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Electricity Industry Restructuring in Tanzania

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Abstract

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All of the effort the Tanzanian Government has put into restructuring the electricity industry up to the present has had little impact on investment, increase in access, or improved efficiency of the industry. Today, most countries have achieved a greater improvement in efficiency, investment and access to electricity that has led to lower electricity price. For the Tanzanian electric industry to catch up with the rest of the world, there is a need to draw from the experience of other countries. In order to achieve this, I conducted a case study analysis of the restructuring of the electricity

industry in developed and developing countries based on competition, vertical separation, ownership, and regulation in relation to their effect on efficiency, investment, prices and fuel diversification.

Based on this, I propose model/structure and policy recommendations for the electricity industry in Tanzania to achieve adequate investment, increase access to electricity, and improve the efficiency and fuel diversification of the industry. With the proposed model, the Government of Tanzania, the investors, and the community will leapfrog from the present situation to catch up with the rest of the world.

Keywords: *Restructuring, Efficiency, Investment, Price, Fuel diversification, Access, Subsidies*

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Table of contents

Abstract i

Table of contents iii

List of tables vi

List of figures vii

1. Introduction 1

2. Theories 6

2.1 Competitive market 6

2.1.1 Definition 6

2.1.2 Productivity and (short term) price 6

2.1.3 Investment 8

2.1.4 Fuel source diversification and greener electricity 10

2.2 Vertical separation 12

2.2.1 Definition 12

2.2.2 Productivity and (Short term) price 13

2.2.3 Investment 14

2.2.4 Fuel diversification and greener electricity 15

2.3 Ownership 16

2.3.1 Definition 16

2.3.2 Productivity and (Short-term) price 17

2.3.3 Investment: including foreign investment 18

2.3.4 Fuel diversification and greener electricity 19

2.4 Regulation 20
2.4.1 Definition 20
2.4.2 Price regulation and subsidies 21
2.4.3 Efficiency and Investment.....21
2.4.4 Price set/tariff control.....22
2.4.5 Fuel diversification.....22
2.5 Subsidies for developing countries.....24
3. Case Studies 26
3.1 Developed countries 26
3.1.1 Competition.....26
3.1.2 Vertical separation 27
3.1.3 Ownership 28
3.1.4 Regulation 29
3.2 Developing countries.....30
3.2.1 Competition.....31
3.2.2 Vertical separation 31
3.2.3 Ownership 32
3.2.4 Regulation 32
3.2.5 Case 1: Mali 34
3.2.6 Case 2: Ghana 36
3.2.7 Case 3: India.....39
3.2.8 Case 4: South Africa 42
3.2.9 Case 5: South Korea.....44
3.2.10 Case 6: Tanzania 48
4. Comparison 56
4.1 Comparison of case study countries 56

4.2 Synthesis between Developed and Developing countries 63

5. Suggestions and recommendations to Tanzania..... 66

5.1 Proposed structure for Tanzanian electricity industry.....66

5.2 Recommendation to Tanzanian Government 68

6. Conclusion 72

References..... 74

Appendix..... 81

초록 82

List of tables

Table 1. Private Generation Plants in Tanzania as of 2013 2

Table 2. Summary of theoretical arguments regarding electricity market competition 11

Table 3. Summary of theoretical arguments regarding vertical separation/unbundling.....16

Table 4. Summary of theoretical arguments regarding ownership 20

Table 5. Summary of theoretical arguments about regulation 23

Table 6: Structure changes of developed countries during restructuring.....29

Table 7. Priority generation projects which have been indentified by the government of Tanzania for the years 2013-2020 53

Table 8. Priority transmission line projects which will evacuate power from the new power plants to extended grid coverage from 2014 to 2016 54

Table 9. Small Power Producers (SPPs) signed SPPA with TANESCO.....55

Table 10. Summary of restructuring for case study countries.....56

Table 11. Electricity consumption, access, and transmission & distribution loss, 2010 57

Table 12. Differences in restructuring processes between developed and developing countries 64

List of Figures

Figure 1. Electricity Demand Outlook 2010-2035 3

Figure 2: Electricity industry structure in Mali before and after restructuring 36

Figure 3. Electricity industry structure in Ghana, 2010 38

Figure 4: Ghana electricity industry structure before and after restructuring 39

Figure 5: Electricity industry in India before and after restructuring.....42

Figure 6: South African electricity industry before and after restructuring 44

Figure 7: Electricity industry structure in South Korea before and after restructuring 48

Figure 8. Power Generation Capacities in Tanzania as March, 2013 51

Figure 9: Tanzania electricity industry structure before and after restructuring ...55

Figure 10. Trend of increased access to electricity for case study countries 58

Figure 11. Access to electricity and total output loss (Trans &Distribution).....58

Figure 12. Investment in the energy sector with private participation after restructuring 59

Figure 13. Electricity consumption (kWh/capita) and GDP (US$) per capita, 2010 60

Figure 14. Trend of transmission and distribution loss (% of total output) 61

Figure 15. Average prices of electricity in case study countries.....62

Figure 16. Proposed structure/ model in Tanzania.....68

1. Introduction

The most vital issues in the electricity industry after restructuring are: efficiency, price, and the investment of the market. Since the 1990s, after Chile and the UK initiated restructuring of their electricity industries, many countries worldwide invoked electricity market restructuring to create competition in the market. Restructuring consists of regulatory restructure, changing ownership, unbundling of vertically integrated utilities, and privatization of public utilities. Restructuring has taken place against the backdrop of a broader shift from a paradigm of state ownership and centralized management of infrastructure industries to one that favors decentralized structure, competition, independent regulatory oversight, and private ownership (OECD, 2000). The main aim of restructuring for developed countries is to improve the performance efficiency of the sector, but for developing countries its purpose is to attract investment and to improve the quality of services in the sector. The restructuring process basically relies on the partial or complete removal of economic barriers for private sector participation in the industry. Electricity restructuring generally involves one or more of the following steps: sectorial restructuring; introduction of competitive electricity markets for wholesale generation and retail supply for retail competition; vertical unbundling of generation, transmission, distribution, and supply; horizontal splitting (regulation) of transmission and distribution networks; establishment of an independent regulator; and privatization of public-owned utilities (Newbery, 2002c; Jamasb, 2002; Joskow,1998).

The restructuring process in Tanzania started in 1992 after experiencing the world liberalization in the early 1990s. The aim of restructuring was to attract investment in the form of private sector participation, improve the quality of service in the delivery of electric services to consumers, and increase access to electricity. From 1992 to the present there has been insufficient investment in the generation side compared to demand growth (demand is suppressed by supply), less private sector participation, unreliability of power, and low access to electricity (18.4%). In addition,

the electricity industry is still highly dominated by a utility called TANESCO, which is responsible for transmission and distribution, while generation is done by both TANESCO and private companies, as indicated in table 1. The Independent Power Producers (IPPs) generate power and sell that power to TANESCO, the grid owner, to transmit and distribute. Currently, the private players include Independent Power Tanzania Limited (IPTL) (100 MW), Songas (190 MW), Aggreco (105 MW), Symbion Inc. (225 MW), Artumas Inc. (now Wentworth Resources), which operates a gas to power scheme in Mtwara and Lindi regions (12MW), and small independent power producers (SPPs), which operate by signing Standardized Power Purchase Agreements (SPPAs) with TANESCO.

Table 1. Private Generation Plants in Tanzania as of 2013

Name	Installed Capacity (MW)	Fuel type
Songas	190	Gas
IPTL	105	HFO
Aggreco	100	HFO
Artumas	12	Gas
Symbion Inc.	60	Gas
	60	Jet A
	105	HFO
Small IPPs	31	NRE
Note: Symbion Inc. and Aggreco are Emergency Power Plants (EPP) NRE: New and Renewable Energy (Small hydro and co-generation)		

Source: TANESCO, Daily Generation Report, March, 2013

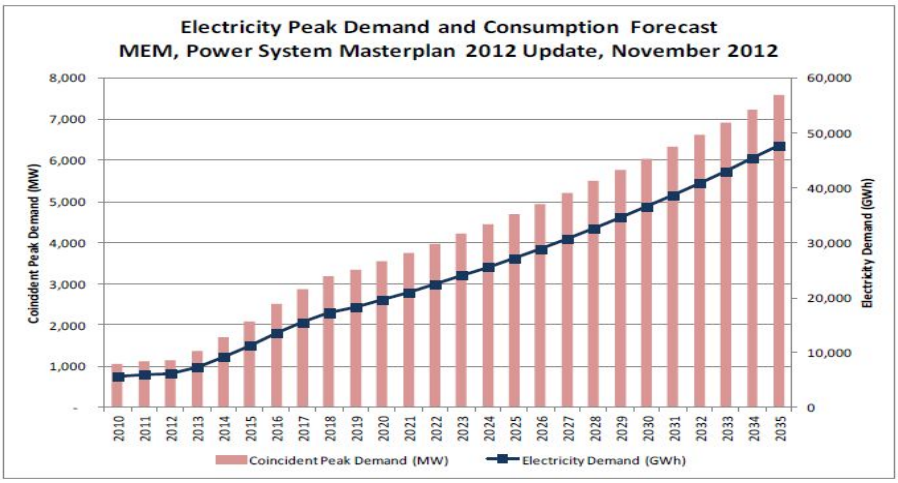
Despite the restructuring instituted by the first National Energy Policy in 1992, the 2003 revision, the subsequent enactment of Energy and Water Utilities Regulatory Authority (EWURA) Act of 2001 (which became operational in 2006), the Rural Energy Act of 2005, which created Rural Energy Agency (REA) in 2007, and the Electricity Act of 2008, there are still some challenges in the electricity industry. These challenges are low access to electricity (18.4%), low generation capacity (about 6,200

GWh), high electricity demand growth (about 10-15% per annum) as indicated in Figure 1, unreliability of power due to loss, and low electricity consumption per capita (100KWh). Transmission loss in Tanzania is very high (about 20%) due to non-rehabilitation of the existing transmission systems and unequal distribution of load, which leads to overload (Ministry of Energy and Minerals, 2012).

TANESCO is still a vertically integrated utility that requires substantial government subsidies to maintain existing levels of service to customers. This is probably due to a lack of financial capital being invested due to low revenue collection by TANESCO, unreliability of power arising from demand suppressed by supply and technical losses, and poor management of the TANESCO utility.

However, complete power sector restructuring is usually considered to include unbundling of vertically integrated companies as a pre-condition in order to create competition in the industry, which leads to improved efficiency and lower prices to consumers. The power market must, however, be sufficiently large to allow for adequate competition.

Figure 1. Electricity Demand Outlook 2010-2035



Source: Power System Master Plan (PSMP), updated 2012

The main objective of this research is to advise the government of Tanzania to draw from the experiences of other countries in order to encourage adequate investment in the sector, increase access to electricity, and improve the efficiency of

the industry. These objectives, if effectively implemented and achieved, would lead to an increase in generation capacity, construction of new and rehabilitation of existing electricity infrastructure networks, an improvement in the quality of service to customers, and attainment of low-cost energy service that is affordable and reliable. A competitive sector will allow more inflow of investment into the country. Based on the objectives above, this research aims to find solutions to the following questions:

(i) Can the restructuring of the electricity industry attract adequate investment and increase access to electricity in Tanzania?

(ii) Will restructuring improve the overall efficiency of the electricity sector?

(iii) What complementary policies should be adopted to improve electricity access?

An enormous amount of research has been conducted on developed and developing countries to analyze the effects of price, efficiency, and investment after restructuring. The effects of competition, vertical separation/unbundling, ownership, and regulation have been documented in terms of efficiency, investment, and price. However, since the issues of subsidies and fuel diversification have been mentioned sparingly in previous research, this will be the main contribution of this research.

The methodology employed in the research is the use of case studies. I investigated Mali, Ghana, Tanzania, South Africa, South Korea, and India as examples of developing countries, and the UK and USA as examples of developed countries. I reviewed the post-restructuring strategies' policies and performance in terms of price, efficiency, investment, and fuel diversification and made comparisons based on similarities and differences between the developed and developing countries in the study scope. In conclusion, I suggest how Tanzania can attract adequate investment in this sector, increase the access to electricity, and improve the efficiency of the electricity industry after restructuring.

This research is divided into six chapters. Chapter One is the Introduction. Chapter Two consists of theoretical arguments on electricity industry restructuring.

Chapter Three deals with analysis of the post-restructuring electricity supply industries of developed and developing countries (case studies). Chapter Four is a comparison and synthesis of investment, price, efficiency, and fuel diversification of the countries in the case studies. Chapter Five gives suggestions and policy recommendations for Tanzania. Chapter Six is the Conclusion of the study.

2. Theories

This chapter reviews theoretical arguments about electricity industry restructuring in terms of competition, vertical separation, ownership, and regulation. These arguments are based on efficiency, investment, price, and fuel diversification.

2.1 Competitive market

2.1.1 Definition

Competition in an electricity market results from the transformation of an electricity market from a public service to a commodity service (Jamasb & Pollitt, 2008). Electricity is traded as commodity in the pool market. Consumers are willing to buy electricity from the wholesale market or retail competition based on competition in market prices. The competitive market allows new entries into generation, transmission, and the supply side and brings more efficiency to the industry by increasing the performance, operation efficiency, and services to the customers. The level of competition in the market may differ from country to country due to differences in market regulations and policies.

2.1.2 Productivity and (short term) price

According to Newbery, (2002b) and Jamasb, (2002), increased competition between generating companies is expected to create more productivity, improve efficiency, and give better service quality to the customers, hence driving down the cost. In contrast, however, Jamasb and Pollitt, (2008) argued that better service, productivity, and reliability of electricity increased the willingness of the customers to pay for the services and depend on electricity as a primary source of power. This stimulates economic activities by stimulating people, especially the poor, to create small businesses which generate income for them. Competition creates profit-based incentives which motivate utilities to increase the quality of their performance due to the competitive pressure to satisfy customers. This in turn creates more revenue for the

government (Bacon & Jones, 2001; Davies, 2005). Competition also offers quality services, affordable costs of services, and competitive energy prices to customers while providing new incentives to control efficiency and reliability in the construction and operation of both modern plants with new technology and existing generating capacity, and also helps foster innovation in the electricity industry (Jaskow, 2003 & 2006; Jamasb, 2002b). Moreover, Bhide et al. (2010) added that competition brings efficiency and cost reduction by improving financial and technical capability, which is essential, and provides incentives for technology change in the power sector.

A regulator is very important in a competitive market. A competitive market without regulation can create high prices due to the power of one big company to dominate or monopolize the market if competition is not perfect. The other smaller firms will follow the market strategies of large firm. Monopoly- and oligopoly-based competition can lead to an increase the price of electricity and cause the poor to suffer. To protect the market and consumers' interests, there should be a credible regulator with the knowledge capacity to monitor and regulate the markets by limiting monopoly power and exercising market power (Graffin and Puller, 2005). Appropriate regulation in the market also ensures that the efficiency gained from market competition is transferred to the consumers.

Market competition in the electricity sector requires an independent regulator with a mandate to monitor and regulate the market as well as appropriate tools. Another factor is clear roles and responsibilities among government institutions as key players in the sector. Transparency is also one of most critical issues in competitive markets. Every utility should be forced by law to submit operation and maintenance cost reports to the regulator for review and approval. Therefore, establishment of market competition and restructuring requires the appropriate cooperation of both sector regulation and an application of competition laws to the electricity industry (Wisuttisak, P., 2012).

2.1.3 Investment

Investment in the electricity industry and power sector at large requires intensive capital and technical capability. Obtaining financial capital to develop the power sector is one of the major challenges for most of the developing countries. Developing countries such as Tanzania require foreign investment due to government budget constraints and a lack of the financial resources required for investment in the power sector. Most of the projects and plans for power sector development in Tanzania are delayed in their implementation due to a lack of financial and technical capabilities (Ministry of Energy and Minerals, 2012). To acquire financial capital for investment and technical capability in developing countries, there is a need for foreign investment and private-sector participation in the electricity industry. The private sector can participate in the Public-Private Partnership (PPP) option following the build-operate-transfer model (Rugabera et al, 2013). Foreign investment delivers better services, a shorter time for and higher quality of project implementation, and standard or higher technology. Foreign investment also facilitates technology transfer due to technology spill over, embodied technology, and diffusion of technology to the local utility companies involved in the development of the power project.

