

A Review of Electricity Market Reforms and Regulations in Ghana

John Ansu Gyabaah^{1,2*}, Paul Owusu-Afriyie²,

¹School of Engineering, University of Energy and Natural Resources (UENR), Sunyani, Ghana.

²College of Engineering, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

Abstract:- Ghana's power sector has gone through several structural changes since independence. Many of these changes are aimed at expanding and improving the delivery of electricity to consumers. The paper assesses the regulations and reforms introduced over the years in the electricity sector and how they have affected the electricity market. Policy documents and literature, detailing key reforms in the power sector have been reviewed along three key aspects; legal, economic and technical. The legal aspect of the market reform discusses the key laws and policy framework in the sector whilst the economic and technical aspects discuss tariff regimes and power supply specifications. The findings suggest a significant successes in some of the implemented reforms, whilst others face serious implementation challenges. The paper concludes with recommendation for addressing the challenges with implementation of policies and programs in the sector.

Keywords:- Ghana; Electricity; Market; Regulation; Reform; Hydroelectric.

I. INTRODUCTION

Ghana's power sector has undergone major structural changes since its independence. The supply of electricity in Ghana began with the installation of stand-alone diesel-fired power plants which were largely owned by industries and mining companies. The commissioning of the Akosombo hydroelectric power station marked a significant milestone in the country's power sector. Akosombo hydroelectric power station for a long time supplied the country's power needs and exported electricity to neighboring Togo and Benin. Ghana's power generation capacity has over the years been expanded and the sources of electricity generation have also been diversified. Access to electricity has dramatically increased, both in the rural and urban populations. Ghana's access rate to electricity is second in sub-Saharan Africa and the first in West Africa.

Growth in GDP, urbanization, and increasing access to electricity has resulted in a 6% yearly increase in demand [1]. Whilst undoubtedly Ghana's power sector is amongst the best in the sub-Saharan region, power delivery has often been met with major challenges such as aging infrastructure, low reserve margins, power shortages, high technical losses, and deteriorating financial state of utilities [2]. Historically, the sector has also had seasonal challenges that have lasted from weeks to months and sometimes years arising out of rainfall variability and its effect on the hydro resources (a major source of electricity)

of the country [3]. Until the late 1990s, the government through its agencies (Volta River Authority, Electricity Company of Ghana) had a monopoly on electricity supply to consumers. The market structure was inefficient with significant losses which affected the quality of power delivered to consumers [4]. The Institute of Statistical, Social and Economic Research (ISSER) indicates that Ghana loses close to one billion dollars of the gross domestic product due to the poor quality of power [5]. This assertion is corroborated by the wholesale power reliability assessment report [6] which indicates that Ghana loses about 6% of GDP annually, due to power shortages.

While addressing the challenges in the sector, regulations, and market reforms such as the unbundling of sections of the industry have been carried out. In a study [2], the authors provide an analysis of the efficiency of power supply in Ghana. Eshun and Amoako-Tuffour [5] provide trends in the energy sector by discussing the gap between supply and demand, challenges in resolving supply deficits, highlights some regulatory constraints and suggests remedies. In [7], the authors presented a review on the trends, policies, plans, and programs for increasing energy access in Ghana with a primary focus on electricity, cooking fuels, and renewable energy. In [8] the authors presented the status, challenges, and prospects of power sector reform in eastern and southern Africa, emphasizing the impact of reform on the poor, also, highlighting some benefits of reforms which include improved generation capacity as well as the improved financial performance of utilities. The authors further highlight the challenges associated with reform which include poor performance at the transmission and distribution end, increased electrification of the poor and, increased local participation in the power sector. In [9] the authors investigate the prospects of gas-to-power market and gas for export. The study finds the gas-to-power market to be more economical but cites ineffective investment regimes, lack of human capital, and inefficient tariff structure are some of the constraints to the deployment of the technology.

Other publications focus on Ghana's renewable energy potential [1][10][11]–[13]. These studies have failed to analyze the market regulation and reforms in which the power sector is situated. The paper contributes to research by highlighting some of the policy gaps in Ghana's power sector and possible remedy. The structure of the paper is as follows: section II is the materials and method used for the study. section III discusses the major developmental stages in the power sector of Ghana. Findings on the multi-dimensional aspects of the reforms and electricity

regulations are discussed in sections IV and V respectively. Finally, prospective reforms in the electricity market are discussed in section VI.

