotes the development of infrastructure for power generation, transmission between member countries as well as investors. It is also

charged with the creation of the enabling power market to facilitate energy trade in the sub-region, i.e. trading in power between exporting and importing countries. In that sense, WAPP has essentially been a launching pad for bi or trilateral agreement for generation, transmission and distribution of energy among member countries.

The grid of WAPP projects is outlined in the map below.

FIGURE 7: MAP OF WAPP NETWORK

Sources: WAPP

Countries like Ghana and Côte d'Ivoire have benefited from the export of electricity to other member Countries whiles Nigeria has benefited from the export of energy fuels like natural gas and oil using the WAGP. Ghana and Côte d'Ivoire again have at times of crises also imported energy fuel especially from Nigeria to power generation stations. In this direction, the WAGP Project has been instrumental in gas supply from Nigeria. In 2005, access to electricity in West Africa was just 37 percent. In 2016, the electricity access was at 52 percent (IEA 2017). The growth is partly attributable to the WAPP project and the other interventions of ECOWAS.

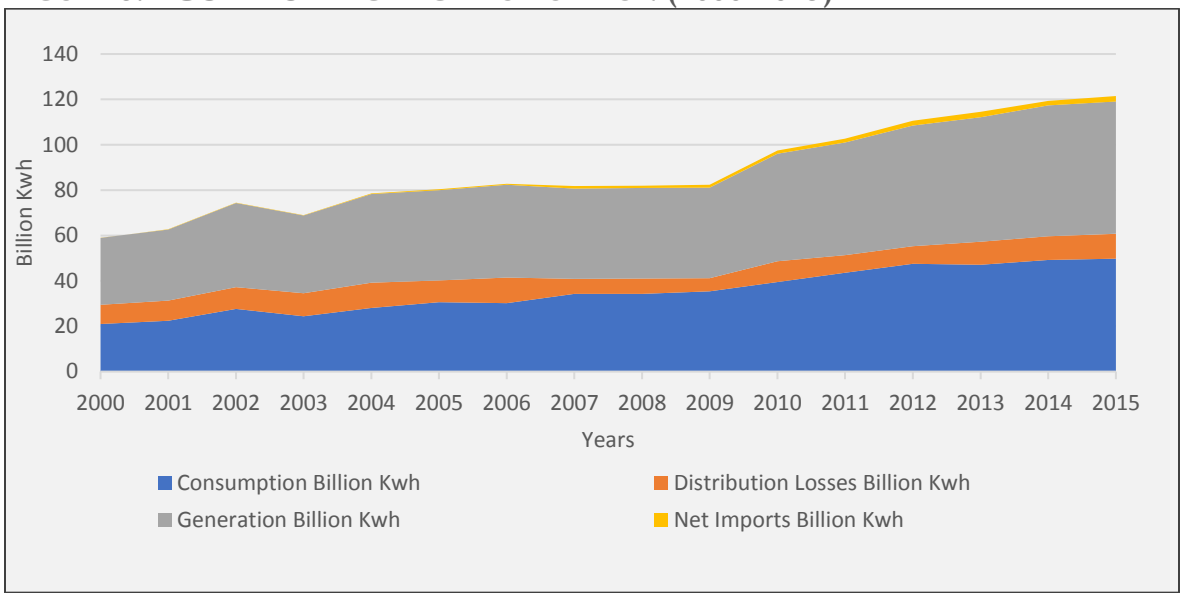
3.2.2 Impact of WAPP

To know the impact of WAPP and for that matter regionalisation dogma, we examine the electricity situation of ECOWAS before and after the creation of WAPP in the areas of; electricity generation, consumption, net import and distribution losses. We again examine the resources mobilisation performance and also ascertain about the excess electricity capacity created since the establishment of WAPP.

3.2.2.1 Power situation with WAPP

In broad terms, electricity situation has changed as seen from the steady rise in both generation and consumption. Electricity trade, however, has not been that significant, and distribution losses have remained virtually at the same level (figure 7).

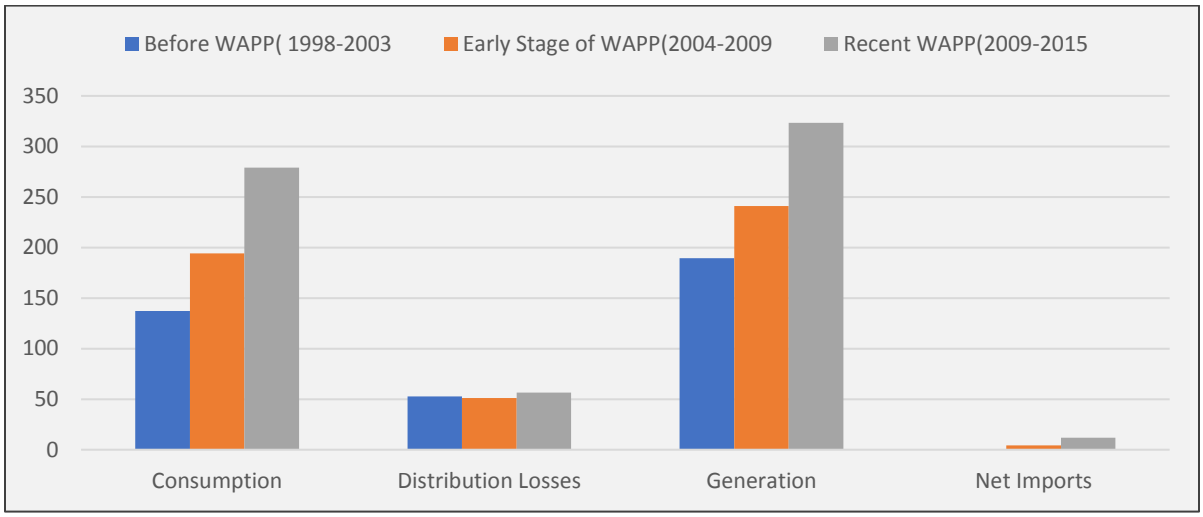
FIGURE 8: ECOWAS ELECTRICITY SITUATION (2000-2015)



Sources: Author with data from U.S. EIA

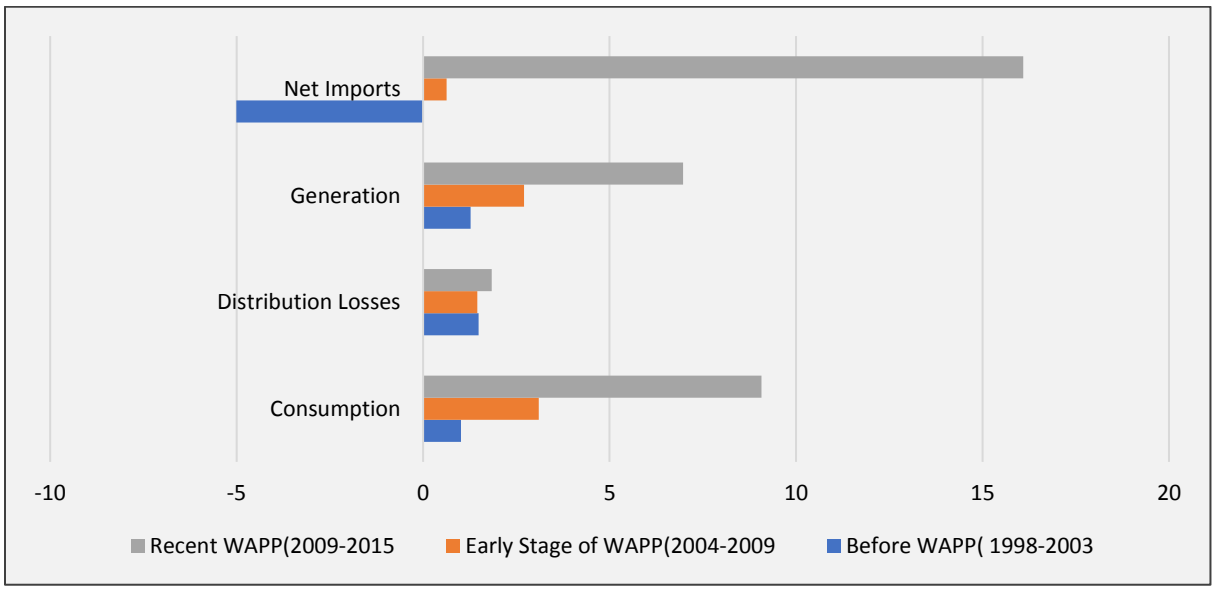
Consumption of electricity has been on the rise before and after the establishment of WAPP. Between the periods of "before WAPP" and "early stage of WAPP, (i.e. 1998-2003 -to- 2004-2009), electricity consumption increased by about 42%. However, recent WAPP period (2009-2015) saw a slight increase in consumption to 44%. In the same timeframe, generation increased by 27% and 37% respectively. Distribution losses, however in the period between 1998-2003 -to- 2004-2009, saw a reduction of about 3%. The situation has since gone worse with distribution losses increased to about 10% between the periods of Early WAPP and Recent WAPP. It is currently at the level as it was before WAPP's establishment. About net importation, the growth has been sluggish and relatively slow when compared to massive jumps in consumption. Between 1995 and 2015, the average change in net importation is 8.5%.