Facilitation of new investment and market competition for investment requires the availability of cheap fuel sources and the deployment of electricity infrastructure such as transmission systems/grids. The availability of cheap fuel sources such as natural gas, coal, and oil stimulates the flow of foreign investment due to lower cost of electricity generation (Newbery, 2002b; Jamasb, 2002). Meanwhile, the availability of infrastructure and a transmission grid provides investors confidence that they will achieve a reasonable return on investment. In this regard, the infrastructure should be thoroughly restructured to sustain market competition (Davies et al, 2005). Although competition creates investment in the electricity industry, it requires appropriate regulation (legal and regulatory framework) to protect the property or facility of the investor/owner (property right) and government initiatives to establish competitive a

market structure and sustainable business environment (Jamasb, 2005; Bacon & Jones, 2001).

Therefore, establishment of market competition supported by competitive laws and regulation may induce more investment in the electricity industry. The benefit of competition in investment is that any company or utility is free to enter into a market with new strategies and innovative ideas due to a promising market price, market information, and fair players in a pure competitive market. But the optimal level of investment in competitive markets depends on the available infrastructure, which should be thoroughly restructured to sustain competition (Kim et al, 2011; Jamasb, 2002; Davies et al, 2005). Bringing more investment into the electricity industry is dependent on government initiatives to establish a competitive market structure by creating a sustainable business environment (legal and regulatory framework) in order to attract the required investment in the electricity industry on competitive terms (Bacon and Jones , 2001). Every institution in the power sector should have a clear role, mandate, and responsibility for development of the power sector. Also, cooperation and coordinating sectorial policy, regulation, strategies, and application of competitive law to the electricity industry is very crucial. Meanwhile, the market should be regulated by a credible regulator with technical capability, sufficient staff, and modern tools (Jamasb & Pollitt, 2005).

Therefore, competition may not always encourage investment if the market is dominated by a private incumbent. Competition may induce less investment in the sector if it is not supported by government incentives and proper regulation (Lestage et al., 2013). The application of government regulations and laws which favor investors being able to recover their investment cost may induce investment. Alternatively, market failure may be caused by improper regulations, such as price regulation, inappropriate subsidies to lower the market price in some area of the market for the purposes of favoring the poor, underdeployment of transmission and distribution infrastructure, insecurity of fuel supply caused by unavailability of fuel sources, and

enforcement of environmental protection laws for generating firms applying new technology. Jamasb and Pollit (2008) argue that the application of laws and regulations has contributed to market failure in investment due to market competition and increased uncertainty in the investment based on price volatility.

To address these challenges and avoid underinvestment in competitive markets, the government should apply appropriate regulation and create an incentive to facilitate investment in the competitive market structure (Jamasb & Pollitt, 2005). Long-term contracts combined with capacity payment based on competitive terms can facilitate the required investment in the electricity industry. A regulator must provide incentives which offer the best price for return on investment (long-term contracts), which would deliver significant incentives to reduce costs and can facilitate efficient operation with the provision of stable cash flow for new investment (Pollit, 2008; Jaskow, 2006, Newbery, 2002d; Borenstein et al., 2001). For example, the most critical areas that stimulated competition and private sector investment in India are open access to the distribution and transmission system and the multi-year tariff principle. The performance-based multi-year tariff framework becomes an important incentive in India to minimize risks for utilities and consumers, as it provides investors with a regulatory guarantee on the cost of tariffs (Bhide et al., 2010).

2.1.4 Fuel source diversification and greener electricity

Competition has some negative effects on resource diversification in generating firms, especially regarding issues of environmental technology. Kim et al. (2012) argue that the restructuring of an electricity industry reduces government spending on the development of new technology for generating firms in the sector and hence reduces new investment, including R&D spending. That is, competition creates small firms in the market that will not invest in new facilities and technology, as compared to a monopoly market with large firms, which tend to invest more. Green energy and new environmental technology in the electricity industry require massive investments

for development and demonstration. Therefore, reduction in the investment of electricity generating firms may be detrimental to the reliability and efficiency of the electricity system as well as an obstacle to building the capability for innovation within the industry, and productivity hence increasing carbon dioxide emissions. Based on these issues, without government incentives and policies on environmental technology deployment, small firms in the competitive market will not be able to afford to invest in new/green technology and recover their investment cost due to volatility, uncertainty, and opportunism in wholesale electricity prices (Joskow, 2006).

Consequently, most generating firms in competitive market tend to use cheap fuel sources, which are more attractive in terms of investment cost. These fuel sources, such as natural gas, coal, and other fossil fuels, have low costs. Power plants using these sources, such as combined heat and power (CHP) and combined cycle gas turbines (CCGTs), require short construction time and have high efficiency. Fossil fuels, which pose a threat to the environment, might eliminate the use of expensive fuel sources, such as wind, solar, tidal, and other renewable energy sources, in the competitive market if there is no adequate government intervention. For the purpose of environmental protection, government policy, regulation, and intervention must ensure that the existing generation resources are split into a sufficient number of potentially competitive units for fuel diversification (Newbery, 2002a; Jamasb &Pollitt, 2005; Bhide et al., 2010). Good examples of these are Chile, Argentina, USA, and the UK. The availability of laws, regulation, and incentives favors more investment in new and renewable energy/green technology in order to reduce carbon dioxide and protect the environment.

Table 2. Summary of theoretical arguments regarding electricity market competition

Author	Efficiency	Investment	Price	Resource Diversification
Kim et al., 2012.		(-)	(+/-)	(-)
Wisuttisak, P., 2012		(+)		
Kim et al., 2011.	(+)	(+/-)		

Jamasb, T. & Pollitt, M., 2008.	(+)	(-)		(-)
Newbery, D. M., 2002c	(+)	(+)	(+)	(-)
Jamasb, T., 2002	(+)	(+)	(+)	
Davies et al., 2005	(+)	(+)	(+)	
Jamasb, T. & Pollitt, M., 2005.	(+)	(+)	(+)	(+/-)
Bacon, R.W. & Jones, J.B., 2001	(+)	(+)		
Joskow, P.L., 2006	(+)	(-)	(+)	(-)
Newbery, D. M., 2002a		(-)		
Newbery, D.M., 2005		(+/-)	(+)	
Newbery, D.M., 2004	(+)		(+)	
Joskow, P.L., 2003.	(+)	(+)	(+)	
Jamasb, T. & Pollitt, M., 2001.	(+)	(+/-)		
Bhide, S. et al., 2010	(+)	(+)		(+)
Joskow, P.L., 2008			(+)	
Borenstein, S. & Bushnell, J., 2000	(+)	(+)	(+)	
Pollitt, M., 2008	(+)	(-)		
Note: Positive (+) in the price column means lowering the electricity price and negative (-) means increased the price				

2.2 Vertical separation

2.2.1 Definition

Vertical separation is a type of restructuring which involves unbundling of electricity utilities from one large company into three different companies, namely: generation, transmission, and distribution. This separation benefits services and management. Breaking up state-owned utilities into three segments creates competition in the market and increases the performance of utilities in the area of specialization. The generating company strives to increase production based on the market demand, while the transmission company struggles to deploy transmission lines and reduce transmission losses in order to bring reliable power to the distribution companies. Also, the distribution companies compete in the market by offering quality

services to their respective customers and also improving revenue collection. Vertical separation makes each company more concerned and responsible in their own areas of operation (Graffin and Puller, 2005). In line with that Newbery (2004) also stressed out that vertical separation/unbundling of generation, transmission, and distribution is very crucial for creating competition in wholesale electricity markets and is the second stage before entry into a pure competitive market.

2.2.2 Productivity and (Short term) price

Vertical separation of the electricity utility happens in order to reduce the monopoly in the market and also to reduce the government burden of subsidizing electricity tariffs. A utility with a sole owner has high risks in terms of transmission and distribution losses, poor operation efficiency, and low revenue collection (Bhide et al., 2010). According to Jamasb and Pollitt, (2005), unbundling the utility by separating transmission and generation prevents non-competitive behavior by incumbent generators and ensures non-discrimination of network access for the others and also puts pressure on companies to reduce costs. Vagliasindi and Jones (2013) also pointed out that vertical separation of a utility increases access to electricity and labor productivity and enhance the level of price.

In agreement with the foregoing, Wisuttisak (2012) also points out that a vertical separation strategy creates competition and that the utility sets the electricity tariff based on the revenue required to ensure stability of their financial position and the operation of the system. An increase in tariff is normally based on the ability to expand operations of a power utility. If an expansion of operations and an increase in productivity are not planned and managed in a competitive way, they might create inefficiency and overcapacity in the system, which transfers costs to the customers via an increase in the electricity tariff.

Most restructurings (vertical separation) of electricity industries involve the implementation of a tariff restructure for the purposes of ensuring financial stability of the firms so that they can recover their investment and operation costs. Tariff

restructuring normally increases the price of electricity and erodes the cross subsidies, especially for the consumers who have been receiving and enjoying extensive subsidies. Restructuring and re-organization of the market structure will reduce the price later on after stabilization of the market and system operation due to the performance efficiency of the utility formed (Davies et al., 2005). Hence, vertical separation of a utility is very important in improving performance and productivity. Most of the research has concluded that monopolistic/vertically integrated or state-owned utilities use excess labor and are less efficient in terms of productivity (Jamasb, 2001). However, the effect of unbundling of the utility does not mean the electricity price will be reduced; it may result in a higher price, but it can increase performance efficiency (Hattori et al., 2004).

2.2.3 Investment

The management of vertically separated firms depends on the legal and regulatory frameworks available, especially the existence of an independent regulator with sufficient staff and technical capability to ensure that efficiency gain is transferred to the consumer. Vertical separation encourages an investor to invest in any part of service, but most investors are encouraged by or attracted to the generation and distribution side rather than the transmission side. Building a transmission line requires more intensive capital when compared to power generation plants. Investments in vertically separated structures are more concentrated on the generation side rather than transmission side due to high competition in the generation side (Jamasb, 2002).

Most of the distribution side is a very risky area for investment, especially in developing countries, due to vandalism of electricity infrastructure, low access to electricity, which leads to illegal connections, and low purchasing power. Most of the settlements in cities, municipalities, and towns are unplanned, which creates difficulties in building distribution infrastructure in the aforementioned areas, for example, India, Tanzania, and South Africa. The poor performance of distribution utilities discourages investment by independent power producers (IPPs) and private sector participation

(Bhide et al., 2010).

On the other side, a vertically integrated structure can facilitate investment if there is adequate and reliable infrastructure: security of supply of primary fuels such as coal, oil, and gas and long-term power purchase agreements (PPAs) to raise the financial capability and return on investment (Bacon & Jones, 2001; and Newbery, 2002b). A vertically integrated strategy in generation and transmission companies causes these companies try to dissuade entry by charging avoidable costs for generation and then recouping these fixed costs through transmission tariffs, all of which discourages investment. A utility sets their electricity tariff based on the revenue required to ensure the stability to expand operations, which creates inefficiency and overcapacity in the systems, and all these costs are transferred to the customers via increases in electricity prices (Wisuttisak, 2012).

In contrast, Kim et al. (2011), argued that vertical separation of one monopolistic company into small firms sometimes creates a delay in the deployment of infrastructure and innovative technologies and also reduces the amount of investment due to the limited financial capacity of the small firms created.

2.2.4 Fuel diversification and greener electricity

Joskow (2006) stressed that, without government incentives and policies on environmental technology deployment, vertical separation/unbundling of firms creates small companies, sometimes with less capital, which cannot afford to invest in new/green technology and recover their investment costs due to volatility, uncertainty, and opportunism in industry prices. Government policy, regulation, and intervention is required to ensure that the existing generation resources are split into a sufficient number of potentially competitive units for fuel diversification for the purpose of environmental protection (Newbery, 2002b; Jamasb & Pollitt, 2005). Most developed and emerging countries have strict environmental laws and regulations and all generating firms are required to generate a certain amount of power from new and

renewable energy sources. The availability of laws, regulations, and incentives favors more investment in new and renewable energy/green technology to reduce carbon dioxide and protect the environment.

On the other hand, Bhide et al. (2010) explained that in vertical separation, firms on the generation side can encourage distributed generation, which can increase the deployment of renewable energy sources such as solar, small wind, and small to medium hydropower plants in remote areas. Distributed generation increases the access to electricity in areas which not connected to the national grid.

Table 3. Summary of theoretical arguments regarding vertical separation/unbundling

Author Name	Efficiency	Investment	Price	Resource Diversification
Wisuttisak, P., 2012	(+)	(+)	(-)	
Kim et al., 2011	(+)	(-)	(-)	
Jamasb, T. & Pollitt, M., 2008	(+)	(-)		
Newbery, D.M., 2002b		(+)		(+/-)
Jamasb, 2002		(+)		
Davies et al., 2005			(+)	(+)
Jamasb, T. & Pollitt, M., 2005		(+)		
Bacon, R.W. & Jones, J.B., 2001		(+)		
Newbery, 2002c		(+)	(+)	
Newbery, 2005	(+)			
Newbery, 2004		(+)		
Joskow, 2003	(+)	(+)	(-)	
Jamasb, T. & Pollitt, M., 2001	(+)			
Bhide et al., 2010	(+)	(+)		(+)
Note: Positive (+) effect on price means lowering the electricity price.				

2.3 Ownership

2.3.1 Definition

Electricity ownership is the possession of an electricity utility or industry.

The ownership of and electricity industry can be public or private. Basically, electricity ownership depends on the country; electricity industries in some countries are private owned, especially most of the developed countries (Germany, USA). In some developing and transitional or emerging developed countries the electricity industry is largely owned by the public. In some cases in both developed and developing countries, the electricity industry is possessed by both privately and publicly through public-private partnership, or the public and private interests each own a certain remaining percentage.

2.3.2 Productivity and (Short-term) price

Publicly owned utilities have experiencing poor performance due to low labor productivity, poor service quality to customers, high labor costs, and high system losses. This becomes a burden to the government in terms of investment and operation. Consequently, this system creates unreliability of power and inefficiency and discourages investment in the industry which requires a huge amount of investment from the government. In addition, publicly owned utilities have low efficiency due to poor management and inefficient system operation (Pollitt, 2008).

On the other hand, privately owned utilities offer better services to customers and increased efficiency and productivity of supply, which lead to incentives to pursue profit through cost saving and reduction of cost (Newbery, 2005; Kim et al, 2012; Jamasb & Pollitt, 2008). The efficiency and productivity gain may have a great impact on both customers and the environment due to reduction of CO_2 emissions. Pollit (1995) and Steiner (2001) added that privatization has the negative impact of increasing electricity prices due to high market power caused by profit maximizing behavior if there is no proper regulation in the market.

Most developing countries' electricity prices are very low due to government subsidies and these prices will not cover operation costs well enough to support new investment in the industry. Inappropriate subsidized tariffs create inadequate investment in power supply facilities and unavailability of services to a large

population due to a low electricity price which cannot cover or support new investment in the sector. According to Jaskow (2003), electricity prices in developed countries are high enough to cover the operating cost and construction cost overrun on new facilities. Vagliasindi and Jones (2013) indicate that high rate of private participation raises the level of tariff to reflect the investment and operation costs. In most cases, privatization goes together with an electricity tariff restructuring that can support operation and maintenances costs and new investment costs, which encourages private sector participation in the electricity industry.

2.3.3 Investment: including foreign investment

Public ownership has a some negative effect on investment due to a lack of capacity to finance any new investment needed; this is often compounded by public-sector price or tariff setting, does not allow a state-owned enterprise to recoup all of its costs, and causes inefficiency in collecting revenue from customers (Bacon & Jones 2001). Inefficiency in collecting revenues/tariff from customers by distribution companies causes generating companies/investors to worry about signing IPP contracts, and making restructuring impossible. In Colombia, for example, the restructuring process was delayed due to most distribution companies being under municipal ownership (*de facto*), local opposition, overstaffed, corrupt or poor tariff collection agencies, and non-technical losses or unauthorized connection (Jamasb, 2002). Distribution utilities are a crucial link between generators and customers. It is obvious that market performance and quality of services depend on the performance efficiency of distribution utilities. Therefore, the financial health of distribution companies affects the generators as counterparts in business transactions, provision of better service to the end-user, and financing necessary investment.

Facilitating investment and delivering adequate generation capacity to the electricity industry requires good sales, revenue returns from distribution utilities or financial stability of the utility, participation of both the public and private sectors, and

the concern of the general public. Also, sufficient incentives, efficient liquidity, such as standardized contracts (long-term PPAs), macro-economic activity in the country, and market stability are key incentives for investment. Wisuttisak (2012) maintained that the retention of sole government ownership of a restructured electricity sector does not contribute to the development of the sector due to the limiting factor of government politics causing an inability to revise tariffs to meet the needs of electricity infrastructure improvements. Purely monopolistic firms/companies, i.e., government or private utilities, employ their market power to create a market barrier from their essential infrastructure which limits private participation in investment and discourages new investment in the industry due to avoidable competition (Michael, 2006).