II. MATERIALS AND METHOD

The paper chronicles the major power sector reforms and regulations in Ghana by using policy documents. The main sources of data for the review are the Energy Commission of Ghana, Electricity Company of Ghana, the Ministry of Energy, Northern Electricity Distribution Company Limited, and published literature. Other sources of data are official policy documents of the Volta River Authority (VRA) and the World Bank. The supply and demand dynamics of the power sector has been analyzed based on the collected data. The paper used qualitative description and analysis in reviewing the power sector. An overview of the power sector has also been presented. From the available data, the reforms in the sector were categorized into three, namely technical, economic, and legal aspects. The review was done along with the three aspects and the findings of the multi-dimensional aspects discussed.

III. POWER SECTOR DEVELOPMENTS

The power sector in Ghana has gone through several developmental stages. The first attempt at providing electricity for the public in Ghana predates the independence era where the colonial administration installed a diesel-fired plant in Secondi to generate electricity. At that time, Accra which is the national capital had no public electricity supply. Secondi served as a port for the shipment of timber and mineral resources by the colonial administration with a western rail line connecting the resources centers and the Secondi port. From 1922 to 1964, twenty-nine (29) stand-alone diesel-fired plants were installed in different locations, including Accra, Tema, Swedru, etc [14]. No rigorous attempts were made to harness other sources of electrical power though there had been a report on the potential hydropower.

In pursuit of industrialization, the government of Ghana established the Volta River Authority (VRA) in 1961 with the mandate to generate and transmit power from the Akosombo hydroelectric plant. In 1965, four generating units with a total installed capacity of 588 MW were commissioned at Akosombo hydroelectric plant, which was more than the domestic demand at the time [14]. This was later followed by an additional installation of two generating units with an installed capacity of 324 MW. Additionally, the Kpong hydro-electric plant was commissioned downstream of the Akosombo dam with an installed capacity of 160 MW in 1981, which brought the total installed capacity of hydroelectric plants to over a 1,000 MW [4], [14]. Within the period 1989-1990, the government embarked on a 30-year rigorous national electrification program aimed at increasing access to electricity after the economic downturn of the 1970s. The program primarily sought to extend electricity to areas where there was no grid power especially the northern section of the country to drive industrialization. The majority of the stand-alone plants were decommissioned after the

VRA commissioned the Akosombo hydroelectric plant, however, the capacity of the Tema diesel plant was expanded from its original installed capacity of 2 MW to 35 MW [14] and subsequently handed the operations to the VRA.

The consumption of electricity also grew steadily at an average of over 9% between 1990 and 2001. The main drivers for the increased consumption were economic growth and the rapid expansion of grid infrastructure to many parts of the country. At the end of the year 2000, Ghana had achieved an electricity access rate of 43.7%, which was substantial compared to the 1988 figure of 28% [7]. As part of the financing agreement for the construction of the Akosombo Dam, the World Bank and the Ghana Government agreed to form a separate entity for the distribution of electricity and so, the electricity Division (under the Ministry of Works and Housing) which was among the departments that managed the operation of diesel-fired power plants and distribution of electricity was transformed to Electricity Corporation of Ghana (ECG), and given additional responsibility to distribute power generated by the VRA. Later, the VRA established a subsidiary, the Northern Electricity Department to distribute power to the Northern section of the country. Figure 1 the yearly installed generation installed capacity for the last five decades.

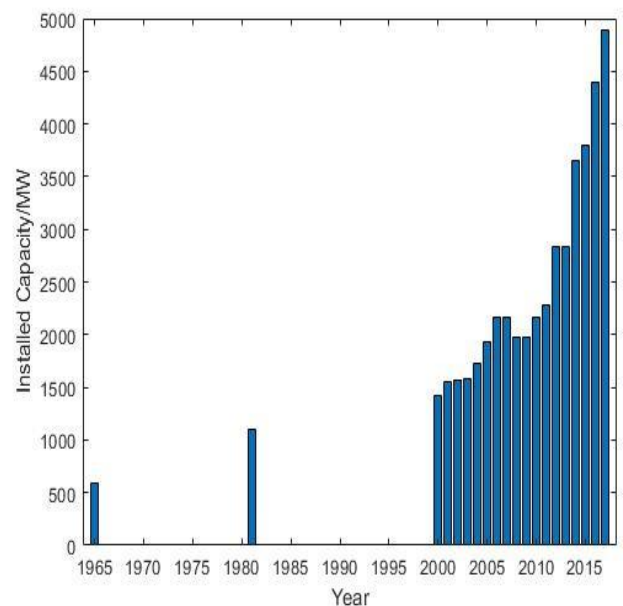


Figure 1: Installed generation capacity [1965-2017]

