AKENTEN APPIAH – MENKA UNIVERSITY OF SKILLS TRAINING AND ENTREPRENEURIAL DEVELOPMENT

ASSESSING THE EFFECT OF ELECTRICITY THEFT ON THE GHANAIAN POWER SECTOR; A CASE STUDY OF ELECTRICITY COMPANY OF GHANA, TEMA REGION

KWASI STEPHEN AMANKONAH

(190013498)

2021

ASSESSING THE EFFECT OF ELECTRICITY THEFT ON THE GHANAIAN POWER SECTOR; A CASE STUDY OF ELECTRICITY COMPANY OF GHANA, TEMA REGION

KWASI STEPHEN AMANKONAH, BSC. ELECTRICAL AND ELECTRONIC TECHNOLOGY EDUCATION

A DISSERTATION IN THE DEPARTMENT OF ELECTRICAL AND ELECTRONIC TECHNOLOGY EDUCATION FACULTY OF TECHNICAL EDUCATION

Submitted to the School of Graduate Studies, Akenten Appiah – Menka University of Skills Training and Entrepreneurial Development, Kumasi in partial fulfillment of the requirements for award of the Master of Technology in Electrical and Electronic Technology Degree

NOVEMBER, 2021

DECLARATION

CANDIDATE'S DECLARATION

I Kwasi Stephen Amankonah, hereby declare that this Dissertation, with the exception of quotations and references contained in both published and unpublished works which have been identified and acknowledged is entirely my original work and that no part of it has been presented for another degree in this university or elsewhere.

CANDIDATE'S SIGNATURE:…… DATE:……

CANDIDATE'S NAME: KWASI STEPHEN AMANKONAH

SUPERVISOR'S DECLARATION

I hereby declare that the preparation and presentation of this dissertation was supervised in accordance with the guidelines on supervision of dissertation laid down by the Akenten Appiah – Menka University of Skills Training and Entrepreneurial Development.

SUPERVISOR'S SIGNATURE:……. Date:……

SUPERVISOR'S NAME: DR. ELVIS TWUMASI

DEDICATION

I dedicate this work to my dear wife, Rita Foriwaa Amankonah and my lovely son Obed Ofori Awuah Amankonah.

ACKNOWLEDGEMENT

All thanks and praises to God the Father for His loving kindness, and all His goodness to me and my family throughout the period of this study. I am grateful to the respondents who participated in this study. I am most grateful to all who contributed in diverse ways to bring this study to fruition especially Dr. Albert K. Awopone, The Head of Electrical and Electronic Technology Education Department and Dr. Elvis Tumasi, my supervisor; Mr. Samuel of Takyimam and Mr. John Nkatsiah; for their special assistance throughout the preparation of the study.

I would like to thank Mr. Jacob Coffi and Joseph Pidassa of Blessed printing press, Duayaw Nkwanta for typing the manuscript. My heartfelt gratitude also goes to Mr. Yaw Dapaah of Boakye Tromo Senior High Technical School for his tremendous support and co-operation. Finally, I acknowledge the support of my family and love ones, may God richly bless you all.

ABSTRACT

The power theft has over the years been one of the factors militating against efficient supply of electricity in Ghana. This study was necessary and timely because of the frequent power supply interruptions Ghana has been facing in the past decade. The study was conducted to assessing the effect of electricity theft on the Ghanaian power sector. The researcher used convenience sampling technique to select 150 respondents from domestic consumers of electricity, commercial consumers of electricity and staff of ECG at Tema. The respondents were made up of 60 males and 90 females. The quantitative research design was used and three sets of questionnaires were designed to collect primary data from each category of the respondents. The study concluded that: high cost of electricity tariffs accounts for power theft among commercial consumers; connivance between staff of ECG and some commercial consumers of power account for power theft; lack of frequent monitoring of meters was found to account for both industrial and domestic power theft; and domestic power theft is caused by poverty, unemployment and high cost of living. The study also revealed that power theft causes: domestic and industrial fire outbreaks; energy sector debt; electrocution; high electricity tariffs; and power supply interruptions. The study recommends that independent meter auditors must be engaged to conduct periodic monitoring of meters; public education on the dangers associated with power theft must be intensified; severe punishment should be handed to perpetrators of power theft to serve as deterrent to others; and "Poor" and unemployed consumers who cannot pay their electricity bills should be identified and offered subsidized solar energy.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ABBREVIATIONS

AMI	Advance Meter Infrastructure
BPA	Bui Power Authority
BXC	Beijing Xiaocheng Company
CEMIG	Companhia Energetica de Minas Gers
CMS	Consumers
COVID-19	Coronavirus Disease 2019
ECG	Electricity Company of Ghana
EGAT	Electricity Generating Authority of Thailand
EC	Energy Commission
GRIDCo	Ghana Grid Company
GOG	Government of Ghana
GWh	Giga Watt hour
IPPs	Independent Power Producers
ISSER	Institute of Statistical, Social and Economic Research
MEA	Metropolitan Electricity Authority
MMDAs	Metropolitan Municipal and District Assemblies
MOE	Ministry of Energy
MOFEP	Ministry of Finance and Economic Planning
MW	Mega Watt
N	Number
NED	Northern Electricity Department
NEDCo	Northern Electricity Distribution Company

PEA	Provincial Electricity Authority
PLN	Perusahaan Listrik Negara
PURC	Public Utility and Regulatory Commission
SD	Standard Deviation
SEB	State Electricity Board
SPSS	Statistical Package for Social Sciences
StD	Standard
T&D	Transmission and Distribution
TAPCO	Takoradi Thermal Power Company
TICO	Takoradi International Company
TTPS	Takoradi Thermal Power Station
USA	United State of America
VRA	Volta River Authority
WAPDA	Water and Power Development Authority
WAPGCo	West Africa Pipe line Gas Company

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The importance of reliable electricity in the world today cannot be overemphasized. It is the power behind the industrial revolution and the catalyst for many discoveries; bringing relief and luxury into the lives of many (Dike, Obiora & Nwokorie, 2015).

The significance of electricity has necessitated the rise in electrification projects all over the world including Ghana; a task of providing every habitable area with access to electric power (Dike, et.al. 2015). Due to the overdependence on electricity coupled with population growth and industrialization, its demand in Ghana has been on an unceasing increase (Brown & Ahmed, 2019).

This continuous increase in electric energy demand calls for corresponding increase in electricity generation, a feat most developing countries in Africa, including Ghana have fail to achieve. These countries often attribute this failure entirely to the lack of readily available resources (Boggs, 2015). One of the challenges confronting the supply of electrical energy is electricity theft, a crime which has assumed global dimension. Electricity theft exists across all social classes; both developed and underdeveloped countries have fallen victim to this crime and Ghana is no exception (Jamal, 2015).

The effects of power theft on the power sector, the consumers, perpetrators and the economy as a whole is dire. The effects are dire in a sense that when one party steals electricity, the entire Ghanaian economy is affected in monetary returns.

In order to compensate the power sector for the energy lost to theft, additional levies are usually charged on power consumption, which contribute to increase in electricity tariffs. These tariff hikes do not only affect those who are stealing electricity, but the whole community (Jamal, 2015). Households that have illegal connections have a greater tendency to abuse the energy than those that buy. This is a vicious cycle that is caused by electricity theft (Johnston, 2006).

Electricity theft affects the financial status of the producers of electricity. This loss is in terms of the Non-technical loss of energy, that is, the energy that is lost due to illegal connections, meter tempering and the buying and selling of illegal electricity prepaid and avoiding the payment of electricity bills (Petracca, 2011). The effect of such is that it does not allow for Electricity Company of Ghana (ECG) to predict the demand of electricity in the country, as a result, one finds that the country experience an issue of power shortages due to the overloading of the power system. Sigauke, Verster and Chikobvu (2013) attests that accurate prediction of daily peak load demand is very important for decision makers in the energy sector because this helps in the determination of consistent and reliable supply schedules during peak periods.

Aside the adverse impact of electricity theft of power generation and revenue mobilization, Baleiras and Jos (2014) held that the illegal electricity connection threatens lives of innocent people, one could easily get electrocuted. Boggs (2015) further posits that power theft could lead to fire outbreak.

Depura, Wang, Devabhaktuni and Gudi (2014) revealed some of the contributory factors that lead to electricity theft as: socio-economic conditions of the customer. That is, consumers who cannot afford to pay their bills resort to stealing electricity from the grid by means of illegal connections. The researchers further associate economic conditions to illegal connections while

they associate meter tempering with greed and opportunity (Jamal, 2015). This study is into the assessment of the effect of electricity theft on the Ghanaian power sector.

1.2 Statement of Problem

No modern society can develop without reliable distribution of electricity. Both domestic and industrial consumption keep growing exponentially which does not only require a corresponding increase in power generation and distribution but also efficient supply (Rose-Ackerman, 2013)

One of the factors that have over the years hampered on the efficiency of power distribution in Ghana is power theft. In 2020, the Tema Region of the Electricity Company of Ghana recorded GH¢9,725,011.18 loss resulting from power theft (www.myjoyonline.com). Regardless, there is no research that has focused on power theft in the Tema Region to generate knowledge and prescribe solutions.

Power crisis is one of the major challenges confronting successive governments in Ghana. There are manifold of studies that have been conducted in the area of energy generation and distribution but Johnston (2006) intimates that the academia has not focused much attention on the impact of power theft on the Ghanaian power sector. Specifically, there is no research that has in recent years taken a holistic view of the electricity theft phenomenon. This has necessitated the conduct of this study. This study seeks to concentrate on wide array of issue on power theft including: the various factors that contribute to electricity theft; the consequence of electricity theft; and identify ways by which electricity theft could be minimized in Ghana.

This study will be novel, as it will be the most recent study that would have sought to expansively examine the situation of power theft in Ghana. The study will therefore bridge the

wide research gap and unveil modern trends and dynamics of the power theft crime and also provide workable recommendations to curb the menace.

This study is into the effect of electricity theft on the entire power sector.

1.3 Objectives of the study

Electricity theft or illegal electricity connection is one of the major challenges confronting the Ghanaian power sector. The main aim of the study is to assess the effect this criminal activity has on the Ghanaian power sector. In order to achieve the set objectives of the study, this study seeks to specifically concentrate on the following objectives:

i. To assess the various factors that contribute to electricity theft at ECG, Tema Region.
ii. To examine the various consequences of electricity theft at ECG, Tema Region.
iii. To identify means by which electricity theft could be minimized at ECG, Tema Region.

1.4 Research Questions

The following questions represent the research questions for the current study;

i. What are the various factors that contribute to electricity theft at ECG, Tema Region?
ii. What are the various consequences of electricity theft at ECG, Tema Region?
iii. How can electricity theft be minimized at ECG, Tema Region?

1.5 Significance of the Study

The power sector serves as the fulcrum of Ghana's development as it is indispensable to both industries and individuals. As the nation battles to ensure efficient power distribution, this study will be timely and useful to policy makers like: Ministries, Department and Agencies with the mandate of managing Ghana's power sector with deeper appreciation of issues relating to power theft. The outcome of this study will thus serve as a panacea of dealing with the situation of electricity theft thereby ensuring efficient power supply.

