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ASSESSING THE PROSPECTS OF GREEN ENERGY TECHNOLOGIES (PHOTOVOLTAIC SYSTEM) AS AN ALTERNATIVE SOURCE OF ENERGY: THE CASE OF MICRO AND SMALL BUSINESSES IN THE LA-NKWANTANANG-MADINA MUNICIPALITY

BY

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THIS DISSERTATION IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF ARTS (MA) DEVELOPMENT STUDIES DEGREE.

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DECLARATION

I, Iddrisu Samad, hereby declare that except for the references of other peoples' work which have been duly acknowledged, this study titled "Assessing the Prospects of Green Energy Technologies (photovoltaic system) As an Alternative Source of Energy: The Case of Micro and Small Businesses in the La-Nkwantanang-Madina Municipality" is my original work carried out under the supervision of Dr. Richmond Atta-Ankomah. This work has neither in full nor part been submitted for any other degree in any institution.

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All praises are due to Allah for a successful completion of this study. I am grateful to my supervisor Dr. Richmond Atta-Ankomah for the instruction and advice he offered me in my pursuit of this study. To my parents and siblings, I am forever indebted to you for the support and trust you have in me. Mr. Hashim Iddrisu, a brother and friend, May Allah bless you for your support, encouragement, the opportunity and the trust you have in me.

DEDICATION

This study is dedicated to the Almighty Allah, my family, friends and every individual who by their effort made it possible for me to recognize my potential and pursue it.

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LIST OF ABBREVIATIONS

AfDB	African Development Bank Group
ECREEE	ECOWAS Centre for Renewable Energy and Energy Efficiency
GDP	Gross Domestic Product
GWh	Giga Watt Hour
HFO	Heavy Fuel Oil
IEA	International Energy Agency
IPP	Independent Power Producer
IRENA	International Renewable Energy Agency
ISSER	Institute of Statistical, Social and Economic Research
kV	Kilo Volt
kWh	Kilo Watt Hour
MW	Mega Watt
PURC	Public Utilities Regulatory Commission
UNEP	United Nations Environment Programme
VRA	Volta River Authority
EU	European Union
GSS	Ghana Statistical Service

ABSTRACT

This study assesses the prospects of green energy technologies (photovoltaic system) as an alternative source of energy in La Nkwantanang-Madina Municipality. The assessment revolves around analyzing the influence of socioeconomic, institutional and technical factors on the adoption of green energy technologies (photovoltaic system) as an alternative source of energy by micro and small businesses. The data are drawn from the administration of questionnaires and in-depth interviews with the aid of an interview guide in La Nkwantanang-Madina. Data consist of a survey of 197 micro and small businesses and five (5) in-depth interviews. The survey was conducted to ascertain the level of education of respondents, business background of respondents, knowledge of green energy technologies, willingness to pay for solar energy technologies and their adoption decision of solar energy technologies as an alternative source of energy. The in-depth interviews were done to assess the existence and nature of policies and/or regulations on solar energy technologies and their influence on adoption in La Nkwantanang-Madina, the cost of solar energy technologies, the rate of demand, payment plans for consumers, and the efficiency of solar energy technologies and so on.

The data were analyzed in terms of the relationship between social, economic, institutional and technical factors and the adoption of solar energy technologies as an alternative source of energy by micro and small businesses. The findings show that the adoption of solar energy technologies is influenced by factors such as the level of education of respondents, business type of respondents, respondents' perception about the efficiency of solar energy technologies and the cost of these technologies. The further assessment indicated that businesses are willing to incur some level of cost in the adoption of solar energy technologies. Taking advantage of the willingness of businesses to pay for solar energy technologies will require the government

and other stakeholders to initiate policies (e.g. subsidies) that will facilitate the adoption of these technologies. It was however found that people's knowledge of these technologies, business value, monthly electricity expenditure of businesses the rate (cost) of electricity from the grid, institutional setup the existence of by-laws and gender of respondents are less likely to exert significant influence on the adoption decision of micro and small businesses in La Nkwantanang-Madina Municipality.

Based on the findings, the study therefore concludes that the prospects of solar energy technologies as an alternative source of energy is appreciable but for the adoption of these technologies to be significant there is the need for institutions and measures to address the factors that have significant influence on the adoption decisions of respondents in the La Nkwantanang-Madina Municipality.

CHAPTER ONE

INTRODUCTION

1.0 BACKGROUND OF STUDY

The global community is faced with a reproving situation in the aspects of energy security, global temperature rise, and energy poverty are pressing, making the greening of the energy sector vitally important. The current challenges are worsened by the projected growth in the global energy demand, as population and incomes increases (Islam et al., 2014). Transitioning from brown energy to green energy plays an essential role complementary with the improvement of generation and transmission infrastructure in particular to increase energy efficiency (Mathews, 2013).

Africa is endowed with numerous resources for the production of energy but suffers a hiccup in the supply of energy. Making sustainable energy accessible is hypercritical to the progress of the region that made up of about 16% of the world's population, but is able to meet only 4% of its energy demand (Kaygusuz, 2012). Since 2000, Africa has experienced a fast economic transition and energy usage has increased by 45% (Wolde-Rufael, 2006). Many governments are gearing up to deal with diversifying barriers that are militating against inflows of fiscal resources into local energy supply, but poverty in terms of energy infrastructure risks putting a halt on critically needed resources for the improvement of well-being, this situation varies across the continent of Africa (IEA, 2014).

The energy situation in Ghana is not different from most African countries that are naturally endowed with green energy resources. Ghana's power sector has over the past decade, been plagued with power supply challenges resulting in a considerable impact on the economic situation of the country. According to Mathrani et al (2013), the World Bank placed access to electricity as the next most essential constraint to economic activities in Ghana and estimated a loss of about 1.8 percent of GDP during the power crisis of 2007. Also, the Institute of Statistical, Social and Economic Research (ISSER) estimated a loss of about $2.1 million daily ($55.8 million monthly) in production value due to the power crisis "dumsor" the country was facing recently (ISSER, 2015). It is an indication that Ghana lost an estimated $680 million (2 percent of GDP) in 2014 due to the power crisis (Kumi, 2017).

Meanwhile, the amount of solar radiation Ghana receives is between 4.5–5.6 kWh/m2/day (UNEP, 2015). Interestingly, solar energy sources in Ghana haven't played any major role in the generation mix, contributing only 0.2 percent to the generation mix in 2016 (Kumi, 2017). In 2016, the only renewable facility (solar photovoltaic plant) feeding directly into the national grid was the 2.5 MW solar photovoltaic plant owned by the Volta River Authority sited in Upper East Region (EADTF, 2014).

To ensure that green/renewable energy provides feasible alternatives to the power crises in Ghana, the Green/Renewable Energy Act was passed into law in 2011 to provide the legal and regulatory framework for the adoption of green/renewable energy sources to complement the other sources. Following the passage of the Green/Renewable Energy Act, the Energy Commission has formulated regulations for the sub-sector with the inclusion of the renewable energy grid code and together with the Public Utility Regulation Commission (PURC) developed feed-in tariffs for fiscal inflows into the green/renewable energy sector. The Act provides for the setup of a Green/Renewable Energy fund to provide fiscal assets for the improvement, expansion, efficient management and consumption of green energy resources. The fund also provides financial incentives for the development of small network and private renewable power technology for rural areas and isolated communities. Under the feed-in tariff scheme, the Public Utility Regulation Commission (PURC) is mandated to set the feed-in tariff rates for the sector based on which developers could sign power purchase agreements with the distribution companies following a documented approval from the Public Utility Regulation Commission (Kumi, 2017).

Green/Renewable energy technologies (main hydropower with the other sources playing a limited role) constitute a huge proportion of Africa total power supply and there is potential for this to widen as numerous range of technologies is being developed. Many countries are working in the development of their possible green energy assets (Redcliff, 2002). For instance, Sweden has taken a step in the development of its green/renewable energy sector through the provision of a wide range of incentives to consumers in the automobile market and Germany is also going in that trajectory (Power and Zulauf, 2011). Green energy has the capacity to aid in transitioning from energy insecurity to energy sufficiency by reducing dependence on brown energy sources (fossil fuels) and assist to vary the energy generation composition (Kaygusuz, 2012).

1.1 STATEMENT OF THE PROBLEM

Electricity is an essential factor in influencing economic growth and development in any given economy or country. Electricity is important in the performance of the day to day activities of businesses, powering machines in the industrial sector, heating and lightening of households (Oyedepo, 2012). Electricity is also essential for the advancement of the healthcare system, human capital development, the mobility of people and goods, effective socialization through communication, exploration of mineral wealth by countries and so on. This emphasizes how crucial and indispensable electricity is for human existence in the 21st century (Kumi, 2017).

Sub-Saharan African businesses most frequently cite unreliable and unsustainable electricity supply as a significant constraint on their effective operation. Insufficient and outdated power generation and supply infrastructure have a huge implication on the efficiency of businesses in Africa (Escribano et al., 2010). On average, there is an estimated potential annual revenue loss of 4.9% as a result of erratic electricity power outages in Africa whilst Central Africa and Nigeria are reported as the countries experiencing very high losses. In South Africa, it is lower compared to the other countries (World Bank, 2014).

According to Attigah and Mayer-Tasch (2013) to have reliable access to electricity in economies with power supply problems, businesses in these countries invest in diesel/petrol powered generators as an alternative electricity source. Foster and Steinbuks (2008, 2010) estimated that investment in diesel/petrol powered generators as an alternative electricity by businesses accounts for 6% of total installed electricity generation capacity in sub-Saharan Africa and 20% in Nigeria and the generation of electricity through petrol/diesel powered generator is thrice the cost of the electricity from the national grid. Malik and Baptist (2006) assert that unreliable access to electricity is now part of the fabric of several businesses in

Nigeria and investment in diesel/petrol powered generators is seen as an alternative electricity source.

The role green energy technologies (photovoltaic system) can play in achieving electricity self-sufficiency or as an alternative energy source cannot be undervalued. The introduction of the Green/Renewable Energy Act in Ghana has provided a stimulus for the advancement of the sector. However, the government needs to strengthen the enforcement of the Act and the various sub-regulations as well as introducing more inducement to capture investments in the renewable energy space (Kumi, 2017).