Reforms in the power sector in many developing countries begun at the end of colonial rule and are in most cases, a consequence of broader changes in the national economy. Most often than not, the key objective was not efficiency; rather resuscitation of a deteriorating financial state of utilities. The establishment of the Volta River Authority in 1961 is among the early reforms in the power sector in Ghana. The VRA integrated the power sector into a robust entity that provided the energy needs of the country and exported power to some neighboring countries. A long period of drought in 1983 drastically reduced the available capacity of the Akosombo hydroelectric plant, plunging the

country into a severe energy crisis. Added to the power shortage were the deteriorating equipment, crippling finances resulting from under-recoveries, and high system losses. Consequently, the government outlined remedial measures to deal with the challenges in the sector which included.

- Establishing independent regulatory institutions in the power industry
- Unbundling the VRA and the restructuring of ECG,
- Opening up the generation sub-section for private sector investment

These objectives were to be realized within a framework of legal, technical, and economic aspects in the power industry.

IV. FINDINGS ON MULTI-DIMENSIONAL REFORMS IN GHANA'S ELECTRICITY MARKET

Reforms in the power sector are classified into three, namely; legal, economic, and technical. The legal aspect refers to laws that govern the sector and outlines the guidelines for dispute resolution to safeguard stakeholders in the sector. The legal aspects ensure establishing regulatory agencies for the protection of participants in the market within the framework of the law. A strong legal base is required if any reform can be effective. The technical reforms relate to the technical requirements in the power sector. The technical reforms define the technologies that would be deployed to ensure efficiency in terms of cost and environmental benefits. As has been noted in the previous discussion, Ghana is pursuing diversified sources of power generation in line with the global advocacy for the use of clean energy sources. The economic reforms seek to improve the cost of electricity by developing the market system into a competitive one. Competition in the market improves efficiency and thereby reduces the cost of energy to the end-user. Over the years of reforms, Ghana has pursued market models that continually improve the efficiency in the market. Ghana's reforms often seek to find a balance between full market deregulation and social protection for holistic community development. In most cases, the government provides subsidies for consumers.

a. Legal reforms

In 1997, the Public Utility Regulatory Commission (PURC), and the Energy Commission (EC) were established by law as independent regulatory institutions in the energy sector [15]. The mandate of EC is to regulate and manage the development and utilization of energy resources in Ghana as well as to provide the legal, regulatory and supervisory framework for all providers of energy in the country, specifically by granting licenses for the transmission, wholesalesupply, distribution, sale of electricity and natural

gas. The Energy Commission is the technical regulator and the main advisor to the government on energy matters.

Similarly, the PURC is the legally mandated body responsible for regulating utilities. The PURC provides regulations regarding the pricing of electricity and other commodities. Energy charges are determined by the PURC in collaboration with representatives of utility providers and other stakeholders. The specific functions of the PURC in the power sector include:

- Determining capacity and bulk generation charges that consumers pay.
- Determining transmission service charges.
- Determining distribution service charge.
- Determining end-user tariffs.

The Act establishing the PURC stipulates its independence from interference by any authority though the president of the Republic of Ghana has administrative oversight over the commission. The membership of the commission consists of representatives from institutions such as Trades Union Congress (TUC), Association of Ghana Industries (AGI), experts in the energy sector, and representatives of consumers. The president of the republic appoints the Commissioners and are required by law to be independent in the discharge of duties.