Vagliasindi and Jones (2013) argue that private participation increases operational efficiency, labor productivity, and expands distribution infrastructure. Private ownership with an upgraded infrastructure network brings about new technologies and improves quality (reliability) by providing new technical solutions to provide power at a lower cost. Private utilities motivate consumers with a low level of demand and create innovative ideas through better customer service (service standards, billing, and collections) and cost recovery mechanisms.

2.3.4 Fuel diversification and greener electricity

Most of the publicly owned utilities in developing countries have faced the challenge of meeting the growth of electricity demand due to low prices imposed by the government and an inadequate revenue collection, which leads to an inadequate and unreliable supply of electricity. On the other hand, privately owned utilities tend to concentrate on expanding business and performance and maximizing profit, while social benefits such as environmental effects get left behind (Bhide et al., 2010). Investment in green energy technology is capital intensive and requires an incentive tariff and reasonable time to recover the investment cost. Therefore, private companies/ownership do not invest much in green energy technology without

government commitment (green energy promotion policies) and assurance such as incentives and fiscal regime such as laws and regulations. On the other hand, privately owned utilities tend to improve performance and efficiency of operation and construct modern power plants to meet the market demand, which leads to a decrease in emissions of CO_2 in the atmosphere.

Ultimately, neither public nor private ownership shows any significant effect on investment in fuel diversification or green energy technology without government intervention in terms of incentives and regulation. Examples of these incentives and regulation are feed-in tariff, capital subsidies, grants, rebates, sales tax credits, energy taxes, exercise taxes or VAT reductions, tradable certificates, public investment (loans and financing), standard and obligation, and public competitive bidding.

Table 4. Summary of theoretical arguments regarding ownership

Author	Efficiency	Investment	Price	Fuel Diversification
Kim et al., 2012	(+)			(-)
Wisuttisak, 2012	(-)	(-)		
Jamasb, T. & Pollitt, M., 2008.	(+)	(+)	(-)	(-).
Newbery, 2002a	(+)	(+)	(+)	
Jamasb, 2002		(+)		(-/+)
Davies et al., 2005	(+)	(-/+)		
Jamasb, & Pollitt, 2005		(+)	(-)	
Bacon, & Jones, 2001.		(-)	(+)	(+)
Newbery, 2002b	(+)	(+/)		
Newbery, 2005	(+)		(+)	
Joskow, 2003	(+/-)			
Jamasb, T. & Pollitt, M., 2001	(+)		(+)	
Bhide et al., 2010	(+)	(+)		(-)
Pollitt, 2008	(-)			
Note: Positive (+) in Price column means a lowering in the electricity tariff				

2.4 Regulation

2.4.1 Definition

Regulation is the application of laws and principles to control, guide, and

oversee electricity market performance. That is, regulation is the application of an autonomous power in the industry based on principles established by government in collaboration with industry stakeholders. The regulator should have adequate information and enough resources, such as staff, legal authority, and appropriate tools to monitor the performance of the industry (Newbery, 2002d). The regulator should have independent power and responsibility to implement incentives and regulation and promote competition in the industry (Sioshansi et al., 2006). Joskow (2003) maintained that an independent market regulator is necessary to identify industry behavior of market participants that can distort the market price from competitive levels and market design flaws that create opportunities for market participants to profit from inefficient strategic behavior such as cross subsidies. The regulator is a very vital component for a successful electricity restructuring (Joskow, 2008).

2.4.2 Price regulation and subsidies

Electricity price and subsidy regulations are very essential for development of the electricity industry in developing and emerging countries. Most investors require electricity prices which can facilitate recovery of their investment costs or returns on investment. Wisuttisak (2012) suggested that to encourage investment in the electricity sector, the role of the regulator should be to promote competition, which brings about competitive pricing in the industry, prevents abusive use of dominance in energy industry operation, and promotes fairness and transparency of provision of service in the energy network system without unjust discrimination.

2.4.3 Efficiency and Investment

The regulator has an important role to play in the market in promoting competition and investment in the industry and improving efficiency. The regulator should have the ability to modify license conditions by using acts and regulations available to assist the task (Newbery, 2004). The availability of an autonomous regulator has significant effects in terms of higher labor productivity and higher likelihood of attracting private participation in the distribution side (Vagliasindi &

Jones, 2013). The regulator should ensure that the regulated price set will both enable the owner or investor to cover operation costs and undertake further investment and allow the customer to afford the services offered. Price regulation and long-term power purchase agreements (PPAs) provide incentives for increased investment, plant availability, cost reduction in generation, and improved generator productivity. Well-designed regulations and a regulator are vital for privatization to be able to deliver efficiency benefits to the customers, achieve effective competition in the sector, and create an inflow of private investment (Newbery, 2002b; Jamasb, 2002). However, it is very dangerous to allow regulators to have continuous oversight and ability to intervene in the competitive market; this will chill the normal dynamism and innovation that can potentially offer the most significant long-term benefits of restructuring.

2.4.4 Price set/tariff control

Regulation is more crucial rather than competition to control the market price (Jamasb & Pollitt, 2005). Vagliasindi and Jones (2013) argue that a credible and autonomous independent regulator has a significant effect on increasing the tariff, insulates the crucial decisions related to pricing from political interference, and ensures that the price set is effectively designed. Newbery (2004) argues that a situation where a regulator is not independent and lacks competitive power, competent staff, authority, and technical tools to assist in market tasks will create market risks such as a reduction in short-term price and market power which can cause hedge price-spikes. The combination of a competitive market and a well-regulated price set should reflect economic costs in order to give the investor confidence to invest and recover his/her long-term costs as far as Long Run Marginal Cost (LRMC) is above or coincides with the price set.

2.4.5 Fuel diversification

The availability of an autonomous regulator has a greater effect on controlling carbon dioxide emissions by ensuring that overall environmental considerations have

achieved a higher target set when compared to the traditional functions of energy policy and regulation. Regulations such as protecting consumers from higher prices and ensuring that power generating companies will be able to recoup their investment costs have a great impact on fuel diversification and carbon dioxide emission (Vagliasindi & Jones, 2013). Likewise, massive investment in higher technologies such as new and renewable energy (green energy technology) in the electricity sector requires government support through price regulation or energy subsidies. These investments cannot attract private investment without government support and regulatory intervention due to high technology uncertainty or risks involved and high investment cost. Price regulation, incentives, and subsidies are crucial for investment in new and renewable energy (Kim et al., 2012; Jamasb, 2008). Price regulation must ensure that the existing generation resources are split into a sufficient number of potentially competitive units or available resources for electricity generation in order to have a balanced fuel mix for resource diversification.

Table 5. Summary of theoretical arguments about regulation

Author Name	Efficiency	Investment	Price	Resource Diversification
Kim et al., 2012		(+)		(+)
Wisuttisak, 2012		(+)		
Kim, 2011		(-)		
Jamasb, & Pollitt, 2008			(+)	
Newbery, 2002d	(+)	(+)	(+)	
Jamasb, T., 2002		(+)	(-)	(+)
Davies, et al., 2005		(-)	(-)	
Jamasb, T. & Pollitt, M., 2005			(+)	
Bacon, R.W. & Jones, J.B., 2001		(-)		
Newbery, 2002b			(-)	
Newbery, 2005		(+/-)		
Newbery, 2004		(+)	(-)	
Joskow, 2003	(+)	(+)	(+)	
Jamasb, & Pollitt, 2001		(+)	(+)	
Bhide, et al., 2010		(+)	(+)	
Joskow, 2008	(+)	(+)		

Pollitt, 2008		(+)		

2.5 Subsidies for developing countries

Government subsidies reduce the price of electricity and increase the accessibility of electricity to areas which have low purchasing power (Newbery, 2002c). Appropriate subsidies can encourage investment if they are provided as investment incentives for investors to recover their investment cost/return; they should be used to serve social benefits rather than political objectives (Jamasb & Pollitt, 2001). It is better to maintain electricity prices uniformly at a national level. Italy is an example, where the electricity price is the same for all residential customers. Incentive-based regulations are an effective way for the distribution of utilities which lead to increases in efficiency in the industry, such as reduction of technical and non-technical distribution losses. One example is India: in 1994, after privatization of distribution utilities/companies and when adequately incentivized by government subsidies, the utilities were been able to invest in distribution infrastructure, reduce technical losses, and improve billing efficiency (Bhide et al. 2010). The benefits of these incentives for efficiency improvement go directly to the final consumers in the form of cost reduction. Incentives and subsidy policy should ensure a sufficient revenue stream for distribution companies to recover investment and operation costs (Jamasb, 2002). Bacon & Jones (2001) added that the issues of income distribution and support for the poor are increasingly regarded as being supportable by targeted subsidies to needy groups for the purpose of providing electricity and increasing access, rather than by across-the-board subsidies, which have the effect of generally distorting patterns of the consumption of energy and investment. However, cost-reflective tariffs and cross subsidies should be clearly addressed at an early stage of restructuring process. An independent monitor is necessary to identify behavior by market participants that distort market prices from a competitive level and market design flaws that create opportunities for market participants to profit from inefficient strategic behaviors such as cross subsidies. An independent regulator is a complement in regulating markets

and creating competitive industry (Joskow, 2003). In Ghana, for example, an electricity subsidy must be approved by the Public Utility Regulatory Commission, which has the authority to approve and, in collaboration with government, make some regulations on electricity subsidies, which would facilitate access to electricity in the country. Through this, Ghana had reached an electrification rate of 76% in 2012. The governments in Zimbabwe and Tunisia provide subsidies for rural electrification, and the electrification rate in rural areas was increased to 80% in Zimbabwe and 100% in Tunisia. For example, the government in Zimbabwe implemented flat rate tariffs from Z$ 4.13 to Z$ 3.21 to consumers using above 1 MWh of electricity, preferential tariffs to domestic consumers, and connection charges lowered to below the true connection charge for the poor. Through these subsidies, more than 40% of households in the national grid were electrified (Dude, 2002).

To increase the electrification rate in Tanzania for low-income people, the government should provide subsidies to households and feeds in tariffs for distributed generation (decentralized generation) in rural areas. Later, after attaining the maximum electrification rate for the country, e.g., more than 95%, the government can start to regulate these subsidies by progressively reducing them on a yearly basis. The progressive reduction of subsidies and having transparent policies regarding subsidies and tariff rationalization by a regulator in the areas where purchasing power is lower will lead the market to be more competitive and open up greater avenues for prospective IPPs. Tanzania needs a national policy that will create an attractive environment for investment and facilitate business-led market growth in rural and urban areas. A business-led market should focus on creating innovative technology to reduce connection fees, distribution costs (efficiency), and the overall costs of increasing access for the poor, all of which seem to be the key/essential tools to increase access to electricity as opposed to relying on subsidies forever.

3. Case Studies

3.1 Developed countries

Most developed countries (German, Spain, Italy, France, USA, and others) have introduced electricity industry restructuring after Chile and the UK introduced restructuring in 1990s. The main lesson of restructuring in developed countries has been the improvement of the performance of relatively efficient systems (Jamasb, 2002). Developed countries restructured their electricity industries by changing ownership for the purpose of improving industry performance of the industry in terms of gaining efficiency, reducing price due to competition, improving the quality of the services offered, and encouraging competition in the sector.

3.1.1 Competition

After the introduction of electricity restructuring, the UK separated generation, transmission, and distribution, and most distribution companies were privatized along with the wholesale market that the electricity pool created (Newbery, 2004). Investment was increased, especially on the generation and distribution side, because of the end of the monopoly in the electricity industry and the competition created by a wholesale market pool. Most of the utilities improved their performance and service due to competitive pressure from the industry and a competent and legitimate regulator. The restructuring of the electricity industry in the UK resulted in the lowering of the electricity price due to improvements in productivity and competitive price bidding by each generating firm (Domah and Pollit, 2001). By five years after the restructuring the tariff had gone down 6%, which is equivalent to 100% return on the sale price (Newbery, 2002b). Operation efficiency was improved due to the construction of modern power plants, such as efficient combined gas turbines and modern nuclear power plants, and new investment from a range of international generating companies that bought divested plants. The UK electricity restructuring was successful in cutting prices and there were increases in productivity and efficient due to the availability of

laws and regulations and a credible regulator, which sustained adequate competition (Jamasb, 2002). However, the transfer of benefits to consumers depends on the intensity of competition: the number of competitors in the market, the independent regulator, and the existence of an open access wholesale market.

Fuel diversification was the major challenge after introduction of a competitive market in developed countries such as the UK, because most generating firms were constructed with efficient combined cycle gas turbines due to the availability of cheap gas, short construction time, and existing gas infrastructure (Newbery, 2002c). Environmental pollution, however, was reduced due to the construction of modern power plants, the decommissioning of older power plants, and the reduction of power losses in transmission and distribution (see Figure 8).

In conclusion, although the effect of competitive markets in most developed countries was an increase in performance efficiency (Stainer, 2001), the issues of whether price benefits are being passed to the consumers and whether new investment was being obtain were still debatable and inconclusive (Kwoka, 2008). In addition, competition in developed counties led to expanded retail access, which lowered industrial prices and increased the price gap between industrial and household consumers (Stainer, 2001; Hattori et al. 2004).

3.1.2 Vertical separation

Many developed countries which underwent electricity restructuring (vertical separation) had improved efficiency of generation and distribution network activities, which was caused by introducing incentive-based regulation (Jamasb, 2002). Incentive regulation rewards and penalties for the regulated firms were based on the comparison of the firms' actual performance versus reference performance. Based on the incentive regulation model, most of the firms improved their performance and efficiency, resulting in a lowering of their operation costs, a benefit which was passed to the customers through lower electricity tariffs and greater reliability of electricity.

For example, in the 1990s, in the five years after the Central Electricity Generating

Board (CEGB) in the UK unbundled the electricity industry into generation, transmission, and distribution, costs were reduced by six percent (Newbery, 2002b). Jamasb and Pollitt (2008) argued that vertical separation offers benefits in terms of economies of coordination, management, and operation if managed well by a credible regulator; it creates innovative activities in the industry (see Table 6).

Attraction of new investment and green energy technology depend on the competitive market, coordination among different government institutions, and the legal and regulatory restructuring created. Electricity restructuring in the UK, for example, created new investment in the electricity industry, but restructuring in Brazil and California failed to attract new investment in the electricity industry due to failure in coordination among the regulatory agencies (Jamasb, 2002).

Investment in green technology depends on the availability of market incentives and regulation. Most firms created after restructuring tend to invest more in available fuel resources that can bring down costs and recover their investment costs in a short period of time. For example, in the UK after the restructuring, most generating firms used natural gas, this was available at a cheap price, and built modern combined cycle gas power plants.

In conclusion, the attraction of new investment and private sector participation in the electricity industry after restructuring heavily depends on the regulatory design, which must ensure a workable framework for division, responsibilities, and coordination of the mandates among the different regulatory agencies (Newbery, 2004).

3.1.3 Ownership

The quality of services and efficiency of the electricity industry in developed countries improved after privatization due to technological innovation. Private sector participation in the UK led to the entry of new Independent Power Producer (IPPs), increased new investment in distribution firms, and improved quality of service (Newbery, 2001). The proponents of privatization of the electricity sector have shown

that there is a significant lowering in the price of electricity in many developed countries which have a pure competition model, but that it does not also necessarily lead to a reduction in carbon dioxide emissions. Restructuring leads to privatization, which allows Independent Power Producer (IPPs) to enter into the generation side. In developed countries, this has led to the commissioning of new and modern power plants, replacement of the oldest power plants, and some innovations (Bhide et al., 2010). This investment in modern power plants has a positive effect on efficiency and the environment. For example, in the UK and Chile after restructuring and privatization of electricity industry, new plants were built. Competition in the sector was also engendered in the areas of generation technology and the deployment of renewable energy technology aimed at reducing greenhouse gas emissions, but this depends on government policy framework, regulation, and incentives.

3.1.4 Regulation

Market regulation is very important to control and monitor the performance of the electricity industry. Developed countries have credible and independent regulators to monitor performance efficiency and market behavior. Price regulations are very crucial to prevent one company from monopolizing the market and preventing price hedging in the industry. Developed countries have applied regulation principles and laws to improve efficiency and assure that the efficiency gain benefits the customers by lowering prices. Also, proper regulation laws and policy created an incentive environment for investment in developed countries such as the UK. Developed countries such as the UK, Germany, France, and USA applied regulation incentives (prices, subsidies, and tax cuts) in the industry for the utilization of green technology. Developed countries and emerging countries strictly applied environmental laws and regulations to control carbon dioxide emissions. Generating firms in developed countries are required to generate a certain amount of power from new and renewable energy sources.