Though there have been reliable energy production and supply in the country for the past two years, businesses and households are still in doubt as to whether this can continue for a very long time. This is because energy generation and supply have not been reliable for several years which always hit businesses hard resulting in shutdowns and laying-off of employees and also, investment in alternative energy sources (Cobbinah and Adams, 2018). Businesses in Ghana also invest in diesel/petrol powered generators to serve as backup electricity in the event of erratic electricity outages.

Taken into consideration the essential role micro and small businesses play in employment and reduction of poverty, especially in urban centres, access to reliable electricity can enhance this role even further and the adoption of green energy technologies serves as an alternative source (Scott et al., 2014).

It is against this backdrop that the research seeks to assess the socioeconomic, institutional and technical factors that influence the adoption of green energy technologies (photovoltaic system) and also, the prospects of green energy technologies (photovoltaic system) adoption as an alternative sources of energy by micro and small businesses in the La Nkwantanang-Madina Municipality as a means of achieving energy efficiency and reliability.

1.2 RESEARCH QUESTIONS

- To what extent does socioeconomic, institutional and technical factors influence green energy technologies (photovoltaic system) adoption?
- What are the prospects of green energy technologies (photovoltaic system) adoption?

1.3 RESEARCH OBJECTIVES

- To examine the extent to which socioeconomic, institutional and technical factors influence green energy technologies (photovoltaic system) adoption.
- To assess the prospects of green energy technologies (photovoltaic system) adoption.

1.4 SIGNIFICANCE OF THE STUDY

Access to reliable, cheap and clean energy is essential to economic and social development. The route to economic development has often been the outcome of the transition from agrarian to the industrialized economy (Asif and Muneer, 2007). Such transitions, in turn, alter the composition, magnitude of energy consumption and types of energy technologies utilizes (Stern, 2011). Advancement in green energy technologies provides diverse opportunities for the achievement of universal access to electricity through the adoption of these technologies but there is still the existence of several constraints (Alstone et al., 2015).

Access and insecurity as well as the cost of electricity in developing countries is considered an essential constraint of developing countries, noticeably more than in developed countries (Scott et al., 2014). Unreliable supply of electricity in sub-Saharan Africa is considered a significant constraint on the efficient and effective operations of businesses (Escribano et al., 2010). The role green energy technologies (photovoltaic system) can play in ensuring electricity access and security for micro and small businesses cannot be underestimated.

Green energy technology (photovoltaic system) adoption can have numerous benefits. For example, global warming and climate change are one of the acute problems that the globe is facing today, hence, efficient transition from fossil fuels (that emits high levels of CFCs into the atmosphere) to green energy will aid in the mitigation or adaptation to climate change and its associated impacts. Economically, green energy technologies adoption has a trickle-down benefits potential i.e. the adoption of green energy technologies has the potential for economic growth, employment opportunities, efficient and cheaper energy generation and supply for households and businesses. (Mallon, 2006; Omer, 2008).

Increasing the adoption of green energy technologies has the potential of reducing annual expenditures in relation to climate change and air pollution up to $4.2 trillion and also, global gross domestic product could increase in 2030 by more than the baseline projection of $1.3 trillion (IRENA, 2016a).

The aim of the research is to assess the prospects of green energy technologies (photovoltaic system) adoption as an alternative sources of energy by micro and small businesses in the La Nkwantanang-Madina Municipality. As mentioned above, access to reliable, cheap and clean energy is essential to economic and social development. Therefore, in order to ensure appreciable access to reliable and clean via the adoption of green energy technologies (photovoltaic system) as an alternative source of energy, the factors that influence the adoption decision of businesses need to be assessed.

The research serves as a tool for identifying and contributing explicitly to the understanding of the socioeconomic, institutional and technical factors that influence green energy technologies (photovoltaic system) adoption as an alternative source of energy. The research also serves as a sensitization instrument for the creation of awareness in relation to green energy technologies (photovoltaic system) through interaction with business owners and the need to gradually move from fossil energy to green energy via the adoption of photovoltaic system. Furthermore, recommendations made with regards to the results of the research can be assessed and implemented to trigger the adoption of photovoltaic system as an alternative source of energy by micro and small businesses and other sectors of the economy. Again, it is an addition to knowledge with regards to green energy technologies adoption as an alternative source of energy.

1.5 ORGANISATION OF THE STUDY

The study is structured into five chapters. Chapter one deals with the background of the study, statement of the problem with the focus on the African and Ghanaian energy sector (demand, supply, access, and potential) and the research objectives and questions. Chapter two deals with literature in the energy sector i.e. it focuses on the various green energy technologies accessible in Ghana (La Nkwantanang-Madina) with a focus on solar energy technologies as an alternative source, factors that influences green energy technologies adoption, energy policies in Ghana, potential benefits of green energy, Ghana energy demand and supply nexus, Ghana energy sector structure, energy access and gender issues. Chapter three spells out the methodologies that were used in the research process. Chapter four deals with presentation and discussions of findings and chapter five focus on summary, conclusion, and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

The literature review used information from scholastic documents, online information and varying official records concerning green energy. The literature aided in the identification of the barriers and challenges in green energy development and adoption, energy access in Africa and Ghana, energy and business, renewable policy in Ghana, gender and energy access as well as the important factors that impact the adoption of green energy technologies (photovoltaic system).

2.1 Green/Renewable Energy Technology Sources

Green energy is the type of energy that is derived from natural resources (sunlight, tides, rain, wind, geothermal heat, and waves)) that are replenish able and have minimal impact on the environment (Ellabban et al., 2014). Brown energy covers energy sources that contains high levels of carbon (petroleum or coal). The utilization of these sources in the generation of energy results in negative environmental impacts due to the emission of greenhouse gases (Dincer, 2000).

Globally, several economies are making use of diverse energy sources in satisfying their energy needs in various sectors of their economy (domestic, industry, agriculture, education, health, service and so on). Due to the negative externalities created by the utilization of traditional energy sources- fossil fuels on global climate. For the reduction and mitigation of current and future threats posed by fossil-fuel consumption to the global climate to be achieved, several alternatives have been recommended by various scientific institutions and essential stakeholders (Commission Proposal COM (2000) 796 final; IPCC, 2007; Mallon, 2006).

Consumption of fossil energy in developed countries have increased rapidly, and are now decreasing as a result of their transition towards energy sources with minimal carbon emissions. But, developing countries consumption of fossil energy is still increasing due to increasing incomes (triggering an increase in per capita energy) and populations (Ritchie and Roser, 2018).

One route to ensure the reduction in greenhouse gases specifically carbon dioxide is the broadening and adoption of alternative sources of energy that emits minimal (debatable zero) greenhouse gases. These alternative sources of energy are either directly or indirectly from the sun (wind energy, bioenergy, and hydropower) and energy not from solar power e.g. geothermal and tidal (Boyle, 2004).

The sphere of green energy technology comprises of a continues discovery of environmentally friendly techniques and approaches for the generation of non-traditional energy such as solar energy to administrative instruments that aid in the regulation of greenhouse gas emissions (Show, 2010). Green energy technology adoption must be sustainable and efficient, meaning the needs that are required to be satisfied should not pose a threat on the capability of subsequent generations to satisfy their own needs and it should be cost-effective without comprising quality and quantity. This can be achieved through an integrated principle i.e. social, economic and environmental aspects of green technology should be considered (Camagni et al, 1998).

The existence of green energy or renewable energy resource cannot be underestimated because there are numerous of them, particularly solar, biomass and wind **(**Jacobsson and Bergek, 2004)**.** The development and utilization of green energy and the conversion of effluent to resources that can be used to generate energy (energy resources), solar radiation and wind have the capacity to turn the energy insecurity in Ghana and alleviate the adverse climate change footprints or effects. The utilization of effluent or waste as resources for energy generation has the prospects to function as an important component of the national sanitation programme (Ministry of Power, 2010). The rapid increase in green energy adoption is leading to significant climate change mitigation, energy security and socioeconomic benefits (IEA, 2012).

For the modernization and upgrading of electricity systems globally, green energy are now the front-runner alternative. In 2015, solar and wind energy attracted a 90% investments in green energy which facilitated their competitiveness with fossil energy due to declining costs in recent years. For every five units of energy consumed, one unit is generated from green energy source (IRENA, 2017).

Below are some of the common green energy technologies sources available in Ghana with priority given to solar energy and a brief information on hydro energy, bioenergy, and wind energy.

2.1.1 Solar Energy

The advancement in technology and decreasing costs are influencing green energy adoption globally, with the front-runner being the power sector in terms of the adoption of green energy technology. Solar photovoltaic technology exhibits this more. In 2015, global solar photovoltaic installations experienced a rapid increase from 40 gigawatts in 2010 to 219 gigawatts, this was as a result of an estimated 20% of newly installed electricity generation (IRENA, 2016b).

Solar energy technologies have not been popular in the African continent in terms of the generation of electricity although sunshine is an abundant resource on the continent. Africa as a continent is distinctly endowed with the potential of solar energy. Of which majority of the continent experiences energy generating sun rays more than 45 weeks per year with irradiation magnitude of approximately 2000 kWh per square meter which is two times the level of irradiance of Germany (European Commission JRC, 2011).

Considerably, Ghana is enriched with resources in terms of solar that can be capitalized on for the generation of electricity and heat. Solar energy utilization has however been restricted as a result of the cost associated with its adoption compared to other energy generation technologies. There is an approximated 50% market increment of solar energy technology adoption annually, this amount to at least 75 GWdc – approximating to more than 31,000 solar energy generating panels that are mounted every sixty minutes – increasing the world aggregate to a minimum of 303 GWdc. China emerges as the country that is leading in the exploration of solar energy with an estimated 85% additions with respect to other top countries. Yet upcoming markets across the globe are contributing appreciably to the world solar energy expansion, and majority identify solar Photovoltaics as a reliable and profitable source for improving efficient electric power generation and for the provision of equitable access to energy (Sawin et al, 2013).

The rapid decrease in the cost of solar energy technologies has influenced the emergence of new markets. The cost of solar photovoltaic has declined to half compared to the cost in 2010 and have the potential to decline further by an approximated 60% within a ten year period. Green energy technologies are competitive economically for the generation of power and in economies or structures well-endowed with brown fuels for energy production, solar photovoltaic is competitive (IRENA, 2016c).