One notable change in the power sector arising from reforms is the change in the focus of the VRA. The government through an act of parliament has restructured the country's main utility company. The vertical structure of the VRA has been revised with a new mandate focusing on only electricity generation. The transmission role of the VRA has been ceded to the Ghana Grid Company (GRIDCo) while separate state-owned companies have been given the mandate to distribute power to the final consumer. The Northern Electricity Department (NED), wholly-owned by the VRA, has been transformed into the Northern Electricity Distribution Company (NEDCo), a stand-alone subsidiary of VRA. These amendments have created an enabling environment for private sector participation in power generation. Table 1 summarizes some of the key reforms in Ghana's power industry.

b. Technical reforms

The power sector in Ghana started with small stand-alone diesel plants in 1914. From the distributed small-scale plants, Ghana has intensified the need for diversification of the energy mix to meet the growing demand (see table 2). The Energy Commission estimates a 10% average growth in demand per annum. To be able to meet the annual demand, the country would require an annual capacity addition of 200MW. Currently, more than 50% of the installed capacity comes from thermal power, of which IPPs provide a significant proportion. It is expected that the share of electricity generation from hydroelectric plants would continually diminish as demand continues to increase.

Year	Event
1961	VRA was established to manage generation and transmission of power from the Akosombo hydroelectric project.
1967	Electricity Corporation of Ghana was established
1997	Energy Commission was established
1997	Public Utility Regulatory Commission was established
1997	Electricity Corporation of Ghana was changed to a limited liability company (Electricity Company of Ghana, still owned by the government)
1999	220MW joint venture with Independent Power Producer was commissioned
2006	Ghana Grid Company (GridCo) was carved out of VRA to provide transmission services
2006	Renewable Energy policy
2009	Developed national Electricity Grid Code
2010	Passed Renewable Energy act

Table 1: Key power sector reforms in Ghana (1961-2010)

To mitigate the financial burden on the government in the power sector, the private sector has been involved in the power generation since 2000, however, there were no formal guidelines for grid connection until 2009 when the EC, together with stakeholders, developed the national electricity grid code to provide guidelines on the procedures, practices, requirements, and standards that govern the development, operation, maintenance and use of the high voltage transmission system in Ghana. The grid code primarily describes the responsibilities and obligations of stakeholders in the provision of electricity. It defines the standards for the generation, transmission, and delivery of bulk electric power over the national interconnected system (NITS), including the functions of electricity transmission utility (ETU), a NITS asset owner, a wholesale supplier, a distribution company, and a bulk Customer. The code allows individual companies to participate in the generation market once they meet the specified requirement and are certified by the EC. Currently, more than half of the country's electricity needs are provided by thermal plants whose ownership includes the private sector.

The national interconnected transmission system act introduced in 2008 provides the legal framework for Electricity Transmission in Ghana. The NITS act provides the technical, operational, and standards of performance for open, fair, and non-discriminatory access to electricity transmission networks for all industry players. Since the introduction of the NITS Act, the independent transmission network operator has upgraded transmission infrastructure in line with developments in the sector to improve transmission efficiency, and to meet the growing capacity requirements. The Ghana Grid Company (GRIDCO), has upgraded and installed critical infrastructure since 2010 to accommodate local and external demand. The company started the construction of its first 330Kv transmission line in the northern part of Ghana and is also pursuing The West Africa Power Pool project. Table 2 indicates the plants that were committed for generation in 2019.

Plants	Installed Capacity	Dependable Capacity	Fuel Type
	(MW)	(MW)	
Akosombo Plant	1020	900	Hydro
Kpong Plant	160	105	Hydro
TAPCO (T1)	330	300	LCO/Gas
TICO (T2)	340	320	LCO/Gas
TT1PP	110	100	LCO/Gas
TT2PP	80	70	Gas
KTPP	220	200	Gas/ Diesel
VRA Solar Plant	2.5	0	Solar
TOTAL VRA	2,263	1,995	
Bui GS	404	360	Hydro
CENIT	110	100	LCO/Gas
AMERI	250	230	Gas
SAPP 161	200	180	Gas
SAPP 330	360	340	LCO/Gas
KAR Power	470	450	HFO
AKSA	370	350	HFO
BXC Solar	20	0	Solar
Meinergy Solar	20	0	Solar
Trojan	44	39.6	Diesel/Gas
Genser	22	18	Gas
CEN Power	360	340	LCO/Gas
Amandi	190	190	LCO/Gas

TOTAL IPP	2,820	2,598
TOTAL (VRA, Bui & IPPs)	5,083	4,593

Table 2: Committed generation capacity for 2019[16]