FIGURE 9: BEFORE AND AFTER WAPP ANALYSIS OF ECOWAS ELECTRICITY SITUATION



Sources: Author with data from U.S. EIA

FIGURE 10: PERCENTAGE CHANGE IN ELECTRICITY INDEX



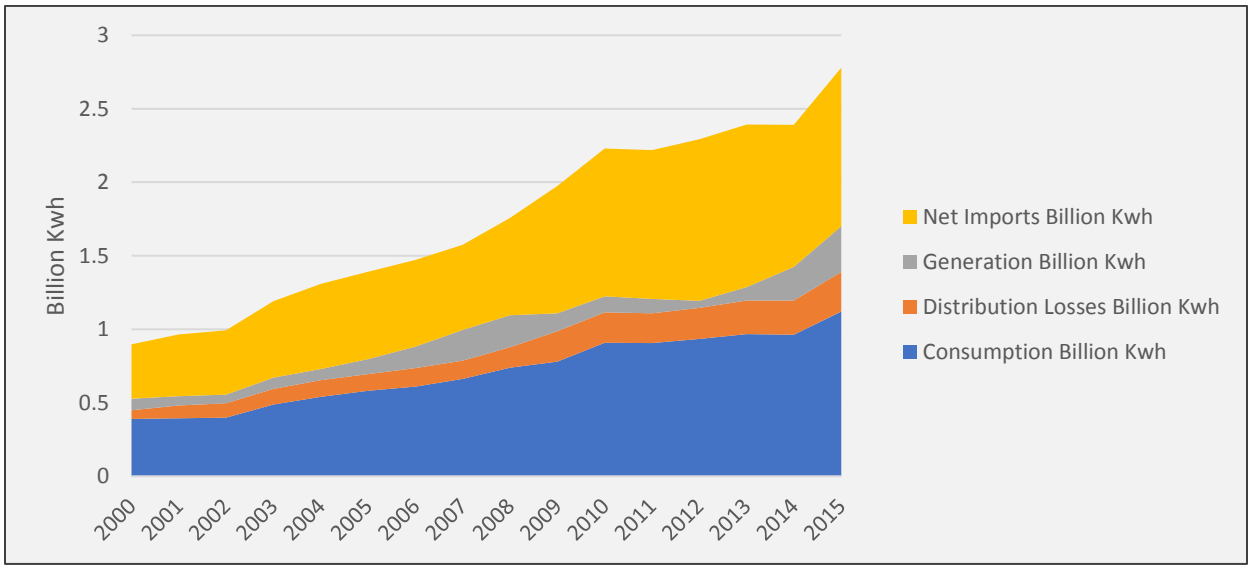
Sources: Author with data from U.S. EIA

Despite the growth in electricity access, it is undeniable that the growth has not been robust as growth in consumption has completely outstripped supply. It means WAPP has not had the impact many expected. Several factors explain the sluggish impact of WAPP on the power situation of ECOWAS. These include; a) weak capacity of WAPP; b) dependence on development partners for funding. The rest are; c) frail WAPP's independence especially in the area of funding and sustainability, d) weak linkage between WAPP and National Power Authority's policy planning; and e) weak power infrastructure and inadequate investments in electricity generation and transmission by member countries.

At the individual country level, regionalisation impact has been mixed. In Benin for instance, distribution losses increased significantly by FY2008, reduced subsequently and since 2014,

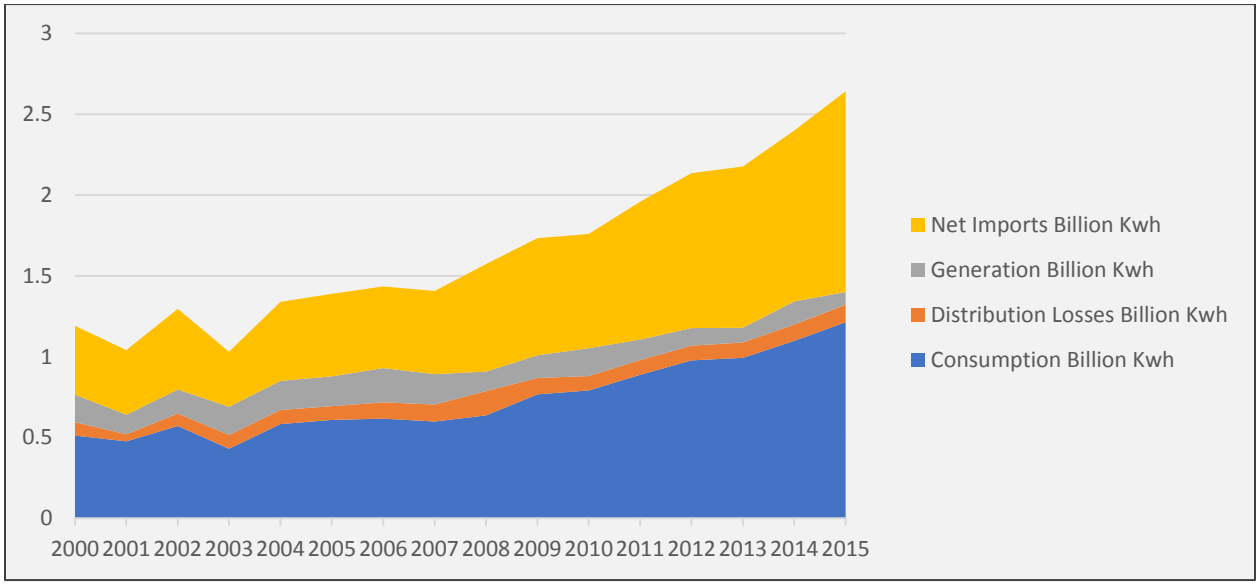
the losses have increased again. Electricity generation has also dipped, whiles consumption is increasing. Electricity importation has filled the gap. In Togo, distribution losses have not attenuated, and electricity generation is also reduced. Consumption and import of electricity have since FY2009 been on the rise. These two countries are net importers of electricity. These two countries have not seen improvement in electricity since WAPP was established and much of their imports only replaces or augment the existing capacity (installed and available) to ensure the needs of existing customers are met.

FIGURE 11: ELECTRICITY SITUATION IN BENIN



Sources: Author with data from U.S. EIA

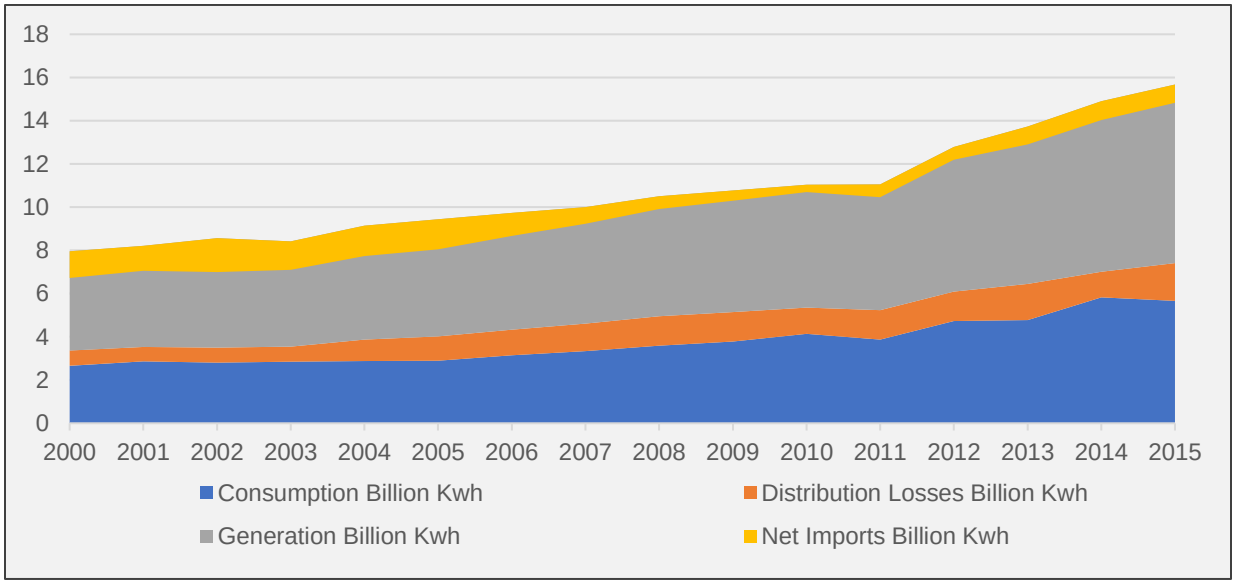
FIGURE 12: ELECTRICITY SITUATION IN TOGO