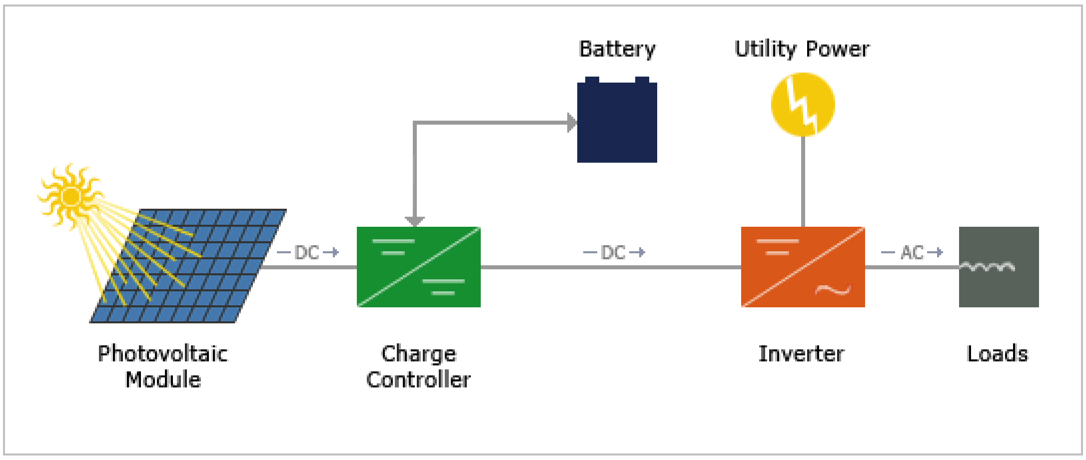
About 30% of green energy was accounted for by solar photovoltaics in 2015 as an additional generation capacity globally. It also received about half ($149 billion) of the total green energy cash inflows ($301 billion) in the energy sector (BNEF, 2016). Furthermore, it is the major green energy employer, globally, creating an approximated 2.8 million employment opportunities in 2015 globally, in excess of 11% in 2014 (IRENA, 2016d). An approximated 200 to 300 million tonnes reduction in carbon dioxide through solar photovoltaics energy generation per year and there can be a further reduction between 1 and 3 gigatonnes per year in 2030 (IRENA, 2016f). This reduction in carbon dioxide emissions represents the emissions of Poland at the high end (JRC, 2016b).

Preceding to 2016, the only green energy facility in Ghana, contributing directly into the national grid is the 2.5 MW solar photovoltaic plant owned by the Volta River Authority in Navrongo and BXC solar power plant of 20MW to increase green energy source in the generation mix. About 500 kW has also been installed (grid and with battery storage) by individual homes and institutions. This still leaves over 100 MW of potential energy unutilized (EADTF, 2014).

The Energy Commission under the umbrella of the Ministry of Energy has initiated a solar energy project called “National Rooftop Solar PV Programme” as a way of issuing fiscal subsidy for the development of rooftop solar PV systems to residential facilities. The programme seeks to minimize the burden on traditional electricity generation infrastructures. The beneficiary will receive a 500 kW of solar panels after the purchase of battery, inverter and charge controller under the initiated programme (Energy Commission of Ghana, 2016a). Furthermore, an approximated 76 private companies have received temporary licenses by the

Energy Commission to commence grid-connected solar projects (UNEP, 2016). The figure below illustrates a simple solar photovoltaic system.

Figure 1.0: A Simple Solar Photovoltaic System



Source: http://www.synergyenviron.com/app/assets/img/resources/res-solar-spvs-gcs.gif

2.1.2 Other Types of Green Energy Sources

Hydro energy is the biggest and the most commonly green or renewable energy source that is being exploited for the generation of power in most countries globally, it utilizes the gravitational force of running water to produce electricity. Electricity generated from hydro was estimated to account for 20% and 80% of the globe's electricity and of the overall electricity produced and supplied from renewable energy sources respectively (IRENA, 2012). In Ghana, a company owned by the government (Volta River Authority) and it is the biggest electricity generation company with an aggregate installed capacity of 1,020 MW as at the end of 2016, which makes up 66.1 % of the country's aggregate installed capacity, the Bui Power Authority manages the Bui Hydro Power Plant whose installed capacity is 400 MW and Kpong 160 MW (VRA, 2016; Energy Commission of Ghana, 2016a).

Also, Bioenergy is a green energy source that is organically obtained from living substance or organisms, like effluent or sewage, lumber, and ethanol fuels. These sources of bioenergy are purposely built for the generation of electricity or the production of heat (Demirbas, 2001). For the generation of electricity and heat, bioenergy is considered as a potential green energy source in most energy expansion developmental plans. In the European Union Renewable Energy Action Plan(s), each EU country made a 19%, 77% for green power and heat respectively will be obtained from bioenergy (ECN, 2011). According to the World Energy Outlook (IEA, 2010a), 1379 TWh (4.6%) of electricity generated globally came from bioenergy and residue or waste and an approximated 1225 Mtoe for heat generation.

Furthermore, electricity generated from wind has remained very insubstantial when setting side by side with electricity generated from hydro, with only 190 MW in all of sub-Saharan Africa, even though the net present value of the factor cost of electricity from mainland wind technologies have decreased considerably in recently. The prospects of wind in Sub-Saharan Africa is approximated to be 1300 GW (Mandelli, et al, 2014). The mechanical wind energy potential of Ghana has been approximated to be over 5,000 MW. It has been approximated that about 200-400 MW of inshore or seaward wind energy has the potential to be developed along this mountainous region of Ghana (Essandoh, Osei and Adam, 2014). There are plans by the Volta River Authority to set up a wind power plant in Ada and Keta of a capacity of 150 MW as a means of diversification in the electricity generation (VRA, 2016).

2.2 Actors in Green Energy Technology (Solar) Adoption

Outlining the main actors or stakeholders that have an influence on the development of green energy is an essential component of comprehending the main hindrances and possibilities associated with the adoption of green energy technology. The literature shows that a discrete set of stakeholders may have a homogeneous but also distinguishable aims, potential, and intensity of impact concerning green energy adoption.

Global, national, regional and local administrations have the competence to formulate and implement effective policies which can stimulate the adoption of green energy technologies through monetary or fiscal arrangements. According to Acker and Kammen (1996), the expansion in the solar market of Kenya was as the result of investment from global donor institutions and this led to investment from private entities in the market. Bawakyillenuo (2012) argues that this investment led to Nairobi-Kenya being Africa's major center of investment in solar energy technology from donor institutions. In addition, this stakeholder has the capacity to provide expertise orientation and sensitization to potential green energy users in order to adopt green energy solutions (Lipp, 2007). Apart from donor organizations, other actors such as non-governmental organizations, businesses, and research institutions have the ability to influence and negotiate with governments to build and adopt green energy technologies as an alternative energy source as stakeholders (Eikeland, 2011).

In Ghana, the main actor that influences the green energy sub-sector is the government (Ministry of Energy, Ministry of Finance, Energy Commission and Public Utilities Regulatory Commission). For instance, policies and projects relating to green energy are formulated by the Ministry of Energy and the financing of these projects are carried out by the Ministry of Finance i.e. the government made a commitment to increase green energy mix to 10% by 2020 in the economy (Ministry of Energy, 2010a), but this could not be realised probably due to financial, technical hiccups and lack of institutional capacity.

Also, economically, the government influences the adoption of green energy technologies through subsidies and tariffs placed on green energy technologies that are brought into the country. Tariffs that are high will result in the shift in tax burden from the supplier to the consumer and this will result in high green energy technologies cost and in turn will result in low purchase or adoption all things being equal (Jacobsson and Lauber, 2006). The Energy Commission has introduced a programme where after purchasing the balance of systems including the inverter, battery and charge controller by a client, he/she can receive a maximum of 500 kW solar panels from the programme (Energy Commission of Ghana, 2016b). Initiatives like these reduce the initial cost of installation.

Another essential actor is businesses. The main goal of every business is often clearly defined: “The objective of the corporation is to maximize stockholder (shareholder) value expressed either as maximizing long-run profits, growth or dividends” (Friedman and Miles, 2006: 3). With this as a goal, businesses will seek alternative energy sources to induce long-run growth and profits. With regards to size and sector in which a business operates, the political and social spheres will be influenced by the interests of the firm. Indigenous businesses possess the proficiency to leverage governments either significantly or marginal and for substantial businesses, their influencing capacity is local. For example, large firms or corporation have the ability to influence markets in the “acceptance of technological transformation”. Furthermore, financial institutions perform a significant role in green energy adoption through the issuance of credits for green energy operations, for instance: “Citigroup and Royal Bank of Canada” provide financial schemes for green energy adoption (REN21, 2006).

2.3 Factors That Influence the Adoption of Green Energy Technologies

This section discusses the factors that influence the adoption of green energy technologies. These factors either facilitate or serve as a barrier to the adoption of green energy technologies. Discussed below are these factors:

2.3.1 Institutional Constraints

A significant factor that drives the adoption of solar energy technology is the institutional setup (policies on energy) of economies according to Bawakyillenuo (2012). For Geller (2003), Institutional Support (national, regional and local levels) and expertise of the populace and local administrations are required in order to formulate policies that facilitate the buildout and installation of green energy technologies. Complementary with the indispensability of the comprehension of the national political field, the prerequisite of local authorities to make pronouncements and efforts for the utilization of green energy sources can be seen as a major hindrance for the adoption of green energy technologies. Simultaneously, strategies to incentivize and stimulate the utilization of green energy is noticed as a recurring concern for alternative technologies (Mallon, 2006; Mendonça, 2007).

According to Karakaya and Sriwannawit (2015), the lack of consistency in incentives and the absence of incentives with regards to solar photovoltaics affects the adoption of solar photovoltaics. According to Brukhardt el al., (2014), solar technology cost has experienced a declined over the past decade, but the institutional cost of adoption has not experienced the same decline and difference in the institutional setup (regulations, by-laws, and permits) can affect the adoption of solar photovoltaics by 8% in terms of price.

The initiation of policies by governments for the establishment of green technology can lead to the deployment and decline in cost via economies of scale and advancement in technology. An estimated 146 economies had implemented policies (electricity, transportation and cooling and heating) to facilitate the adoption of green energy by the close of 2015 (REN21, 2016). According to IRENA (2014), policy measures are being altered frequently to provide an investment-friendly environment with the efficiency of green energy in mind.