Ghana’s attempt at diversifying sources of electricity generation dates back to the late 1990s where thermal plants were incorporated to complement the existing hydroelectric plants. Early plans to introduce renewable energy started in 1998, where financial incentive was given to renewable energy developers, mainly wind energy. Since then several other programs and policies have been implemented. The strategic national energy plan of 2006 proposed a 10% share of renewable energy by 2020. This policy proposed a 0.05% renewable energy mix in 2007 to kick start the policy and a gradual increase towards the 10% target by 2020. In 2010, another strategic energy plan was out-dated arising out of change in government. The new strategic plan focused on wind and mini-hydro technologies and proposed an aggressive plan of achieving a target of 500MW by 2020. The policy proposed a 2% share of renewable energy for the year 2010. The regular shift in focus of the Ministry of energy and its agencies has affected developments in the sector. Targets of increasing share of RE to 10% at the end of 2020 is likely to be missed because no aggressive efforts are made by the regulators, enforcement is generally weak and monitoring is almost non-existent. The state agencies have not been able to execute their mandate under the changing political authority. The Feed-In-Tariff (FIT) policy which offers a guaranteed price for a kWh of electricity added onto the grid is not been currently practiced as proposed by the PURC. The FIT is key to achieving the desired renewable energy target as has been implemented in many European countries. Regulation on access to grid infrastructure is a major challenge for RE deployment. Transmission and distribution losses on Ghana’s grid is estimated to be about 25%. This is highly inefficient considering the investment requirements for RE. The weak grid infrastructure poses a limitation on the amount of RE permissible on the grid. The grid code in Ghana requires voltage and frequency to conform to some specified range before connecting to the grid. The policy puts the cost involved in meeting such requirements on the RE developer, making the cost of RE production very high compared to the conventional sources. It is not surprising that the RE market is still under development with no clear timelines since all previous plans have failed to yield the desired results. Figure 1 is the composition of electricity generation by sources and plant ownership.

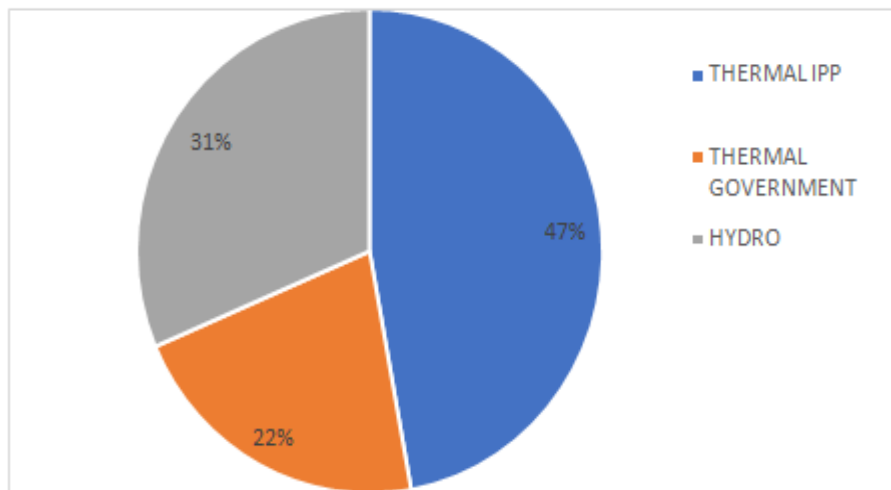


Figure 2: Ghana’s power generation mix

c. Economic reforms in the electricity market

Ghana’s power sector reform program (PSRP) in the 1990’s adopted a competitive wholesale electricity market to encourage private investment and improve efficiency. The program developed policies that removed the monopolistic tendencies and market dominance of the VRA. An independent transmission service operator was established which provides equal and open access to all the power generating companies to provide power economically. In furtherance of transforming the electricity market, the wholesale electricity market that facilitates the trading of wholesale electricity has been established. All generation companies supply consumers through the wholesale market which is regulated by the state institutions. The dispatch of a generating plant is largely determined by economics, availability, and the requirements of the grid. Ancillary services such as black start capabilities, reactive power generation, and system balancing requirements, and associated compensations are provided by the national interconnected system (NITS). The wholesale market also sets out the framework for contracts between wholesale suppliers and bulk consumers and provides rules for spot market contracts for demands that may not be met by the contracted arrangements. The Ghana Grid Company derives authority from the electricity regulations Act of 2008 to develop market rules to serve as primary guidelines in the wholesale market.