Sources: Author with data from U.S. EIA

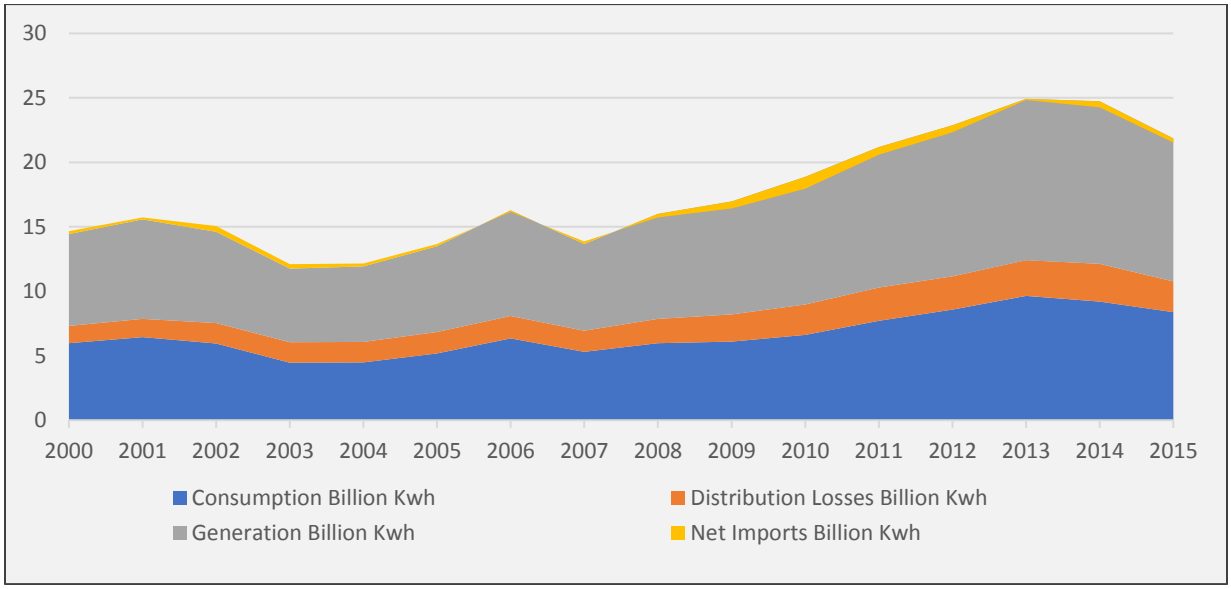
In Ghana and Côte d'Ivoire, the situation is much different from those of electricity importing countries. Ghana and Côte d'Ivoire exports and at the same time import power as and when needed. In Côte d'Ivoire, generation, consumption and net import seem to be on a rising trajectory, except for FY2011, where exportation of power slowed. In Ghana, the fluctuation in electricity generation is quite grave and volatile when compared to Côte d'Ivoire. Ghana's net import situation has worsened in recent time due to a significant increase in domestic electricity demand and idling installed capacity due to high fuel cost.

FIGURE 13: ELECTRICITY SITUATION IN CÔTE D'IVOIRE



Sources: Author with data from U.S. EIA

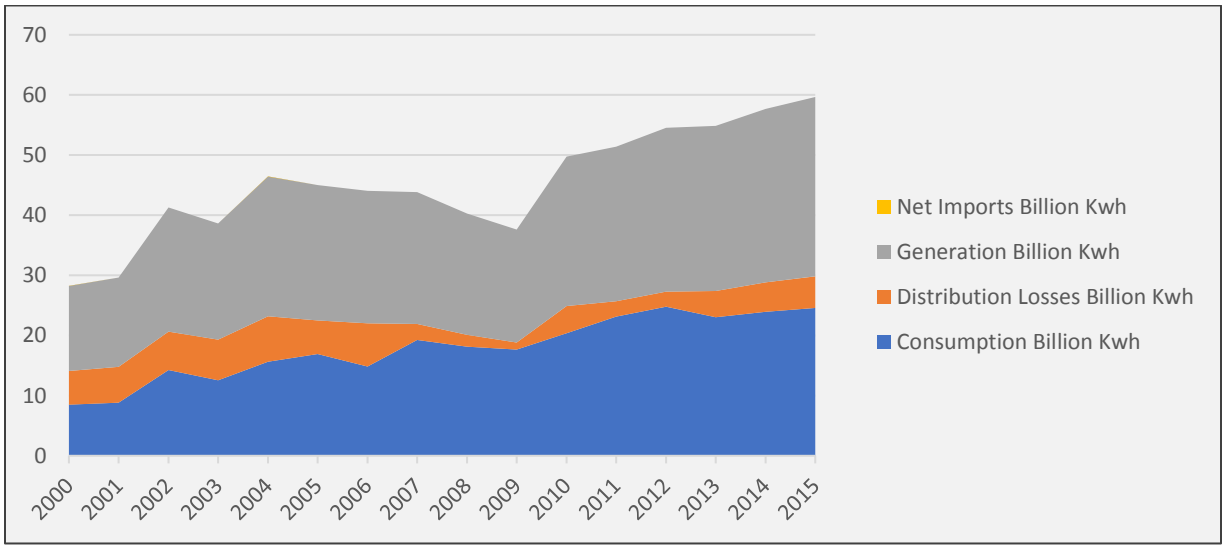
FIGURE 14: ELECTRICITY SITUATION IN GHANA



Sources: Author with data from U.S. EIA

Nigeria is a lead producer of natural gas in the region. However, regarding electricity export/import, Nigeria's net position is zero[4] due to the non-existence of inter-country electricity transmission networks and the surging domestic demand. Nigeria's relevance in WAPP is very significant, as major electricity trading countries like Ghana and Côte d'Ivoire depend to a large extent on the supply of natural gas from the WAGP as the cheap primary fuel source. Nigeria is currently building its infrastructure to become a dominant player in electricity trade as the country is now investing in transmission infrastructure. Nigeria has also been successful at reducing distribution losses (figure 15).

FIGURE 15: NIGERIA'S ELECTRICITY SITUATION



Sources: Author with data from U.S. EIA

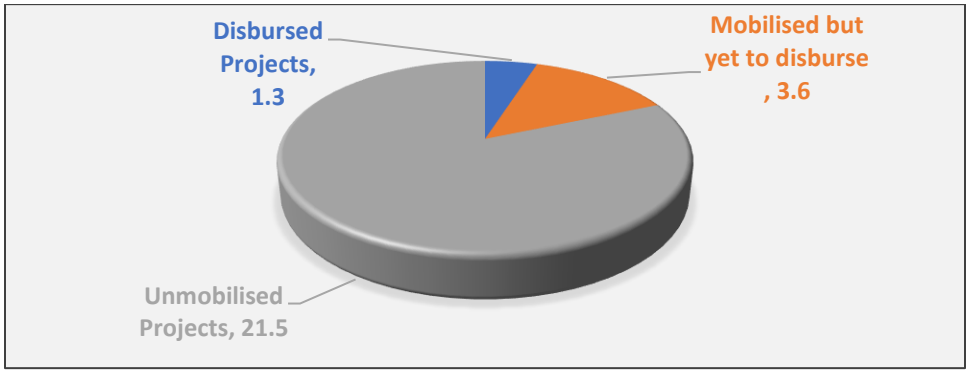
3.2.2.1 Resources mobilisation performance

The WAPP is an ambitious project, and since its establishment, a number of projects and programmes have been planned with some implemented. As of 2017, a total of 23 projects valued at $4.9 billion were at various stages of implementation. Six of such projects dubbed "priority projects" plus other finalised projects have since been completed and are in operation. The total cost of the completed projects amounted to $1.3 billion. The projects in this category were chiefly transmission systems and occasional rehabilitation of power station.

The remainder of the projects are at various stages of preparation and amounts to $3.6 billion. For many of these projects, financing is secured or almost secured for their implementation. The principal financiers are the development partners, traditional development banks, New financiers specifically, China and the country where such projects are to take place (list of WAPP projects attached as appendix 2).

[4] Nigeria's net position is zero because, here we are looking at electricity trade. In broader energy resource market, which includes oil and natural gas, petroleum etc, Nigeria is a net exporter.

FIGURE 16: PORTFOLIO OF WAPP AS OF 2017, (BILLION $)



Sources: Author with data from WAPP

The $4.9 billion (15.6%) forms a part of the planned WAPP grid projects which are estimated to cost $26.416 billion from 2012 to 2025 (WAPP 2012, 21). Under this, a total of 33 generation projects estimated at $20 billion and 26 transmission projects estimated at $6.5 billion are to be undertaken by 2025.

3.2.2.2 Excess electricity capacity created

WAPP is also expected to assist member countries in increasing their electricity excess capacity to ensure reliability and sustainability in cross-country trade. Here the interest is in available capacity and not installed capacity[5]. Excess Available capacity is defined as below;

$$E.CAP = f(G_i, Pl_i, C_i,) \quad (1)$$

and $i = \{1, 2, \ldots \ldots N\}$. The key variables in the function are defined as follows;
$E.Cap$ is Excess System Capacity, G is the size of Generation, $Pl\ i$s the Production Losses due to systems, and finally, C is the total electricity Consumption.

We then express the function as contained in equation (2) and the final function of interest is the equation (3).

$$ec = g_i - pl_i - c_i \quad (2)$$

$$ec = g_i - z_i \quad (3)$$

Where; yi is number of years, $ec = \sum_{i=1}^{N} \frac{E.Cap}{yi}$, $g_i = \sum_{i=1}^{N} \frac{G}{yi}$, $pl_i = \sum_{i=1}^{N} \frac{Pl}{yi}$, $c_i = \sum_{i=1}^{N} \frac{C}{yi}$ and $z_i = pl_i + c_i$.