2.3.2 Education and Awareness of Green Energy Technologies

According to Hankins (2004) "….PV markets grow in an organic manner. Consumer demand grows once awareness is built up…." (p. 34). There is the existence of a considerable gap in the aspect of knowledge concerning the recognition of the presence of options to become energy self-reliant with the efficient utilization of green resources for the generation of energy. This is a top-tier situation that requires a prioritization when appraising the establishment of green energy designs and resolution of energy problems. The access to information by central or local governments and citizens in relation to the adoption of green energy technologies and the numerous benefits that can and will be realized as a result of the utilization of green energy can influence the utilization of resources that exist in the local sphere. This determinant can affect the increase in utilization of green energy while suitable or apt strategies to build green energy should make provisions for the integration of education and awareness. This can be promoted by the establishment of webs/alliance between suppliers and/or consumers in order to utilize resources by the provision of knowledge regarding funding opportunities and the existence of alternative technologies (McCormick, 2007; European Environment Agency, 2004).

2.3.3 Constraints in the aspect of monetary or fiscal constraints

Access to most efficient (photovoltaic) green energy technologies is constraint by the high initial installation cost which is not possible for the majority of Africans due to high importation cost or tariffs (World Bank, 2001). This is further strengthened by the utilization of brown fuels (petrol, diesel, kerosene and so on) for many years. Nonetheless, there are noteworthy precedents of the possibility of the reversal of the brown fuel approach. Government financial assistance projects have developed large green energy markets; for instance, Germany and

Spain have such financial assistance projects in the aspect of windmill's adoption (Geller, 2003; Mallon, 2006; Mendonça, 2007).

According to IRENA (2017), the social and economic benefits of green energy technologies can be broadened if there are sufficient inflows (investment) in the sector. Inflows into the green energy sector have to experience a rapid increase through private sector investment in durable assets with appreciable returns. The inflows of investment in economies with expanded green energy potential experience low inflows due to market barriers and perceived investment risks. According to BNEF (2015), inflows from the public sector in the green energy sector from national and international financial institutions experienced a steady rise from an estimated USD 18 billion to USD 54 billion from 2007 to 2011. Inflows have plunged to USD 39 billion in 2014.

The Energy Commission of Ghana has initiated a programme to mitigate the financial constraints faced by potential users of green energy technologies (solar). Under this programme, there is the provision of 500 kW solar panels to individuals that have purchased batteries, inverter and charge controller (Energy Commission of Ghana, 2016b).

2.3.5 Technical Barriers

Implementation of a novel energy generation technology (green energy technology) requires technical competency to function efficiently and effectively. The significance of technical knowledge and skills in the establishment and utilization of green energy technologies cannot be underestimated because a functioning green energy technology is dependent on the availability of technical personnel that will carry out installation and maintenance processes (Baguant and Manrakhan, 1994; Reddy, 1991). For Karakaya and Sriwannawit (2015), the durability, efficiency, safety, and complexity of solar energy technologies affect their adoption, utilization and maintenance and, inadequate knowledge of solar photovoltaics results in deficient building plans where rooftop solar systems installation are not considered.

2.4 Access to Electricity in Africa

Accessible electricity is an all-important integrant of stimulating the progression of the human race throughout the globe. It permits greater use of energy technologies for agricultural activities such as irrigation of crops and watering of animals, provision of avenues for employment and improving conditions for the acquisition of knowledge through studies, work, leisure, advanced healthcare delivery and improved education (Karekezi et al., 2012). Notwithstanding the fact that Sub-Saharan Africa is endowed with resources for the generation of energy, there is the existence of inadequate advanced infrastructure to facilitate access to cheap, reliable, sustainable and up-to-date or advanced electricity for all of Africans in the continent (IEA, 2014). According to IEA (2016), an approximated 634 million sub-Saharan Africans have no access to electricity i.e. for every three people two have no access. The power sector in several African economies is faced with an erratic supply of electricity, generation capacity constraints and inadequate efficiency resulting in rising production and consumption costs (Sokona et al., 2012). In addition, the estimated expansion of African population and robust economic development has the potential of resulting in a high increment in electricity demand (Lucas et al., 2015). For the expansion of access to electricity to be successful, there is a need for the improvement of the energy infrastructure i.e. generation and distribution infrastructure.

For Brazilian et al., (2012), though there is an increment in terms of electricity access, the number of sub-Saharan Africans still living without electricity access currently exceeds the number of people about two and a half decades ago. An estimated 77% (400 million) of sub-

Saharan Africans was without electricity in 1990. Comparatively, there has been an improvement in the access to electricity in Africa significantly since 2010, but the absolute number of sub-Saharan Africans that are without electricity access has experienced an increment due to an increased population with inadequate development of power generation and distribution infrastructure. The rate of electrification is different across countries i.e. the rate of electrification was 86% in South Africa and the rate was 1% in South Sudan in 2014. In addition, electricity access inadequacies is a constraint, especially in rural communities. According to Brew-Hammond (2010), an estimated 63% of sub-Saharan Africana are located in rural areas, with electricity access being 19% compared to an access of 63% in urban areas.

2.5 Access to Electricity in Ghana

The International Energy Agency (IEA) reports in the 2016 World Energy Outlook that as of 2014, of the total sub-Saharan African, 35% of the population had electricity access (IEA, 2016). Ghana's commitment to attaining universal access to electricity (physical and financial access) by the year 2020 commenced in 1989 with the inauguration of the National Electrification Scheme (Ministry of Energy, 2010b). The National Electrification Scheme (NES), which is one of Ghana's flagship projects, serves as the principal instrument leading the efforts to widen the access of electricity to all the areas of Ghana throughout a thirty-year period from 1990–2020. At the start of the scheme, only 15- 20% of the country's populace had electricity access (Ministry of Power, 2016).

Recent electricity access reviews have put access rates at 66.7% in 2009, 80.51% in 2015 and 82.5 % in 2016 (Ministry of Power, 2016). An annual increase in electricity access rate of 2.60 %. At this rate, Ghana is likely to miss its goal of attaining universal electricity access by the year 2020 by a 5 % margin. Universal access can, however, be attained by the year 2022 unless measures are put in place to accelerate the process; in which case the target could be achieved by 2020 with an annual increase of 4.38 % in electrification rate (Kumi, 2017).

It is, however, significant to be guided by the factor that, electricity access does not only signify having a house connected to the electricity grid but also ensuring the reliable supply of affordable electricity to the household (Mensah, Kemausuor, and Brew-Hammond, 2014). Unfortunately, Ghana's power sector seems to be suffering the curse of the unreliable power supply, which could negatively impact the achievements made towards universal access.

2.6 Business environment and Energy Access

Sub-Saharan African businesses most frequently cite unreliable and unsustainable electricity supply as a major hiccup in their effective operation. It is a common deficiency that impacts both economies with large indigenous energy generating resources and those that are a handicap in terms of energy resources. Insufficient and out-dated power generation and supply have a huge implication for businesses in Africa in the aspect of productivity (Escribano, Guasch, and Pena, 2010). For instance: On average, there is an estimated annual sales to be loss of about 4.9% as a result of erratic electricity power outages, Central Africa and Nigeria are being reported as the countries experiencing very high losses, in South Africa it is lower as compared to the other countries (World Bank, 2014b). For Castellano et al., (2015), the usage of petrol/diesel powered generators as an alternative energy source has resulted in an increment in cost of business, loss of an estimated 2% of sub-Saharan Africa gross domestic product and 5% of yearly sales of businesses.

The World Bank placed access to electricity as the next most essential constraint to economic activities in Ghana and approximated a loss of about 1.8 % of gross domestic product in the course of the energy crisis of 2007. Also, a research institute (ISSER) under the University of

Ghana estimated in their 2014 study that, a loss of about $2.1 million daily ($55.8 million monthly) in the value of production due to the power crisis that the country was facing (ISSER, 2015. It is an indication that Ghana lost an estimated $680 million (2% gross domestic product) in 2014 due to the power crisis.

Access to cheap, reliable and clean electricity is essential for businesses or commercial activities. The enterprise survey on infrastructure, 30% of the business proprietor's in developing countries perceive erratic electricity access as a considerable inconvenience or limitation (Arlet et al., 2017). Kirubi et al., (2009) proclaim that accessible electricity has the potential to increase output by 100%, 50% to 170% in rural areas in Kenya for joinery or carpentry workers and tailors respectively. Access to cheap and reliable electricity impact on output, revenue, profits, and income is not automated and to realize the optimal economic effect of access to electricity, the existence of certain significant preconditions is crucial; capital adequacy, accessible markets and efficient transportation infrastructure (Attigah and Mayer-Tasch, 2013).

2.6.1 Green Energy and Economic Growth

Electricity is an essential factor in influencing economic growth and development in any given economy or country. It performs an important task in the day to day activities of businesses, powering of machines in the industrial sector and heating, lightening of households (Oyedepo, 2012). Rud (2012a) asserts that economic growth and output per man's hour (productivity) are correlated to electrical power infrastructure and electrical power consumption positively. For World Bank (2017), economies in Sub-Saharan Africa were distressed of an average of 690 hours of electricity service interruptions, with an approximated cost of 2% points of gross domestic product to those counties. Also, Adenikinju (2005) asserts that "It is fairly settled in the literature that infrastructure plays a critical and positive role in economic development."

The potential benefits of green energy technologies to improved healthcare services, education, and alleviation of poverty, employment, and mitigation of climate change have delimited the sphere of gross domestic product. Access to healthy, cheap and reliable energy facilitates the empowerment of individuals and groups to maximize welfares, control of the supply of energy, reduction in energy bills and a route out of poverty (IRENA, 2017).

The reduction in the cost of green energy technologies (solar) in recent years have paved the way for green energy technologies (solar) to be an efficient alternative for an off-grid energy source in many societies (IRENA, 2015). In Ghana, the initiation of a project that is geared towards access to advanced and healthy energy – solar photovoltaic water pumps for irrigation, modern cookstoves, access to grid and manufacturing at small-scale has led to the establishment of one thousand (1000) small, micro and medium-sized businesses and the provision of three thousand (3000) employment opportunities (IRENA, 2016).