The market for Renewable energy is being developed with the introduction of Feed-In Tariff (FIT) and net metering which offers a guaranteed market for the developers. For the full development of the RE market, issues like payment of transmission

charges, the supply of reactive power and harmonics from solar plants would have to be addressed. Figure 3 is the current structure of Ghana’s electricity market.

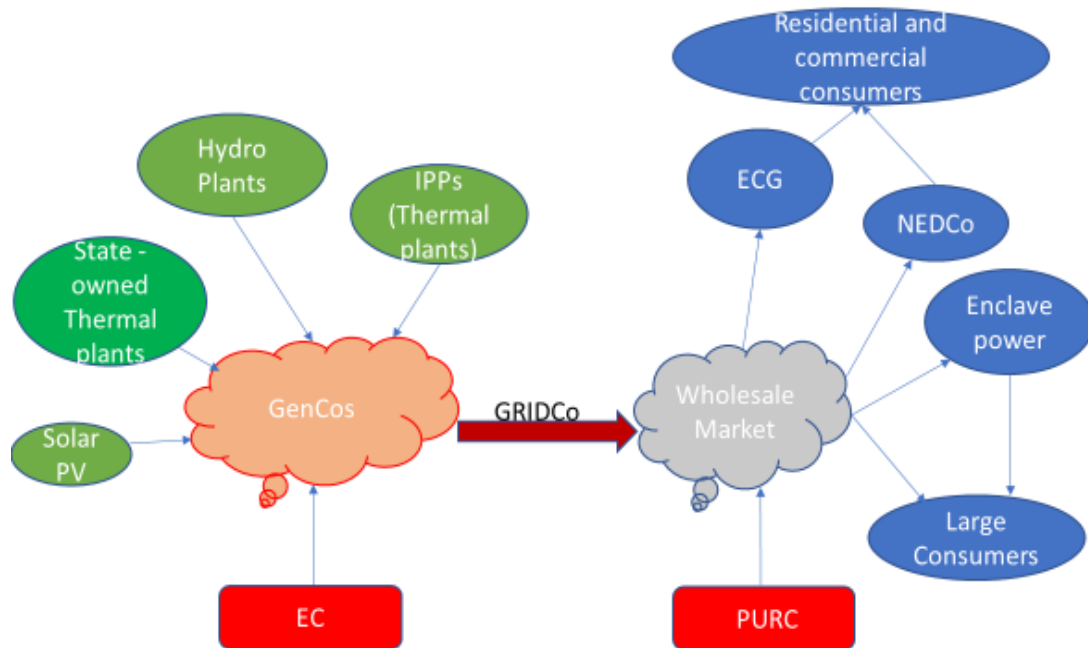


Figure 3: Structure of Ghana's electricity market.

V. ELECTRICITY MARKET REGULATION IN GHANA

Power sector reforms in developed countries are influenced by reforms in other industries relying on robust foundations and functional legal and political systems, however, in developing countries, the unpinning factors for reforms are as a result of general reforms in the national economy arising from the deteriorating state of the entire country. Most often than not, these reforms in the power sector are based on theories and models that are copied from other countries. The legal and institutional framework of such reforms is often not robust so, resulting in failures. A careful study of policy documents in Ghana’s power sector reveals that reforms have been implemented mostly under crises. These reforms only proffer a temporal solution and may not be good after the crisis. During the 2007 energy crisis, the government committed itself to buy plants that were later found not useful and had to be rented out to another country after lying idle for sometime. Similarly, the 2015 power agreements with IPPs were later found to be problematic. In the 2015 energy crisis, the government signed lots of power purchase agreements. The result is the current excess installed capacity. The nature of the 2015 crisis agreements is that the government is required to ‘either take or pay’, meaning that consumers are forced to pay for unused capacity. This is partly the reason for the high cost of electricity in Ghana.