Table 6: Structure changes of developed countries during restructuring

Monopoly	Vertical integration	Vertical Separation	Competition
Utility companies are owned by the government and each IPP signs a PPA contract with the public utility or with the government.	The utility is owned by the government or the public and competition is introduced on the generation side (wholesale), with one transmission company which buys electricity in competitive bidding.	Competition is introduced in generation, transmission, and distribution. The generation company can sell power directly to distribution companies/retail or large customers.	Competition is introduced in both sides and the customers are able to choose a service provider other than one distribution company. Here power is traded as a commodity in the market.
Traditional/old stage	Single buyer with IPPs	Second stage before entry to competition	Final stage (Wholesale/retail)

3.2 Developing countries

Most developed countries have undergone electricity restructuring to bring competition and the flow of foreign investment into the electricity industry. Restructuring also improves the financial and technical performance of state-owned utilities through commercialization, cooperation, and seeking private sector participation. The major reasons for electricity restructuring in developing countries are low performance of electricity utilities, high transmission and distribution losses, unsatisfactory services offered to the customers, the government burden of inappropriate price subsidies, low revenue collection, and low investment in the electricity sector (Clark et al. 2005; Newbery, 2002c; Jamasb, 2002; Joskow, 2001).

Restructuring transforms state-owned electricity utilities into decentralized, market-oriented utilities with competition in generation, transmission, and distribution, and brings private sector participation and regulation of natural monopoly activities. In order for a decentralized industry to function well, the restructuring and regulatory design must establish an appropriate structural, institutional, and operational framework. The main steps of restructuring are: restructure the sector, establish regulatory authorities, organize markets for generation, regulate the transmission and distribution network, privatize existing assets and promote new investments, and allow for cost-reflective in electricity tariffs (Newbery, 2002c; Joskow, 1998; and Jamasb,

2002).

3.2.1 Competition

After the restructuring of the electricity industry in developing countries (in Africa, for example), most of the countries had induced foreign investment (private participation-IPP) in the industry. Restructuring has significantly improved the physical performance of the sector, offered better/quality service to the customers and increased access to electricity (Bhattacharyya, 2011). Utilities improved their financial viability and technical performance due to improved efficiency and tariff increases that reflected the investment cost. Some countries in Africa were faced with some challenges after their electricity industries were restructured, such as failure to induce adequate foreign investment in the sector, rises in electricity prices that led to electricity not being affordable to the poor, and political unwillingness to support restructure (Kesside, 2004).

3.2.2 Vertical separation

Many developing countries have significantly improved the performance of utilities after separation/unbundling of vertically integrated utilities. This was done by creating a competent regulator position in the industry and the application of laws and regulations in the market. For example, Ghana improved the physical performance of their utilities after the vertical separation of their public-owned utility in 2008. Ghana created a strong and independent regulator to oversee the performance of the industry. Other developing countries used some incentives to improve the efficiency of the industry after restructuring. Latin American countries, for example, have improved efficiency by introducing and adopting "efficiency standards" as an incentive regulation for performance (Jamasb, 2002). Actual performance was compared to reference performance and this helped to improve efficiency, reduce losses, and increase the quality and reliability of supply. In developing countries, investment significantly increased, but was heavily dependent on the stability of the microeconomic condition of the country. Most investors in generating firms in

developing countries looked at the financial capabilities of the off-taking company (transmission and distribution), deployment of transmission infrastructure, revenue collection by distribution companies, and economic stability of the country (market demand).

3.2.3 Ownership

Many developing countries have restructured the electricity industry for the purposes of increased investment in the sector, improved performance of the sector, the promotion of competition, and the encouragement of private sector participation. In many cases in developing counties after privatization, efficiency has increased and performance of services has improved, but the tariff was also increased due to tariff restructuring for the purpose of enabling investors to recover their investment costs (Clark et al., 2005).

After the restructuring and privatization of national utilities, most developing countries have allowed significant entry of private companies into generation and distribution. The entry of private companies into the generation side increased investments. For example, in South Africa and India restructuring paved the way and created the space for new private players in the renewable energy sector. This has encouraged private sector participation in the area of green energy development in rural areas as independent power producers/distributed generators. In India, private sector participation in upgrading transmission and distribution infrastructure has led to an improvement in the effect on the environment (Bhide et al., 2010). Privatization also led to new investment in the generation side by independent power producers and hence encouraged foreign investments either by private ownership or public-private ownership. In general, the restructuring and privatization of the electricity industry brings about some significant impacts in developing countries, but there are still some challenges on the regulation issue (Jamasb, 2002).

3.2.4 Regulation

Electricity industry regulations in developing countries are very crucial for

business growth and customers' safeguarding. Developing countries need to have independent regulators to control markets and facilitate new investments in the industry. The best way to encourage investments is price regulation, which can set the price to favor both investors and customers. An example is India; the State Electricity Board (SEB) used multiyear tariffs to encourage investment in the generation and distribution side. The SEB offers a subsidizing tariff to the poor and a feed-in tariff (on- and off-grid) in rural areas in order to increase rural electrification. These caused an increase in access to electricity in rural areas in India by the use of new and renewable energies. Price regulation will stimulate investment if it is managed and controlled by credible regulator.

Price regulation and subsidies to the poor still dominate in most developing countries, because most of the poor cannot afford to pay electricity bills. Offering subsidies and regulating the price in restructured markets in developing countries is not an issue of market failure, but most importantly the commitment of the government to set aside the budget which provide incentives in terms of money to the utility at the agreed time. For example, most of the governments in India subsidizes electricity tariffs and releases money to the electricity utility at the right time or every month/year in order to keep business running smoothly. Every year, the India government sets aside subsidy money from the budget. Price regulations and subsidies in most developing countries are usually interfered by politicians who are not committed to release the money to the utility at the right time. It is a debating process which does not end.

To serve the poor, developing countries should keep regulating prices and offer appropriate subsidies or subsidize the electricity tariff every year according to their financial capability and budget plans. The regulator should offer investment incentives to the private investor to recover their investment cost. The most appropriate incentives are capacity charge, long-term contracts, multiyear tariffs, and other physical incentives. Also, the regulator should be innovative in creating competition in the

industry and offer motivation to utilities which reach power-loss reduction targets set by regulator. Generally, price regulations and subsidies are still promising options for increasing electricity access and deployment of renewable energy in remote areas.

3.2.5 Case 1: Mali

The electricity industry in Mali was dominated since 1962 by *Energie du Mali* (EDM-SA), the public utility responsible for generation, transmission, and distribution. In 1994, Mali privatized the company due to company's high debt level (poor balance sheet or company's financial capability) and high resistance from unions and the public in general due to an unreliable electricity supply, high price/tariff, and poor service (Kesside, 2004). In 1995, the management of EDM-SA was handed over to four different companies (SAUR International, Hydro-Quebec International, EDF International, and CRC SOGEMA) and, in 1998, the contract with the government (EDM-SA) and the four companies was terminated due to unreliable supply and little expansion of the infrastructure system.

Clark et al. (2005) further explained this issue by adding that in 2000; EDM-SA shares were made available to private investors by the government of Mali. After privatization, the government owned 40% and 60% was owned by a private company, SAUR/IPS-West Africa, which has a 20-year concession to provide 97% of the electricity to the country. SAUR/IPS remained under the umbrella of EDM-SA, who owned generation, transmission, and distribution, and the *Societe de gestion de l'electricite de Manantali* (SOGEM), who owned generation from hydro and transmission, but all distribution was done by EDM-SA. SOGEM has contracted *Eskom Energie Manantali*, a subsidiary of Eskom of South Africa (South Africa's national utility), to carry out operations and maintenance for 15 years. Later in 2000, Mali established the *Commission de régulation de l'eau et de l'électricité* (CREE) as a regulator of the electricity industry. The regulator was responsible for approving electricity tariffs and ensuring compliance with contracts and also monitoring the development of the sector. Consumer interest is very important in electricity industry

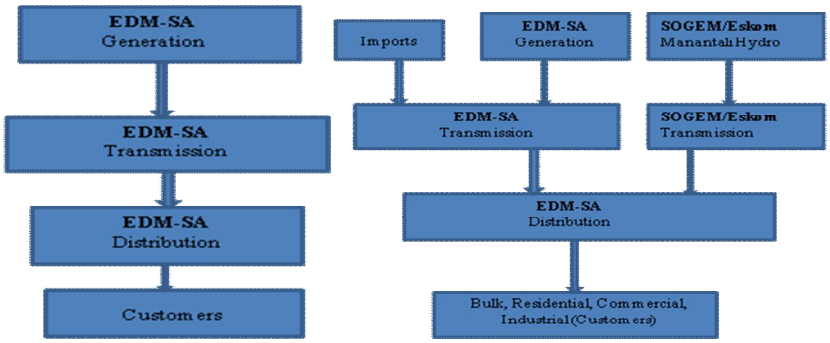
(Davies et al., 2005). CREE protects the consumers' interests and resolves conflict between service providers and consumers. Refer to Figure **2** for the electricity market structure in Mali before and after restructuring.

After their electricity industry restructuring, Mali was able to increase customer satisfaction due to services offered by the service providers; for example, an increase in the performance efficiency of electricity industry. The utility improved the quality and reliability of the electricity supply, which increased customer demand for more connection, hence increasing the access rate by three times. Mali increased per capita consumption of electricity from 22 kWh in 1990 to 34 kWh per person in 2000 (Clark et al., 2005). Mali also encouraged foreign investment and private participation (IPPs) in the electricity industry by allowing to long-term concessions to take over from the old state-owned utilities. Mali attracted new sources of finance in the industry to expand generation capacity and rehabilitate and expand the transmission and distribution network. Competition lowered the cost of production due to introduction of new hydropower plants, but average national tariffs were inflated by the cost of diesel generators in remote areas. As a result, the price of electricity was increased to recover the cost of investment (cost reflective). In 2003, Mali increased the tariff 49% from the year before, but the government took the initiative to lower the price by subsidizing it. The resulting tariff was affordable to most people since the government subsidized it. Still, in the rural areas the price is highly subsidized by the government due to the low income of the poor.

The privatization of the electricity industry in Mali did not lead to fuel diversification in Mali until the government introduced investment subsidies to generating firms to encourage them to invest in rural areas and use new and renewable energy sources. However, most generating firms use hydro generation due to availability and low cost. Although, Mali improved their performance and encouraged investment in electricity after their restructuring, they failed to deliver much investment to the rural areas. The government of Mali made regulations and incentives for the

investors to invest in rural areas for the purpose of increasing electricity access to rural areas. Later, CREE initiated incentives to service providers to increase rural electrification, which led to nearly double the electrification rate in the country, from 8% in 2000 to 12% in 2002. Some firms started to invest in rural areas as independent producers in order to generate and distribute off-grid as distributed generation, using solar PV, diesel generators, and small hydro (Word Bank, 2008). In 2010, Mali had an electricity access rate of 34%, with 43,311 off-grid connections for households and public lighting provided to about 650,000 people. In addition, about 803 public institutions, including 172 schools and 139 health centers, received off-grid access. With the installation of multifunctional platforms by local operators in 64 communities resulting in 7,200 connections as of mid-2011, numerous business opportunities were created. The electrification program also fostered the use of renewable energy; in six years, more than 7,926 households and 500 institutions were connected to solar-powered systems (Alleyne and Hussain, 2013)

Figure 2: Electricity industry structure in Mali before and after restructuring



Source: Clark et al., 2005

3.2.6 Case 2: Ghana

The electricity industry in Ghana is dominated by the Volta River Authority (VRA), a state corporation established in 1961. It provides generation, transmission, and some parts of the distribution service via the Northern Electricity Department (NED). The generation is done by VRA and Takoradi International Company (TICo). The transmission is done by VRA transmission and distribution is done by the

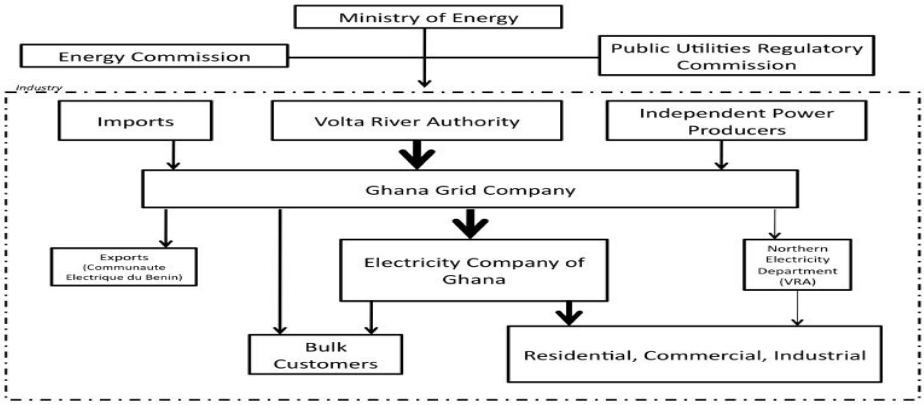
Electricity Company of Ghana (EGC), which distributes 95%, and NED, which distributes around 5% of the electricity to the northern part of the country. In 1987, Ghana introduced the first power sector restructuring in the Ghanaian power sector due to "substandard service levels: a poor financial situation, labor disputes, and disruptions at senior level," but this restructuring did not bring major changes in sector as intended (Malgas, 2008).

In 1997, the government of Ghana accepted the recommendations of the Chilean firm SYNEX Consulting Engineers for the Ghanaian power sector restructuring. The VRA, which the main electricity monopoly, was to be vertically integrated (unbundled) into three parts, generation, transmission and distribution, and the ECG was to be horizontally unbundled as well for readiness for privatization. IPPs were also to be allowed to enter into the market. The main objectives of the restructuring were to attract private investment and create a competitive framework in the electricity sector for generation, transmission, and distribution. Ghana formed two industry regulators: the Public Utilities Regulatory Commission (PURC) and the Energy Commission (EC). The PURC was responsible for economic regulation and primarily tariff setting; the EC was responsible for technical regulations, licensing, and policy advice; and the government, through the Ministry of Energy, was responsible for policy formulation and its aspects of implementation (Kapika and Eberhard, 2013).

The country entered into its first IPP in 2000 and from this point the restructure proceeded slowly due to political unwillingness and opposition from civil servants; however, in 2008 the VRA was unbundled. After 2008, the Ghanaian electricity sector entered into a liberalized market as follows: the VRA was the power generation company, the Ghana Grid Company (GridCo) was responsible for transmission and system operation, and the ECG was responsible for the national distribution utility along with the NED, which was part of the VRA. Also, in 2000, independent power producers (IPPs) began to enter into the electricity industry. Therefore, the ECG and NED had to supply consumers with loads less than 5 MW, while those consumers

above this threshold would have the option to participate in the wholesale power market (Resource Center of Energy Economics and Regulation, 2005). Figure 2 shows the current electricity industry in Ghana, but for more details of the electricity industry structure before and after restructuring, refer to Figures 3 and 4 which show the electricity industry in general.

Figure 3. Electricity industry structure in Ghana, 2010



Souce: Guide to electricity power in Ghana, 2005

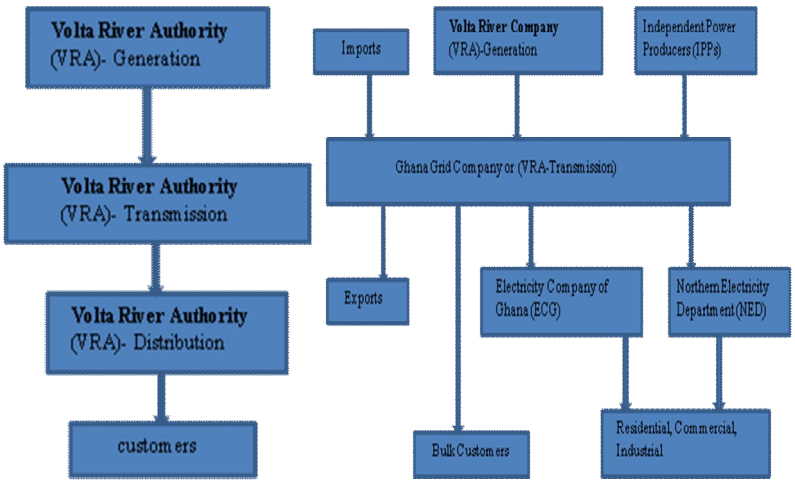
Restructuring caused Ghana to have success in the electricity industry, with many private companies involved in the electricity business (IPPs in place). In 2000, the government introduced a program called Self Help Electrification Programme (SHEP), proposed by the government to deploy electricity distribution systems using less expensive materials to connect communities and households 20 km or more from the existing network. Distribution companies concentrated on this program in order to expand the network, which raised the number of new connections and increased the access to electricity from 34% in 1994 to about 54% in 2000 (Kesside, 2004).