2.6.2 Micro and Small Businesses

A micro business is a type of business or enterprise with the engagement of 1 to 5 people and small business or enterprise involving the engagement of 6 to 30 people (GSS, 2014). Micro and small businesses or enterprises facilitates in the reduction of unemployment and the alleviation of poverty in urbanized areas of developing economies. This role can be strengthened through policies that are targeted at ensuring access to cheap and reliable power (Ayanda and Laraba, 2011). A study by Kusnir et al. (2010) revealed an estimated 90 million micro, small and medium businesses exist in the global south and emerging economies and the concentration of these businesses is on the rise in low and middle-income economies.

According to the Ghana Statistical Service (2014), about 5793 micro and small businesses exist in La Nkwantanang-Madina Municipality. Also, there is an approximated 35%, 42% and 34% generation of employment by micro, small and medium businesses in the upper middle, lower middle and low-income economies respectively (IFC MSME Country Indicators).

2.7 The Electricity Demand and Supply Nexus Ghana

There has been an increase in the peak load of Ghana by 49.8% over the last decade; appreciating to 2,087MW in 2016 to 1,393 MW in 2006. This depicts a 4.29% annual increase of peak load over that period. There has been a more than double increment i.e. 3,759 MW in 2016 from 1,730 MW in 2006 in terms of generation capacity, with an annual mean increment of 8.60%. Moreover, there was an installed generation capacity increment of 29.14% in 2015 exceeding the installed generation in 2014 of 2,831 MW and an additional 3.79% increment in 2016. The demand for electricity declined by 1.88% in 2015 and there was an increment of 7.97% in 2016. With this, the economy is still faced with electricity supply problems, which it has been the experience over the last ten years (Energy Commission of Ghana, 2016c; VRA, 2015; Energy Commission of Ghana, 2017).

Gross electricity consumption in Ghana took a rather sharp decline from 9,059 GWh in 2006 to 7,413 GWh in 2007 (a reduction of 18.2 % of the 2006 figure) before rising steadily by an annual average of 10.8 % till 2014. This trend, however, declined by 11.3 % from 2014 to 2015 before increasing by 15.3 % in 2016 (Energy Commission of Ghana, 2016c; Energy Commission of Ghana, 2017).

2.8 Energy Access and Gender Equality

There is an obvious and essential relationship involving energy access (physical and financial) and gender equality. Meanwhile, inadequate access to advanced, sustainable and reliable streams of energy affects both genders (women and men), disparities in social status, economic potentials and socially constructed roles indicate women are often exposed due to inadequacy in terms of energy access in a disproportionate way. The responsibility of the collection, preparation of fuelwood and cooking is for women in developing countries (Practical Action, 2016).

Considering that most (57%) of Ghanaians resides in agrarian areas, a lot of people have no access to electricity, and particularly women have minimal access to electricity and depend on rudimentary methods of bioenergy for cooking as indicated by statistics. The adverse health externalities of indoor air pollution from rudimentary bioenergy fuels on the vulnerable group of societies (women, girls, and babies) persist as a hypercritical concern in Ghana's power buildout or progress (Ministry of Power, 2010). For the collection of fuelwood, an approximated 1.4 hours per day is allocated by households, a burden experienced mostly by women and children. Furthermore, the bundle of fuelwoods conveyed by women potentially have a negative effect on their well-being physically; African women convey bundle that weigh approximately from 25-50 kilograms (UNEP, 2017). Deficiency in the access to green, advanced cookstoves and fuels, and a dependence on the rudimentary utilization of bioenergy for the preparation of food also indicate that women and children are the groups frequently affected by indoor pollution (smoke) from household activities. In the pastoral family circle in South Asia, it is approximated that per day, 4 hours is spent by women in the preparation of food when using rudimentary cookers or furnaces (Practical Action, 2014).

Women also put up with nearly all the answerability for burdens of the household such as sponging and laundry of clothes, without access to advanced and modern energy, this takes long time and energy to be done with. Making advanced energy available at a more efficient and reliable energy source has the capacity of bettering the welfare of women and children, and to make available economic opportunities for women. Surplus time gain through access to advanced energy can be channeled towards economic, social and educational aspirations. Education has been viewed to be an essential factor that induces a reduction in poverty and generation of income and increment through employment, and to improve gender equality (ECREEE, 2015). In sub-Saharan Africa, an estimated 90 million primary school-aged children attend schools that have no access to electricity (UNESCO Institute for Statistics, n.d).

In agrarian Brazil, the access to electricity by girls have 60% chance of completing primary education by 18 years of age than those without access and access to energy by women that own businesses have an appreciable incomes (two times) more than those businesses without access to energy (O'Dell, et al., 2014). In South Africa, expansion of electricity coverage has increased female economic participation in societies that have been newly electrified by almost 10% points owing to the fact that it has enhanced the effectiveness of attaining household burdens (Dinkelman, 2010). There has been an increment in the ability of women to work out of rural homes by 23% due to access to inexpensive and dependable power in Nicaragua (Grogan and Sadanand, 2013). However, there is the generation of income through the sales of fuelwood by women, and so the provision of healthier cooking alternatives may have a negative impact on the income generation opportunities of these women unless alternative opportunities are available or made available.

2.9 The Structure of Ghana's Power Sector

The power sector of Ghana was in the form of monopoly preceding to the late 1990s, with Volta River Authority being the generator and distributor to every part of the country except the northern part of the country where distribution was done by Northern Electricity Department a subordinate of Volta River Authority. For the distribution of electricity in the southern part of the country, this is carried out by the Electricity Company of Ghana. The reform of the power division in the 1990s led to the breakdown of the Volta River Authority into a separate production and distribution system operations which facilitated the entry of Independent Power Producers (IPP) into the energy market (Kumi, 2017).

Currently, power generation in Ghana is carried out by three major groups; the Volta River Authority (VRA), Bui Power Authority (BPA) and Independent Power Producers (IPP). The sources of generation include hydropower plants, thermal power plants, and solar photovoltaic power plants. The Volta River Authority, a government-owned enterprise, is the major and large-scale electricity generation company in Ghana with a total installed capacity of 2,435 MW as at the close of 2015, which makes up 66.1 % of the country's total installed capacity (VRA, 2015; Energy Commission of Ghana, 2016). VRA also owns a solar photovoltaic plant in the country, a 2.5 MW plant situated in Navrongo. The Bui Power Authority manages the Bui Hydro Power Plant whose installed capacity is 400 MW. The Independent Power producers together contribute a total installed capacity of 850 MW to the generation mix including a newly installed 20 MW solar photovoltaic plant owned by BXC Ghana. In 2016, a 100 kW biogas electricity generation facility was connected to the grid (Energy Commission of Ghana, 2017).

Edjekumhene, Amadu, and Brew- Hammond (2001) recognizes the World Bank as an essential driver of the reform of Ghana's power sector because the World Bank is a traditional financier.

The power sector of Ghana is made up of several stakeholders i.e. regional, national and international institutions. These stakeholders are in the form of researcher's, policy formulators, analysts, implementers, consumers, pressure groups, agencies responsible for production, distribution, and regulation.

2.10 National Energy Policy / Energy Sector Strategy and Development Plan of Ghana

The National Energy Policy is the main policy which facilitates the establishment and administration of the energy sector of Ghana, it promulgate that "the goal of the renewable sub-sector is to increase the proportion of renewable energy, particularly solar, wind, mini hydro and waste-to-energy in the national energy supply mix and to contribute to the mitigation of climate change" (Government of Ghana, 2010). The principal aim of the energy sector is mentioned in the "Energy Sector Strategy and Development Plan of 2010" as "to guarantee the availability of an adequate level of energy supply to meet the country's internal demands and ensure universal access to modern energy by 2020 as well as provide surplus energy for export" (Government of Ghana, 2010).

2.10.1 Renewable Energy Act, 2011

Under Ghana's Energy Sector Strategy and Development Plan, the goal set for green/renewable energy is to include 10% of the overall generation of energy in the country by 2020. To accelerate the attainment of this goal, the Parliament of Ghana ratified the "Renewable Energy Act 2011, Act 832" to provide the legal and regulatory framework necessary for developing and expanding the country's renewable energy sub-division. The Act seeks to create an enabling regulative and monetary systems in addition to agreeable rating motivations for the establishment and utilization of energy resources that are renewable. The stipulation of the Act guides the initiation, application and streamlined administration of renewable energy resources in Ghana (Government of Ghana, 2011).

2.10.2 Policy Direction of Solar Energy

The policy emphasizes:

- ✓ Enhanced the affordability of solar and wind technologies.
- ✓ Establish appropriate control and financial mechanisms;
- ✓ Assist local study and development to scale down the cost of renewable energy technologies (solar and wind); and
- ✓ Assist the utilization of acentric isolated substitute technologies where they are rivalrous with mainstream technologies.

(Ministry of Power, 2010).