Tema is invariably the hub of industries in Ghana. Since industries rely on electricity to generate energy, the Tema region of the Electricity Company of Ghana is one of the busiest branches of the company, serving numerous household and high voltage consumers. This study will be useful to the Tema Region of E.C.G, as recommendations from the study will provide the company with remedy for dealing with power supply challenges resulting from illegal electricity connections.

Finally, the outcome of the study will be of enormous benefit to the academia, as the study will add to the existing literature on electricity theft and earlier studies which have been conducted in the area of power generation and transmission.

1.6 Scope of the Study

The study is into electricity theft at ECG. The study seeks to focus on the Tema Region of ECG. The study will examine: the various factors that contribute to electricity theft; the various consequences of electricity theft; and how electricity theft could be minimized at ECG. Due to time and resource constraint, the study seeks to consider only the Tema Region of ECG. The outcome of this study may not reflect the happenings within other regions in Ghana.

Notwithstanding the above limitation, the researcher is confident that the outcome of the study will serve a good purpose of unearthing salient energy generation and distribution issues.

1.7 Organization of the Study

This study has been divided into five main chapters as follows: Chapter one is the Introduction. This deals with the Background of the Study, Statement of the Problem, Objective of the Study, Research Questions, and Significance of the Study, Scope and Limitation of the Study, Organization of the Study. Chapter two is the Literature Review. Chapter three is Methodology. It entails the Type of Research, Population, Sampling and Technique, Data Collection and Method of Data Analysis. Chapter four is the Results and Discussion of Findings. This highlights General Information on Sampled Firms, Data Presentation and Analysis, and Discussion of Research Findings. Chapter five is the Summary of Findings, Conclusion and Recommendations of the Study.

CHAPTER TWO

LITERATURE REVIEW

This chapter gives an overview of different studies relating to electricity theft and other analogous crimes. The chapter is divided into three main sections. The first section presents the conceptual literature. The second section contains the conceptual literature of the study while the third section also looks at the empirical review which provides a discussion on the key outcomes of previous empirical studies that are related to the current study.

2.1 Theoretical Review

2.1.1 General Strain Theory

Emile Durkheim's work greatly influenced the development of the Strain Theory. Merton (1938), Agnew (1992), Messner and Rosenfeld were among the first to advocate it in (1994). All of these experts contributed significant to the theory, many laws and standards exist within society (state or community) to keep individuals in check and maintain a particular level of good and acceptable behavior. In spite of this, society as a whole lacks diverse social tools (service delivery) for meeting people's demands. As a result, deviant behavior (crime) is used to achieve the desired existence. The strain theory therefore suggests that there is a structural and individual strain. The former relates to societal systems that drive individual needs and how their intrinsic insufficiency to provide those needs frequently influence individual misbehavior. The latter describes how an individual's desires and needs often lead them to seek satisfaction through unconventional means. With this in mind, the focus this study will be on Agnew's Strain Theory (1992). The General Strain Theory is the name given to this variant. According to Agnew

(1992), general strain theory contends that persons or organizations who restricts one from reaching one's goals influence one's decisions to commit crime (Murphy & Robenson, 2008). For instance, in the case of electricity theft, the need or goal of having electricity and living a better life is thwarted by poor services or high tariffs from the power supplier, ECG, as situation that forces both businesses and individuals to indulge in illegal connection, power fraud and other illegal activities.

2.1.2 Rational Choice Theory

Rational choice theory was first proposed by Anthony Downs in the late 18th century, based on Cesare Beccaria's work (1957). It is more of an economic theory that describes the human desire for profit as the primary motivator for making decision. As a result, the theory "proposes that in whatever situation, everyone tries to maximize their advantage and, hence continually strives to limit their losses". Furthermore, Levin and Malgrom (2004:1) define it as "the process of determining which options are accessible and selecting the most desirable option based on a standard criterion". The theory is founded on the concept that all humans make rational decisions, act rationally while making decisions, and strive to increase either pleasure or profit" (Investopedia, 2017). Other viewpoints, such as deterrence, situational crime prevention, and routine activity theory have been added to the theory. According to the notion, humans are logical beings who assess the risks of committing a crime against the advantages

(Westhuisen, 2011). In the context of research, it is reasonable to believe that stealing electricity provides greater benefits than risks of being arrested. Individuals and organization involve in power theft in Tema see their illicit access to electricity as a more rewarding cause than the penalties. Clarke (2016) explain why power prices are considered as exorbitant and bribing

electricity authorities for illegal connections and avoiding paying electricity bills is more beneficial for them than following legal procedures. As reported by Petracca (1991), the rational choice approach to politics posits that individual conducts is driven by self-interest, utility maximization, or, to put it in another way, goal fulfillment. As a result, the theory aids in identifying the inconsistences in service delivery procedures of the nation, forcing the individuals to rationalize and validate illegal behaviors as they operate in self-interest and profit making. Moreover**,** the theory describes how criminals will try to maximize their profits while minimize their losses during their illicit operations (Sato, 2013). Furthermore, according to Scott (2000), many sociologists, have recognized that individuals act rationally, but they have observed rational alongside other forms of activities. Therefore, the assumption is that while some criminality activities may be rational, others may not. As the community indulges in electricity theft, not all of them rationalize the act of theft.

2.1.3 Agency Theory

Agency theory is based on the principle that in modern business organization where share ownership is largely accepted, managerial decisions are differentiated from shareholders who are just interested in increasing their share values or returns. As stipulated by the Agency Theory, the stockholder or shareholders of the business are known as the principals who leave the daily administrative and managerial decision making activities in the hands of another group called Agents. The Principal in this case entrust the Agent to make decisions that will raise his gains. The basic reason for the Principal-Agent strategy is that in most situations, the Principal may not have what it takes to run the business or may be too busy to manage the business which makes it difficult or impossible for the Principal to monitor the Agent well. The Principal may decide to motivate the Agent by way of giving him or her some incentives such as attractive remunerations

and other non-financial incentives. (Wellbery, 2016). These incentives are to serve as a reward for the Agent to maximize shareholders' interests like taking good decision such as planning for the organization (Awudu, 2015). It is incumbent on the Agent to make wise decisions that will increase the value of the shareholder's investment in the long term. In most cases, efforts by the Agent to take some vital long term decisions impact the amount of dividend received by the Principal in the short-run which may lead to disagreement between them.

The Agency theory is relevant to this study with the nuance that management of ECG are mandated with the responsibility of taking the right steps to institute and implement the appropriate steps that will ensure that power theft is prevented

2.2 Power Losses

Not all the electricity generated in a power system gets to paying consumers due to managerial practices and wastefulness. What brings about power losses in a power system may include;

2.2.1 System use

Before an electric power system can produce and distribute electricity; it will certainly have to use some of the electricity generated. The electrical energy used for lighting, maintenance etc, in power stations and facilities is exempted from metering or not ‘‘sold’’ in the economic sense. System use may differ from 2% to 6% of generation (Flavin & Lenssen, 2014).

2.2.2 Technical Transmission and Distribution Losses

During transmission and distribution of electricity to the various consumers in the power system, electric power is lost in the transformers used as well as on both the transmission and the distribution lines (Flavin & Lensen, 2014). The amount of Transmission and Distribution (T&D)

losses in a power system is directly proportional to the length of the lines. Also, the efficiency of the system depends directly on the quality of the lines and the transformers in the system. The T&D losses in a power system can be minimized greatly through proper maintenance practices and investment in high technology of the transmission and the distribution system (Dhume, 2019).

2.2.3 Gratis

Electricity assigned as gratis is one of the causes of power loss In. some power systems, electricity supply to certain prominent personalities and organizations such as the presidential or residence of ministers, members of parliament, mayors and chief executives and the royal palaces is free of charge. The employees of the power system may also enjoy free electricity (Patterson, 2001).

2.3 Electricity theft

According to Flavin and Lenssen (2014), there are four kinds of "theft" which are commonly found in all power systems; the magnitude of which depends on various factors ranging from cultural to the managerial style of the utility.

2.3.1 Fraud

An intentional attempt by the consumer to cheat the utility is what is known as fraud. A prevalent practice is to tinker with the meter in order that the reading shown on the meter is a reduced version of power used. This can be a very dangerous operation for an inept, and a lot of cases of electrocution have been recorded. In some cases, a modest fee has been arranged between ''professionals'' and consumers to fix the meter (New Straits Times, 1999).

2.3.2 Stealing

Electricity may be stolen through the rigging of a line from the power source to a consumer going round a meter. This kind of practice mostly occurs in impoverished residential areas where those needing electricity may not have lines allocated and may not afford payment should they be connected. This occurrence is sometimes yielded to by the managers of the utility as a fact of life in poverty stricken communities. The illegal lines are clearly visible since they are often above ground and not hidden. However, there are reports that staffs are frequently being attacked and requiring police protection in order to disconnect the lines. Money may change hands between employees of the utility and costumers to allow the practice to continue. Voluminously, businesses can buy off power organization staff to rig direct lines to their buildings or offices bypassing the meter. The bribes could be very moderate compared to the cost of the power. Inspectors may also be paid off to restrain them from detecting and/or disclosing the theft.

2.3.3 Billing Irregularities

There are a lot of sources which account for billing irregularities in a power system. In some power systems, measurement of the quantity of electrical energy used by consumers may not be effectively done and inadvertently produce a greater or less value than the actual value. This unintended situation may be regularized with time. In some power systems however, it is painless to methodize for considerably smaller bills to be given than for the actual power used. The utility staff could be bribed to read the meter at a smaller figure than is shown. Customers may discover that some power organization employees are ‘‘on-the-take’’ for rendering these services. The staff may keep payments and could easily gain from this type of corrupt practice, as it is very difficult to discover. This kind of corruption could be institutionalized in such a way that employees may consider the illegal settlements as part of the normal work they do.

2.3.4 Unpaid bills

Some consumers of electricity fail to pay what they owe the utility for using electricity. Residential or business consumers of electricity might have left the city or an enterprise might have been insolvent. This convention is extensive; there are chronic defaulters in some power systems. For example, the affluent and politically powerful in society who are aware that their electricity will not be disconnected irrespective of whether they default or not. Another group of habitual defaulters could be the departments and the agencies of the government.

2.3.5 Power Distribution Losses in Ghana

The electricity distribution system in the country has experienced many upsets during the past decade. According to Bokpe (2016), about 21.7 percent of total electricity generated in the last decade has been lost yearly through transmission and distribution. While transmission losses for this era only averaged 3.9 percent, distribution losses which also cover commercial losses added up to 16.2 percent annually by the biggest distribution company ECG in the country. These losses could be linked with inefficiency of some equipment in the distribution systems attributable to their antiquated nature as well as the loss of income for electricity used as a result of unpaid bills and electricity theft. It is reported that at the end of 2015, the Government of Ghana owed ECG an accumulated amount of GH¢ 950 million in subventions and unpaid bills by state institutions comprising ministries, departments and agencies (MMDAs) (Bokpe, 2016). The private ownership and individuals also owed ECG to the tune of GH¢ 610 million (Bokpe, 2016). These liabilities have made it strenuous for the distribution companies and the other institutions they owe including the VRA to carry out their commitments to their providers including WAPGCo.