The restructuring in Ghana has caused the electricity tariff to increase due to the introduction of thermal generation, which is more expensive to run; in 1998 the tariff moved to fully cost-reflective prices. Before restructuring, the government had subsidized the electricity industry; this meant that tariffs had to be increased to recover the cost of investment and operation. The large tariff increases in the 2000s (close to doubling of tariffs) were followed by a period of currency devaluation and inflation,

which eroded the real level of the tariffs. From 2002 to 2006, successive tariff adjustments partially corrected this; although tariffs have increased significantly in nominal terms, they remain below the 2000 level in real terms. A lifeline tariff revolutionizes the impact of tariff increases on the poor.

Deployment on generation side was increased, but most of the IPPs were run on thermal power, and the VRA invested more in hydro generation. Currently Ghana is building 33-inch natural gas pipeline to the Takoradi area for the purpose of generating power, and it is investing in green energy technology based on distributed generation and subsidization of solar home systems. In 2012, electricity access was 72% and total electricity generation was 12,024 GWh. The electricity installed capacity is 2,280 MW, where 1,180 MW (51.8%) is hydro and 1,100 MW (48.2%) is thermal. Ghana reduced electricity generation losses from 26.6% in 2008 to 24.7% in 2012 and it exports electricity to Benin and Nigeria during off-peak periods (Energy Commission of Ghana, 2012).

Figure 4: Ghana electricity industry structure before and after restructuring



Source: Power sector Restructure and Regulation in Africa, 2010

3.2.7 Case 3: India

The power sector in India is owned by the state government. Generation is done by the state government and private companies, either by public-private partnership or by private companies as independent power producers. The transmission side is owned

by government (the state government-owned medium transmission infrastructure and high transmission system are owned by the central government) and distribution is done by both private and public utilities. In 1991, India undertook electricity sector restructuring due to political and economic crisis. India was under pressure from the World Bank and the International Monetary Fund (IMF) to open up the economy for foreign investment as part of a restructuring package (Bhattacharyya, 2011). Other forces driving electricity restructuring in India were the need to encourage more investment in the generation side, a shortage of power/insufficient generation of electricity, and the desire to create market competition in order to achieve efficiency targets (Bhide et al., 2010). The power shortage in India was caused by the lack of financial investment capital needed to expand generation facilities. IPPs were allowed to enter into power generation business and were offered some attractive incentives in different states. Before restructuring, the electricity industry in India was dominated by a state-owned monopoly; since this monopoly was politically led and considered financially suspect, the private sector worried about investment.

Due to this crisis, in 1992, the State Electricity Board (SEB) began to unbundle the state utility and even the state of Orissa went further and fully privatized its generation, transmission, and distribution assets. Refer to Figure 5 below for the electricity structure in India before and after restructuring.

Between 1992 to 1998, there were 17 thermal power plants (5,533 MW) operated by IPPs and some showed interest in investing due to Power Purchase Agreements (PPAs) established by the SEB. In 2003, India enacted a new electricity act that aimed to replace the prevailing acts that were governing the function of the electricity industry (Singh, 2006). The new act allowed private investors to participate in all sources of generation except hydro and separated system operation and transmission activities. It also allowed trading at wholesale and retail levels and permitted multiple licensing at the transmission and distribution level (Bhattacharyya, 2007). As of March, 2008, only 14% (20,011 MW of a total of 143,061 MW) of the

electricity generated in India was produced by the private sector. In 2011, the total grid installed capacity was about 178,000 MW. Efficiency was improved by reducing technical transmission and distribution losses, improving the bill collection, and providing quality power to the customer. Therefore, participation of the private sector in transmission and distribution had upgraded the system and had a great impact on improving the technical efficiency of the system. In some states in India, distribution restructuring has resulted in concession agreements under which the private sector has to meet certain norms (Bhide et al., 2010).

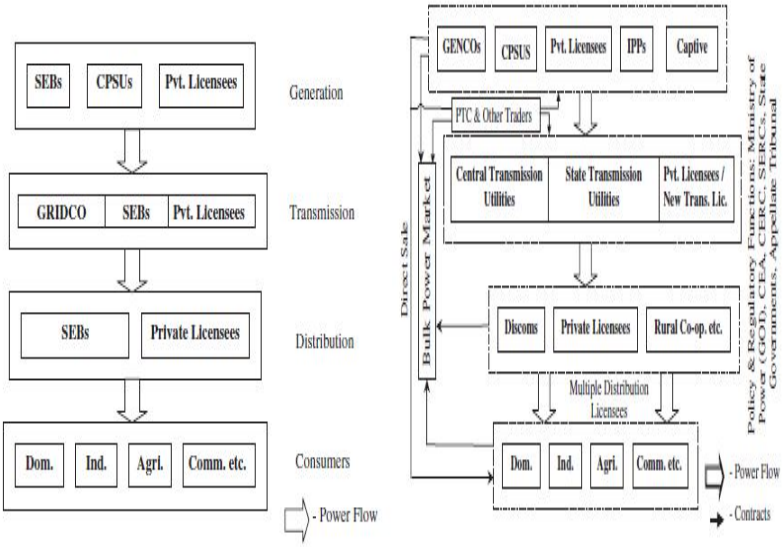
Electricity industry restructuring has significantly reduced the tariff in some states in India due to efficiency improvement and reduction of technical and non-technical losses. However, some states have faced challenges in improving efficiency; aggregate technical and commercial losses are between 18% and 62% due to theft and pilferage in some states. In most of these states, distribution companies are facing poor billing and collection efficiency. Moreover, electricity prices were increased and cross subsidies still predominate in some states. Electricity tariffs are highly subsidized on domestic consumers and even the agriculture sector is paying little as they consumed (Bhide et al., 2010).

Despite the enactment of a comprehensive legal framework for governing the electricity industry, such as regulatory commissions set up at the central and state levels, India has not made significant progress in terms of achieving full restructuring and privatization (Bhattacharyya, 2007). However, the power sector restructuring in India has encouraged private sector participation and removed barriers to business entry in generation, transmission, and distribution. Also, it has promoted the use of renewable energy generation by creating a room for a "standalone system" of generation in rural areas, and most of the private sector is participating.

In conclusion, the Indian electricity industry has not been able to attract as much investment as needed in the power sector. According to Singh (2006), investment in the electricity industry sector was not able to keep pace with the growing demand for

electricity. This was caused by improper institutional frameworks, such as regulatory institutions, appropriate markets structures, and lack of mitigating risk associated with long-term investment or return on investment as the right incentives for investment (Bhide et al., 2010).

Figure 5: Electricity industry in India before and after restructuring



Source: Singh, A., 2006

3.2.8 Case 4: South Africa

The electricity Industry in South Africa is dominated by a state-owned company, Eskom, which generates about 96% of electricity in the country. The remaining 4% is obtained through import from Democratic Republic of Congo, Zambia, and generated by IPPs. Eskom's own transmission grid supplies 50% of the electricity to industry and big customers. The remaining 50% is supplied by 180 local authority companies which buy bulk supply from Eskom and distribute it to customers (Kapika and Eberhard, 2013). Some local authorities generate small amounts of electricity and sell it to their areas of jurisdiction, and also a few private industries generate their own electricity.

South Africa undertook electricity restructuring due to low investment by Eskom, lack of competition in the industry, and low productivity. For example, in the 1970s

and 1980s, the South African electricity industry faced serious problems with investment, and the government restructured Eskom to allow private participation (Clark et al., 2005). Restructuring progressed by establishing an independent regulator, corporatization of Eskom, restructuring of the distribution sector, and preparation and awarding of tender to attract private participation (IPPs). In 1995, the National Electricity Regulator (NER) was founded for the purpose of licensing all electricity suppliers, approving tariffs, monitoring the quality of supply, and settling disputes. Refer to Figure **6** below for the electricity industry structure in South Africa before and after restructuring.

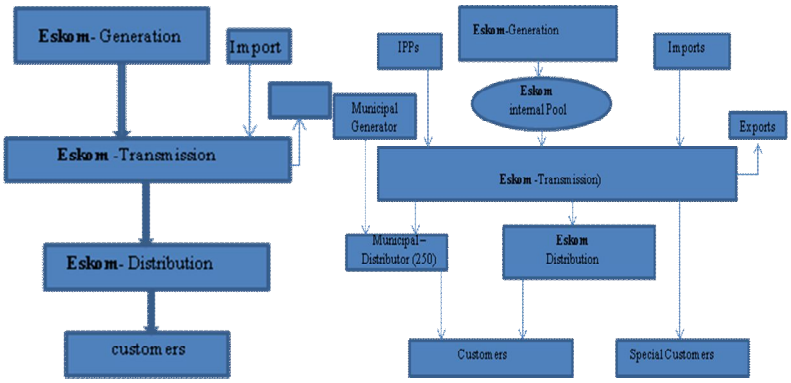
After market restructuring the electricity price was reduced; about 15% in 2003 as compared to 1995, but new connection fees were increased. In 2003, the industrial price was 2.2 US cents/kWh, the cost to residential customers was 5.6 US cents/kWh, and the average tariff to cover the average cost was 2 US cents/kWh, which was the price used to sell electricity to local distribution companies (Manibog, 2003). The industry maintained cross subsidization for electrification of customers and subsidized tariffs for low-income customers who consumed about 50 kWh. Restructuring created innovation at the local distribution company level and the utilization of renewable energy sources such as solar, wind, and small and medium hydropower for power generation in off-grid/remote areas. The electricity industry of South Africa is still dominated by Eskom, which indicates that restructuring did not bring large investment (IPP) on the generation side and most distribution companies and small generating firms are owned by municipalities or local governments.

South Africa has a variety of sources of power generation for diversification of fuel source. Eskom generates power from 10 coal stations (34,532 MW), one nuclear power plant (1,930 MW), six hydropower plants situated on the Orange River (600 MW), and two pumped storage hydropower plants (1,400 MW) to meet peak demand. Also, there are 22 generating power stations owned by municipalities and gas turbines for backup (Eberhard, 2001). Plans are underway to construct thermal gas power

plants (open cycle gas turbines) capable of producing a total of 2,053 MW in the Atlantis area (Ankerling power station) and Mossel Bay (Gourikwa power station).

In order to favor more investment in generation, there should be sufficient deployment of transmission infrastructure. The NER was introduced as an incentive regulation for investment, and the price favored economic rate of return in investment which was good for investors and distribution utilities. In 2001, NER also implemented the national electrification program so that distribution companies would meet a certain percentage of electrification in their areas of operation. Through this program, there was increased access and more than 70% of households were electrified (Dude, 2002). The NER is facing some challenges, such as ensuring sufficient investment, improving efficiency, reducing loss to municipal distribution companies, and increasing affordability of electricity to the poor. Despite the facts that South Africa is facing some challenges in efficiency improvement, it has increased its electrification rate by 76% and Eskom is the ninth largest company in terms of electricity sales in the world. It exports electricity to Lesotho, Mozambique, Namibia, Swaziland, Zimbabwe, and Zambia.

Figure 6: South African electricity industry before and after restructuring



Source: Eberhard, 2001

3.2.9 Case 5: South Korea

Electricity industry restructuring in South Korea started in the mid-1990s (Kim & Kim, 2008). Up to that point, the electricity industry was dominated by a vertically integrated company called KEPCO (Korean Electric Power Corporation). KEPCO is

the sole company responsible for transmission and distribution, including retail sales. KEPCO is also responsible for generation, but there are other six generation companies and IPPs. The main aim of restructuring was to end the monopoly of KEPCO by introducing competition into the industry and to increase efficiency (Kim, 2013). In 1994, the government of Korea formed a task force to evaluate KEPCO and come up with a basic plan to restructure the electricity industry. In 1996, evaluation started and public hearings to incorporate ideas and opinions on how to restructure the power industry began. In January, 1999, the government announced the restructuring plan (Chang, 2003). The restructuring plan comprised three stages: divesting the generation sector from KEPCO to initiate the creation of a competitive wholesale market, divesting the distribution sector from KEPCO to complete the wholesale market, and creating a competitive retail market. The last stage was planned to be completed by 2009 (Lee, 2011). At present, the first stage of the restructuring has been implemented.

The first stage of the basic plan was to prepare for the competitive market in terms of legislation, valuation, and separation of KEPCO's assets; to form generation companies; and to develop a wholesale power pool. The basic plan was for the government to establish a new act to promote restructuring of the electric power industry and revise the electricity business law (Kim, 2013). In accordance with the enactment of related laws, the KEC (Korea Electricity Commission) and KPX (Korea Power Exchange) were established in April, 2001, to ensure fair competition. Also, the generation sector of KEPCO was split into six subsidiary companies, consisting of five thermal power companies and one nuclear power company (Kim & Kim, 2011). These companies are Korea South-East Power (KOSEP), Korea Midland Power (KOMIPO), Korea Western Power (KOWEPCO), Korea East-West Power (EWP), Korea Hydro and Nuclear Power (KHNP), and Korea Southern Power Company (KOSPO).

The five thermal power companies were designed to secure fair competition by

ensuring equal power source composition, installed capacity, asset, profit valuation, etc. By December, 2002, the electric power market was to be operated as a cost-based generation pool, which is the second stage. In this second stage, the distribution sector of KEPCO was to be separated and divided into several companies. At that point, a two-way bidding pool (wholesale competition), which is the third stage, was planned to start in January, 2003. Finally, retail competition was planned to start in January, 2009 (Kim, 2013).

The KPX operated a cost-based pool (CBP) to determine real-time wholesale equilibrium prices, which equate electricity supply and demand on an hourly basis. Demand was determined by the amount of power consumption, and supply by marginal cost, reflecting the merit order of the generators adjusted for real-time availability (Lee, 2011). Therefore, the equilibrium price was determined by the marginal cost of the marginal generator; this is called the system marginal price (SMP). Since pricing by SMP may not recover fixed costs, for the marginal generator in particular, a fixed amount of compensation was allowed under the title of a "capacity payment." The final payment to the generators was the composed of the SMP, which represents the level of the marginal cost for generation, a capacity payment, and compensation for ancillary services. Refer to figure **7** for the electricity industry structure in South Korea before and after restructuring.

Although the history of the electricity industry in Korea started in 1961, when the total installed capacity was 367 MW, the total capacity had reached 79,342 MW by 2011. This more than 200-fold increase between 1961 and 2011 shows the rapid expansion of power generation capacity and massive investment in the sector. The transmission and distribution networks in Korea expanded at an equal rate due to commensurate generation capacity addition. In 1961 the network was 2,384 circuit lengths per kilometer in the distribution system and 291 substations; by 2011 there were 31,249 circuit lengths per kilometer in the distribution system and 749 substations. Also, in 1961 there were 9,171 circuit lengths per kilometer in the

transmission line; by 2011 there were 435,549 circuit lengths per kilometer in the transmission line.

Restructuring in Korea from from 1990s to the present has consisted of the separation of generation companies, although without change of ownership (Lee, 2011). Since the restructuring of electricity industry in Korea, access to electricity was increased from 82% in 2000, to 97% in 2008, and to 100% in 2012. The quality of service was improved to world standard class. Efficiency was increased due to a decline in transmission and distribution losses from 5% in 1999 to 3% in 2010.

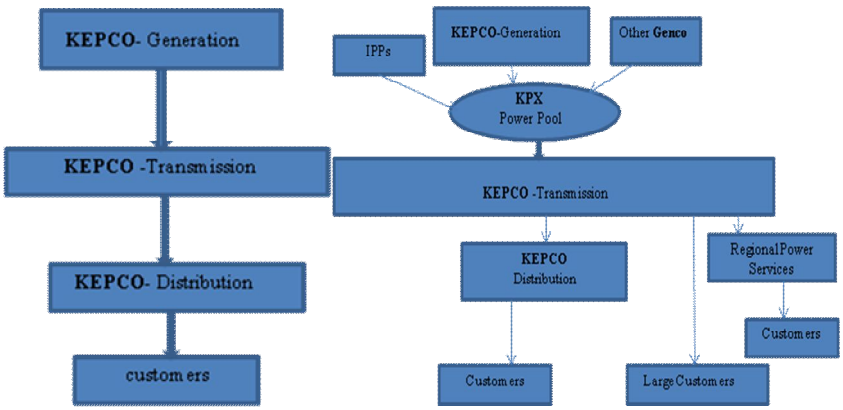
Electricity prices in Korea are very low due to strict price regulation and government policy to ensure that the energy sector is managed well to provide low cost energy supplies in order to encourage and sustain economic development of Korea (Chang, 2003). The price is subsidized by the government and there is cross subsidization between industrial, agriculture, and residential. Since 2001, the residential tariff increased from about 7 US cents/kWh in 2001 to 10 US cents/kWh in 2007 (Valgliasindi &Jones, 2013). The average tariff increased from 7.38 US cents/kWh in 1994 to 8.34 US cents/kWh in 2000 and slightly increased to 7.45 US cents/kWh in 2012. The electricity tariff in Korea depends on the fuel price on the world market.