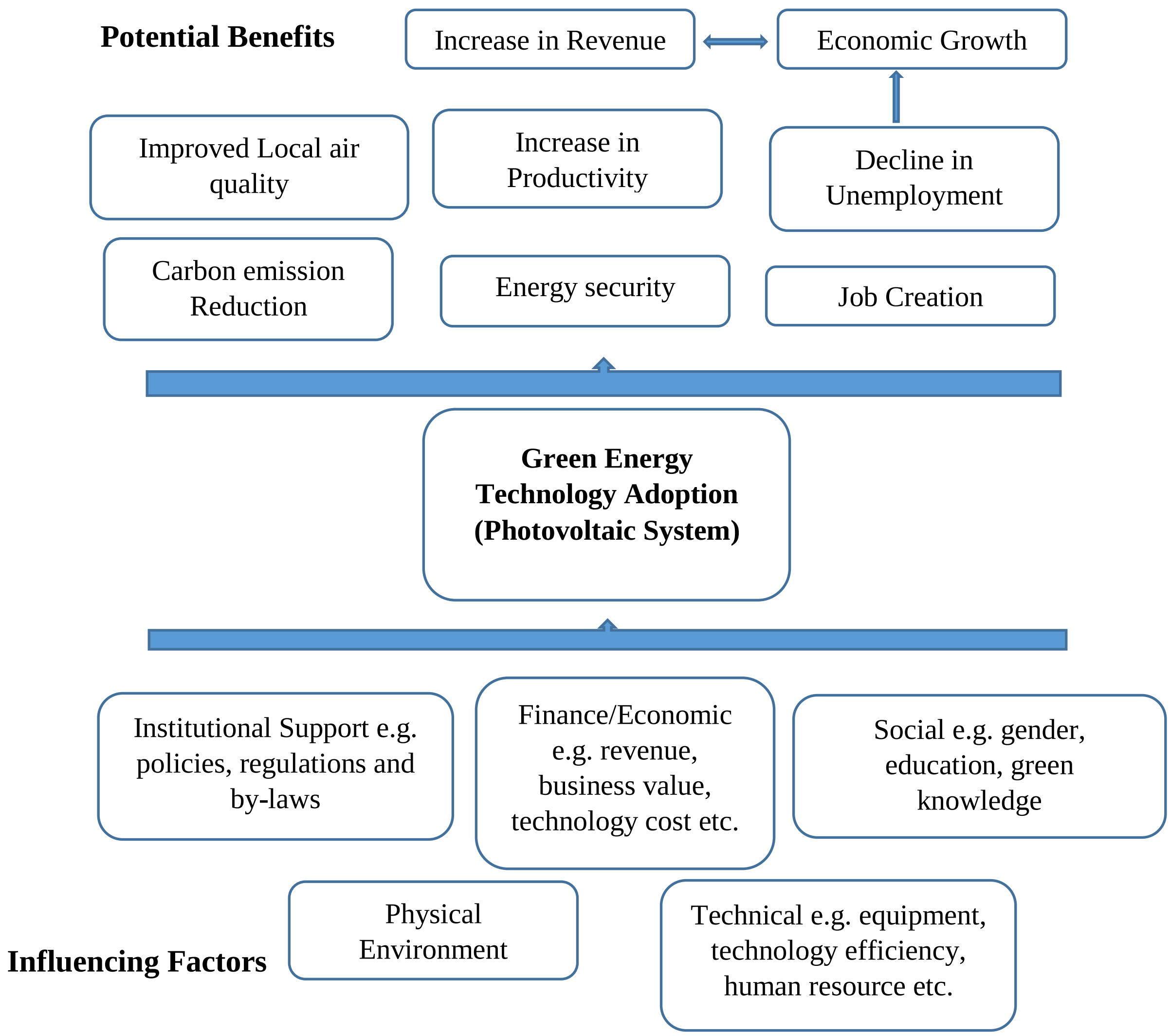
2.11.0 Theoretical Framework of the Study

The study uses Rogers' (1983, 2003) Diffusion of Innovation Theory (DIT). Rogers' diffusion innovation theory (1983) provides a comprehension of the adoption of a contemporary innovation (solar energy technology) by an individual. The diffusion innovation theory illustrates estimate and considers the factors that influence the adoption of an innovation. For this study, these factors are: social, economic, institutional and technical. According to Rogers' (2003), the adoption of an innovation (solar energy technology) is influenced by the perceptions the individual have concerning the relative advantage, compatibility, complexity, trialability, and observability of the innovation (solar energy technology). In the projections of Roger, the adoption of this innovation is not influenced by these elements solely. Comparatively the individual passes through an "innovation-decision" procedure constitute five phases; information, suasion, decision, application, and verification.

2.11.1 Conceptual Framework of the Study

The conceptual framework which is derived from literature, it is in the form of a problem tree. It is divided into three sections: the influencing factors, the focal problem (green energy technologies (photovoltaic system) adoption) and the potential benefits of the adoption of green energy technologies (photovoltaic system). The figure below depicts the conceptual framework of the study:

Figure 2.0: Conceptual Framework



Source: Authors Construct from literature, (2018).

The influencing factors are conditions that impact the adoption of green energy technologies. These factors are in the form of social, economic, institutional, technical and the physical environmental conditions that either facilitates or hinders the adoption of green energy technologies. The social factors are related to the characteristics of the potential consumer of solar energy technology: gender, level of education and knowledge of green energy technologies. Though prospective consumers may have the ability and willingness to patronize green energy technologies, without the knowledge of the existence of these technologies consumption or adoption will not be possible. The economic factors in the case of micro and small businesses deal with the type of business, business value, revenue, electricity cost and the cost of solar energy technology as an alternative source of energy.

The institutional factors focus on policies, regulations, and laws that either permit or restrict the adoption of green technologies in a particular jurisdiction. Furthermore, the technicality of these technologies influences their adoption by consumers through the availability of personnel, efficiency as in performance, equipment, and spare parts. Without the availability of these, the adoption and utilization of green energy technologies will be minimal if not zero. Lastly, for any technology to be effective, it must be appropriate for its adopted environment. And for solar energy technologies, there must be the presence of solar radiation because that is the “fuel” of this technology.

At the top of the conceptual framework is the potential benefits (private and social) that are associated with the adoption of green energy technologies. The adoption of green energy technologies has the potential of ensuring energy security, increase in business revenues and reduction in electricity cost. Socially, the adoption of green energy technologies will lead to the reduction in the consumption of brown fuels which in turn will lead to carbon emission reductions, improved local air quality and the creation of jobs or employment opportunities.

CHAPTER THREE

METHODOLOGY AND PROFILE OF LA NKWANTANANG-MADINA

3.1 Introduction

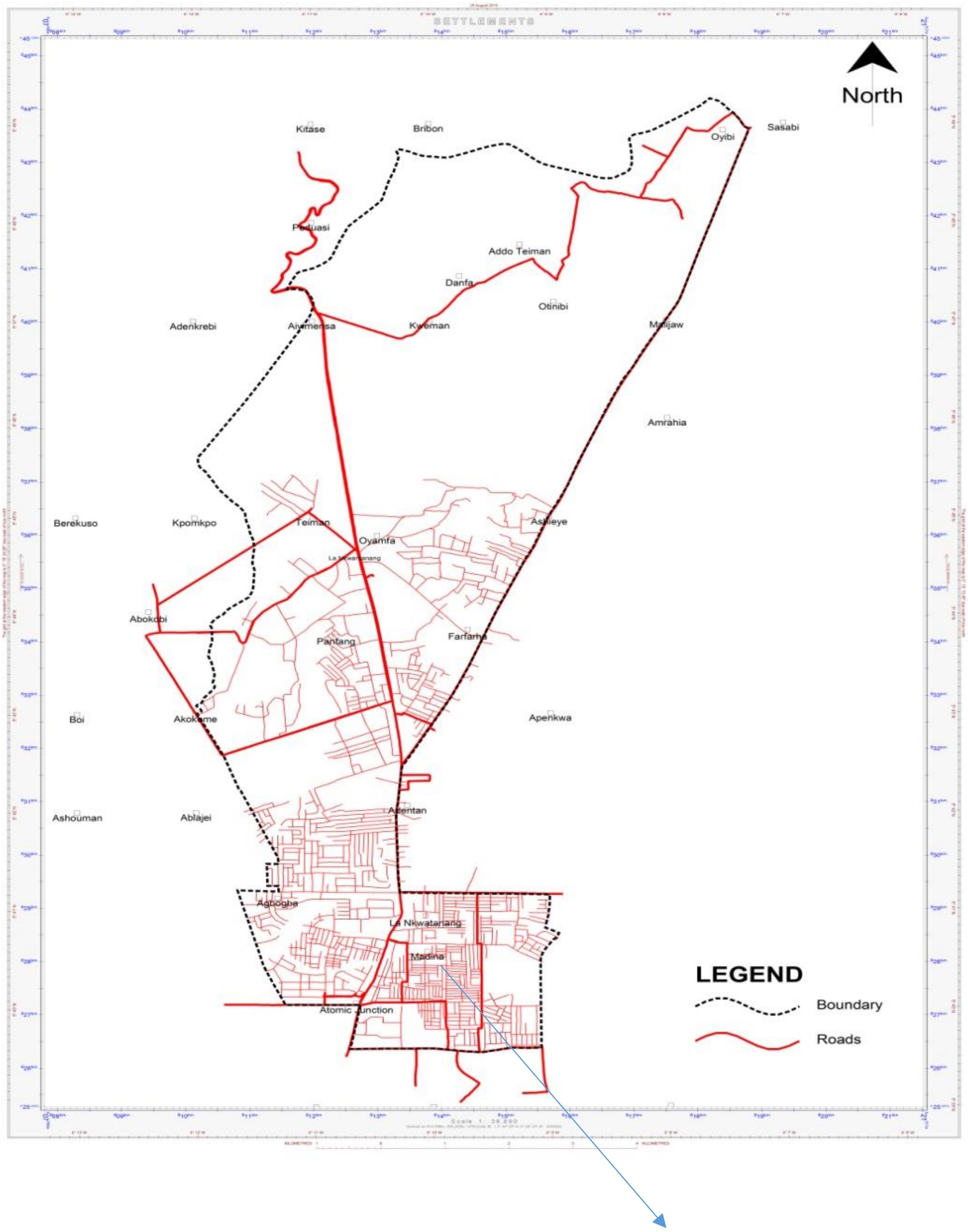
This section considers the profile of La Nkwantanang-Madina Municipality (study area) and the methodology of the study. It focuses on the research design, data requirement and sources, methods of data collection and target respondents, sampling techniques and analysis of the data.

3.2 PROFILE OF LA NKWANTANANG-MADINA

La Nkwantanang-Madina Municipal Assembly was established in 2012 as one of the newly established Assemblies. Its establishment is backed by the Legislative Instrument (L.I 2131). The Ga East Municipality is the Municipality from which La Nkwantanang-Madina Municipality was established from in 2012. The Municipality is located at the northern part of the Greater Accra Region with a total land area of 70.887 kilometers, bordering Ga East Municipal at the west, Adentan Municipal at the east, Accra Metropolitan at the south and Akwampim South District at the north (GSS, 2014).

The Municipal Assembly draws its strength from the Legislative Instrument (L.I 2131) as a local government institution. It is urban with a total population 111,926 (48.5% males and 51.5% females) with 94.1 as a sex ratio (GSS, 2014). Figure 3.0 is the map of the study area.