Average Excess Capacity (Available)	
Before WAPP	After WAPP
1980-2003 - 15981.74 (kW)	2004-2015 - 154019.59 (kW)[6]

[5] Installed capacity is the intended full-load sustained output of an electricity generation stations whiles available capacity is the amount of load physically and readily accessible by end users.
[6] Conversion from kWh to kW was done using this formula: kW=kWh/h

From the analysis of excess capacity, before WAPP, the average excess capacity of West Africa was 15981.74kW (1980 to 2003). During this period, energy trade market was small, countries with low domestic electricity production could not expand coverage and outages were rampant. However, the period after WAPP (2004-2015), average excess capacity improved steadily to 154019.59kW. However, they were not significant enough to allow for expansion of the electricity market and also provide electricity access to new consumers. At best, the increases in excess capacity only came to strengthen existing systems which feeds a fraction of the people. The improvement is not as robust as expected and is far less than the average consumption of, for instance, Mali for the period 2009-2015.

It is evidentially demonstrated through the situational analysis, the resources mobilisation and excess capacity analysis that the National and Regionalise dogma to electricity provision have not attenuated the energy access and insecurity although there are glimpses of improvements. It requires the adoption of a multifaceted approach which calls for a revision of country-level systems as well as WAPP's operations systems. It requires targeted interventions in generations and transmission and incorporating new energy sources into the mix.

Chapter Four

4.0 Alternative approach to energy security

In the previous discussions, we exhaustively made bear the ECOWAS energy situation and the applicable approaches been used [understanding the problem (Review)]. Now we explore the other remaining R's - using less energy (Reduce), shifting to other sources (Replace) and limiting new demand to secure sources (restrict). In specifics, the discussion focuses on alternative measures which could impact the energy generation, transmission and distribution network of ECOWAS positively and potentially affect the 2030 sub-regional target of universal access to modern energy.

Before that, it is rightful that we establish the energy potential of the ECOWAS, the challenges inherent in the sector and follow through with discussions on the alternative measures.

4.1 Energy supply potential of ECOWAS

The ECOWAS region is endowed with plentiful energy sources many of which have not been exploited as yet (Avila et al. 2017; Karaki 2017). The energy resource potential is in three primary areas of; oil and gas, hydropower and solar irradiation (Karaki 2017). Oil and Gas are heavily skewed in favour of Nigeria. Circa 2,956.66 million tonnes of crude oil reserves and 3,509.38 billion m3 of natural gas representing 98 percent of proved crude oil and Natural gas reserves of ECOWAS is found in Nigeria (Karaki 2017). Hydropower potential is estimated at 23.9 GW. Of this potential, about 91 percent is found in five countries of Nigeria (37.6 percent), Guinea (25.8 percent), Ghana (11.4 percent) and Cote d'Ivoire and Sierra Leone have 10.9 percent and 5.2 percent, respectively. In the case of solar irradiation, the estimated potential is about 5kW.h/m2/day and can be found in all the ECOWAS countries (ECREEE 2015; Karaki 2017). Converting this potential into actual energy is an urgent need of ECOWAS in other to guarantee energy security of the region.

4.2 ECOWAS energy sector challenges

Despite the potential of the energy sector on access and security, in reality, considerable efforts are required to realise these potentials. The ECOWAS region faces a plethora of challenges - economic, political and cultural- that if not managed well, the envision energy potential might peak at sub-optimal. Below, we discuss some of the challenges:

i. Political instability, especially in resource-endowed countries – Many of the resource-endowed countries, face some amount of instability. Nigeria, which is the most energy resources endowed country is also one of the most unstable countries within the sub-region. The existence of insurgency groups like the Boko Haram poses a persistent threat to Nigeria and her political system and by extension the West African region. With such high political risk, the much-needed investment might not happen, or when they do, they come at a higher cost. Exterminating such potential political threats would be critical for attracting new investments into the energy sector of Nigeria.

ii. Weaker economic integration – Under the broader auspices of ECOWAS, the region has been working for almost four decades to deepen economic, social and political integration among the member countries. That singular effort is very critical to the energy market integration. The need for commonness in the technical specification (goods and services), taxation and tariff regimes, and ease of doing business are essential for power pooling. Integration of the energy market will not have the desired impact if there is weaker economic, social and political integration as such weaknesses result in a high cost for businesses.

iii. The mismatch between private investment interest and country energy policy objectives- to effectively roll out energy market roadmap of ECOWAS would require substantial private sector participation and investment. Moreover, such investment would occur when there is consistency in ECOWAS governments' policies and programmes across the region. A harmonised and consistent policy framework would help WAPP to be able to leverage on the collective will and power of the region to mobilise resources for the projects identified for implementation under the common energy market.

In that regard, a rethink of key policies such as subsidies and rural electrification policies became critical for attracting private sector financing. The two policies do not allow for the application of economically and cost-reflective tariffs for electricity. It is equally important to know that the West Africa situation is peculiar as electricity cost is high in Africa by world standards (IEA 2014, 433) and this is due in part to inefficiencies in the electricity value chain. Rural Electrification Projects essentially extends electricity to rural areas where income levels are low, and people are poor such that they are unable to pay an economic price for electricity. As a result, many governments are unable to pass the full cost to citizens and thereby provides subsidies to citizens. The two policies are a disincentive to attracting private sector investment. Indeed, rather than the wholesale application of pricing subsidy, the well-held view is for ECOWAS governments to utilise targeted subsidies in the form of household income support to the poor and needy as such arrangements are impactful and efficient.

iv. Spike in economic "rivalry" among member countries –We think that increased economic "rivalry" among the ECOWAS members could be inimically debilitating to regionalised efforts. Historically, the economic interest of West Africa is intrinsically organised on colonised grouping structure of Anglophone and Francophone. Many of the economic activities today in the region are organised along this structure. Also, within the groups, there are subtle rivalries which often gets goaded. For instance, Ghana and Nigeria are acknowledged for having a healthy rivalry. However, the supposed healthy rivalry has not always been healthy. In 1979, Ghana expelled Nigerians resident in Ghana to Nigeria for various economic offences, and in retaliation, Nigeria suspended oil supply to Ghana. Nigeria again in 1983 and 1985

expelled over a million and 300,000 Ghanaians respectively (Ademola 2016). We know that energy resources are unevenly distributed, and therefore, there are some countries whose dependence on other countries are high. In the event of hostile economic "rivalry", such energy-dependent countries will bear the brunt as the exporting countries could use supply curtailment as an economic tool to punish the other.

v. The other equally important challenge is the height of pessimism among ECOWAS member countries about regionalism approach to energy security and access. For many countries, energy is still viewed as a national security matter, and therefore, domestic considerations are defining factors in matters of energy. Indeed, the energy policy objectives of many of the countries lend credence to this. They are domestic-focused, narrow and misaligned to the regional objectives. As a result, the regional interest of ensuring efficient and low-cost electricity provision across the region is threatened, and many of the individual countries are happy to maintain their position as a lead exporter of power. Importing countries are also worried about supply inconsistencies and therefore, rely on a small fraction of imports for their domestic needs. Many of these countries still use high-cost domestic energy production methods because of unreliability in imported electricity and the local political consequence of having an erratic power supply.

vi. Data quality- Energy sector data is still deficient and hampers specific analysis from being conducted. In some countries, data on critical energy issues are difficult to access, and in instances where such data exist, the quality is difficult to vouch for. Though the situation has improved a bit with support from International Organisations in data gathering, the situation is still frail especially data on energy trading, bioenergy and energy demand. The data deficiencies affect the quality of analysis and ultimately, the potency of the policy prescriptions.