In determining electricity prices in Ghana, the PURC proposed a transition plan that sought to automatically adjust electricity tariffs by the input factors of production. Subsequently, the PURC developed a four-year transitional rate adjustment scheme known as the automatic adjustment formula (AAF) for the period from 2001-2004. The automatic adjustment formula sought to review electricity tariffs quarterly in line with changes in external inputs such as crude prices, exchange rate, and inflation. Implementation of the AAF was suspended after the initial four-year period for political reasons. The long period of no review in tariff resulted in weak finances of the utilities and deteriorating equipment. The utilities, therefore, proposed a high percentage increase which was approved by the PURC in 2004-2006. The commission resumed the use of the AAF after public uproar over the large increases but suspended it again in 2006. The suspension of the AAF led to an increment of 35% and 89% in 2007 and 2010 respectively to improve the financial and deteriorating quality of service of the utility operators [15]. The AAF has still not been fully implemented since 2010 because the issue of electricity pricing in Ghana is more of a political decision rather than economic. End-user pricing remains inconsistent throughout that period of government control. Prices to the public are held artificially low, while even lower prices are occasionally offered to a few major industries to boost national development. The debt in the sector as a result of unpaid subsidies and under-recoveries is, therefore, a major challenge in the power sector and a disincentive to the private sector.

VI. NEW DEVELOPMENTS IN THE POWER SECTOR

Ghana has successfully been able to attract the private sector in the generation of electricity. Currently, the state has a monopoly on hydroelectric plants which supplies 35% of the demand. Several IPPs have invested in thermal plants bringing the total installed capacity to 5000MW which is more than the peak demand. Reforms have improved efficiency and have re-oriented the electricity market towards competition. The review in the previous sections has also indicated weak regulation in the sector. Political interference and lack of consistency have often led to poor execution of reforms. If the country is to derive maximum benefits from reforms, policies, and programs in the sector must be coherent and consistent and must be aligned to the broader long-term objectives of the sector.

Because of these challenges, the United States of America through the Millennium Challenge Corporation (MCC) signed a power compact agreement with the government of Ghana in 2007. The objective of the compact is to continue with the power sector reforms that began in the 1990s. One of the key objectives of the compact is to improve efficiency in the energy sector by restructuring the distribution companies. As part of the compact, the Electricity Company of Ghana is to be repositioned to be a viable financial entity capable of recovering costs and able to undertake investment in maintenance, and expansion without requiring financial support from the government. With this, ECG is required to operate on sound commercial principles to be creditworthy and able to enter contractual off-taker power purchase agreements and execute on its own. The turn-around project of the ECG is to be pursued in two forms; strengthening the governance and management structure by bringing in the private sector to provide the needed investments in infrastructure and foundational investment designed to reduce operational and commercial losses and improve quality of service. If this reform is successfully implemented, it would modernize the operations of ECG by introducing new technologies such as automated billing systems, geographic information, and enterprise resource planning among others.

Consequently, assets of ECG were transferred to a private company, Power Distribution Services (PDS) in 2018 but the government abrogated the contract only six months after coming into force for the failure of PDS to provide the required equity as defined in the agreement. As part of key objectives, PDS was supposed to turn-around the fortunes of ECG by improving revenue collection, and by reducing the technical losses of the distribution system. PDS was mandated to replace the deteriorating equipment, and also deploy efficient technology in its operations but failed to show signs of embarking on any of the performance indicators. Other future reforms in the MCC compact focus on developing projects and initiatives to address the constraints in the supply of adequate and reliable power. These projects also seek to address the attendant socio-economic and gender issues that are related to electric

power. Some of the key projects under the new power compact agreement include:

- Strengthening and capacity building of regulatory institutions
- Increasing access to clean, reliable and energy
- Improving energy efficiency and demand-side management programs
- Addressing environmental concerns related to energy production and consumption

Besides, there is an ongoing debate to find better ways to utilize excess capacity. One school of thought advocates renegotiation of the power purchase agreement with IPPs, another also suggesting Ghana can capitalize on this capacity to become the power hub of the sub-region. In both scenarios, one critical factor that needs to be addressed is the cost of the power generated and whether it is competitive and as such consumers would be willing to pay considering the levels of poverty in the sub-region. Considering the “take or pay” contracts with the IPPs, the country would be better off if Ghana exports the power to other countries considering the supply deficits in the West African sub-region. Ghana can take advantage of the west African power pool project and sell the excess generation as was done with the Akosombo hydroelectric plant. Government’s industrialization programs like the “one district one factory” would also require a lot of electricity for production, the excess generation can be channeled into these factories for rapid development.