Figure 3.0: Map of La Nkwantanang-Madina Municipal Assembly



Source: Ghana Statistical Service (2014) Study Area (Madina)

The population of the Municipality comprises 91.3% literates and 8.7% illiterates. Of the total population of males in the Municipality, 95.4% are literate compared to 87.5% for the female population (GSS, 2014). The Municipality has an estimated 70% economically active population and 30% non-active population (15+ years). Of the 70% economically active, 92.3% are engaged in various economic activities and 7.7% are not engaged in any economic activity. A large proportion (56.7%) of the non-active population are students, 24.9% are engaged in care work whilst 3.7% are too sick or disabled (GSS, 2014).

3.3 Research Design

The research design was based on a mixed methods approach. Creswell (2007) argues that the mixed methods approach will yield a satisfactory comprehension of the research problem than either research approach independently because it utilizes both quantitative and qualitative data. The approach focused on the socioeconomic, institutional and technical factors that influence the adoption of solar energy technology by micro and small businesses in La Nkwantanang-Madina Municipality.

3.4 Target Population

The research covered the local government administration of Madina, solar energy technology companies (retailers) and, micro and small businesses in the La Nkwantanang-Madina Municipality. The focal point for the study was the central business district (Madina market) of the municipality which has a high concentration of micro and small businesses.

3.5 Sampling Techniques

The research made use of non-probability sampling techniques (purposive and convenient sampling). Purposive sampling was employed for the collection of "rich-information" from respondents as asserted by Patton (2002) while convenient sampling technique was employed to avoid or minimize the situation of missing observations through the collection of data from respondents that were available and willing to participate in the study. Data were elicited from micro and small businesses that were ready and willing to participate in the study process through convenient sampling whilst data was elicited from La Nkwantanang-Madina Municipal Assembly three (3) solar energy technology companies (suppliers and retailers) purposively.

3.6 Sample Size Calculation

To arrive at a sample size, Yamane's formula for sample size estimation with a 90% confidence level was used. Below is the formula;

$$n = \frac{\mathrm{N}}{1+\mathrm{N(e)2}}$$

Where :

n = sample size required

N = total population of micro and small businesses in La Nkwantanang-Madina

e = acceptable level of error (0.10%)

$$n = \frac{5793}{1+5793(0.1)2}, \quad \mathrm{n} = 98$$

To ensure precision and reliability (Bhattacherjee, 2012), the sample size was doubled. Hence, the sample size was 197 instead of the original 98.303.

3.7 Methods of Data Collection

Because of the nature and objectives of the study, the study made use of quantitative and qualitative data. For the quantitative data, both open and closed-ended questionnaires were formulated and administered to the sampled population (micro and small businesses). In-depth interviews (with the aid of an interview guide) were used in eliciting qualitative data, the data was elicited from La Nkwantanang-Madina Municipal Assembly through key informants and solar energy technology companies via face-to-face and telephone interviews. Data elicited via interviews were recorded during the process.

The data elicited from the Municipal Assembly Administration focused on the institutional setup (policies, projects, and by-laws) that influence the adoption of solar energy technologies. For the solar energy technology companies, three in-depth interviews were conducted with the aid of an interview guide. These interviews focused on the various solar energy technology products, performance/efficiency level, the demand for these products, cost of their products, payment plans, and their technical expertise.

In the collection of the quantitative data which serves a portion of the primary data requirement via the administration of semi-structured questionnaires, the study are was divided into zones to ensure representation with attention given to the central business district of the municipality because it serves as the focal point of micro and small businesses. Also, the number of male and female respondents were taken into consideration. The questionnaire covers the socio-demographic characteristics of respondents, business background, energy consumption and knowledge of green energy technologies, willingness to pay and adoption decision of solar energy technologies.

3.8 Data Processing and Analysis

The quantitative data collected from micro and small businesses were analyzed through the use of descriptive statistics where tables, percentages, and charts were obtained. To establish the relationship between certain variables cross tabulation was undertaken. For instance, the relationship between sexes, level of education, business type, adopted solar energy technology efficiency, knowledge of green energy technologies and adoption of solar energy technology. For the analysis of qualitative data elicited from institutions and solar energy technology companies through in-depth interviews, transcription was used in the extraction of relevant information in the form of quotes and paraphrasing to reflect the views of the respondents based on themes. For the purpose of confidentiality, code names were used for respondents in the in-depth interviews.

3.9 Ethical Consideration

Ethics for the conduct of a research strictly adhered to in the elicitation of information from respondents. The permission and consent of respondents were sought before the commencement of the elicitation of information. The purpose of the research was made known to them and their identities were to remain anonymous. Respondents were also made to know that they are at liberty to discontinue the interviews or administration of the questionnaire at any time during the interview.

CHAPTER FOUR

PRESENTATION OF FINDINGS AND DISCUSSIONS

4.0 Introduction

This section considers the presentation and discussion of the findings obtained from the study via questionnaires and in-depth interviews. It is arranged into four sections: socio-demographic characteristics of the respondents; the background of the respondents' businesses, electricity consumption of businesses; and a discussion of the factors that influence green energy technology (photovoltaic system) adoption as an alternative source of energy.

4.1 Socio-Demographic Characteristics and Business Background of Respondents

This section focuses on the age distribution, sex, level of education, business type, business value, number of employees and apprentices in the various business types. It further assesses the relationship between the socio-demographic characteristics of respondents and the business background.

4.1.1 Socio-Demographic Characteristics of Respondents

This sub-session presents and summarizes the background information of the respondents particularly with regards to age, sex, and educational level. From table 4.1, data obtained through questionnaires indicates majority (53.80%) of the respondents are between the ages of 30 - 39 years whilst the least percentage of respondents (2.54%) are within the age bracket of 50 – 59 years. This suggests that the respondent population is a youthful population.

Of the total respondents' population, 49.7% are males whilst 50.3% are females.

For the level of education of respondents, 40.1% have attained Senior High School education being the majority whilst the attainment of tertiary education is the least with 18.80% attainment. A little over twenty-one percent of the respondents have not received any kind of formal education.

Table 4.1: Socio-Demographic Characteristics of Respondents

Age	**Percentage**	**Sex**	**Percentage**
20 – 29	15.74	Male	49.70
30 – 39	53.80	Female	50.30
40 – 49	29.92	Total	100
50 – 59	2.54		
Total	100		

Level of Education	**Percentage**
None	21.80
Jnr High	19.30
Snr High	40.10
Tertiary	18.80
Total	**100**

Source: Field Survey, 2018.

There is an educational gap of 6.53% between the males and females, with a majority of 46.94% males attaining formal education whilst 40.41% of the female respondents attained formal education even though the majority of the respondents are females. From table 4.2, the majority of the respondents (14.21%) that have not attained formal education are females. This education gap is also evident in Ghana Statistical Survey of the Municipality (2014). To further understand the relationship between gender and level of education, Pearson chi square was used. The chi square test indicates a p-value of 0.029 which is above the significance level at

0.05, which signifies that there is no significant relationship between sex and level of education among respondents

Table 4.2: Socio-Demographic Characteristics of Respondents cont'd

			Level of Education			
	None	Jnr High	Snr High	Tertiary		**Total**
Sex						
Male	7.60	8.60	20.80	12.70		49.70
Female	14.20	10.70	19.30	6.10		50.30
Total	**21.80**	**19.30**	**40.10**	**18.80**		**100**
		Pearson chi square (4)	**= 9.028**		**P-value = 0.029**	

Source: Field Survey, 2018.

4.1.2 Business Background of Respondents

This section considers the type of businesses operated by respondents, number of employees and apprentices, the business value, and the distribution of business type by sex and level of education of respondents. From the field survey, four types of businesses were realised through the administration of questionnaires: service business. These are businesses that provide value to consumers in the form of skills, expertise, and advice e.g. salon operators, carpenters, electricians, seamstress etc. Retail business. These are businesses that buy products at wholesale price and sells them to obtain profit through the increment of the wholesale price e.g. convenience store, building materials dealers, cosmetic retailers, electricals dealers etc. Manufacturing business. These businesses convert raw materials into new products for consumers e.g. Aluminium glazers, welders, block factories, blacksmiths etc. Hybrid business.

These businesses combine both services and retailing of products e.g. salon operators, electricals dealers, seamstresses etc.

From table 4.3, the majority of the respondents (49.20%) are engaged in the retail business of which 30.44% are females. Manufacturing recorded the least with 1.5% of the respondents engaging in it, with all of these businesses being operated by males. The service sector has the second highest proportion, accounting for 33% of the total respondent population.

An average of 3.70 employees was recorded in manufacturing business which is the highest among the business types whilst service business had the least average of employees (0.54). For the number of apprentice's engagement across the various businesses, the retail and service business recorded the highest with an average of 2.41 apprentices whilst retail had the least average of apprentices of 0.14.

Table 4.3: Business Background of Respondents

Business Type	**Percentage**	**Average Employees**	**Average Apprentices**
Service	33.0	0.54	1.70
Retail	49.20	1.20	0.14
Manufacturing	1.50	3.70	1.33
Service and Retail (hybrid)	16.20	1.10	2.41
Total	**100**		

Source: Field Survey, 2018.

The table below illustrates an assessment of the association between sex and business type using Pearson chi square, a p-value of 0.000 which is less than the significance level of 0.05 indicates a significant relationship between sex and business type. The business a respondent engage in is a precondition of his/her sex.

Table 4.3: Business Background of Respondents cont'd

			Business Type			
Sex		Service	Retail	Manufacturing	Service and Retail	**Total**
Male		22.94	18.80	1.52	6.60	49.70
Female		10.05	30.44	0	9.64	50.30
Total		**32.99**	**49.20**	**1.52**	**16.24**	**100**
	Pearson chi square (3)	**= 19.189**		**P-value = 0.000**		

		Business Type			
Level of Education	Service	Retail	Manufacturing	Service and Retail	**Total**
None	3.60	15.70	0.50	2.0	21.80
Jnr High	8.60	8.60	0	2.0	19.30
Snr High	16.80	15.70	1.0	6.60	40.10
Tertiary	4.10	9.10	0	5.60	18.80
Total	**33.0**	**49.20**	**1.50**	**16.20**	**100**
	Pearson chi square (9)	**= 22.886**		**P-value = 0.006**	

Source: Field Survey, 2018.