4.3 Specific alternatives

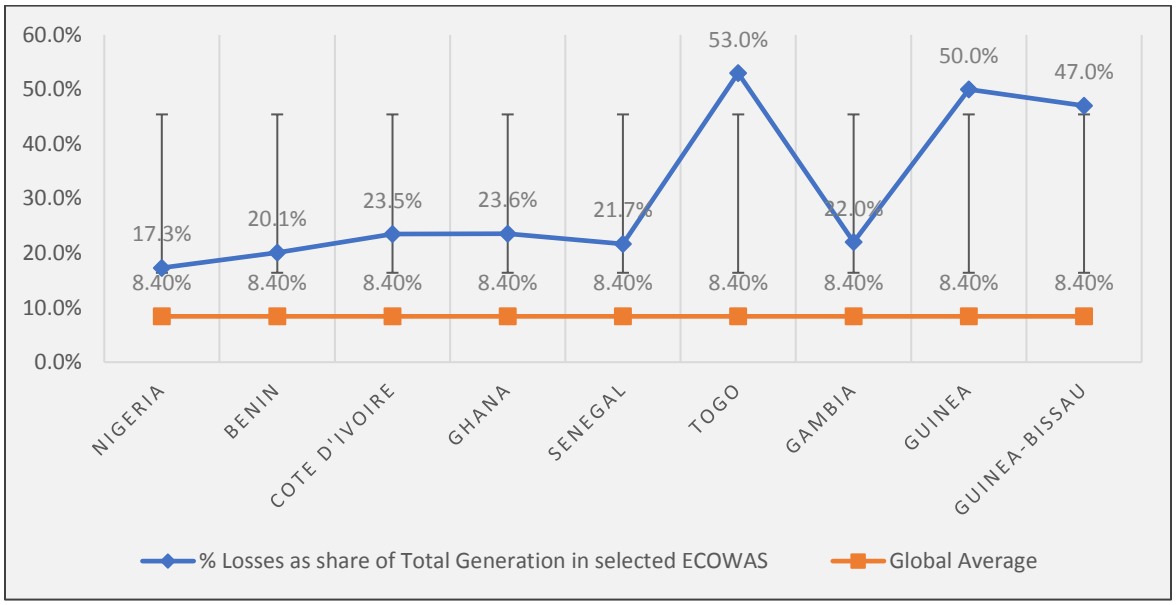
As discussed above, there are multiple and deep-rooted challenges, which are common for not only energy but also broader regional cooperation. However, there are many steps which could be discussed and implemented to ameliorate the current energy challenges. We anchor the discussion here on the positive energy outlook of ECOWAS. In that regard, we firmly think that ensuring a fine alignment between country and regional level efforts would reduce fragmentation, weak coordination and inefficiencies in the generation, transmission and distribution of power. It would require well-defined governance and administrative systems, encouraging fruitful collaborations among countries and adoption of international standards in policy planning. Having such a well-delineated arrangement would guide and guard the interlocutory exchange between national utilities and WAPP in the delivery and implementation of ECOWAS energy policies and plans.

4.3.1 Improve the quality of existing infrastructure

The first measure aims to expand the qualitative and quantitative capacity of existing and new infrastructure for generation, transmission and distribution. On the quality of existing infrastructure, the situation needs improvement. Many of the energy sector infrastructures in the ECOWAS area were put-up during the colonial era. They were built with technologies currently not in use and very difficult for the utilities to find components when they get faulty. General maintenance culture of the utilities is equally to blame for the dilapidated state of infrastructure. Skipping of maintenance schedules are frequent incidence. Such occurrences are often due to; political considerations - governments forcing utilities to overrun energy equipment even when maintenance is due; and utilities not having the financial muscle for maintenance. The practices have negatively impacted the lifespan, quality and reliability of the infrastructure.

As a result, many of the utilities are experiencing high technical and commercial losses. For instance, the percentage of transmission and distribution losses in West Africa ranges from 17.3% in Nigeria to a high of 53% in Togo. The global average is 8.4%. They represent a wedge lost to society. The need to address this wedge has become pressing in the wake of rising energy demand of the region.

FIGURE 17: PERCENT OF ELECTRICITY LOSSES AMONG SELECTED ECOWAS COUNTRIES



Sources: Author with data from ERCEEE

Here, we propose complete reprioritisation of existing energy infrastructure in the context of individual government's key development priorities. In this sense, national budget needs to allocate sufficient financial resources for rehabilitation of these infrastructures. Governments could raise cheap funding (Concessional) for the Utilities to carry out such activities[7].

[7] Tools such as On-lending and escrow mechanism have become fashionable instruments for managing troublesome debt(s) especially those of SOEs. It requires central governments to raise facilities on their books

The other complementing option is for the central government to open up the power sector by listing on the domestic stock markets to allow fresh investments to come in to enable it to carry out the required retrofit of the many energy infrastructures. Attracting such investments from the public and the private sector will not come easy as there is no all-fit plan for such processes. There are some necessary conditions, however, for stimulating such investments. They include; state government putting in place a realistic and comprehensive energy sector investment plans. The next is for countries to adopt transparent project development, procurement and contracting procedures that meet international standards. Also, States must as much as possible assuage the gut notion of many private investors concerning the risk of non-payment. The final point is about having electricity pricing and tariff structure that assures investors of full cost recovery and less governmental intervention by way of subsidies. Such assurance improves investor confidence.

4.3.2 Providing new infrastructure

The critical challenge to energy provision in ECOWAS is the several decades of disinvestment in the sector by many state governments. Existing infrastructure is unable to cope with increasing demand and with weak interconnectivity among member states, countries with limited energy resources have had to endure frequent outages and low coverage, especially for rural communities. The need for scaling up investment to provide the needed power to meet the growing demand is paramount.

Both WAPP and the various national governments have still very much not deviated from the traditional means of financing of new power infrastructure, i.e. national budgetary allocation, Development Partner and bilateral and multilateral financing/assistance in the form of grants, technical assistance and concessional loans, increasing IPPs and IPDs. These options are good, but, they do not guarantee anything different from individual country-led resources mobilisation efforts. Also, the recently announced discontinuation[8] of World Bank's (WB) investment in oil and gas exploration makes it more imperative to rethink the funding modalities as the WB has for a long time been a significant investor in fossil fuels (Zhong and Bazilian 2018). The traditional finance mobilisation tactic has proving to be insufficient at providing the financing needed to exploit the energy potential of the region entirely.

4.3.2.1 Funding strategies

Given this, we propose a couple of alterations to the current funding mechanism for energy provision within the sub-region.

(explicit liability) and pass on such facilities to the SOEs (implicit liabilities) for specific purpose. Proceeds from such specific activities are escrowed and the first right of usage of the proceeds is for the repayment of the facility.

[8] The WB in a press release dated December 12, 2017 communicated the Bank's decision to discontinue funding of upstream oil and gas activities, after 2019. However, in poor regions where such resources still present positive impact on energy access, the bank might consider. http://www.worldbank.org/en/news/press-release/2017/12/12/world-bank-group-announcements-at-one-planet-summit?CID=ECR_TT_worldbank_EN_EXT_OnePlanet

a) Firstly, ECOWAS must empower WAPP to initiate and issue a special Energy Bond for the big generation projects which would impact the whole of the region. The bond must be underwritten by the Africa Development Bank and the West Africa Development Bank. The participating countries must share in the risk associated with the bond proportional to the energy need of each country. This approach is different from the others which are primarily driven by bi or trilateral country agreements.
b) Secondly, a special purpose vehicle (SPV) must be created to be the off-taker of the power to be generated under such arrangement. The SPV will ultimately become the most prominent player in the energy sector and must have a presence in many of the major countries of ECOWAS. The notion here is borne out of the SAPP setup. Eskom- the public utility of South Africa- is the biggest in SAPP. It has installed capacity of 42,011 MW. Eskom's capacity is several thousand folds bigger than the other utilities. Eskom has become an important player in the import and export of power within SAPP. Eskom's strong capacity is benefiting other Utility companies within SAPP and also positively impacting power supply among SAPP countries.

   It is natural that the SPV to be created under WAPP be affiliated to Nigeria's National Electric Power Authority (NEPA). Nigeria because, its energy potential is vast, and the domestic market already exists and further expanding (over 74 million Nigerians still do not have access to electricity). It is a truism that NEPA, as it stands today, is weak in capacity, but an SPV built on strong and sound technical prowess and supported by WAPP would be able to morph NEPA for better within the shortest possible time.

c) The third option is to form a special group of Nigeria, Cote d'Ivoire and Ghana (Loose Power Pool). WAPP as an organisation essentially operates on the instructions of the Authority of Heads of States and Governments of ECOWAS. In such a political structure, decision-making grinds quite slowly. Also, the interest of the individual States is different and varied on many of the matters including energy. In such an environment, achieving the optimal result is a difficult task especially when constrained by time. Given the difficulties with the current arrangement, and the fact that energy security and access matters are urgent makes it imperative to tinker the WAPP arrangement and seek other methods that will deliver quick results without altering the existing structures markedly. The Loose Power Pool is an ad-hoc arrangement, but it seeks to accelerate the interest of the major players in the electricity market. Important matters such as the harmonisation of electricity market design and electricity pricing (import and export) standardisation must be the major matters that should preoccupy the group.

   These three countries currently produce about 80 percent of the energy needs of the region and consume same. Both Cote d'Ivoire and Ghana export and import power as and when needed and Nigeria is the only country that only exports energy resources but do not import power. In other words, the energy market of ECOWAS revolves

very much around these countries. They, taking additional steps would further strengthen the region's resolve of providing energy for all. The "Loose Power Pool Group" must also assume special assignments such as embarking on the advance step in the exploitation of renewables and other areas of common interest. The spillover effect would be that power production and transmission potentially would be coordinated and improved, and exportation to energy-needy countries would increase.

The Loose Power Pool notion is expected to increase the frequency of engagement between the three countries and importantly allow for speedy decision making since many of the issues to come before WAPP would have been deliberated and consensus reached between them forehand. Though this arrangement ultimately, would increase the operational efficiency of WAPP, the caveat is that the impact on the capacity of other WAPP member countries could be negative. This is contrary to the objective of WAPP of building the capacity of all member Utility companies.