VII. CONCLUSION

The paper provides a critical review of the regulatory reforms and the market structure of Ghana’s power sector. The structure of the power industry has changed since independence, major structural changes are driven by the crisis in the industry. The study has revealed several policy gaps in the power sector. Although key objectives of market reforms such as unbundling the power sector and establishment of independent regulatory institutions have been achieved, key challenges remain in the sector. Most policy failures are as a result of improper planning, hasty implementation, and political interference in the work of the mandated state institutions. The review also highlights the weak market structures for renewable energy. Most of the targets of renewable energy generation have been missed due to inconsistencies in policies, lack of operationalization of policies, and lack of enabling the market for renewable energy.

Reform in Ghana’s power sector has had some achievements particularly in the reduction of both technical and commercial losses resulting in the improved financial position of utilities. The semi-independence of the utilities has allowed for proper focus and therefore some significant investments in the assets of the utilities.

If developmental goals are to be met under reform, the government will have to play a more active role. The government would have to look at other strategies of reducing the cost of production of electricity by focusing on

renewable energy such as solar PV, which has proven to be cheaper than fossil fuel which now constitutes a higher proportion of Ghana's electricity generation.

With the growing electricity demand, more private investments would be needed, it is, therefore, important to pursue policies that would encourage investments whilst at the same time adopting programs and policies to provide the electricity for low-income households.

The Government and policymakers in the power sector should be proactive in investigating implications for different reform options and choosing accordingly in line with the objectives of the reform. Given this, the government should encourage the skills and capacity development of key regulatory institutions in the sector and give them the needed independence to execute their mandate. To be able to develop reforms devoid of external influence from developing partners whose interest is the privatization of the sector, the government can use local resources and involve stakeholders to develop public-private sector partnerships to address some of the challenges in the sector.

REFERENCES

- [1]. M. Obeng, S. Gyam, N. Sarfo, and A. T. Kabobah, "Technical and economic feasibility of a 50 MW grid-connected solar PV at UENR Nsoatre Campus," no. XXXX, 2019.
- [2]. S. Gyam, F. Amankwah, E. Nyarko, and F. Sika, "The energy efficiency situation in Ghana," no. XXXX, 2017.
- [3]. E. Energy Commission, "2015 ENERGY (SUPPLY AND DEMAND) OUTLOOK FOR GHANA," 2015.
- [4]. J. H. Williams and R. Ghanadan, "Electricity reform in developing and transition countries: A reappraisal," vol. 31, pp. 815–844, 2006.
- [5]. M. E. Eshun and J. Amoako-tuffour, "A review of the trends in Ghana's power sector," *Energy. Sustain. Soc.*, pp. 1–9, 2020.
- [6]. P. Systems and E. Consulting, "Power Systems Energy Consulting (PSEC)," 2010.
- [7]. F. Kemausuor, G. Yaw, A. Brew-Hammond, and A. Duker, "Author's copy A review of trends, policies and plans for increasing energy access in Ghana."
- [8]. S. Karekezi and J. Kimani, "Status of power sector reform in Africa: impact on the poor," vol. 30, pp. 923–945, 2002.
- [9]. J. Fritsch and R. Poudineh, "Gas-to-power market and investment incentive for enhancing generation capacity: An analysis of Ghana's electricity sector," *Energy Policy*, vol. 92, pp. 92–101, 2016.
- [10]. M. Hensley, S. Gu, and E. Ben, "A comprehensive review of biomass resources and biofuels potential in Ghana," *Renew. Sustain. Energy Rev.*, vol. 15, no. 1, pp. 404–415, 2011.
- [11]. W. Paper and S. No, "Design and Analysis of a 1MW Grid- Connected Solar PV System in Ghana," no. 78, pp. 1–24, 2013.
- [12]. S. Gyam, M. Modjinou, and S. Djordjevic, "Improving electricity supply security in Ghana — The potential of renewable energy," vol. 43, pp. 1035–1045, 2015.
- [13]. M. S. Adaramola, M. Agelin-Chaab, and S. S. Paul, "Assessment of wind power generation along the coast of Ghana," *Energy Convers. Manag.*, vol. 77, no. 2014, pp. 61–69, 2015.
- [14]. J. Kapika and A. Eberhard, *POWER-SECTOR...*
- [15]. T. Guidelines, "PUBLIC UTILITIES REGULATORY COMMISSION (PURC), ELECTRICITY RATE SETTING," pp. 0–18.
- [16]. S. Plan, "Electricity Supply Plan," 2019.