The countrywide application of prepaid meters in the Ghanaian power sector for all consumers can go a long way in helping the electric companies to correctly account for the consumption of electricity in the country. According to Gyamfi (2017), most consumers in the government sector are jet to be put on prepaid meters whereas the majority of those consumers in the private sector are on the prepaid meters. This is a major contributive factor to the huge debt levels in the power sector. Since the board members and some of the top management members of the public utility companies are appointed by the government, they are not independent. As a result, it becomes extremely difficult for these state own utilities to completely make the governmental institutions accountable for the electricity they use. One of the factors that hinder the implementation of the prepaid metering system in the private sector is the unenlightenment on the part of the utility companies to the consumers. A study by Kemausuor & Ackom (2016) revealed that the fruitful implementation of the prepaid metering system in the power system for both private and public sector would provide adequate funds for the effectual operation of the utilities to ensure that outmoded equipment in the transmission and the distribution system are replaced to reduce the T&D losses in the sector.

2.4 Electricity Company of Ghana (ECG)

The Electricity Company of Ghana is a limited liability company wholly owned by the Government of Ghana and is being run by the Ministry of Energy. It was incorporated under the Companies Code, 1963 in February 1997 (ECG). It started as the Electricity Department on 1st April, 1947 and later the Electricity Division in 1962. Afterwards, it became a legal entity known as Electricity Corporation of Ghana under the NLC Decree 125 in 1967. Up until July 1987, it was in charge of the distribution and supply of power in the entire country. The Government of Ghana established the Northern Electricity Department (NED) to augment the Volta River

Authority (VRA) in 1987 which assumed the responsibility of running electric power distribution in Brong-Ahafo, Northern, Upper East and Upper West Regions. This made the ECG to be responsible for the distribution of electricity in only the southern part of the country thus, Ashanti, Central, Eastern, Greater Accra, Volta and Western Region (IEA, 2016).

2.5 Distribution of Electricity in Ghana

Companies that generate, transmit or distribute electricity are known as power utilities. These institutions have the responsibility to serve essential human needs for a better way of life. The generation, transmission and distribution of power in Ghana are discharged by separate organizations. The Volta River Authority (VRA), Bui Power Authority (BPA) and Independent Power Producers (IPPs) are responsible for the electricity production. The transmission of electricity is the sole duty of the Ghana Grid Company (GRIDCo). Electricity Company of Ghana (ECG) and Northern Electricity Distribution Company (NEDCo) are responsible for the distribution of electricity. The NEDCo is however directed by the VRA. The electric power market forms the wholesale and the retail market. While the wholesale market is controlled by VRA and GRIDCo, the ECG and NEDCo dominate the retail market. ECG is the principal national distributor and retailer of electric power in the country. It has the mandate to provide quality electricity services to aid socio-economic development of Ghana. ECG is also required to provide quality and reliable services for its customers (ISSER, 2005).

2.6 History of Electrical Power Generation in Ghana

The story of electricity generation in present-day Ghana stem from the colonial era in 1914 when the electricity supply funded by the government started off in Sekondi in the Western part of modern Ghana (Held, 2014). Ever since, several reforms and reorganizations had occurred.

Nevertheless, this section of the report will not focus on the long history and the different transitional reforms which had occurred in the pre independence era.

However, the history of power generation in Ghana could be grouped into three major phases. Pre-hydro years, which refers to the time period before the main hydro plant in Akosombo was constructed in the year 1966. The hydro years, representing the time period from 1966 when the Akosombo hydro plant was completed to the 80s, and the "thermal complementation years", also referring to the 90s up until now when thermal plants are being used to augment the hydro generation (Held, 2014).

2.7 Sources of Electricity in Ghana

According to the Ministry of Energy (2017), the sources of Ghana's power supply are hydroelectricity, thermal; fueled by crude oil, natural gas and diesel, solar and imports from La cote d'lvoire. The total installed capacity for existing plants in Ghana as at the end of 2019 is 5,172MW consisting of Hydro 1,580MW, Thermal 3,549MW and Renewables 42.6MW (EC, 2020). Per the information obtained from the Energy Commission of Ghana, the total dependable energy generation capacity as at the end of 2019 amounted to 4,695MW with hydro 1,365MW, thermal 3,296MW and renewables 34MW. In 2019, 127GWh of electricity was imported representing 0.7% of total electricity generated.

2.7.1 Hydro Generation

Presently, Ghana operates three main hydro power plants. The first and the biggest hydro plant to be constructed is the Akosombo hydro plant with an installed capacity of 1020MW based in the Eastern part of the country in 1966 and originally built to supply electric power to the aluminum industry (Claxton, 2018). The construction of the

Akosombo hydro dam inundated the Volta river basin occasioning the largest manmade lake in the world covering about 3.6% of Ghana's coast (Brown & Ahmed, 2019). The electricity produced by the Akosombo plant was the main driving force behind Ghana's economic evolution and also aided neighboring countries such as Togo, Burkina Faso and Benin by selling power to these countries (Suave, 2002).

With Ghana's swelling industry and economic growth led to a greater clamor for electric power in the country. So in 1982, a second but smaller hydro power plant known as the Kpong Hydro plant with an installed capacity of 160 MW was built on the down-drift of the same Volta River to augment the Akosombo hydro plant (VRA, Ghana).

Being a remarkable step to confronting the electricity demand of Ghana's population and industry, a third hydropower plant called the Bui Dam was commissioned for operation in December 2013. The Bui Dam on the other hand, is a multifunctional dam which, apart from generating power, supplies water for irrigation. It has an installed capacity of 400MW and is located on the Black Volta River at the Bui National Park in the Bono Region of Ghana. Far from the two other hydro plants, the Bui Dam is a strategic partnership between the Government of Ghana (GOG) and a Chinese construction company Sino Hydro (BPA, Ghana).

2.7.2 Thermal Sources

To augment the existing hydro power plants, the Volta River Authority (VRA) in 1997 commenced the Takoradi Thermal Power Station (TPPS) in the Western region of the country, novel in Ghana. A 550 MW installed capacity with a joint private partnership against the backdrop of the government plans to avow private participation in the electricity generation sector. The Takoradi thermal Power Company invovves two companies all based in the same

region. It consists of a 330 MW combined cycle plant called Takoradi Thermal Power Company (TAPCO) with a private partnership with CMS Energy of USA in a ratio of 90% (VRA) to 10% (CMS Energy, USA). And the second part is the Takoradi international company (TICO), A 220 MW installed gas turbine plants in a ratio of 10% (VRA) to 90% (CMS Energy, USA). The table below gives a detail account of the various sources of Electricity in the country as of now.

Table 2: Sources of Electricity in Ghana

PLANT	INSTALLED CAPACITY (MW)	DEPENDABLE CAPACITY (MW)
Hydro		
Akosombo	1,020	900
Kpong	160	105
Bui	400	360
Total	**1,580**	**1,365**
Thermal		
Takoradi Power Company (TAPCO)	330	300
Takoradi International Company (TICO)	340	320
Tema Thermal 1 Power Plant (TT1PP)	110	100
Cenit Energy Limited	110	100
Sunon Asogli Power (Ghana) Limited	560	520
Tema Themal 2 Power Plant (TT2PP)	87	71.5
Kpone Thermal Power Plant	220	200
Karpowership	470	450
Ameri Plant	250	230
Trojan	44	39.6
Genser	95	85
Amandi	203	190
Aksa	370	350
Cenpower	360	340
Total	**3,549**	**3.296.1**
Renewables		
Safisana Biogas	0.1	0.1
VRA Solar	2.5	2

BXC Solar Meinergy	20 20	16 16
Total	**42.6**	**34.1**
Grand Total	**5,171.6**	**4,695.1**

Source: Energy Commission, Ghana, 2020

2.8. Electricity Consumption in Ghana

In Ghana, electricity is basically generated from two main sources being hydro and thermal source. According to data gathered from the Energy commission of Ghana and the Volta River Authority the quota of electric power generation from these two sources stood at 68% of hydro and 32% of thermal as of 2005 compared to 65% and 35% respectively in 2000. The share of hydro in the total electricity generation decreased from 68% in 2005 to 39.9s% in 2019 whereas that of thermal increased from 32% in 2005 to 59.8% in 2019. With nearly 2.7 million customer base, about 85% of the Ghanaian population has access to electricity (EC, 2020). Majority of these people can be found in the cities and the regional and district capitals across the country. Within the southern part of Ghana, where ECG operates, there are about 1.8million customers and the company distributes 90% of all electricity sold in Ghana (ECG & EC, 2020). ECG customer base consists of: Lifeline Residential Consumers who constitute 51% of the customers and consume 6% of the total distributed power; Non – Lifeline residential Consumers representing 34% of energy consumption; Non – Residential Consumers representing 12% of the energy consumption; and Special Load Tariff and High Voltage Mines who also represent 48% of energy consumption (ECG)

NEDCo serves about 64% of Ghana's landmass which constitutes the northern sector but distributes about 10% of all electricity sold in the country. As at March, 2019, the customer population of NEDCo stood at 888,203 as against 17,940 in 1987. Energy consumption by its customers has also grown from as low as 60.03GWh in 1990 to 1190GWh by the end of

December, 2017 (NEDCo). About 81.39% of its customers who are in the Residential Category consumed 64.35% of the total 1190GWh, the Non – Residential Customers constituting about 18.6% of the total customer population also consumed 29.18% of the NEDCo energy distributed whilst the Special Load Tariff Customers consisting of only 0.01% consumed 6.47% of the total billed energy (NEDCo).

Total electricity consumption as at 2005 (from ECG and NEDCo sales) add up to 4127 GWh (Labandeira, 2015) while in 2019, the total consumption amounted to 13,942GWh. Out of this, the residential share of the final electricity consumed was 6,357GWh whereas that of the industrial sector stood at 4,242GWh. Nearly 70% was used by the private sector, i.e. residential and commercial, and the rest for industries (EC, 2020).

The rural penetration of electricity consumption in the country differ considerably with the rural dwellers along the coast having the highest penetration of 27% followed by those along the forest belt regions with 19% and the lowest being the savannah regions in the northern part of Ghana with about 5% penetration. There have been several governmental policies and programs directed towards rural electrification. The purpose was to improve those rural economies through job-creation and to control the inrush and the expedition of rural – urban migration. The annual electricity demand growth is approximately between 10 and 15% (Mzini, & Lukamba-Muhiya, 2014).