Electricity generation in Korea shows a good mixture of diversification of energy in order to ensure energy security and a stable energy supply for economic development. The total grid installed capacity is 79,342 MW, and the electricity generated is dominated by coal (30.5%), Liquidified Natural Gas (LNG) (25.4%), nuclear (23.6%), oil (10.1%), and hydro plus other sources (10.4%), as per 2011 data. The government policy is to progressively reduce dependence on fossil fuel, and the current government is emphasizing the efficient use of energy. The strategies are directed toward the target of increasing the utilization of nuclear energy to 27.8% and renewable energy to 11% in electricity generation mix by 2030.

The goal of increasing the utilization of renewable energy sources in

electricity generation seems to be a challenge for generating companies. Basically, electricity generated from renewable energy is a non-dispatchable technology due to its dependency on nature, hence the need for back-up power by the main grid. Renewable energy sources usually have small capacities compared to non-conventional or fossil fuel sources. Renewable sources are considered to be economic in terms of tariff comparison (not with conventional generator's unit generation cost). These make them non-competitive under natural monopoly hence they need subsidies under regulated tariff in order to be realized.

Figure 7: Electricity industry structure in South Korea before and after restructuring



Source: Vaglisiandi & Jones, 2013

3.2.10 Case 6: Tanzania

The electricity industry in Tanzania is dominated by a state utility called the Tanzania Electric Supply Company (TANESCO). TANESCO is a vertically integrated company dealing with generation, transmission, and distribution of electricity in the country, and the company has operated since 1932 according to Tanzania's Company Ordinance Act (Ministry of Energy and Minerals, 2005). The Act stipulated that the firm should follow business principles, including paying taxes and dividends to the government. The government of Tanzania started its restructuring of TANESCO in 1992 due to its poor technical and financial performance (Manibog, 2003). The company's poor financial performance was caused by inadequate revenue collection, illegal connection, and vandalism of electricity. Technical performance was

poor due to high transmission losses and inadequate generation. The first step toward commercialization involved implementation of tariff restructures which caused the electricity tariff to nearly double from 1993 to 1996 (Kapika and Eberhard, 2013). Refer to Figure 9 for the electricity industry structure in Tanzania before and after restructuring.

After restructuring in 2002, Independent Power Tanzania Limited (IPTL) came in as the first independent power producer (IPP), followed by Songas Limited in 2004. Both IPTL and Songas produced power and fed it into national grid. Songas produces 190 MW using natural gas and IPTL produces 100 MW using heavy fuel oil. There are also small independent power producers, such as Artumas, who act as self-generators. Despite the enactment of EWURA, REA, and the Electricity Act of 2008, there were only four IPPs (Songas, IPTL, Aggreco, and Symbion Power LLC), with Aggreco and some power plants of Symbion being emergency power plants. These companies generate power and sell it to TANESCO. The fifth IPP, Artumas Power Ltd, now Wentworth Resources, is franchised in an isolated area and does generation, transmission, and distribution activities (Ministry of Energy and Minerals, 2007). Emergency power plants came on in December, 2010, after Tanzania experienced heavy drought which reduced the power generation capacity from major hydropower plants in Mtera, Kidatu, Pangani, and Kihansi, and the main power from hydro power plants to fell from 561 MW to 120 MW. TANESCO spends 5.4 billion Tanzanian shillings (TSZ) (US$ 5 million) per day on fuel to produce 368 MW from emergency power plants and independent power plants, as categorized in Figure 8 below, while the company's total revenue per day is TSZ 2.4 billion; this caused a loss of 200 billion in 2012. In 2013, the loss is expected to be TSZ 120 billion (TANESCO financial report, 2012).

After the restructuring, TANESCO was faced with high commercial and technical losses, which persisted due to low revenue collection, more expensive thermal power in place, and the dry season, which caused most of hydro power plants to shut down

operation. In 2002, the government entered into a two-year management contract with Net Group Solutions (Pty) Limited from South Africa for the purpose of improving the performance of TANESCO. The two-year contract ended in April, 2004, and was renewed for another two years until 2006. Net Group Solutions was assigned the following: improve sales and collection, improve liquidity, improve the efficiency of power system operations, reduce outage and improve system stability, and reduce staff and increase overall staff competency (TANESCO, 2007).

Restructuring progressed with the enactment of the Energy and Water Utilities Regulatory Authority (EWURA) Act in 2001 and the Rural Energy Agency (REA) Act in 2005. The EWURA's aim was to regulate the electricity business, and the Authority became operational in 2006 after the formation of the EWURA board, which was to ensure regulatory oversight and promote private sector investment in the energy sector. The REA become operational in 2007 for the purpose of furthering rural electrification programs via the Rural Energy Fund (REF). The REA Act and the REF are intended to facilitate rural electrification and off-grid investment in rural areas. In addition, the government enacted the Electricity Act in 2008 in order to guide the electricity sector's business. The Electricity Act of 2008 provided the regulations for the generation, transmission, distribution, supply, and end-use of electric energy and provided for cross-border trade in electricity and the planning and regulation of rural electrification. The Electricity Act provides guidance to the EWURA in its approach to regulation. The Electricity Act also has provisions relating to restructuring and organization of the electricity industry, re-enforcing the power of the minister responsible for restructuring the industry and the design of the electricity market (Ministry of Energy and Minerals, 2005).

After this major restructuring, operation efficiency was improved and the number of customer connections increased. For example, the customer-to-employee ratio was improved from 67 in 2001 to 97 in 2003 and the number of customers increased from 450,947 in 2001 to 530,000 in 2004 and in 2013 is now 1,200,000. The average price

went up 4.3% (nominal terms) in 1993. The average price was nearly doubled from 6.2 US cents/kWh in 1993 to 10.7 US cents/kWh in 1996. Currently in 2013, the average tariff is 11 US cents/kWh and there is a plan for a further increase in January, 2014. The lifeline electricity tariff subsidy was reduced from 100 kWh to 50 kWh and the industrial tariff was kept constant, resulting in a 8% real reduction (Kapika and Eberharde, 2013).

Restructuring has attracted substantial private sector participation in the development of the power sector, with electrification of over 90% of district headquarters from the previous level of 30%. Installed capacity both in the main and isolated grids has more than doubled from 482 MW in 1992 to 1564.1 MW in March, 2012 (See Figure 8). Restructuring also brought about investment in the industry, such as deployment of 190 MW from Songas, and TANESCO has managed to raise a loan from US$ 33 million to US$ 38 million for capital that was spent in 2003 from TANESCO's own funds for distribution infrastructure development.

Restructuring also created investment in generation using heavy fuel oil, natural gas, and solar as fuel diversification to reduce dependence on hydropower, which created power shedding during the dry season. Before the restructuring, most power plants in Tanzania were hydro (about 80% in 1990s) and the rest were diesel generators; in 2012 the mixture is 35% hydro, 61% thermal, and 4% new and renewable energy, as shown in Figure 3 below. This government effort is intended to create a good generation mixture in the industry for supply security.

Figure 8. Power Generation Capacities in Tanzania as March, 2013

Generation Capacities (MW) in March 2013						
Source	TANESCO	IPP	EPP	SPP	Total	Percent
Hydropower	553.0	-	-	-	553.0	35%
Small Hydro (<10 MW)	8.8	-	-	4.0	12.8	0.8%
Oil (Jet-A1 and diesel)	88.3	163.0	205.0	-	456.3	29%
Gas	252.0	249.0	-	-	501.0	32%
Biomass	-	-	-	27.0	27.0	1.7%
Imports	14.0	-	-	-	14.0	0.9%
Total	916	412	205	31	1,564.1	100%
Percent	59%	26%	13%	2.0%	100%	

IPP: Independent Power Producers, EPP: Emergency Power Producers, SPP: Small Power Producers, Imports from Uganda, Kenya and Zambia

Source: TANESCO, March 7, 2013

As of the present, however, a full restructuring has not brought about successful regulations and competition that have been able to supply readily available, reliable, and affordable electricity energy to consumers and the community of Tanzania. Tanzania still faces the challenges of the need to induce more flow of investment of private capital into the power sector, scarcity of financial resources allocated to the sector from the government budget, low access to electricity (about 18.4% of the population have access), poor state of transmission and distribution networks leading to abnormal technical losses in the system (19.4% in 2010), the national grid network not being reinforced enough to deploy sufficient electricity from neighboring countries' grid systems, and prolonged under-investment in the power infrastructure (Ministry of Energy and Mineral, 2012). The sustainable development of the power sector is currently a global challenge for developing countries, particularly in view of attracting private investments (Morisset and Lee, 2012). Tanzania, as is generally the case in many developing countries, is facing many challenges of investment in the industry, such as fully restructuring to bring competition in the electricity industry (JESR, 2012).

To overcome the situation of low access, the government of Tanzania set the target of reaching an electrification rate of 30% by 2015. Currently, the government is implementing a natural gas pipeline (37 inch) project from Mtwara to Dar es Salaam (512 km) with a total project cost of US$ 1.2 billion. The pipeline will bring 769 mscfd of natural gas, which can generate about 3,000 MW of electricity (MEM-budget speech, 2013). The government has set priority projects to be implemented from 2013 to 2020 which will generate more than 5,000 MW from different sources, as indicated in Table 7. These priority projects go along with the deployment of transmission lines (national grid) to off-take the power, as indicated in Table 8. All transmission lines are planned to be finished by the end of June, 2016. These priority projects require a large investment capital of about TSZ 9.8 trillion (US$ 6.5 billion), foreign investment, and joint cooperation between government and private sectors for implementation. To

achieve the targets set, this huge investment requires the rule of law, transparency, and government commitment. More emphasis also should be on national grid deployment and expanding the distribution system to at least to cover the whole national area where it is not connected to the grid. Because of this, more investment on the generation side should go along with infrastructure development. The availability of this infrastructure will lead more investors to have open access to this infrastructure, thereby encouraging more investment and confidence in their investment in the competitive market which will be created later.

Table 7. Priority generation projects which have been indentified by the government of Tanzania for the years 2013-2020

Project Name	**Capacity (MW)**	**Fuel type**	**Year**	**Financing Model**
Mwanza	60	HFO	2013	GoT
Kinyerezi-I	150*	Gas	2014	GoT
Kinyerezi-II	240*	Gas	2015	GoT
Kilwa Energy-Phase-I	210*	Gas	2014	Private/IPP
Singida Geo-Phase-I	50*	Wind	2015	PPP
Kinyerezi-III	300*	Gas	2016	EPC
Kinyerezi-IV	300*	Gas	2016	EPC
Singinda East Africa	50	Wind	2017	PPP
Mchuchuma	300*	Coal	2014-2018	EPC
Ngaka (I, II & III)	450	Coal	2014-2020	EPC &PPP
Kiwira	200*	Coal	2015-2017	PPP/JV
Somanga Fungu	300	Gas	2017	Joint Venture
Singida Geo-Phase-II	50	Wind	2017	IPP
Kilwa Energy-Phase-II	300	Gas	2018	PPP
Stiegler's Gorge (I & II)	300 & 400	Hydro	2017-2020	PPP & GoT
Geothermal Potential	300	Geothermal	2015-2018	GoT
Solar Potential (Shinyaga & Dodoma)	120	Solar	2016-2018	GoT
Biomass Potential	50	Co-generation	2014	IPP/Private
Mapembasi	10*	Hydro	2014	IPP/Private
Mbamgamao	10*	Hydro	2015	Private/IPP
Note: *Denotes contracts are already signed. Mwanza HFO inaugurated in September, 2013				

Source: Power System Master Plan, updated, 2013

In June, 2012, the government implemented the program called Big Results

Now (BRN) which aims to increase access to electricity from 18.4% in 2012 to 30% in 2020. As part of this program, the government announced the lowering of connection fees from the current 100% to 66% and 37% in urban and rural areas, respectively (Budget speech, 2012). This offer effectively started in January, 2013, and from June to September, 2013, there were 450,000 applications for electricity connection. This led to an increase in the number of monthly connections from 50,000 to 140,000.

Table 8. Priority transmission line projects which will evacuate power from the new power plants to extended grid coverage from 2014 to 2016

Project Name	Distance (**Km**)	Capacity (**kV**)	Cost (**Bill.Tshs**)
Iringa-Shinyanga	647	400	481
Dar es Salaam-Arusha	420	400	1,232
Singida-Arusha	480	400	391
Somanga-Kinyerezi	500	220	136
Makambako-Songea	320	220	146
North West Grid Phase-I	360	400	218
Dar es Salaam-Dodoma	530	400	325

Source: Ministry of Energy and Minerals, 2013 (Energy Laboratory, April, 2013)

Restructuring brought rural electrification to the industry, but this should be developed more seriously in order to bring power into the rural areas where more than 70% of the Tanzanian population lives. Currently, the REA through the REF is conducting rural electrification projects. The REA finances any eligible energy projects in rural areas through the REF. Also, the REA is conducting training to build capacity and provide technical assistance to the project developers and rural communities to undertake and implement projects in rural areas. The REA facilitated projects for developers with small power plants of equal to or less than 10 MW in rural areas to enter into contracts with TANESCO or to sign Standardized Power Purchase Agreements (SPPAs) to sell power, as shown in Table 9. However, reaching the maximum target should be emphasized before further restructuring, such as privatization or entry into a competitive market. Privatization of the utility or entering

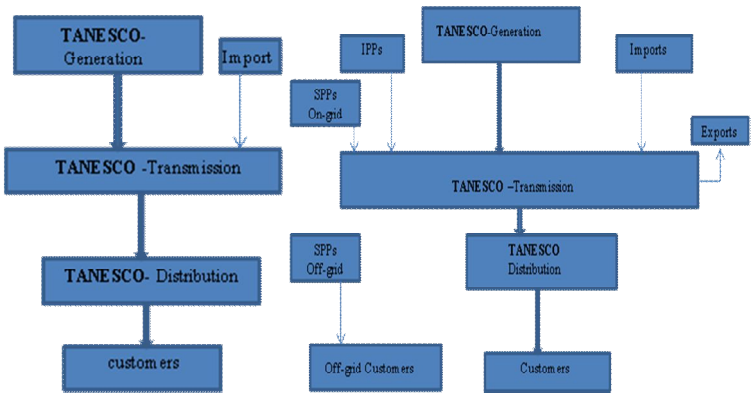
into competition before addressing the rural electrification issue will require too many government incentives, such as subsidies to electrify rural areas.

Table 9. Small Power Producers (SPPs) signed SPPA with TANESCO

Name	Capacity (**MW**)	Fuel type	Connection
TANWATT	1.5	Co-generation	Main
TPC, Moshi	9.0	Co-generation	Main
Mwanga, Mfindi	4.0	Hydro	Main
Ngombeni, Mafia	1.5	Biomass	Isolated
Sao Hill, Mfindi	6.0	Biomass	Main
Symbion KMRI, Tunduru	0.3	Biomass	Isolated
Symbion, Kigoma	3.3	Biomass	Isolated
St. Agnes Chipole, Songea	7.5	Hydro	Isolated
Next Genetarion Solawazi Kigoma	2.0	Solar	Isolated
EA-Power, Tukuyu	10.0*	Hydro	Main
AHEPO, Mbinga	1.0*	Hydro	Isolated
Total	**46.1**	* *Not commissioned*	

Source: Rural Energy Agency, May, 2013

Figure 9: Tanzania electricity industry structure before and after restructuring



Source: TANESCO, 2007

4. Comparison

4.1 Comparison of case study countries

Developed and developing countries have restructured their electricity industries in order to bring competition and improve performance efficiency. The main aim of the restructuring in developed countries is to improve the performance efficiency of the sector, but for developing countries the aim is to attract adequate investment and to improve the quality of service in the industry. Tables 10 and 11 below show the restructuring processes and achievements obtained in case study countries.