4.3.2.2 Additional funding options

a) In addition, specialised Equity scheme for WAPP developed projects/programmes must be introduced. Such a scheme must target mineral mining companies operating in the ECOWAS region for co-ownership projects. These companies require reliable energy for their business. They must get the first right to the electricity produced by such arrangements.

b) Equally, a Special ECOWAS levy for Energy generation and transmission can be a viable option for the finance of new projects/programmes. The levy, which must be initiated by the ECOWAS, would fortify WAPP and become a better leveraging tool for sourcing cheap funding from the International Capital Market. Consumers will bear the levy. The model for dispensing such funds can mimic the EU's Grid System programme, where the European Commission provides funding for projects that strengthen EU's internal energy Market, enhance the security of energy supply and assists EU's clean energy initiative.

4.3.3 Making renewables the core of energy security

Renewable energy potential presents an opportunity for ECOWAS to meet the unmet power demand of the region. Renewable resources are available in virtually every part of the region. The ECOWAS has recognised Renewables as one of the solution paths to energy security. It recently adopted Renewable Energy Policy (REP). The REP's objective is to increase the share of renewable to 10 percent of the overall electricity mix by 2020 and increase to 18 percent by 2030. The country-level efforts so far indicates the objective might not be met. So far, only Ghana and Cape Verde have initiated substantial projects/programmes in this direction. This goes to show that to make renewables the order of the day would require deliberate action by WAPP to get the national governments to commence work on many renewables projects currently under

development. Big renewable projects must be included in the projects to be financed by WAPP energy bonds.

Another recommendation is to continue to deepen the mechanism currently being used to increase renewables share in power generation. These tools are the pricing mechanism- Feed-in Tariff (FIT) and the regulatory tool- Renewable Portfolio Standards (RPS). Regarding RPS, a fair amount of ECOWAS Countries have incorporated renewables into their energy policies. The region is also part of almost all the international accord on renewables and by extension clean energy. Also, in relations to FIT, our hunch is that it remains an essential tool in accelerating the penetration of renewables in Africa. However, improving the institutional design and having sufficiently acceptable FIT rate is a necessary condition for its success. With regards to institutional design, renewable projects financed through FIT must elaborate and emphases the job creation opportunities especially for rural communities along with the climate change and lower future cost notions. Also, having a standard FIT template applicable to ECOWAS will ensure harmonisation and eliminate to a large degree the cost differential among member countries as such cost differential affects the ECOWAS common energy trade.

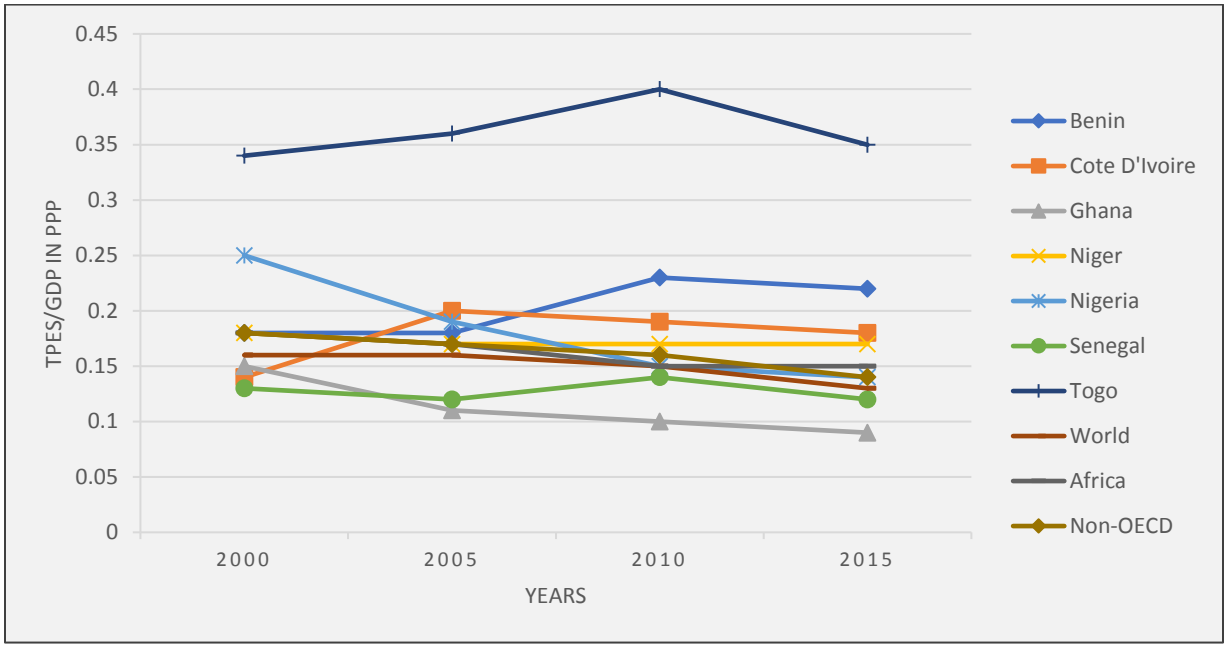
4.3.4 Mainstreaming energy efficiency

Energy use inefficiencies are common in developing countries including ECOWAS. Energy Efficiency use is key to ensuring a safe, reliable, affordable and sustainable system of energy for the future. Promoting energy efficiency measures in ECOWAS has the capacity of making available about 2000 MW of power from the existing electricity system (ECREEE 2012). Presently, many of the ECOWAS governments have embarked on energy efficiency campaigns. The campaigns are aimed at helping to reduce the inefficiencies in energy use. Many of the projects are built on economic levers[9] such as providing subsidies to citizens- e.g. free exchange of fridges, bulbs, free solar panels and television sets; bans- importation of certain energy inefficient related goods; and mandates- enactment of energy-related policies and regulations. These measures have been the primary vehicle for pushing energy efficiency in many countries. However, the results have been mixed, and energy use efficiency is still a concern. For instance, almost all ECOWAS countries except Ghana, have an energy efficiency[10] rate lower than the world average. When compared with Non-OECD rate, only Senegal, Cote D'Ivoire and Ghana do have a better rating. The worse performers are Togo and Benin. The figure below sums up about the performance of selected countries of ECOWAS in comparison with Non-OECD, Africa and World average.

[9] Economic levers are interventions often deployed to deliver tremendous value addition or cause positive economic externalities. They include bans, mandates and incentives.

[10] Energy Efficiency is calculated as; TPES/GDP in PPP (toe/thousand 2010 USD).
https://www.iea.org/statistics/statisticssearch/report/?country=WORLD&product=indicators&year=2015

FIGURE 18: ENERGY EFFICIENCY IN ECOWAS



Sources: Author with data from IEA

In this sense, the recommendation is to infuse nudges[11] into such programmes to achieve maximum impact. These nudges must include strategies such as priming, framing and defaults. Nudges are a viable option for addressing energy security matters of the sub-region. Efficiency matters must become crosscutting in national-level planning as well as at WAPP.

Nudges are preferred because many of the challenges in energy-efficient use relate to human behaviour. In that regard, nudging becomes a forgetive and vital step for correcting the adverse behavioural trends. For instance, the status quo or the default of the human mind is highly bias. In such bias manner, human prioritise personal interest ahead of anything else. When people purchase gadgets for personal use, the cognitive bias clouds their decisions. They take decisions which satisfy their parochial interest today. So, the decisions could be inefficient even for the well-educated. To ameliorate the bias of the human mind, choice architects could introduce systems where all gadgets get labelled. The labelling must be visible and must carry information as; gadget energy consumption levels, efficiency stars, the average cost to be incurred for owing such device. Such information (priming) could avert the minds of customers to future cost for owing gadget A or B. People, therefore, will decide on a specific gadget not only on the price today, but, the future cost for owning such gadget. The Choice Architect could also use anchoring system where each gadget's past information is listed and shared with the prospective buyer to change behaviour.

[11] Nudge is defined as altering people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives (Sunstein 2014). Nudge is a behavioral economies concept that allows Choice architects to positively impact social good without changing people's preferences.

4.4 Conclusion

The study delved into the energy situation of ECOWAS and suggests that indeed, the region is energy poor when compared with the rest of the world. Large proportions of people are without access to modern forms of energy, and traditional bioenergy sources are still dominant energy for the region. The dependence on bioenergy, especially in the rural communities is also having a deleterious impact on the health, economy and the environment. The energy situation thus requires urgent redress, and the region cannot wait any longer.

In that direction, the ECOWAS has been instrumental in championing and coordinating sub-regional effort to permanently barred the situation. The ECOWAS has, therefore, established some dedicated agencies including, WAPP to deal with the energy situation of the region. WAPP together with the various participating governments has worked on some projects or programmes to enhance energy production, transmission and distribution. The efforts have produced result though not that robust. It is fair to say; much is still required of the players as the region works towards the 100 percent access target by 2030. We are, however, skeptical about the 100 percent access target even in lead countries like Ghana. The evidence of progress towards the attainment of the target is not that encouraging. We are, therefore, sure the target is not likely to be met. Moreover, regionalised approach itself is not a panacea. Instead, it complements national-level efforts to ensure energy access and security.