2.9 Household Behavior and Power Consumption

The majority of the energy efficient measures employed throughout the world require technological involvement. Nevertheless, the success of these interventions depends highly on people mending their energy consumption Behaviour. Household Behaviour towards energy

utilization is mostly dictated by the actions and decisions of the householders and these actions are prompted by some psychological, social and economic factors. Therefore, it is necessary to know these factors and how they impact household behavior and choices in their consumption of energy. Various studies on household energy conservation center on the household behavior, the drivers of household behavior and how that affects their energy consumption. In sociology, there are a lot of studies which have drawn attention to what factor and situation create certain type of energy consumption behavior. For instance, household's mindset on energy efficiency and Eco friendliness. The focus of many studies has been social and psychological factors connected to energy-saving behavior and how they are related to cognitive variables such as values, social norms and beliefs (Labandeira, 2015). Several studies propose that social factors could be a major contributing factor of energy consumption and conservation behaviour. A social norm may be defined as a shared expectation by a group which is assumed to be proper for a given situation (Ritchie, 2016). Ritchie (2016) also defined norms as an established behaviour pattern for members of a given societal system; and also said that attitudes are organized sets of feelings and beliefs about a subject or a situation, which can influence an individual's behaviour. According to Claxton (2018), it is vital to scrutinize attitudes since "appropriate energy related attitudes and beliefs may constitute an important condition for suitable energy related behaviours. Because new attitudes can be cultivated, attitude-action association has significant indication for energy education (Ritchie, 2016). Whereas some researchers have started to hypothesize on the factors intimated above, others have begun to supply pertinent proof. Through the use of econometric analysis, researchers have established that beliefs and behavioural intents are strongly linked to specific energy-using behavior and are prognostic of these behaviours. Participants considered their consumption of energy pursuant to their astuteness of the consequence of energy

conservation on individual well-being, the effort needed to conserve and the monetary reward for doing so, the capability of the individual to have an influence on the energy issue and their belief that the problem is admissible. A study by Olsen (2015) which surveyed 2,366 Canadian households showed that none of the attitudinal variables was relevant in the final paradigm of actual energy consumption. Eliel and Boateng (2014) asserted that people's perception of their own input to energy crisis is predictive of household energy conservation. Supposedly, the greater the perceived graveness of the crisis, the more decisively one should be to assist strategies for advocating energy conservation (Labandeira, 2015). Gaur and Gupta (2016) argues that there is a substantial indication that regular energy usage is largely controlled by social norms and is greatly formed by culture and economic factors. All these factors impact consumer's needs and belief system and determine the opportunities and abilities of a consumer which in the long round influences the individual decide based on presumptions to attain some comfort or gains. This implies that a person's decision to conserve electricity or consume energy efficiently is motivated by multidimensional factors that influence his or her choice to conserve or do contrarily.

2.10 Electricity Supply Challenges in Ghana

The main objective of Ghana's electric power supply system is to guarantee security and continuously provide electricity to match the socioeconomic needs of the country (Eliel & Boateng, 2014). The supply of electricity in Ghana has been undependable in the past three decades, contributing to four huge national power crises and rationing exercises for the periods 1984/1993, 1997/1998, 2006/2007 and 2012/ 2016 (Gaur & Gupta 2016), until mid-2017 when it became a bit stable. The power supply shortages were mostly assigned to perpetual droughts which caused the Akosombo hydropower station to under generation of electricity. The situation

was marked by recurrent national power crises including localized power outages in the country (Labandeira, 2015). This situation is now known as "Dumsor" which means on and off. This word has been used by Ghanaians to express anger since 2012. Dumsor menace has gain international attention and is a period where Ghana suffered severe power rationing/load shedding. As reported by Wikipedia, Dumsor is a persistent, irregular and unpredictable electric power outage in Ghana. The perennial droughts necessitated a move to the initiation of thermal power generators in 1997 that operate mainly on crude oil, and presently running on a combination of fossil fuel alternatives. Undependable gas feed from Nigeria has, in succession, plunged Ghana into regular power shortages lately (Gaur & Gupta, 2016). If this persists, high crude oil and natural gas prices in the future will be a source of danger to the nation's electricity generation leading to monumental effect in the cost of thermal electricity generation (Eliel & Boateng, 2014). In the long round, this will put a considerable pressure on electricity tariffs and household electricity bills, which is already a huge segment of the insufficient monthly household expenditure in Ghana (Labandeira, 2015). As a prompt remedy to these crises, steps have been taken to make use of local gas supplies from the Atuabo gas project in addition to the building of emergency power plants, bettering the situation accordingly. As a country, Ghana has made short and medium-term electricity plans through the Energy Commission (EC, 2006). There is the need to redevelop the scope and content of the electricity sector planning into a long-term electricity planning and implementation policy for the nation to attain economic progress and robustness, which should lead to the creation of reliable and affordable electricity accessible to industries, social services and households.

2.11 The Structure of the Ghanaian Power Sector

The Ghanaian power sector, up until the late1990s, was a vertically integrated, regulated utility having complete downstream market power which had the Volta River Authority (VRA), generating and transmitting electricity to all the regions in the country and also distributing to the Northern Sector via its subsidiary, the Northern Electricity Department (NED). The Electricity Company of Ghana was in charge of the distribution of electricity in the southern sector of the country. The Volta River Authority (VRA) was split into a separate generation and transmission system operations where the VRA concentrated solely on power generation with the Ghana Grid Company (GRIDCo), responsible for power transmission, making it possible for other Independent Power Producers (IPPs) to enter the market; during the power sector reforms in the late 1990s. Dike, Obiora, Nwokorie and Dike (2015) argues that power supply shortfalls vis-à-vis increasing electricity demand along with the difficulties in connection with raising monetary support from the conventional financiers of the sector, as well as the World Bank, as the major determining factor for the power sector reform in the country. The stakeholders in the Ghanaian power sector include national, regional and international institutions. They are policy making and implementation institutions, regulatory agencies, generation, transmission and distribution companies, consumers, research and advocacy groups as well as financial institutions.

2.12 National Stakeholders in Ghana's Power Sector

The Ministry of Energy (MOE) is the governmental agent in charge of formulating, monitoring and evaluating policies, programmes and projects for the nation's power sector with financial assistance from the Ministry of Finance and Economic Planning (MOFEP). Also, the Ministry is charged with the responsible of the implementation of the National Electrification Scheme in all parts of the country. The Energy Commission (EC) and the Public Utilities Regulatory

Commission (PURC) are the bodies mandated to be responsible for regulating the activities of the power sector. The technical regulation of the power sector, as well as the licensing of the operators and advising the Minister of Energy on matters relating to energy policy and planning, is the mandate of the EC. However, the PURC is an independent regulatory agency in charge of economic regulation of the power sector, particularly approbation of rates for electricity vended by distribution utilities consumers. Again, PURC is responsible for monitoring the quality of electricity services delivered to the public (Brown & Ahmed, 2019).

2.13 Measures for Reducing Electricity theft

The study has identified three ways by which power theft could be minimized namely; technical/engineering, managerial, and system change.

2.13.1 Technical and Engineering methods

The technology involved in electric power systems is not a new one, and innovations taking place allow cost effective systems to be deployed and maintained. The resources and effort allocated to the transmission and distribution systems in many power systems are woefully inadequate and as well use outmoded technologies. The investment required to minimize losses includes upgrading power lines, transformers, information technology monitoring systems, and installing and maintenance of contemporary metering systems that are at the interface of the utility and the users of the electricity. Remarkable technological development in metering systems has come about. Considering the fact that much theft is from meter tampering, it is crucial to replace old and easy to tamper-with meters. Modern high-tech sealed meters which cannot be altered in any way and can be read automatically are very expensive, but can minimize theft when required of medium to heavy power consumers (Jamal, 2015). Brown and Ahmed

(2019) maintain that the investment in high technology metering requires a sound and complex infrastructure in place to make the system work effectively.

2.13.2 Managerial Methods

Power utility companies are very large organizations that run with excessively complicated administrative procedures even though many are private sector entities. Remarkable improvements can occur should strong technical advancements be integrated with an intelligent and functional anti-theft program (Jamal, 2015). Power theft could be reduced significantly by regular inspection and monitoring of the users of electricity. CEMIG incurred $12 million losses in Brazil. When $2.1 million was invested in tests and inspection, $6.2 million was recuperated (Mzini & Lukamba, 2014).The attention should be focused on areas and facilities which have the utmost potential quantum of power theft in terms of electricity use. Studies have revealed that the affluent steal electricity for residential use, factories, and businesses (BRDC, 2000). Many of the people in the urban ghettos could be stealing power even so the quantum of power is very little by contrast. Yet inspection many a time, earmark the poor of the community. Singapore's former Prime Minister Lee Kuan Yew remarked that corruption was a lifestyle but in his country it should not become a way of life. The same comment can appertain to power theft. Theft may be common in all power systems to different levels as a fact of life. Obviously, some power systems seem to be working where electricity theft has come to be a way of life. Corruption is among the most difficult areas of concern for electricity organizations since power theft happens with the involvement of staff of the power institution. Increased investigation and surveillance may provide opportunity for more corruption (Brown & Ahmed, 2019).

Staff could even elicit money from power users not to reveal theft. It is crucial to discover and indict corrupt power sector staff, as well as those at the very top of the organization if the need

be. Employees should be paid sufficiently in order that they would not resort to bribes before they can support their families. The organizational factor in the power sector is vital. Power utilities are hug and complicated organizations. By the number of employees it could be a nation's biggest organization. In Thailand, EGAT and the two distribution agencies have over 60,000 employees, while Indonesia's PLN has over 50,000 employees. Tenaga in Malaysia has 23,000 employees and WAPDA in Pakistan has over 100,000 employees. There are about a million workers in India's state electricity boards. Most part of the job are routine and in many organizations a bureaucratic system is advanced whether private or public entity. Electricity utility employees do interface intensively with the users of power in residences, factories and offices. This enables ''street level'' decision making to occur (Jamal, 2015). Staff may exercise discretion by not communicating violations or could amend bills. Because the usual power sector utilities do run at the customer level, employees are dispersed throughout the remote corners of the nation, making it extremely hard to control and coordinate operations from the central office. If the commodity supplied is a meager and essential product, as is electric power in most developing countries like Ghana, employees can exercise a lot of discretion. Regular allocation found in some power systems becomes discretionary in others. For instance, who would be connected to power? When would the connection be made? Where and when will power blackouts take place? What quantum should the consumer pay for power? All these discretionary decisions could be ''for sale'' by the employees. The utility's management and employees flourish on power scarcity and there is no motivation to increase supply or to run a better or effectual service. The lawful sides of power theft have drawn attention in some countries. Out of date laws handle theft as a common error. Many countries have lately codified laws governing power theft and regard it as a serious offense. The Andhra Pradesh amendments to the Indian

Electricity Act (1910) prescribe punishments from 6 months to 5 years imprisonment, fines of between 5000 to 50,000 Rupees, and denial the corporate of electricity for up to 6 years. In Malaysia, half-page ads newspapers alert users of the illegality of power theft with sanctions of up to RM 100,000 and imprisonment of up to 5 years. The current regulations make the punishment for theft simpler to apply and the sanctions serve as a deterrent to others. The issue of arrears or unpaid bills is very complex. Electricity is an indispensable commodity and a no pay, no- electricity strategy might not be politically expedient in some countries. Disconnection also could be threatening as per World Bank study (1999). In Albania, customers with guns threatened to kill the employees of the utility who tried to disconnect nonpaying users. The depth of this matter can be so devastating that the economic stability of the utility is endangered. A way of encouraging some effectiveness in the area of revenue collection is by contracting the collection of the bills to a private agency. Issuance of varying techniques and places for payment of bills might also be of good help. Some power systems have employed prepaid cards as way to effect payment. Nevertheless, overcoming a culture of non-payment has no simple solutions (Brown & Ahmed, 2019). In some instances the highly indebted customers are government agencies, and collecting can contend legal and political barricade.