Table 10. Summary of restructuring for case study countries

Country Name	Restructure	Privatization	Vertical Separation	Competition	Establish of Regulator
Mali	1994	1995 (Private 60% and Gov. 40%)	Genco & Trans. (2001)	Generation side and transmission	2000
Ghana	1997	NEDO is owned by Volta	2008	Entry of IPPs (2000)	1998
India	1991	1993 (Orissa State)	1994-2000s (All states)	There is competition in generation, state transmission and distribution	1995 (Orissa) 2004 (Central)
South Africa	Mid of 1991	There is no privatization	Vertically integrated	1993 Involvement of (IPP)	1995
South Korea	Mid of 1990	No privatization done so far	Vertically integrated	Division of generation (Six-Genco) in 2001	2001
Tanzania	1992	2002 entered Management Contract (4 years) with Net Group Solution (Pty)	Vertically integrated	1996 entry of first IPP (IPTL)	2006

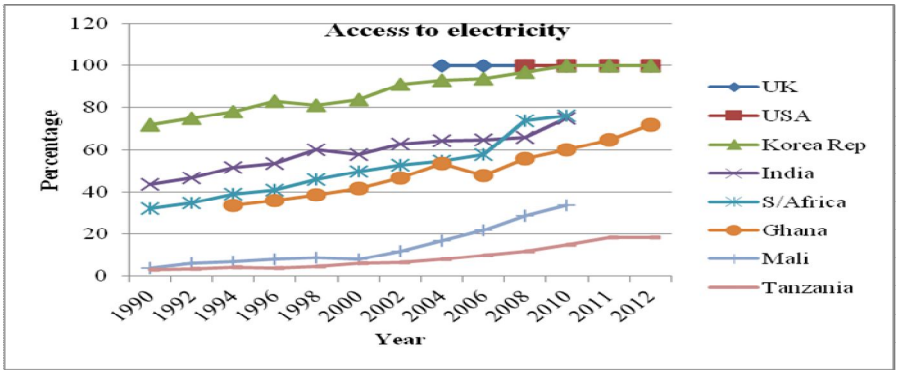
Table 11. Electricity consumption, access, and transmission & distribution loss, 2010

County	Electricity consumption (kWh/capita)	GDP per Capita	Access to electricity (% population)	Transm & Distrib loss in total (% output)
South Africa	4654	7266	76	9.5
India	641	1419	75	20
Ghana	300 (336.7)	1326	60.5(72)	19.5
Mali	185	674	34	19.5
Tanzania	91 (100)	525	15 (18.4)	19.4 (20)
Korea Republic	10162	22388	100	3.3
UK	5745	36233	100	7
USA	13395	46616	100	6
	Note: () figure are 2012 data			

Source: World Bank, CREE, EGC &TANESCO

Electricity industry restructuring has led to an increase access to electricity, especially in developing counties. Most of the developing countries who have restructured the industry have shown increases in access to electricity due to competition in generation, improved efficiency and quality of service. Increased investment in generation has motivated transmission and distribution companies to expand their infrastractures, increasing the number of costomers and new connections, hence the rise in access to electricity. For example, Ghana increased their electrification rate from 36% in 1996 to 72% in 2012. The Republic of Korea increased access to electricity from 81% in 1998 to 100% in 2012. Tanzania increased their access rate from 6% in 2000 to 18.4% in 2012. Figure 10 below shows the progressive increase in access to electricity in case study countries.

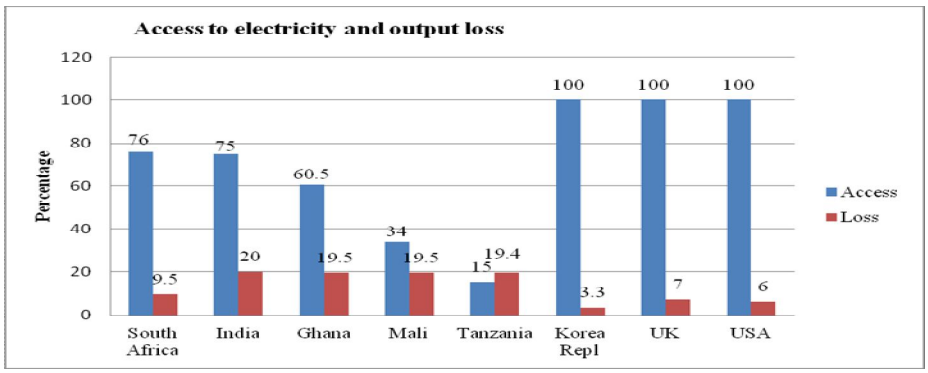
Figure 10. Trend of increased access to electricity for case study countries



Source: World Bank (2013), TANESCO, CREE

There is a considerable improvement in efficiency due to a reduction of transmission and distribution losses. However, developing countries are still facing some challenges in reducing transmission and distribution losses (total loss output). This is probably due to vandalism, illegal connection, and lack of rehabilitation of system infrascture. Figure 11 below shows the rate of access to electricity and the total output loss of electricity for case study counties in 2010.

Figure 11. Access to electricity and total output loss (Trans &Distribution)

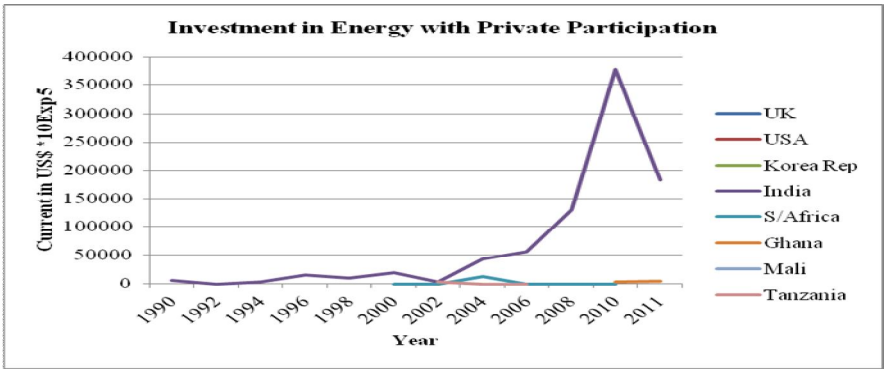


Source: World Bank data, CREE, EGC &TANESCO

Restructuring has encouraged private sector participation in the electricity sector. Restructuring of the electricity industry and appropriate strategies, incentives, and policy have attracted private sector participation. Figure 12 below indicates that India has attracted significant private sector participation in the electricity sector (investors) especially in the year 2003, after a new energy policy was enacted and

multi-year tariffs were introduced. In the case study countries in general, there was significant investment due to attracting private sector participation in generation, distribution, system maintenance, and expansion of system infrastructure. This happened because of the entry of new IPPs and new projects conducted by private sector. For example, there was considerable investment in Ghana, South Africa, and Tanzania in the 2000s (see Figure 12). All of the developing countries studied had special programs to promote electrification and increase access to electricity, and these programs attracted private sector investment in rural areas. Rural electrification programs were conducted in Ghana, Mali, Ghana, Tanzania, India, and South Africa.

Figure 12. Investment in the energy sector with private participation after restructuring



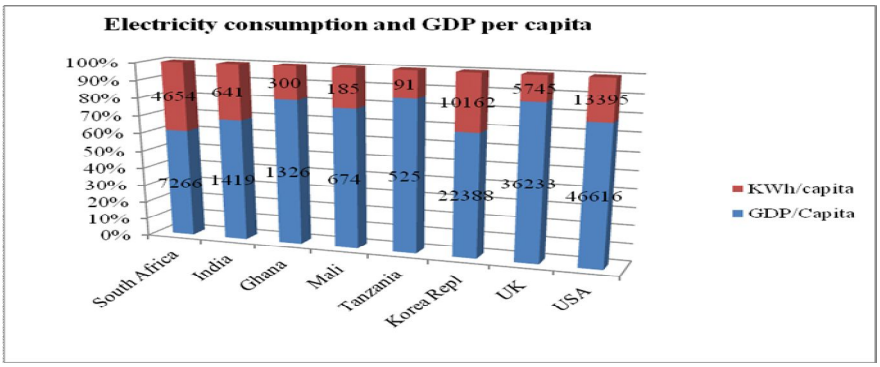
Source: World Bank, 2013- PPI indicators

Electricity industry restructuring has changed the old tradional industry model to a new model (see Appendix for models of each of the developing countries in the case study). In some of the case study countries such as South Korea, South Africa, and Tanzania, the model is still vertically integrated, with partial separation on generation side while the existing state-owned utility as the sole player. Instead, private participation is being explored to a greater or lesser concentration in generation and some in decentralized distribution. In all the case study countries has an industry regulator which exists, but in most developing countries the regulators are not independent or autonomous and are influenced by the political system.

The electrification level in developing countries in the case study has risen, while per capita consumption has only increased slightly due to rises in tariffs which

cause many households not to be able to afford electricity services and be forced to rely on other tradional power sources for many of their daily activities such as cooking, heating, and cooling, using electricity for lighting only. See Figure 13 for electricity consumption and GDP per capita. In some cases when the situation became worse, customers even disconnect their households from the electricity network. For example, in 2004, when the electricity tariff in Ghana increased, some customers disconnected their service and the electricity consumption dropped from 331 kWh/capita in 2002 to 231 kWh/capita in 2004. By 2010, however, consumption had increased to 300 kWh/capita.

Figure 13. Electricity consumption (kWh/capita) and GDP (US$) per capita, 2010

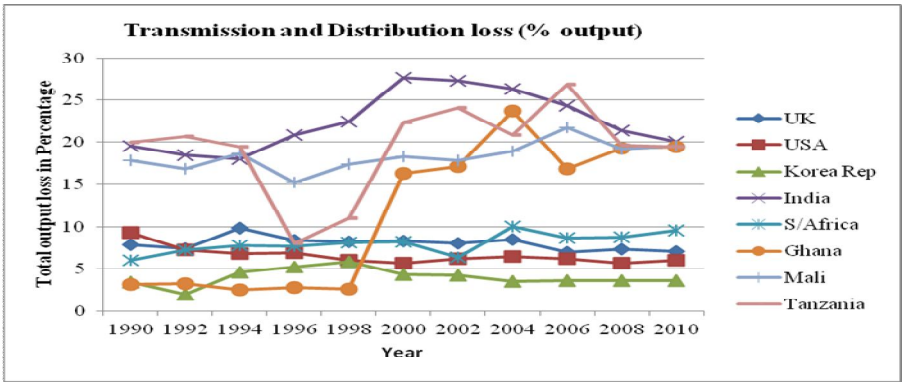


Source: World Bank data, 2013

The effective access to electricity services by customers is influenced by the quality and reliability of the electricity supply and also its price, which affects affordability and usage patterns. In all case study countries, electrification levels have increased dramatically but efficiency and quality of service failed to improve, except for the developed countries and South Korea. In developing countries, the percentage of transmission and distribution losses increased, as indicated in Figure 14. The increase in transmission and distribution losses is due to system overload, vandalism of system infrastructure, pilfering, illegal connection, technical losses, and non-technical losses due to the failure of distribution utilities to collect enough revenue from their customers. System vandalism, illegitimate connection, and inadequate revenue collection demotivate the performance of the utility. In cases of Ghana, South Africa,

India, Tanzania, and Mali access to electricity has more than doubled but losses are increasing.

Figure 14. Trend of transmission and distribution loss (% of total output)



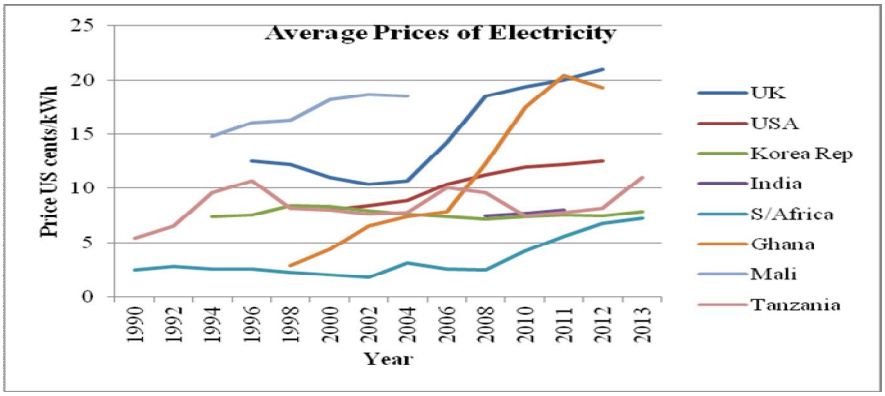
Source: World Bank data, CREE, ECG & TANESCO

Despite the fact that rural electrification in developing countries increased, they are still facing many challenges due to the high cost of providing electricity to dispersed rural populations with limited affordability and lack of financial resources to meet capital investment and operating costs. The situation continues to render these areas financially unattractive, even after restructuring. But in some of the developing countries, such as South Africa, South Korea, India, and Ghana restructuring made possible the entry of new private service providers, mainly operating in rural areas beyond the service areas of incumbent utilities. The extent to which these companies have increased access to electricity in rural areas are by applying of plans and strategies even though they depend on subsidies from the government and grant aid. Some of these companies provide services to customers and electrify them through renewable energy generation sources such as solar, small hyropower, small wind turbines, and co-generation.

Price restructuring has typically been a key and initial element of the electricity power restructuring process. In all the case study countries, tariff restructuring has taken place with the intention of introducing cost-reflective prices, both in average tariff levels and across tariff categories. For example, in the UK, Ghana, Mali, and Tanzania, electricity tariffs were increased after restructuring (see

Figure 15). Countries such as USA, Korean Republic, South Africa, and India cross-subsidize electricity tariffs due to strict government policy and strategies and to sustain their ecomomic development.

Figure 15. Average prices of electricity in case study countries



Source: APEC,World Bank, SAPP, IEA, EIA &PURA

In developing countries such as Ghana, Mali, and Tanzania, the desire to attract private sector capital has an impact on price levels. The establishment of cost-reflective prices is almost a prerequisite to attracting private sector capital (multilateral credit). The need to meet private sector returns on capital has an upward pressure on price levels, and, if not compansated fully by efficiency gains, it may affect the poor. To protect the poor (low-income households) and sustain economic development in developing countries, governments should subsidize electricity tariffs to make them affordable and reliable.

Most of the developing countries (Ghana, Mali, and Tanzania) use hydropower in their electricity generation. To diversify fuel sources, the government of developing countries should provides adequate incentives for generators. Otherwise, the government should pay capacity charges directly to the IPPs and also subsidize the generation cost in order to increase generation from thermal power plants (diesel, coal, and gas) and reduce dependence on hydro power plants, which are unreliable during dry seasons. An insufficient fuel mix in power generation makes electricity prices change and reduces the security of the electricity supply. For example, in Tanzania in

2003 and Ghana in 2004, electricity tariffs rose due to recovery of investment costs from thermal power plants. Changes in prices have a significant impact on a country's economy as well as having environmental effects. For example, in developing countries, increases in electricity tariffs cause the poor to switch to other alternatives fuels (biomass) to satisfy household energy requirements.

Above all, electricity market restructuring goes along with tariff restructuring, and tariffs have a great impact on investment. In Ghana, for example, a lack of electricity tariff restructuring might have acted as a barrier to investment from 2000 to 2004, because lifeline tariff rates that bring revenue from electrifcation projects remain below the margininal cost of supply. Furthermore, the national tariff structure implies that distribution in the regions with high electrification burdens will fail to recover the cost of supplying low-income and rural customers. Consequently, the restructuring program in Ghana may have failed to stimulate additional investment in extending access until 2008 when they verically unbundled the utility.

4.2 Synthesis between Developed and Developing countries

In the electricity industry, restructuring does not have much impact on the consequence of investment, price, efficiency, and fuel diversification but most important is the competitive efficiency of wholesale and retail markets which depend on government institutions which function well and the economy of the country. The government institutions which are key players in the industry should have clear responsibilities. Availability of infrastructure, such as transmission and distribution networks, to support new investment should be in place. Both privately and publicly owned utilities require good management plans, implementation of investment plans, adequate prices to recover investment costs, and government incentives to deliver cost efficiently and secure supply. If restructuring is required in developing countries, it should be aimed at increasing efficiency and productivity and bringing about competition in the market that will lead to customer benefits, rather than changing the structure of public utility. However, publicly owned utilities in developing countries

face management constraints in terms of decision-making because of the influence of political systems, but these can be solved by creating clear policies, responsibilities, and strategies, and also by the application of relevant laws and regulations. In general, transparency in the electricity industry is very crucial.

In developing countries most restructuring involved tariff restructuring, which normally increases tariffs to the poor by eroding subsidies. Without proper policy and regulations, restructuring, especially privatization, hurts the poor the most. Still, the government plays the major role in the electricity industry in that it creates a conducive environment for business and investment.

In general, the achievement of restructuring differs between developing and developed countries. Developing countries concentrate on increasing investment in generation and supply, seeking private sector participation (foreign), promoting competition, and improving regulatory restructure, while developed countries are interested in finding ways to reduce the price and increase the utilization of renewable energy in a competitive market.

Some developing countries (e.g., India and Ghana) have achieved the objective of restructuring due to the establishment of strong institutions, legal and regulatory policy restructures, and an independent regulator to oversee business trends. Also, to enter into a liberalized market requires political and social willingness. Basically, restructuring requires political willingness, clear policies and strategies, clear roles and responsibilities among government institutions, and the participation of private institutions during the restructuring processes. Table 12 below shows the difference between developed and developing countries' processes of restructuring their electricity industries.