However, with adequate governance and administrative systems at both WAPP and the various country-level Utilities, we are confident that the region could move much closer to meeting the target. Such governance and administrative changes require the altering of the protocol that established WAPP to be able to mobilise resources for projects or programmes with region-wide benefit from the International market. It requires adequate and swift integration of renewable energy into the energy stream as quickly as possible. It also requires the intensification of education on energy efficiency. Here, the use of nudges to change the behaviour of electricity users is quite useful.

Equally important is for Africa to begin to think about Africa-Wide Grid Project (AWGP). Though the immediate focus is on building solid regionalised power pools, the future direction must be about the integration of systems across regions. A stable and functioning regionalised power pools are a prerequisite for the future Africa-wide integrated system. The AWGP will require the integration of all power pools (SAPP, WAPP, EAPP and CAPP). Such a move would allow for electricity trade within individual power pools as well as between power pools. Given the uneven allocation of energy resources, trade between power pools would make big and cheap hydro projects such as Grand Inga of DR Congo increasingly viable and implementation to be done quicker. Such projects would reduce the cost of power generation, and the price citizens ultimately pay for electricity and more expensive power generation mix also eliminated. However, this idea will only become feasible when all the regional power pools are functioning properly.

Bibliography

Ademola, Adedeji. 2016. "Nigeria-Ghana Trade Relations : Politics , Problems and Possibilities" 6 (1): 94–102.

AREI. 2015. "A Framework for Transforming Africa towards a Renewable Energy Powered Future with Access for All," no. October: 44.

Avila, Nkiruka, Juan Pablo Carvallo, Brittany Shaw, and Daniel M Kammen. 2017. "The Energy Challenge in Sub-Saharan Africa : A Guide for Advocates and Policy Makers Part 1 : Generating Energy for Sustainable and Equitable Development." *Oxfam Researcher Backgrounder Series* Part 1. https://doi.org/10.13140/RG.2.2.25037.44001.

Bazilian. et al. 2010. *Measuring Energy Access: Supporting a Global Target*. The Earth Institute,Columbia University,New York, USA. http://us-cdn.creamermedia.co.za/assets/articles/attachments/28017_bazilian_et_al_2010_measuring_energy_access_supporting_a_global_target.pdf.

Brew-Hammond, Abeeku. 2010. "Energy Access in Africa: Challenges Ahead." *Energy Policy* 38 (5). Elsevier: 2291–2301. https://doi.org/10.1016/j.enpol.2009.12.016.

Brew-Hammond, Abeeku, and Francis Kemausuor. 2009. "Energy for All in Africa - to Be or Not to Be?!" *Current Opinion in Environmental Sustainability* 1 (1): 83–88. https://doi.org/10.1016/j.cosust.2009.07.014.

Cherp, Aleh, and Jessica Jewell. 2011. "The Three Perspectives on Energy Security : Intellectual History , Disciplinary Roots and the Potential for Integration." *Current Opinion in Environmental Sustainability* 3 (4). Elsevier B.V.: 202–12. https://doi.org/10.1016/j.cosust.2011.07.001.

Dorian, James P., Herman T. Franssen, and Dale R. Simbeck. 2006. "Global Challenges in Energy." *Energy Policy* 34 (15): 1984–91. https://doi.org/10.1016/j.enpol.2005.03.010.

Dubash, Navroz K., and Ann Florini. 2011. "Mapping Global Energy Governance." *Global Policy* 2 (SUPPL.1): 6–18. https://doi.org/10.1111/j.1758-5899.2011.00119.x.

ECA. 2004. "Assessment of Power Pooling Arrangements in Africa," no. June: 1–95. http://www.dundee.ac.uk/cepmlp/journal/html/Vol16/Vol16_6.pdf%5CnC:%5CDocuments and Settings%5Civny%5CMy Documents%5Clitteratur%5Cassesment of power pooling in africa.pdf.

"Ecowas Energy." n.d., 1–79.

ECREEE. n.d. "From Vision to Action."

———. 2012. "Ecowas Energy Efficiency Policy."

———. 2015. "ECOWAS Renewable Energy Policy."

Energy Commission of Nigeria. 2003. "Federal Republic of Nigeria National Energy Policy the Presidency Energy Commission of Nigeria," no. April.

Hailu, Yohannes G. 2012. "Measuring and Monitoring Energy Access : Decision-Support Tools for Policymakers in Africa." *Energy Policy* 47. Elsevier: 56–63. https://doi.org/10.1016/j.enpol.2012.03.065.

Hughes, Larry. 2009. "The Four 'R's of Energy Security." *Energy Policy* 37 (6): 2459–61. https://doi.org/10.1016/j.enpol.2009.02.038.

IEA. 2014. *World Energy Outlook 2014*.

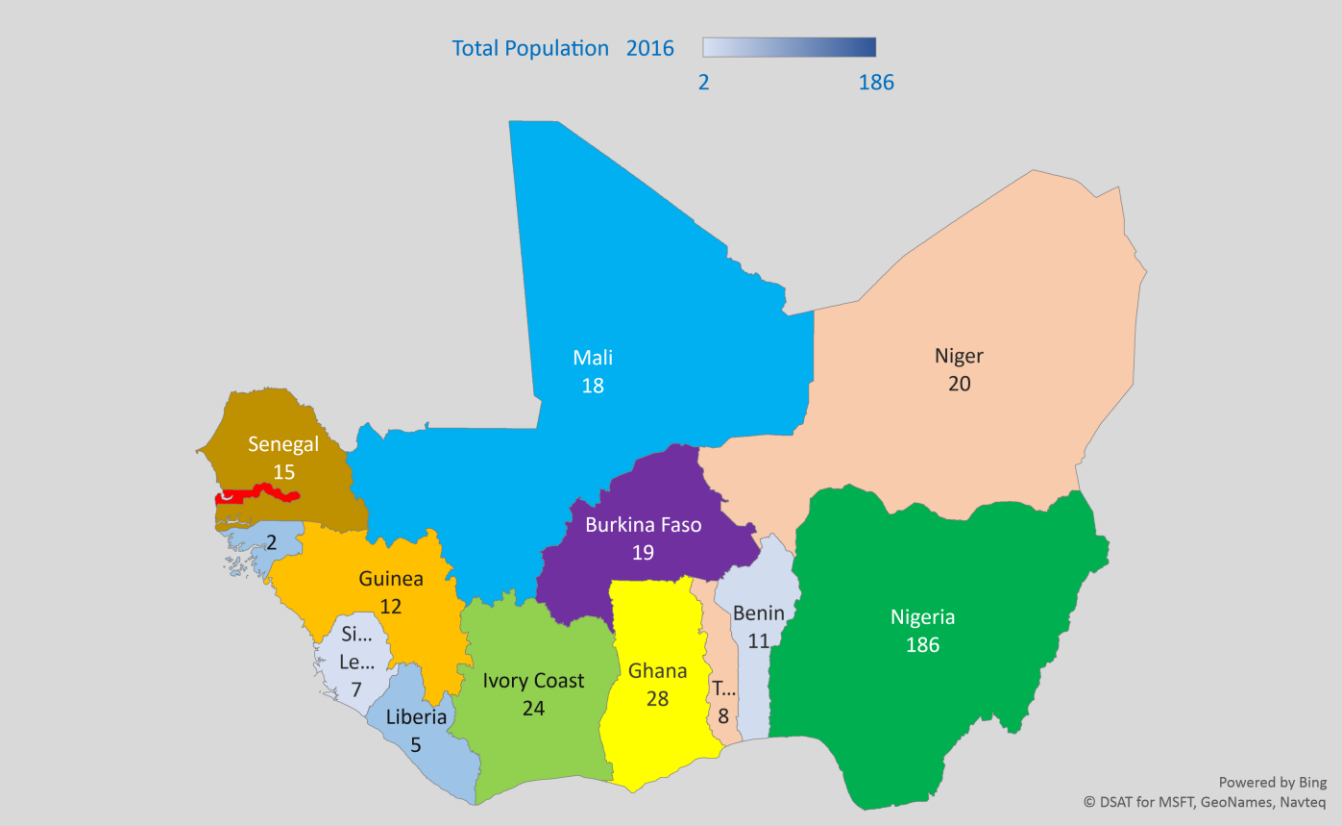
———. 2017. "Energy Access Outlook 2017: From Poverty to Prosperity."

Iwayemi, Akin. 2008. "Nigeria's Dual Energy Problems: Policy Issues and Challenges."