2.13.3 System Changes

Power theft is at its peak in the systems where electricity sector organizations are state owned and run companies. Some power utilities which are state own have performed with considerable efficacy; a case in point is in Singapore. So, one cannot say that the public sector is incompetent of operating services effectively and efficiently. Since the state owned and operated enterprises are not run as true businesses, one can argue that they do not thrive to maximize profits. The enterprises might interlace political with bureaucratic structure and procedures. Therefore, there

is very little motivation to reducing theft. In the Indian case for instance, theft did not emerge gradually; it has been there for a very long time; the issue is that nothing has ever been done about it. All stakeholders in India's power sector including political leaders, power consumers and SEB managers and employees have benefited from the system. A global measure has been liberalization and the modification of public sector organizations into the private sector. During the past decades several power systems were privatized and now run as businesses with shares traded on the stock markets (Mzini & Lukamba, 2014). The total power sector is very challenging to privatize into effective private sector organizations since transmission and distribution of power are accustomed oligopoly, and competition is needed to drive businesses to be more efficient. In many countries around the word, national and state level power systems have been modified in the past decade and the establishment of an independent regulatory commission for electricity has also been a general trend. The issue of how to handle technical and non-technical losses is a difficult one for the new regulatory bodies. The problems to deal with comprise setting levels of ''acceptable loss,'' whether utilities should be permitted to pass on theft and other inefficiency costs to users, and whether utilities must be sanctioned if they do not attain reductions in T&D losses and theft. The transformation of electric power utilities into more business-like ventures implies that for a lot of countries, the removal of subsidies given by the state which ensured low electricity tariffs for users. As tariffs in low income countries increases to global levels, a lot of users are endangered. Their own earnings by local standards may be $2 to $5 per day, however their electricity bills could the same as a user in Los Angeles in the US who earns $80 per day. Under these situations, users might felt that there is non- other means but to indulge in electricity theft or refuse to pay their bills. Logic and theory causes one to think that private owned power utilities would be a lot more worried about theft than public

sector enterprises. Comparing Malaysia's privatized system with Thailand's public utility system with respect to electricity theft is amazing (Seger, 2018). The two systems have almost the same T&D losses of about 11%. In 1994 Malaysia divested Tenaga, the power generation, transmission and distribution utility company for peninsular Malaysia. Government kept majority ownership, however its shares were sold on the Kuala Lumpur stock market. Independent power producers (IPPs) were allowed from the mid-1990s to produce power and trade it to Tenaga for distribution. In the case of Thailand, the EGAT is a public utility organization that generates and transmits power to two big distribution public utilities, the Provincial Electricity Authority (PEA) and the Metropolitan Electricity Authority (MEA). Efforts to privatize Thailand's electricity have been a subject for discussion for almost 20years; nevertheless the 32,000 member EGAT employees' union has vehemently resisted the move. Electricity theft is not a major problem in Thailand since EGAT, PEA and MEA seem to have no unity of purpose to handle the issue. The utilities gain enough profits to make the government happy and give the employees free electricity including a considerable end of year benefit, which in EGAT is about US$1000 per employee. By comparison, Tenaga in Malaysia has had to disclose its operations and profits to the public and shareholders. Tenaga's profitability has been affected heavily in recent times due to economic crises. Low profits affect the stock market price of shares. Forced to run efficiently, Tenaga was forced to operate efficiently and management therefore had to turn vigorously to the reduction of power theft that causes losses of about M$500 million a year. Caution must be exercised when emphasize is placed on privatization as the solution for the problems of inefficiency. The Orissa (India) electricity sector was privatized in 1996 with the corporatization of the Orissa State Electricity Board, the establishment of the Grid Corporation of Orissa to manage T&D of electricity and the Orissa Electricity Regulatory

Commission to regulate the system. The record shows uneven improvement (Seger, 2018). Electricity tariffs increased by 76%, T&D losses rises to 45%, and revenue mobilization was only at 54% of those billed (Brown & Ahmed, 2019). Investment in improving the system and adding additional capacity cannot be undertaken, loans and payments cannot be met, and the consumer faces increased power tariff. Even in efficient systems, theft losses can account for millions of dollars each year in lost revenue. Power theft in its different forms can be minimized and kept under control only by the strong and assertive action of power sector organizations. The strategy and the action should be based upon a thorough understanding of the specific nature of the theft problem. A strong case can be made that each power system, including consumer's attitudes and behavior has its own unique qualities and only by knowing the system and the problem can effective solutions be designed and implemented. Because a greater degree of electricity theft is associated with corruption, the analysis cannot be confined to technical and managerial perspectives and needs to be multi-disciplinary in approach. Theft as an activity in some systems is closely intertwined with governance and with the social, economic and political environment. Corruption and electricity theft thrives off each other. In an overall culture of corruption as a way of life, electricity theft can be reduced to moderate levels by technical and engineering methods. But it is an uphill battle to reduce the electricity theft rate drastically as long as extensive corruption continues. Reduction in power theft and keeping it within reasonable bounds is more likely to be successful in systems with a good governance culture. This is because the theft reduction mechanisms find a friendly environment for initiation and implementation. As part of generating and sustaining good governance in communities, electric power systems have the opportunity to take the lead in promoting sound corporate governance. The technological innovations make this task easier should the managerial skills and desire exist.

Electric power systems can be restructured to make power sector organizations operate in competitive environments where efficiency and effectiveness in service delivery are both virtues and necessities.

2.14 Empirical Literature

This section presents a review of previous literature on the subject under consideration, power theft. The section is sub-divided into the following subheadings: factors that contribute to electricity theft; consequences of electricity theft and strategies for preventing electricity theft.

2.14.1 Contributory Factors to Electricity Theft

A study conducted by Yakubu (2018) sought to identify the underlying contributory factors that fuel electricity theft in Ghana. The researcher collected data from the Ashanti Region which is among the most densely populated regions in country. The study discovered that: high cost of electricity, poor quality of power supply services, poor enforcement of laws against power theft, failure of Public Utility Regulatory Commission to protect the interest of consumers as the main contributory factors. The study also found other factors as attitudinal, illiteracy, poverty and unemployment.

Mbanjwa (2017) conducted a study to investigate illegal connection of electricity in KwaXimba. The main objective of the study was to determine the major cause of electricity theft in KwaXimba, South Africa, the strategies employed to minimize the increase in electricity theft and moreover; it aimed to evaluate the effects electricity theft has on electricity supply and the community. In order to achieve this, the qualitative approaches were used. Interviews were conducted on participants that were purposively selected. The data was then analyzed thematically. Findings of this study revealed that the issue of electricity theft in the community

was a structural issue. The issue of theft is normalized within the community. The study also revealed that individuals steal electricity based on personal decisions and preferences. Another factor was that it is acceptable to steal electricity in the community. The minority of the members stole electricity because they had bought houses that had readily stolen electricity. The researcher deduced some recommendations from the study, for one, an electrification program should be made to save both Eskom Revenue from illegal consumption and to save the lives of the community members especially the vulnerable group and children who fall victims to exposed cables. Also, organizations such as community safety and Eskom should formulate programs that are aimed towards de-normalization.

A study by Smith (2004) examined the tendency of electricity theft in different countries and concluded that Electricity theft is closely related to governance indicators, with higher levels of theft in countries without effective accountability, political instability, low government effectiveness and high levels of corruption.

According to Gaunt (2012), the factors contributing to electricity theft in rural areas are mostly driven by underdevelopment whilst in urban areas including informal urban settlements the main drivers include overpopulation. The study also found electricity prices, urbanization, poverty, literacy, per capita income and rate of urban unemployment as the key determinants of power theft.

2.14.2 Consequences of Electricity Theft

A study by Gordon (2016) found that electricity theft is responsible for the economic problems of the electric utility due to revenue loss caused by electricity consumers that are not paying for it. The stealer has the tendency to consume more energy, resulting also in power quality

problems. The study also revealed that increased consumption of energy resulting from power theft can also result in different quality deviations like transformer overload, voltage unbalance and steady state voltage drop on system buses.

The study by Jamal (2015) on the consequences of power theft found that electricity theft and the resultant energy losses suffered by power producers contribute to increased electricity tariffs. Ultimately, the resultant consequences of this are that food prices and other essential commodities will rise. Moreover, when one does not buy electricity, it is of no cost to them hence they are not likely to adopt an energy efficient life style. Electricity theft affects the financial status of the producers of electricity

Sigauke (2010) found that another effect of electric theft is that of non-technical loss of power. The causes of non-technical losses of power that are relevant to this study are electricity theft and the non-payment by the legal consumers which is one that contribute the greatest degree of loss.

According to Kelly (2015), illegal connections and power theft is one of the major causes of fire outbreaks in private homes, factories and markets. The study also found that power theft leads to electrocution.

2.14.3 Strategies for Preventing Electricity Theft

A study by Seger (2018) identified the Mobile Remote Check Meter as a method that could be adopted to reduce electricity theft. This method is used to detect electricity theft at a small scale that is low voltage electricity through the meters (Doorduin, Mouton, Herman & Beukes, 2014). This method operates in such a way that the resolution of illegal consumers detected depends on the deviation of the losses and the connected time of the check meter. This way, the machine is able to pick up energy that is being consumed illegally hence the ability to combat it.

Shopeju (2017) also suggested that various strategies and policies detecting electricity theft, awareness campaigns, and prosecution of electricity thieves could help curb the incidents of power theft.

Mzini and Lukamba (2014) also suggested that electricity theft can be curbed by applying technical solutions such as tamper-proof meters, managerial methods such as inspection and monitoring, and in some cases restructuring power systems ownership and regulation.

Reiche, Covarrubias and Martinot (2019) also recommended the use of Smart Grid Technologies, Advanced Meter Infrastructure, and the Intelligent Electricity Device to deal with power theft. The new strategies to address the challenges of electricity theft include the use of smart grid technology and Advanced Meter Infrastructure (AMI). They define smart grid technology as the modernization of the power grid infrastructure with new technologies, enabling a more intelligently networked automated system with the goal of improving efficiency, reliability, and security, while providing more transparency and choices to electricity consumers.

2.15 Conclusion

The chapter begun by providing a brief discussion on conceptual review of the key variables in the study thus power theft. The theoretical framework and findings reported in earlier related studies on power theft. Local studies that have been done on power sector did not focus on power theft; there is therefore a gap in the empirical evidence available which this study seeks to bridge the gap.

CHAPTER THREE

RESEARCH METHOD

This chapter elaborates on the methods which have been used by the researcher to generate solutions to the research questions. It describes the methods used to conduct the study, the population of the study, sample size used, sampling techniques, sampling procedure, study instruments, and the analytical tools and techniques used in the study.