Table 12. Differences in restructuring processes between developed and developing countries

Criteria	Developed	Developing Countries (Africa)
Aims of restructuring	Improved efficiency, facilitated competition, and	Attracted the required (foreign) investment, reduced

	improved the performance of responsiveness to customers' preferences	inappropriate government subsidies, and improved the quality of service/increased access
Institutional arrangement	Most institutions are arranged and coordinated well. They have clear roles and responsibilities.	Institutions are not arranged and coordinated well. They don't have full mandate and roles.
Regulatory body	Most of regulatory bodies are transparent and independent They have full autonomy and adequate skills required Most regulators have sufficient manpower The role of government and political influence is reduced	Most of regulatory bodies are not transparent and not independent. They are interfered with by the political system. They don't have full mandate and adequate skills and tools Lack of manpower Influenced by political system
Infrastructure	Most infrastructure (transmission and distribution) is fully deployed to encourage competition in the industry	Most infrastructure is not yet fully deployed and in progress. It cannot accommodate competition in the industry
Preparedness	Well prepared beforehand to enter into restructuring. All restructuring steps and rule of law followed	Not ready (not prepared well) to enter into restructuring. Restructuring entered into to fulfill obligation from IMF and World Bank
Policy	Application of incentives law to increase efficiency and facilitate competition in the industry. Direct the utilization of green energy as fuel diversification	Application of subsidies to lower the price for political will and use of incentives to attract investors. Most of policies do not emphasize the utilization of green energy technology

5. Suggestions and recommendations to Tanzania

5.1 Proposed structure for Tanzanian electricity industry

In Figure 16, I propose a restructuring model that the government of Tanzania could adopt in the electricity industry. My considerations are based on a case study analysis of market structures in other developed and developing countries. I have considered the weaknesses of the current structure in terms of generation, transmission, and distribution. In the area of fuel diversification, the proposed structure is to divide the generation companies into three parts: thermal, hydro, and new and renewable energy. Each generation company will be responsible and accountable for specific resource utilization. Thermal Genco will be responsible for generation from oil, coal, and natural gas; hydro Genco for hydro (medium and large hydro power plants); new and renewable Genco for geothermal, solar, wind, and co-generation. In the current structure, TANESCO is responsible for all generation sources and this has posed a huge burden on the planning and implementation of electricity generation. All of TANESCO's plans have been based on cost-efficient power plants, such as large hydro power plants, which is a threat during dry season. Nowdays the company is concentrating on natural gas generation to increase the security of electricity supply rather than diversification of available indigenous natural fuel resources.

The proposed stucture suggests having a Tanzanian power (exchange) pool where all generation companies and IPPs are required to bid for power generation and compete for generation expansion and appropriate utilization of available indigenous natural resources. The power exchange pool will contain technical experts who will decide tariffs based on the agreed model. This will increase transparency and remove the monoply of TANESCO. The current model allows EWURA and TANESCO to negotiate Power Purchase Agreements (PPA) and investment decisions. It also gives TANESCO autonomy to decide off-taking tariff and "first right of refusal". The first right of refusal is the clause in the Electricity Act of 2008 which requires IPPs to obtain approval from TANESCO in order to supply or distribute power to large customers.

This hinders the investment from the private sector and competition at large in the industry.

My structure proposes the inclusion of a national grid system or transmission grid which will be owned by the public to allow open access to the grid and create competition in investment on generation side. Therefore, the government will be allowed to concentrate on the extension of the national grid and transmission infrastructure to the provinces which are not connected to the national grid (see Appendix I).

In the current structure, the government is limited to generation rather than extension of system infrastructure to areas not included in the national grid. This constraint is partly due to a large area of concentration and a lack of budget. Limited national grid and distribution infrastructure in the country have hindered the investment of the private sector and attraction of business to the electricity industry. Most of the generation bids do not mature due to limited transmission infrastructure and an unexpanded national grid. The availability of infrastructure will encourage investors because it will ensure open access to the national grid infrastructure. In addition, lack of deployment of infrastructure has hindered independent distribution generators from investing in remote areas and utilizing renewable energy sources.

My proposed structure will have six distribution companies based on the six zones available in Tanzania. It will be easy to monitor the performance of each distribution company based on revenue collection and reduction of distribution losses. Each distribution company will be responsible and accountable for its area of operation and will be given a target which they should attain. Basically, the distribution utilities are vital links between the generators and the customers. Good performance of distribution utilities will encourage the entry of IPPs. The current structure available in Tanzania has one distribution company, TANESCO. TANESCO is performing poorly in terms of quality of service delivery due to a lack of competition in the distribution segment and a lack of innovative ideas. Also, it does not collect enough revenue to recover its

operation and maintenance costs. Failure in the collection of revenue leads to delays in payment to the IPPs and causes debt to accumulate, which leads to defaults in payment and demoralized performance of the IPPs. This is the critical barrier to investment.

The proposed structure allows on-grid Small Power Producers (SPPs) that generate less than 10 MW to sell electricity directly to transmission or distribution companies without bidding in the exchange power pool. However, the current Standardized Power Purchase Agreement/Tariff (SPPA/T) should be used in the proposed structure. The proposed structure will encourage decentralized distribution and generation and the use of renewable energy sources. Off-grid small power producers will be allowed to generate electricity and sell it directly to the customers. In general, the model will maintain the current structure for small power producers (SPPs).

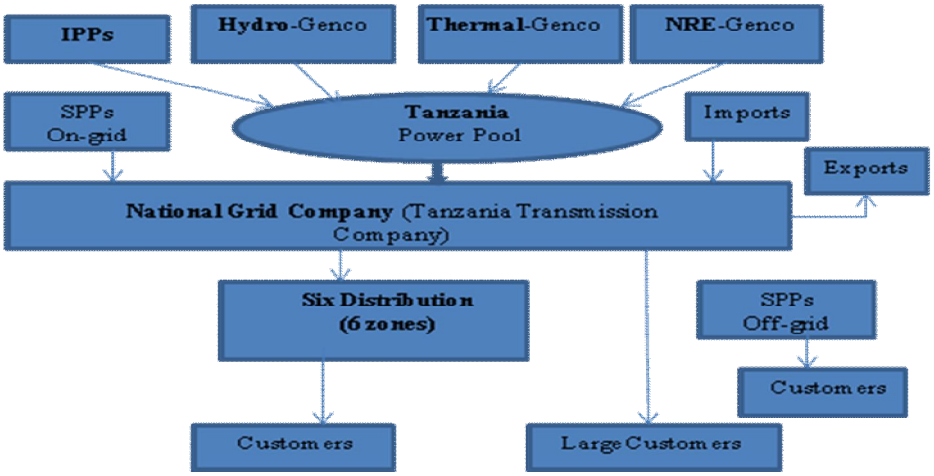


Figure 16. Proposed structure/ model in Tanzania

5.2 Recommendation to Tanzanian Government

In this part, I propose recommendations that, if strictly adhered to by the Government of Tanzania, would attract adequate investment, increase access to electricity, improve the efficiency of the utility, and facilitate the utilization of fuel diversification in the electricity industry. These recommendations are based on my

analysis of post-restructuring electricity industries in developed and developing countries.

Encouraging investment and improving the performance of the electricity industry require sufficient rule of law, proper and well-coordinated government institutions, government incentives, efficient liquidity, such as standardized contracts (long-term PPAs), and macroeconomic activities of the country. Based on these requirements, Tanzania should create an environment for the electricity industry which is conducive to business. In addition, market stability (the political situation of the country) is a key incentive for investment.

To create competition in the distribution and generation sides, there is a need completely restructure TANESCO. Vertical separation/unbundling of TANESCO into generation, transmission, and distribution segments will encourage more private investment in generation and distribution. Following our proposed structure, transmission, or the national grid, should remain under government control, while generation and distribution should remain under public control for the short and medium term. They should later be privatized in order to bring competition into the industry.

Vertical separation of TANESCO will encourage competition and hence lower operational costs that would require tariffs to be further lowered to be affordable to most customers. Furthermore, vertical separation will reduce the financial burden to the government in terms of electricity industry investment and generation subsidies. However, TANESCO will be able to concentrate in the areas where it has the competitive advantage in operation.

I further recommend that the Government of Tanzania should review the National Energy Policy (NEP) of 2003 and Electricity Act of 2008. The reviewed NEP should encourage fuel diversification while the "first right of refusal" clause should be removed from the Electricity Act. This will create competitive pressure in the industry and will defray the 12-15% demand growth gap between demand and supply in the

industry.

Furthermore, I recommend that electricity contracts for IPP generators should be embarked upon with long-term power purchase agreements supported by suitable guarantees so that investors are able to raise long-term financial capability for operation and maintenance and obtain returns on investment. In addition, on- and off-grid generation by small power generators (decentralized distribution generation using new and renewable energies) should be facilitated by providing them with fiscal incentives, such as feed-in tariffs, in order to increase the access rate of electricity in rural areas.

In addition to the above recommendation, the government should give priority to extending the national grid to the areas where the national grid does not exist. Extension and deployment of the national grid will attract foreign investment in the sector and increase the electrification rate. Grid extension using least-cost technologies such as wooden poles and concrete poles in distribution generation will raise access to electricity in rural areas (Rugabera et al., 2013). I recommend that to ensure fuel diversification, our indigenous sources (hydro, natural gas, coal, wind, geothermal, biomass, solar, uranium, and tidal power) should be sufficiently utilized to improve energy security and affordability. Diversification of these resources will lead to a reduction in dependence on hydropower and imported heavy oil. To achieve this, effective policies, plans, and strategies are needed.

I recommend that our greatest concentration should be on the maximum utilization of the natural gas generation which is in place.

Electricity tariffs should be subsidized for the poor in order to increase the access rate in the country. Subsidies should be increased from current 50 kWh to 100 kWh to make electricity affordable for cooking, cooling, and other social activities. The government should make an annual budgetary provision for subsidizing electricity tariffs. Also, to facilitate electrification in rural areas, the government should provide feed-in tariffs or subsidize the electricity tariff charged by decentralized distributed

generators, so that people in rural areas can afford electricity. In addition, the government should continue to lower electricity connection fees 40% and 20% in urban and rural areas, respectively, to motivate more people to connect to electricity.

I recommend that a Rural Energy Policy which gives vision, directives, strategies, and plans for rural electrification and appropriate use of modern energy in rural areas should be formulated. If access to electricity attains 98%, laws and regulations on the utilization of modern energies in rural areas, rather than relying on firewood and charcoal, should be put in place because excessive use of charcoal creates deforestation, which has environmental hazards.

Finally, the government of Tanzania should facilitate EWURA becoming an independent (autonomous) regulator with full capability to monitor the market and create good environmental conditions which will support, promote, and attract the capital required for investment in the sector.

6. Conclusion

In this research, I dealt with electricity restructuring in developed and developing countries. The research conducted was a case study analysis of the impact of investment, efficiency, price, and fuel diversification on the electricity industry.

I found that restructuring alone does not attract adequate investment in developing countries, whereas in the developed countries, it improved efficiency and quality of services and brought about lower prices. The research further showed that attraction of investment to the sector depends on the macroeconomic situation of the country and requires legal and regulatory institutions which are responsible, accountable, and transparent. Furthermore, restructuring does not contribute significantly to fuel diversification. Therefore, fuel diversification is always based on policy and fiscal incentives from the government of a given country.

However, most electricity industry restructuring in developing countries has led to price restructure for investment recovery, resulting in increases in tariffs. These price restructurings resulted in increases in electricity tariffs, but a sustainable lower price depends on an autonomous regulatory regime and the policy of the country. In order to attract adequate inflow of foreign investment into the generation side, infrastructure, performance of distribution segments, and revenue collection are imperative.

I thereby conclude that Tanzania should focus on deployment of electricity infrastructure and expanding the national grid system to cover at least 90% of the country. Moreover, good government policies, plans, strategies, and commitment would enhance better deployment of electricity infrastructure in Tanzania.

Because vertical separation of utility companies enhances performance in term of efficiency, management, and quality of services, Tanzania should take appropriate measures to separate the vertically integrated utility into separate segments responsible for power generation, transmission, and distribution according to our proposed model. Unbundling of TANESCO will thereby enable successful

restructuring, encourage investment, and improve efficiency in the electricity industry in Tanzania.

The government of Tanzania should encourage regional power trading agreements with neighboring countries in order to improve reliability and quality of supply. In addition, distribution generation should be decentralized by using new and renewable energy technology in order to increase access to electricity, particularly in remote areas. Generally, to increase access to electricity, the government should lower connection charges and subsidize electricity tariffs.

It is worth noting, however, that the proposed model is specifically designed for Tanzania. To test the generality and acceptability of the model, I encourage further study to analyze the applicability of the proposed model in Tanzania and other developing countries.

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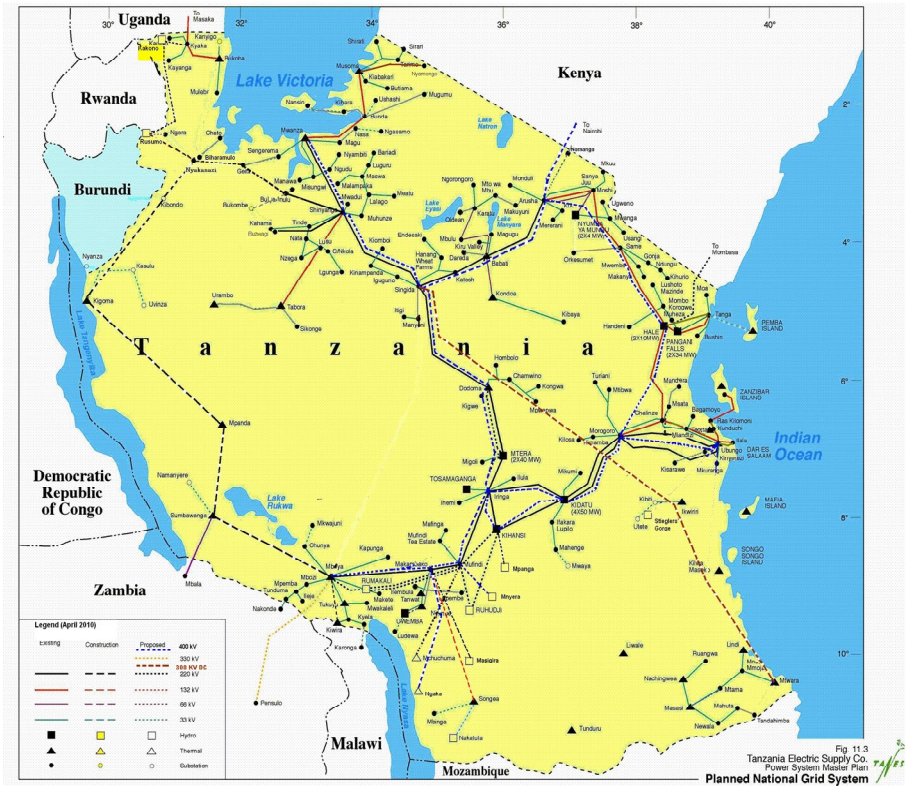
Appendix

Appendix I: Transmission and distribution system infrastructure network available and planned in Tanzania



Source: Power system Master Plan, 2009 and TANESCO, 2012

초록

지금까지 탄자니아 정부의 전기시설 재건 노력은 투자유치와 전기 이용 접근성 그리고 산업 효율성에 있어 큰 효과를 보이지 못했다.

오늘날의 대부분 국가들은 전기 시설의 효율, 투자 및 접근성에 대한 큰 증진을 이루었고 이로 인해 전기공급가를 낮추어 왔다. 탄자니아 정부는 이러한 국가들을 따라잡기 위해 그 국가들로부터 성공경험을 배우는 것이 필요하다. 이것을 위해 본 연구에서는 경쟁의식, 수직분리구조, 주인의식 그리고 규제들이 전기 시설의 효율, 투자, 가격 그리고 연료 다양화에 미치는 영향을 근거로 선진국과 개발도상국의 전기시설 사례연구를 진행하였다.

이러한 연구에 근거하여 본 연구는 탄자니아 산업을 위한 전기시설 모델/구조 및 정책을 제안하고 이로 인해 적절한 투자와 전기 접근성, 효율 그리고 연료 다양화가 증진되기를 기대한다.

이러한 모델을 제안하며 탄자니아 정부, 투자자 그리고 지역사회가 현재의 상황에서 도약하여 세계 여러 국가들의 기술과 발맞추어 나가기를 기대한다.

핵심어: *재건설, 효율, 투자, 가격, 연료 다양화, 접근성 , 침하*