International Association for Energy Economics, 17–21. https://ww.iaee.org/en/publications/proceedings.aspx.
Jewell, Jessica. 2011. "The IEA Model of Short-Term Energy Security (MOSES)."
Karaki, Karim. 2017. "Understanding ECOWAS Energy Policy From National Interests to Regional Markets and Wider Energy Access?" http://ecdpm.org/wp-content/uploads/ECOWAS-Energy-Background-Paper-PEDRO-Political-Economy-Dynamics-Regional-Organisations-Africa-ECDPM-2017.pdf.
Kebede, Ellene, John Kagochi, and Curtis M Jolly. 2010. "Energy Consumption and Economic Development in Sub-Sahara Africa." *Energy Economics* 32 (3). Elsevier B.V.: 532–37. https://doi.org/10.1016/j.eneco.2010.02.003.
Merem, E. C., Y. Twumasi, J. Wesley, P. Isokpehi, M. Shenge, S. Fageir, M. Crisler, et al. 2017. "Regional Assessment of Energy Trends in West Africa Using GIS." *International Journal of Energy Engineering* 7 (1): 1–27. https://doi.org/10.5923/j.ijee.20170701.01.
Ministry of Energy and Water Resources. 2009. "Government of Sierra Leone Sierra Leone National Energy Strategic Plan," no. September.
Ouedraogo, Nadia S. 2017. "Modeling Sustainable Long-Term Electricity Supply-Demand in Africa." *Applied Energy* 190. The Author(s): 1047–67. https://doi.org/10.1016/j.apenergy.2016.12.162.
Parshall, Lily, Dana Pillai, Shashank Mohan, Aly Sanoh, and Vijay Modi. 2009. "National Electricity Planning in Settings with Low Pre-Existing Grid Coverage: Development of a Spatial Model and Case Study of Kenya." *Energy Policy* 37 (6). Elsevier: 2395–2410. https://doi.org/10.1016/j.enpol.2009.01.021.
Quartey, Jonathan Dagadu. 2014. "Energy Poverty and Climate Change Mitigation in Ghana: An Economic Assessment." *Journal of Economics and Sustainable Development* 5 (8): 72–85. http://iiste.org/Journals/index.php/JEDS/article/view/12608.
Republic of Ghana. 2010. "National Energy Policy," no. February: 1–30.
Saghir, Jamal. 2015. "On Energy Access in Sub-Saharan Africa: Transforming Sub-Sahara Africa- Energy Investment Opportunities."
Smart Villages. 2014. "Energy Situation Report – West Africa," 1–7. www.e4sv.org.
Sunstein, Cass R. 2014. "Nudging : A Very Short Guide."
The World Bank. n.d. *Africa ' S Infrastructure A Time for Transformation*.
U.S. EIA. 2017. "International Energy Outlook 2017."
WAPP. 2012. "West African Power Pool Business Plan 2012 - 2015," no. September 2012.
Yekini, Mohammed, Mohd Wazir, Nouruddeen Bashir, Nor Asiah, and Ahmad Safawi. 2013. "Power Sector Renewable Energy Integration for Expanding Access to Electricity in Sub-Saharan Africa." *Renewable and Sustainable Energy Reviews* 25. Elsevier: 630–42. https://doi.org/10.1016/j.rser.2013.04.033.
Zhong, Minjia, and Morgan D Bazilian. 2018. "Contours of the Energy Transition : Investment by International Oil and Gas Companies in Renewable Energy." *The Electricity Journal* 31 (1). Elsevier: 82–91. https://doi.org/10.1016/j.tej.2018.01.001.

Appendices

Appendix 1: Population of ECOWAS member Countries, 2016



Appendix 2: List of Interconnected Projects under WAPP

S/N	Project Name	Type of Project	Financiers	Project Cost	Completion Status
Projects before WAPP					
1	161 kV Double-Circuit Line between Ghana and Togo and Benin - (130kn to Togo and 178km to Benin)	Transmission Systems	Government of Ghana		Construction completed and project operational since 1972
2	225 kV Double-Circuit Line between Ghana and Cote d'Ivoire - 220km	Transmission Systems	Governments of Ghana and Cote d'Ivoire		Construction completed and project operational since 1984
Priority Projects under WAPP					
1	330 kV West (Nigeria) – Sakete (Benin) Interconnection Project – 70 km	Transmission Systems	AfDB, BOAD, EBID as well as Gov'ts of Nigeria and Togo/Benin	$92.5 million	Construction completed and project operational since 2007
2	225 kV Bobo – Ouaga Tranmission Line Project IN BURKINA – 339 km	Transmission Systems	WB, AFD, EIB, Danida, Danish Mixed Credit and Gov't of Burkina	$87 million	Construction completed and project operational since 2009

3	330 kV Aboadze - Volta Transmission Line Project IN GHANA – 219 km	Transmission Systems	WB, EIB, Kuwaiti Fund and Government of Ghana	$47.41 million	Construction completed and project operational since 2010
4	225 kV Côte d'Ivoire - Mali Interconnection Project – 234 km	Transmission Systems	EBID, BOAD and Governments of India, Mali and Côte d'Ivoire	$167 million	Construction completed and project operational since 2012
5	60 MW Felou Hydropower Project UNDER OMVS	Transmission Systems	WB and EIB together with Gov'ts of Senegal, Mali and Mauritania	$210 million	Construction completed and project operational since 2013
6	240 MW Kaleta Hydropower Project in Guinea	Transmission Systems	Gov't of Guinea with support from China Exim Bank	$458 million	Construction completed and project operational since 2015
Finalised Projects					
1	Cross-Border Supply of Electricity to Rural Communities in Southern Togo from Ghana	Others	EU and WAPP utilities, CEET, CEB, ECG	$3 million	The programme was completed in March 2015. The final taking over has been delivered on March 10th, 2016.
2	Cross Border Supply of Electricity to Rural Communities in Northern Togo from Benin	Others	EU and WAPP utilities CEET and CEB	$3 million	The programme was completed in March 2015. The final taking over has been delivered on March 10th, 2016.
3	50 MW Bumbuna Hydropower Project	Others	AfDB, Govt Italy, OPEC Fund, Sierra Leone	$110 million	Commissioned in December 2009
4	Cross-Border Supply of Electricity to Rural Communities in Burkina Faso from Ghana	Others	EU and WAPP utilities, SONABEL, VRA	$2 million	The programme was completed in 2012. The final taking over has been delivered.
5	Gambia Emergency Program	Others	WAPP	$96 thousand	Study on emergency works and supply completed in 2017
6	Mali Emergency Program	Others	WAPP	$78 thousand	Study on emergency works and supply completed in 2017
7	Guinea Emergency Program	Others	WAPP	$117 thousand	Study on emergency works and supply completed in 2017
8	Refurbishment of Kainji and Jebba Hydro Power Facilities in Nigeria	Others	WB/IDA	$21 million	Rehabilitation completed in 2015
9	161 kV Tumu-Han-Wa Transmission Line (Ghana)	Transmission	Societe General Bank of France	$71 million	Works has since 2015 been completed
Projects at the Preparatory stage					
1	Yiben Reservoir (expansion of Bumbuna Phase I)	Power Generation	Not Yet Determined		Project Concept developed. The Government of Sierra Leone is re-evaluating its implementation strategy for the project.
Projects for Implementation					

1	225 kV OMVG Loop (Gambia, Guinea Bissau- Senegal-Guinea Interconnection) + Hydro sites at Kaleta and Sambangalou	Others	NEPADIPPF	$802 thousand	Complementary studies on-going
2	128 MW Sambangalou Hydropower plant	Generation	OMVG governments to provide $68 million and the remaining financing of $387 Million to be mobilised from China	$455 million	Financing discussions on-going
3	225 kV Guinea - Mali Interconnection Project	Transmission	Potential financiers are AfDB, EIB, BOAD, KfW, EBID, AFD, IsDB and WB	$565 million	Financing discussions on-going with $379 million of the cost secured. There still is a funding gap of 186 million.
Projects under Preparation					
1	225 kV OMVG Interconnection Line	Generation	WB, IsDB, AfDB, EIB, AFD, EBID, KfW, BOAD	$738 million	WAPP to follow up with OMVG on the implementation project
2	450 MW WAPP Domunli Regional Power Generation Facility in Ghana	Generation	To be funded by AFC anf Government of Ghana	$652 million	Project development phase
3	225 kV Côte dIvoire - Liberia - S.Leone - Guinea Interconnection Project	Transmission	WB, EIB, KfW, AfDB	$404 million	Contracting for the works on-going
Projects under Implementation					
1	225 kV Ghana - Burkina Faso - Mali Interconnection Project	Transmission	EIB, USAID	$2.7 million	Feasibility study on-going
2	150 MW WAPP Regional Solar Power Park in Burkina Faso	Generation	EU	$209 thousand	Pre-Feasibility Study on-going
3	225 kV Ghana - Burkina Faso - Mali Interconnection Project	Transmission	AFD, EIB (EU-A ITF)	$1.62 million	Complementary Studies

Appendix 3. Data Sources

S/N	Data Type	Source	Link
1	Electricity Access	International Energy Agency-WEO2017 Electricity and clean Cooking Dataset	http://www.iea.org/energyaccess/database/
2	Electricity Generation, Consumption, Production Losses and Import and Export	International Energy Statistics	https://www.eia.gov/beta/international/data/browser/#/?pa=0000002000002000020007vo700009002&c=0006000108000000190000000800400c0000000048004&ct=0&tl_id=2-A&vs=INTL.2-2-BEN-BKWH.A&ord=CR&cy=2014&vo=0&v=H&end=2015
3	Energy Efficiency	International Energy Agency	2017 CO_2 Emissions from Fuel Combustion Year Book https://www.iea.org/statistics/statisticssearch/report/?year=2015&country=WORLD&product=Indicators
4	WAPP Portfolio	WAPP website	http://pipes.ecowapp.org/en/projects/projects-for-financing/for-implementation