3.1 Research Design

The study was descriptive, as it sought to present a clear view of power theft and other related issues surrounding the objectives of the study. A cross-sectional survey design was adopted in the conduct of the study because the researcher went to the field once to collect data. The study was quantitative in nature so the responses gathered have been expressed in numerical terms. The method is capable of reducing researchers' bias in the presentation of the result, and hence presents a reliable and credible result.

3.2 Target Population

The study was conducted in 30 selected households in Tema; 3 selected private manufacturing companies in Tema with; and staff of ECG in Tema Region. The population of the study was 1,218 residents of Tema, Staff of E.C.G and employees of private manufacturing companies in Tema.

3.3 Sample and Sampling Technique

The sample size of the study was 150 respondents who were made up of 90 domestic consumers of electricity in Tema; 50 employees of private companies; and 10 staff of ECG. The sample size was carefully selected in order to provide results that represent perspectives of different sections of consumers of electricity and also the perspectives of experts on issue of power theft.

The study adopted the convenience sampling technique to solicit views of (90) domestic consumers of electricity; (50) commercial consumers of electricity; and (10) staff of ECG. This convenience sampling technique offered all domestic and commercial consumers of power in Tema, and ECG staff equal opportunity to participate in the study. Also, the questionnaires were administered directly by the researcher personally to all the respondents.

3.4 Sources of Data

Primary data from domestic consumers; commercial consumers and staff of ECG was used for the study. The researcher used primary data because primary data ensures the originality of the data collected.

3.5 Data Collection Instrument

The data was collected using questionnaires which were designed by the researcher for the purpose of conducting the current study. In order to obtain full perspective of domestic consumers, commercial consumers and staff of E.C.G on the subject matter of power theft, three different set of questionnaire were designed to collect the data. Each of the instruments (questionnaires) was designed with close-ended questions. The respondents were presented with the questionnaires which offered them opportunity to select from five-point likert scale as: 1 represents Strongly Agree; 2 represents Agree; 3 represents Neutral; 4 represents Disagree and 5

represents Strongly Disagree. In order to ensure the validity of the instrument used and the reliability of the result thereof, the researcher sought the views of an electrical engineer in designing the instrument. The instrument was also reviewed and further approved by the supervisor of the research.

3.6 Data Collection Procedure

Due to large sample size and time constraint the researcher engaged the services of six enumerators to assist in collecting data from domestic consumers of electricity. However the researcher personally administered the questionnaires to commercial consumers of electricity and staff of ECG. Before the field data collection, the researcher took the enumerators through a training session to ensure that the purpose regarding the study as well as the questions was well explained to the enumerators to soften the fieldwork for the enumerators. The data collection spanned 8 days to enable the enumerators to have adequate time with respondents to obtain adequate information relevant for the study. During the field data collection exercise, all the necessary safety protocols regarding COVID-19 were adhered to ensure the safety of data collectors as well as the respondents.

3.7 Data Analysis

After collecting the primary data, the response gathered from the data was imputed into computer software, Statistical Package for Social Sciences (SPSS) 14.0 and analyzed. Mean and standard deviation were used to analyze the data and the results were tabulated.

CHAPTER FOUR

ANALYSIS OF DATA AND DISCUSSION

This chapter presents the results received from the survey thus, "the effect of Electricity theft on the Ghanaian power sector". This chapter is divided into three main sections namely, demographic, analysis of the results and discussion of the results. The analysis was based on the data which was collected from householder consumers, commercial consumers of electricity and staff of ECG. The analysis was based on the data collected. The analysis was done in demarcations of sub-headings.

4.1 Demographic Analysis

The demographic variables under this study are: gender of respondents and category of consumers of electricity.

4.1.1 Category of Respondents

In order to obtain responses and views of wide array of perspectives on the issue of power theft, the study solicited views from both domestic consumers of electricity and commercial consumers of electricity. In order to obtain experts views on the subject of power theft, the study included views of staff of Electricity Company of Ghana.

Table 4.1: Category of Respondents

Category of Respondents	N	%
Domestic Consumers	90	60
Industrial Consumers	50	33
Staff of ECG	10	7
TOTAL	**150**	**100**

Source: Field Survey (2021)

Table 4.1 above shows that out of the 150 respondents who participated in the study, 90 of them were domestic consumers of electricity in Tema which represent 60% of the total respondents; 50 of the respondents were commercial consumers of electricity from private manufacturing companies in Tema which represent 33% of the total respondents; and 10 of the respondents were staff of ECG which represent 7% of the total respondents. The above analysis shows that the outcome of the study was drawn from data which was collected from respondents from diverse backgrounds and with varied interest. The outcome of this study and the recommendations therefore truly represent the views of diverse interest groups and hence reliable.

4.1.2 Gender of Respondents

The study provided an opportunity for both male and female consumers and staff of ECG to share their views on the subject of power theft in Ghana.

Table 4.2 Gender

Gender	N	%
Male	60	40
Female	90	60
Total	**150**	**100**

Source: Field Survey (2021)

Table 4.2 above shows gender disposition of the various respondents as follows: out of the 150 respondents, 60 of them were males which represent 40% of the total respondents while 90 of the respondents were females which represent 60 % of the total respondents. This shows that the conclusion of the study represent the views of both males and female consumers of electricity in Tema and staff of EC.G in the Tema Region.

4.2 Data Presentation and Analysis

This section presents the analysis of data collected from domestic and commercial consumers of electricity in Tema as well as staff of E.C.G. Responses to each of the questions under each heading were expressed in five-point likert scale where: 1= Strongly Agree; 2= Agree; 3= Neutral; 4=Disagree and 5= Strongly Disagree. An arbitrary mean of 2.5 which was proposed by Ling and Ahadzie (2007) was used to decide whether a mean value recorded represent respondents' agreement or otherwise.

A hypothetical mean less than 2.5 represent respondents' acceptance of the statement while hypothetical mean greater than 2.5 represent respondents' rejection of the statement.

Table 4.3 Causes of Industrial Power Theft

Statement	Mean	Std. Deviation	N
High cost of electricity bills motivate commercial consumers to engage in power theft	1.21	1.60	50
Dishonest staff of E.C.G connive with commercial consumers to engage in power theft	1.74	0.71	50
Lack of proper monitoring of meters lead to power theft among commercial consumers of electricity	2.12	1.08	50
Failure of Public Utility and Regulatory Commission to act in the interest of consumers encourage power theft among commercial consumers	3.40	0.19	50
Public sector corruption encourages power theft among commercial consumers of electricity.	3.01	0.12	50
Lack of stiffer punishment for perpetrators of power theft encourages illegal connection in industries	2.17	0.20	50

Source: Manufacturing Companies in Tema (2021)

4.2.1 Factors Encouraging Industrial Power Theft

Table 4.3 above presents the descriptive statistics on factors encouraging industrial power theft. All the 50 commercial consumers of electricity in Tema who participated in the study responded to all the statements that were presented to them through the questionnaire as follows:

On the statement, "high cost of electricity bills motivate industrial consumers to engage in power theft" (Mean= 1.21, SD=1.60) which represent respondents' agreement was recorded. The

response received indicates that high cost of electricity bills accounts for power theft among commercial consumers. Earlier study by Covarrubias and Martinot (2019) similarly found that high cost of electricity was the major cause of power theft.

Also on the statement, "dishonest staff of E.C.G connive with commercial consumers to engage in power theft" (Mean=1.74, SD = 0.71) which also represent respondents' agreement to the question. The response received shows that respondents were of the view that connivance between staff of ECG and some commercial consumers of power account for power theft in Tema. Mzini and Lukamba (2014) also found that power theft is masterminded by staff of Electricity Company of Ghana who out of greed connive with consumers to engage in power theft.

Further on the statement, "lack of proper monitoring of meters lead to power theft in manufacturing companies". (Mean=2.12, SD=1.03) which represent respondents' agreement to the statement. The response received indicates that lack of proper monitoring accounts for the high incidents of power theft among industrial consumers of power in Tema. Lucas (2016) similarly revealed that lack of proper systems to monitor meters leads to power theft.

On the statement, "failure of Public Utility and Regulatory Commission to act in the interest of consumers encourage power theft among industrial consumers" (Mean=3.40, SD= 0.19) which represent respondents' rejection of the statement. There is a mismatch between this finding and the outcome of a study by Yakubu (2018) which concluded that failure of PURC to hold management of the power sector to task motivate power theft.

Moreover on the statement, "public sector corruption encourages power theft in industries". (Mean= 3.01, SD= 0.12) which represent respondents' rejection of the statement. The responses

received indicate that the respondents were of the view that public sector corruption has nothing to do with power theft among industrial consumers of power. Conversely a study by Smith (2014) revealed that corruption encourage power theft.

Finally on the statement, “lack of stiffer punishment for perpetrators of power theft encourage illegal connection in industries”. (Mean=2.17, SD = 0.20) which represents respondents’ agreement to the question. The outcome of the study is in line with the result of a study by (Yakubu, 2018).

Table 4.4: Causes of Domestic Power Theft

Statement	Mean	Std. Deviation	N
High cost of electricity bills motivate domestic consumers to engage in power theft	3.21	0.10	90
Dishonest staff of E.C.G connive with domestic consumers to engage in power theft	2.94	0.11	90
High cost of living leads to power theft among domestic consumers of electricity	1.34	1.02	90
Lack of effective monitoring of meters lead to power theft among domestic consumers	1.82	1.03	90
Failure of Public Utility and Regulatory Commission to act in the interest of consumers encourage power theft among domestic consumers of electricity	3.40	1.20	90
Public sector corruption encourage domestic power theft	3.21	0.22	90
Poverty is a motivation for domestic power theft	1.63	1.30	90
Lack of stiffer punishment for perpetrators of power theft encourages illegal connection in homes	1.17	0.21	90

Source: Domestic Power Consumers in Tema (2021)

4.2.2 Factors Encouraging Domestic Power Theft

Table 4.4 above presents the descriptive statistics on causes of domestic power theft in Tema. All the 90 domestic consumers of electricity who participated in the study responded to all the statement that was presented to them as follows:

On the construct, "high cost of electricity bills motivate domestic power consumers to engage in power theft" (Mean= 3.21, SD=0.10) which represent respondents' rejection of the statement was recorded. The response received indicates that respondents were of the view that high cost of electricity bill is not the cause of power theft among domestic consumers. Earlier study by Covarrubias and Martinot (2019) conversely found that high cost of electricity was the major cause of power theft.

Also, on the construct, "dishonest staff of E.C.G connive with domestic consumers to engage in power theft" (Mean=2.94, SD = 0.11) which also represent respondents' disagreement to the question. The response received shows that respondents were of the view that staff of ECG do not connive with domestic consumers of electricity to engage in power theft. Mzini and Lukamba (2014) conversely found that power theft is masterminded by staff of Electricity Company whom out of greed connives with consumers to engage in power theft.

On the statement, "high cost of living leads to power theft among domestic consumers" (Mean=1.82, SD=0.10) which represent respondents' agreement to the statement. The response received indicate that high cost of living compel people to engage in power theft. Covarrubias and Martinot (2019) similarly found that high cost of living leads to power theft.

Further on the statement, "lack of effective monitoring of meters lead to power theft among domestic consumers" (Mean=1.82, SD= 1.03) which represent respondents' acceptance of the statement. The responses received indicate that respondents were of the view that power theft is caused by lack of frequent and effective meter monitoring. Lucas (2016) similarly revealed that lack of proper systems to monitor meters lead to power theft.

Moreover on the statement, "failure of Public Utility and Regulatory Commission (PURC) to act in the interest of consumers encourage power theft among domestic consumers of electricity" (Mean= 3.40 , SD= 1.20) which represent respondents' rejection of the statement. There is a mismatch between this finding and the outcome of a study by Yakubu (2018) which concluded that failure of PURC to hold management of the power sector to task motivate power theft.

Also on the statement, "public sector corruption encourage domestic power theft" (Mean=3.21, SD = 0.22) which also represents respondents' rejection of the question. The response received

shows that respondents were of the view that domestic power theft is not caused by public sector corruption. Conversely a study by Smith (2014) revealed that corruption encourage power theft.

Further on the statement, "poverty is a motivation for domestic power theft" (Mean=1.63, SD= 0.11) which represent respondents' acceptance of the question. The response received shows that respondents were of the view that poverty compels domestic consumers to engage in power theft. The outcome of the study is in line with a study by Smith (2014) which revealed that power theft is caused by poverty.

Finally on the statement, "lack of stiffer punishment for perpetrators of power theft encourage illegal connection in homes", (Mean=1.17, SD=0.21) which represent respondents' acceptance of the statement. The outcome of the study is in line with the result of a study by (Yakubu, 2018).

Table 4.5 Consequence of Power Theft

Statement	Mean	Std. Dev	N
Power theft leads to fire outbreaks	1.24	0.21	10
Power theft causes financial loss to the state	2.12	0.14	10
Power theft causes electrocution	1.63	1.34	10
Power theft leads to increase in electricity tariffs	1.37	1.01	10
Power theft leads to frequent power supply interruptions	2.17	0.39	10

Source: ECG, Tema (2021)

4.2.3 Consequence of Power Theft

Table 4.5 above presents the descriptive statistics on the consequence of power theft. The 10 staff of ECG at Tema was asked to present their views as follows:

On the statement, "power theft leads to fire outbreaks", (Mean= 1.24, SD=0.21) which represent respondents' agreement. The response received indicated that the respondents were of the view that power theft leads to fire outbreak. Earlier study by Gordon (2016) revealed that both domestic and industrial fires are caused by illegal electricity connection.

Also on the statement, "Power theft is financial loss to the state" (Mean=2.12, SD = 0.14) which also represent respondents' agreement to the question. The response received shows that respondents were of the view that power theft is a loss to the power sector and ECG. Jamal (2015) similarly found that power lose to theft compound to become huge energy sector debt.

On the statement, "power theft causes electrocution", (Mean=1.63, SD=1.34) which represent respondents' agreement to the statement. The response received indicates that the respondents were of the view that illegal connections lead to electrocution. Kelly (2015) similarly concluded that power theft threaten lives as it is a primary cause of electrocution.

Further on the statement, "power theft leads to increase in electricity tariffs" (Mean=1.37, SD= 1.01) which represent respondents' agreement to the question. The responses received indicate that respondents were of the view that power theft leads to increase in electricity tariffs. A study by Jamal (2015) found that in order to compensate for power lose to theft, management of the power sector is compelled to shift the cost to the consumer.

Moreover on the statement, "power theft leads to frequent power supply interruptions" (Mean= 2.17, SD= 0.39) which represent respondents' agreement. The response received is consistent

with the outcome of a study by Sigauke (2010) which revealed that illegal electricity connection and power theft leads to unanticipated technical faults which causes power supply interruptions.

Table 4.6: Solution to Power Theft

Statement	Mean	Std. Dev.	N
Frequent meter monitoring minimize power theft	1.20	1.10	10
Stiffer punishment deter power theft	1.36	0.13	10
Subsidizing electricity bills minimize power theft	1.40	1.01	10
Enhanced efficiency of power supply reduce power theft	2.81	0.14	10
Public sector accountability reduce power theft	3.41	0.11	10
Public education reduces power theft	1.67	1.01	10

Source: ECG, Tema (2021)

4.2.4 Solution to Power Theft

Table 4.6 above presents the descriptive statistics on solution to power theft. All the 10 staff of ECG at Tema who participated in the study expresses their views on each of the statement that were presented to them in questionnaire as follows:

On the statement, "frequent meter monitoring minimize power theft" (Mean= 1.20, SD=1.10) which represent respondents' agreement. The response received indicates that respondents were of the view that frequent and effective meter monitoring help minimize power theft. Mzini and Lukamba (2014) also concluded that meter monitoring reduce power theft since any unauthorized tempering is detected.

Also, on the statement, "stiffer punishment deter power theft" (Mean=1.36, SD = 0.13) which also represent respondents' agreement to the statement.

The response received shows that respondents were of the view that stiffer penalty could deter perpetrators of power theft from engaging in the act. Seger (2018) similarly posits that stiffer punishment of perpetrators of power theft help minimize power theft since it serve as deterrence to others.

Further on the statement, "subsidizing electricity tariffs minimize power theft" (Mean=1.40, SD= 1.01) which represent respondents' agreement to the question. The responses received indicate that respondents were of the view that reduction of tariffs minimizes power theft. Covarrubias and Martinot (2019) similar postulate that in order to minimize domestic power theft, the state should subsidize tariffs for poor and unemployed consumers.

Moreover on the statement, "enhanced efficiency of power supply reduce power theft", (Mean= 2.81, SD= 0.14) which represent respondents' disagreement. There is a mismatch between the outcome of this study and the recommendation by Doorduin, Mouton, Herman and Beukes (2014) who suggested that power theft is reduced when the consumers are satisfied with the efficiency of the services rendered by institutions mandated to supply electricity.

Also on the statement, "public sector accountability reduce power theft" (Mean=3.41, SD = 0.11) which also represents respondents' disagreement to the question. Seger (2018) in contrast found that public accountability and transparency help prevent power theft.

Finally on the statement, "Public education reduces power theft" (Mean=1.67, SD= 1.01) which represent respondents' agreement to the question. The response is in line with recommendation by (Shopeju, 2017)

4.3 Discussion of Findings

4.3.1 Factors Encouraging Power Theft

The first objective of the study was to assess the various factors that encourage power theft. The outcome of the study shows that high cost of electricity tariffs accounts for power theft among industrial consumers. Covarrubias and Martinot (2019) similarly found that high cost of electricity was the major cause of power theft. On the other hand, high cost of power tariffs did not account for domestic power theft.

The outcome of the study also shows that connivance between staff of ECG and some industrial consumers of power account for power theft in Tema which corroborate the findings of (Mzini & Lukamba, 2014). The opposite was found in the case of domestic power theft.

Lack of frequent monitoring of meters was found to account for both industrial and domestic power theft which corroborates the finding of (Lucas, 2016).

The study further revealed that lenient punishment that are handed to perpetrators of both domestic and industrial power theft does deter others from engaging in the act as was found by (Yakubu, 2018).

The outcome of the study is in line with the outcome of a study by Smith (2014) which revealed that domestic power theft is caused by poverty, unemployment and high cost of living.

4.3.2 Consequences of Power Theft

The second objective of the study was to establish the consequences of power theft.

The outcome of the study corroborates the findings of (Gordon, 2016) that power theft leads to domestic and industrial fire outbreak.

The outcome of the study is in line with the outcome of a study (Jamal, 2015) which found that power loss to theft compound to become huge energy sector debt. Ghana is currently saddled with huge energy debt. Government paid $2.7 billion energy sector debt in 2018 and $604 million by the end of June, 2019 (www.mfep.gov.gh)

The study also found that illegal connection leads to electrocution which is in line with Kelly (2015) similarly concluded that power theft threatens lives as it is a primary cause of electrocutions.

The outcome of the study shows that power theft leads to increase in electricity tariffs which corroborate the findings of a study by (Jamal, 2015).

Finally the outcome of the study corroborate the findings of a study by Sigauke (2010) which revealed that illegal electricity connection and power theft leads to unanticipated technical faults which leads to power supply interruptions.

4.3.3 Solution to Power Theft

The third objective of the study was to identify the strategy that could be adopted to deal with power theft. The outcome of the study was that frequent and effective meter monitoring help minimize power theft which corroborate the findings of a study (Mzini & Lukamba, 2014).

The outcome of the study also shows that taking punitive action against perpetrators of power theft will deter others from engaging in similar action as was found by (Seger, 2018).

The outcome of the study also indicates that subsidizing tariffs will minimize power theft which corroborates the outcome of a study by Covarrubias and Martinot (2019) that in order to

minimize domestic power theft, the state should subsidize tariffs for poor and unemployed consumers.

Finally the outcome of this study is in line with the result of a study by Shopeju (2017) which found public education as an effective tool for dealing with power theft.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

The study had the general objective of assessing the effect of electricity theft on the Ghanaian power sector. This chapter presents the summary of findings of the study, conclusion drawn from the study, recommendations suggested by the researcher. The chapter ends by suggesting areas that will be relevant for future researchers to focus upon.

5.1 Summary of Findings

This study was conducted to analyze the causes, effect and strategies for dealing with power theft. The quantitative study used data collected from 150 respondents who were made up of domestic consumers, commercial consumers and staff of ECG. The methodology of the study served as blueprint on how the study should be conducted to answer the research questions. The convenience sampling technique was used to select the 150 respondents out of which 60 of them were males and 90 females. Three set of questionnaires consisting of close-ended questions were used to collect the data. The presentation of data was done in tabular form with descriptive statistics. The findings of this study are summarized under the objectives of the study as follows: The first objective of the study was to assess the various factors that encourage power theft. The outcome of the study shows that high cost of electricity tariffs accounts for power theft among commercial consumers; connivance between staff of ECG and some industrial consumers of power account for power theft; lack of frequent monitoring of meters was found to account for both industrial and domestic power theft; lenient punishment that are handed to perpetrators of power theft accounts for both domestic and industrial power theft; and domestic power theft is caused by poverty, unemployment and high cost of living.

The second objective of the study was to establish the consequences of power theft. The study found that: power theft causes domestic and industrial fire outbreak; power lose to theft compound to become huge energy sector debt; illegal connection leads to electrocution; power theft leads to increase in electricity tariffs; and illegal electricity connection and power theft leads to power supply interruptions.

5.2 The Conclusion of the Study

- The study concluded that greedy staff of E C G connives with consumers to engage in power theft.
- The study also concluded that lack of effective and frequent meter monitoring leads to power theft.
- The study further revealed that power theft causes financial loss to the state as it increases energy sector debt.
- The study also found out that power theft leads to power supply interruptions and increases the cost of maintenance at E.C.G.
- The study finally revealed that unemployed and poor consumers who cannot pay their bills engage in power theft.

5.3 Recommendations

The recommendations of the study are based on the findings of the study.

- It is recommended that independent meter auditors must be engaged to conduct periodic monitoring of meters.
- Public education on the adverse effect of power theft must be intensified.

- This study recommends that severe punishment should be handed to perpetrators of power theft to serve as deterrence to others.
- A system should be developed to ensure remote monitoring of meters from centralized point.
- "Poor" and unemployed consumers who cannot pay their electricity bills should be identified and offered subsidized solar energy.

5.4 Suggestions for Further Studies

Considering the adverse effect of electricity theft on power supply and the Ghanaian economy, there is the need for further studies to be conducted on the subject of power theft. It is therefore suggested that future studies on electricity theft should consider the designing of a centralized meter monitoring system.

REFERENCE

Arango, Lucas. Deccache, Elcio., Silveira, F, P.,& Benatto, D, B. (2016). Impact of electricity theft on power quality

Backman, C. (2017) *Social psychology,* New York: McGraw-Hill.

Baleiras, R, N., & Jos, S. C. (2014). To be or not to be in office again: an empirical test of a local political business cycle rationale. *European Journal of Political Economy 20(1):655–71.*

Bardhan. P., & Dilip, M. (2016). Capture and governance at local and national levels. *American Economic Review 90(2*):135–39.

Bernard, J., Stephen, G., & Jos, T. (2017). Electricity Prices and Elections in Quebec. *Canadian Journal of Economics 30(3):*505–25.

Boggs, S.L. (2015). Urban crime patterns. *American Sociological Review 30 (6)* 899-908.

Brown, D, S., & Ahmed, M, M. (2019). The Transforming Power of Democracy: Regime Type and the Distribution of Electricity. *American Political Science Review (2*): 193– 213.

Claxton, J. (2018) Complexities of household energy consumption and conservation*, Journal of Consumer Research, 8(2),* 233-242.

Curtis, F. (2019), Household energy conservation, *Energy Policy. 12 (4),* 452-456.

Dhume, S. (2019). Crossed wires. *Eastern Economic Review* 12 (8), 40–41.

Dike, D.O., Obiora, A.U., Nwokorie, E.C and Dike, B.C. (2015). Minimizing household electricity theft in Nigeria using GSM Based Prepaid Meter. *American Journal of Engineering Research* 4 (1)59-69.

Edjekumhene, I., Amadu, B. A., & and Brew-Hammond, A. (2001). Power Sector Reform in Ghana: The Untold Story. *Renewable and Sustainable Energy Reviews*, 30, 317–323.

Eliel, K, K.O.,& Boateng, G.(2014).A Smart Retrofitted Meter for Developing Countries, *International Journal for Computer Applications 9(5),* 12-32

Flavin, C., & Lenssen, N. (2014). Reshaping the electric power industry. *Energy Policy 22* (12), 1029–1044.

Gaur, V., & Gupta, E. (2016). The determinants of electricity theft: *An empirical analysis of Indian States. 9(3)*127-136

Gordon, D. (2016). Capitalism, class, and crime in America. *Crime and Delinquency*, 19(2), 163– 186.

Gyamfi, S., Amankwa Diawuo, F., Kumi, E. N., Sika, F., & Modjinou, M. (2017). The Energy Efficiency Situation in Ghana. Renewable and Sustainable Energy Reviews.

Held, M. (2014) Social impacts of energy conservation, *Journal of Economic Psychology, 3 (3-4),* 379-394.

IEA (2016) World Energy Outlook 2016. International Energy Agency, Paris.

ISSER (2005) Guide to Electric Power in Ghana. Institute of Statistical, Social and Economic Research, Accra.

Jamal, N. (2015). Options for the supply of electricity to rural homes in South Africa. *Journal of Energy in Southern Africa 26(3)*2413-3051

Johnston, M. (2006). *Syndromes of Corruption: Wealth, Power, and Democracy Cambridge*: Cambridge University Press.

Kelly, M. (2015). Inequality and crime. Review of Economics and statistics. 82 (4) 530-539.

Kemausuor, F., & Ackom, E. (2016). Toward universal electrification in Ghana. Wires Energy Environment, 6(10).

Labandeira. X. (2015). Energy Efficiency: Economics and Policy. *Journal of Economic Survey 24(3)*: 573-592.

Levin, J., & Milgrom, P. (2014). Introduction to choice theory. Thanet Press Limited, Northumberland, England.

Mbanjwa, T. (2017) An analysis of electricity theft: The case study of KwaXimba in eThekwini, KwaZulu- Natal. *Journal of Engineering Research* 4(1), 59-69.

Mensah, G. S., Kemausuor, F., & Brew-Hammond, A. (2014). Energy access indicators and trends in Ghana. *Renewable and Sustainable Energy Reviews,* 30, 317–323.

Mzini, L., & Lukamba, T. (2014). An assessment of electricity supply and demand at Emfuleni Local Municipality. *Journal of Energy in Southern Africa, 25(3),* pp.12-20.

Olsen, M. (2015) Consumers attitudes toward energy conservation, *Journal of Social Issues, 37 (2),* 108-131.

Patterson, W. (2001). Transforming Electricity the Coming Generation of Change Royal Institute of International Affairs, London.

Petracca, M.P (2011). The Rational Choice Approach to Politics: A Challenge to Democratic Theory. *The Review of Politics, 53(2)* 289-319.

Reiche, K., Covarrubias, A., & Martinot, E. (2019). Expanding electricity access to remote areas: off-grid rural electrification in developing countries. Fuel, 1(1.2), pp.1-4.

Ritchie, J. (2016) Consumer energy research: a review, *Journal of Consumer Research, 8 (2),* 343-354.

Rose-Ackerman, S. (2013). *Corruption and Government: Causes, Consequences, and Reform*. Cambridge: about the causes of corruption from ten years of Cross-National Empirical Research? *Annual Review of Political Science* 10:211–44.

Seger, K.A. (2018). Power theft: The silent crime. FBI Law enforcement Bulletin, pp 20-25.

Shopeju, J.O. (2017). Urbanisation and crime in Nigeria. 1 (2)154-163

Yakubu, O., Babu, C., & Osei, A. (2018). Electricity theft: analysis of underlying contributory factors in Ghana. *Energy Policy, Elsevier, 123(3)* 611-618

APPENDIX I

QUESTIONNAIRE FOR DOMESTIC CONSUMERS

AKENTEN APPIAH-MENKA UNIVERSITY OF SKILLS TRAINING AND ENTREPRENEURIAL DEVELOPMEN, KUMASI

As part of the requirement for completing my postgraduate program in the Akenten Appaiah-Menka University of Skills Training and Entrepreneurial Development, Kumasi, I am conducting a study on the topic, "Assessing the effect of Electricity theft on the Ghanaian power sector". Any information you will provide as part of your contribution to this study will be used solely for academic purposes and will be held strictly confidential.

Section A- BIO-DATA:

i) **Gender:** Male **[ ]** Female [ ]

ii) **Category of Users of Electricity :** Household User **[ ]** Industrial user **[ ]**

SECTION B

FACTORS THAT CONTRIBUTE TO ELECTRICITY THEFT

The questions below relate to various factors that contribute to electricity theft. Kindly express your extent of agreement by ticking **(√)** the most appropriate option below: **1= Strongly Agree; 2= Agree; 3= Neutral; 4=Disagree and 5= Strongly Disagree**

STATEMENT	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. High cost of electricity bills motivate power domestic consumers to engage in power theft					
2. Dishonest staffs of E.C.G connive with domestic consumers to engage in power theft					
3. High cost of living leads to power theft among domestic consumers					
4. Lack of proper monitoring of meters lead to power theft among domestic consumers					
5. Failure of Public Utility and Regulatory Commission to act in the interest of consumers encourage power theft among domestic consumers of electricity					
6. Public sector corruption encourage domestic power theft					
7. Poverty is a motivation for domestic power theft					
8. Lack of stiffer punishment for perpetrators of power theft encourages illegal connection in homes					

APPENDIX II

QUESTIONNAIRE FOR INDUSTRIAL CONSUMERS OF ELECTRICITY

AKENTEN APPAIAH-MENKA UNIVERSITY OF SKILLS TRAINING AND ENTREPRENEURIAL DEVELOPMENT, KUMASI

As part of the requirement for completing my postgraduate program in the Akenten Appaiah-Menka University of Skills Training and Entrepreneurial Development, Kumasi, I am conducting a study on the topic, "Assessing the effect of Electricity theft on the Ghanaian power sector". Any information you will provide as part of your contribution to this study will be used solely for academic purposes and will be held strictly confidential.

Section A- BIO-DATA:

i) **Gender:** Male **[ ]** Female [ ]

ii) **Category of Users of Electricity :** Household User **[ ]** Industrial user **[ ]**

SECTION B

FACTORS THAT CONTRIBUTE TO ELECTRICITY THEFT

The questions below relate to various factors that contribute to electricity theft. Kindly express your extent of agreement by ticking **(√)** the most appropriate option below: **1= Strongly Agree; 2= Agree; 3= Neutral; 4=Disagree and 5= Strongly Disagree**

STATEMENT	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. High cost of electricity bills motivate industrial consumers to engage in power theft					
2. Dishonest staffs of E.C.G connive with industrial consumers to engage in power theft					
3. Lack of proper monitoring of meters lead to power theft in manufacturing companies.					
4. Failure of Public Utility and Regulatory Commission to act in the interest of consumers encourage power theft among industrial consumers					
5. Public Sector corruption encourage power theft in industries					
6. Lack of stiffer punishment for perpetrators of power theft encourages illegal connection in industries					

APPENDIX III

QUESTIONNAIRE FOR STAFF OF ECG

AKENTEN APPIAH-MENKA UNIVERSITY OF SKILLS TRAINING AND ENTREPRENEURIAL DEVELOPMENT, KUMASI

As part of the requirement for completing my postgraduate program in the Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development, Kumasi, I am conducting a study on the topic, "Assessing the effect of Electricity theft on the Ghanaian power sector". Any information you will provide as part of your contribution to this study will be used solely for academic purposes and will be held strictly confidential.

Section A- BIO-DATA:

Gender: Male **[ ]** Female [ ]

SECTION B

CONSEQUENCES OF ELECTRICITY THEFT

The questions below relate the various consequences of electricity theft. Kindly express your extent of agreement by ticking (√) one of the options below:

1= Strongly Agree; 2= Agree; 3= Neutral; 4=Disagree and 5= Strongly Disagree

STATEMENT	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. Power theft leads to fire outbreaks					
2. Power theft is financial loss to the state					
3. Power theft causes electrocution					
4. Power theft leads to increase in electricity tariffs					
5. Power theft leads to frequent power supply cut.					

SECTION C

MEANS BY WHICH POWER THEFT COULD BE MINIMIZED

The questions below relate to means by which power theft could be minimized at ECG. Kindly express your extent of agreement by ticking (√) one of the options below:

1= Strongly Agree; 2= Agree; 3= Neutral; 4=Disagree and 5= Strongly Disagree

STATEMENT	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. Frequent meter mentoring minimize power theft					
2. Punishing perpetrators of power theft minimize power theft.					
3. Subsiding rates for the unemployed will minimize power theft					
4. Improving service efficiency and reliability in will minimize power theft					
5. Transparency and public sector accountability will minimize power theft					
6. Public education will minimize power theft					