In assessing the level of education across the various business types, senior high school attainment dominates with 40.10% with the least being tertiary education (18.80%). An assessment of the relationship between the level of education of respondents and business type indicates a p-value of 0.006 which is less than the significance level of 0.05, which indicate a significant relationship between the level of education of respondents and business type they engage in.

4.2 Consumption of Electricity

This section displays information concerning the source of electricity, the amount spent on electricity monthly, a rating of the cost of electricity and alternative access to electricity in case of power outage.

4.2.1 Business Type and Source of Electricity

Table 4.5 illustrates that businesses use two electricity sources: E.C.G (national grid) and Generator. Of the total respondents, 41.1% of businesses gain access to electricity through E.C.G (national grid) only and 58.9% of businesses use both E.C.G (national grid) and generator. The utilization of a generator serves as an alternative electricity source in case of power outage. Also, E.C.G (national grid) serves as the main or frequent source of electricity to all the businesses regardless of the possession of a generator which serves as a backup plan. Most businesses that possess generators acquired this alternative power source during the power crisis 'dumsor' period. Of the total alternative source of electricity, service businesses are the majority (40.0%) that have invested in petrol/diesel powered generator as an alternative source and the least being manufacturing businesses with only 0.87%.

Investment in generators by micro and small businesses in La Nkwantanang-Madina as an alternative source of electricity confirms a study by Attigah and Mayer-Tasch (2013) where they asserted that to have reliable access to electricity in economies with power supply problems, businesses in these countries invest in the purchase of petrol/diesel powered generators as an alternative source of electricity. Castellano et al. (2015) asserted that the usage of petrol/diesel powered generators as an alternative energy source has resulted in an increment in cost of business, loss of an estimated 2% of sub-Saharan Africa gross domestic product and 5% of yearly sales of businesses.

Table 4.5: Business Type and Source of Electricity

	Source of Electricity		
Business Type	E.C.G Only	E.C.G and Generator	Total
Service	10.15	22.85	33.0
Retail	28.41	20.82	49.23
Manufacturing	1.01	0.51	10.61
Service and Retail	1.52	14.73	16.25
Total	**41.1**	**58.90**	**100**

	Alternative Source of Electricity (Generator)
Service	40.0
Retail	33.91
Manufacturing	0.87
Service and Retail	25.22
Total	**100**

Source: Field Survey, 2018.

4.2.2 Cost of Electricity

From table 4.6, the majority of businesses (57.90%) spend GH¢ 100-250 monthly in purchasing electricity and only 8.10% of businesses spend GH¢ 500-700 monthly as electricity cost. Service businesses spend the highest (GH¢ 500-700) in purchasing electricity monthly, of the total 8.10%, service accounts for 4.60% and with the majority of retail businesses (37.60%) spending GH¢ 100-250 as electricity cost monthly. Service being the business that spends more on electricity was evident from the field survey, in that, most service businesses use electronic gadgets in their operations and some of these gadgets are high consuming gadgets.

Table 4.6: Cost of Electricity

		Cost of Electricity (GH¢)			
Business Type	20 – 50	100 – 250	300 – 450	500 - 700	**Total**
Service	1.01	18.30	9.20	4.60	33.11
Retail	8.10	37.60	3.60	0.0	49.30
Manufacturing	0.0	0.0	0.51	1.01	1.52
Service and Retail	0.51	2.03	11.20	2.53	16.27
Total	**9.60**	**57.90**	**24.40**	**8.10**	**100**
	Pearson chi square (42)	**= 144.819**		**P-value = 0.000**	

Source: Field Survey, 2018.

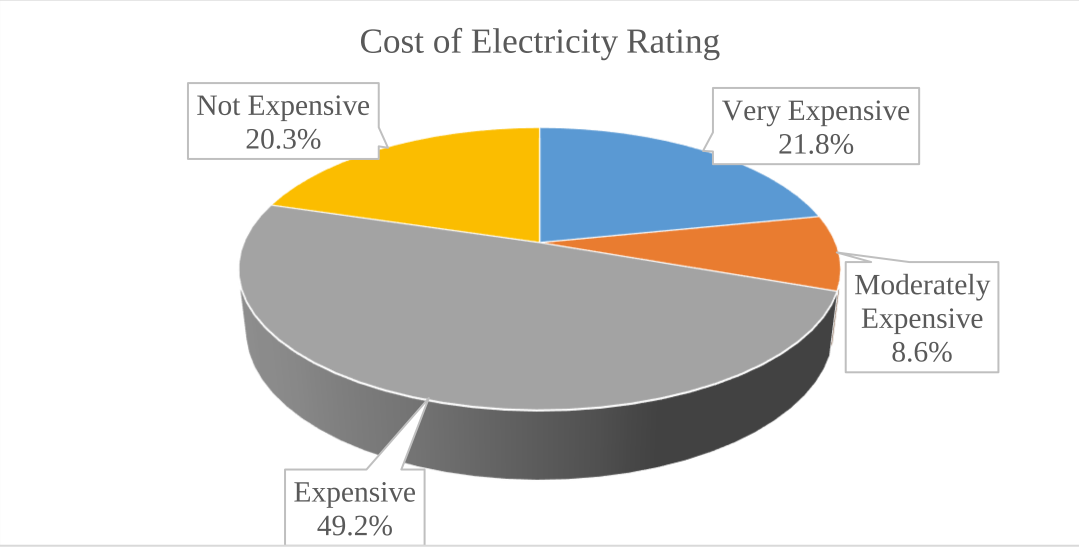
In determining the association between business type and cost of electricity, the p-value is 0.000 which is above the significance level of 0.05, hence indicating a significant relationship between business type and cost of electricity. The amount spent on electricity depends on the type of business a respondent engages in.

4.2.3 Rating the Cost of Electricity by Respondents

This subsection aggregates respondents' assessment of the cost of electricity.

From figure 4.0, 49% of businesses rate the cost of electricity as being expensive which represents the majority of the businesses and 22% of businesses rate electricity cost as being very expensive. Cumulatively, the cost of electricity is expensive by 71% of businesses.

Figure 4.0: Cost of Electricity Rating



Source: Field Survey, 2018.

Table 4.7: Cost of Electricity Rating by Business Type

Rate	Service	Retail	Manufacturing	Service and Retail	Total
Very Expensive	9.13	9.13	1.01	2.53	21.80
Moderately Exp.	5.10	3.04	0	0.51	8.60
Expensive	16.23	21.81	0.51	10.70	49.20
Not Expensive	2.53	15.23	0	2.53	20.30
Total	**32.99**	**49.21**	**1.52**	**16.27**	**100**
	Pearson chi square (9)	**= 24.130**		**P-value = 0.004**	

Source: Field Survey, 2018.

From table 4.7, 9.13% of respondents in retail and service businesses rate the cost of electricity as very expensive which is the majority at that rate. Of the 8.6% of respondents that rate the cost of electricity as moderately expensive, the majority (5.10%) of the respondents are in the service business. Also, out of the 49.2% of respondents that rates the cost of electricity as expensive, the majority (21.81%) are engaged in retail business. Again, respondents that rate the cost of electricity as not being expensive, the majority of the respondents are engaged in retail business with 15.23% of the total 20.3%. A further assessment of electricity cost rating and business type using Pearson chi square indicated a p-value of 0.004 which is less than the significance level of 0.05. Hence, indicating a significant relationship between the rate of the cost of electricity and business type.

4.3 Socioeconomic, Institutional and Technical Factors that Influences the Adoption of Green Energy Technologies (photovoltaic system) by Micro and Small Businesses as an Alternative Source of Energy

This section assesses the socioeconomic, institutional and technical factors that influence the adoption of green energy (solar) technologies an alternative source of energy. The discussions have been presented in two subsections which respectively focuses on Social and institutional factors and economic and technical factors which influenced the adoption of green energy technology.

4.3.1 Social and Institutional Factors that Influences the Adoption of Green Energy Technologies (photovoltaic system) by Micro and Small Businesses as an Alternative Source of Energy

This subsection focuses on assessing respondents' knowledge of green energy technologies, use of green energy technologies, switch to solar energy technology, and the existence of by-laws and policies that either permits or restricts the adoption of solar energy technologies in La Nkwantanang-Madina. Also, it discusses the adoption of solar energy technologies in relation to sex and educational level of respondents.

Illustrated in table 4.8, data obtained via questionnaires indicates a surprisingly 95.9% of the total respondents have knowledge of green energy technologies and only 4.1% of the respondents have no knowledge of green energy technologies. The source of information with regards to green energy technology was via electronic and print media according to the respondents i.e. internet, television, radio, and newspaper.

With regards to access to information on green energy (solar) technology, there was no such thing done previously by the Assembly. A respondent in an in-depth interview from the municipal assembly said:

"….for education on green energy we have not, but the Assembly has acquired a 64 acre land for the construction of waste recycling and waste-to-energy plant in partnership with a private investor and solar street lights have been installed by the Assembly...'' (KII A)

For Rogers' (1995), the awareness of the existence of an innovation is a driver in the adoption of innovation. And Hankins (2004) asserted that potential adopter's demand for solar energy technology broadens as their knowledge about the technology appreciates. Also according to Hankins (2004) "….PV markets grow in an organic manner. Consumer demand grows once awareness is built up…." (p. 34).

Table 4.8: Knowledge of Green Energy Technologies

	Knowledge of Green Energy Technology	**Percentage**
Response	Yes	95.90
	No	4.10
	Total	**100**

Source: Field Survey, 2018.

Of the 95.9% of respondents that have knowledge of green energy technologies, 49.22% are males whilst 46.7% are females indicating a gap of 2.52% between the various sexes. This gap suggests that more males are likely to have knowledge of green energy technologies than females. For the purpose of further analysis, a Pearson chi square test was run to determine the association between these variables and the test indicates a p-value of 0.031 which is less than the significance level of 0.05, hence there is a significant relationship between gender and knowledge of green energy technologies.

Table 4.9: Sex, Level of Education and Knowledge of Green Energy Technologies

		Knowledge of Green Energy Technologies	
		Yes	**No**
Sex	Male	49.22	0.51
	Female	46.70	3.60
	Total	95.90	4.10
	Pearson chi square(1) = 4.627	**P-value = 0.031**	
		Yes	**No**
	None	19.30	2.50
Level of Education	Jnr High	18.30	1.0
	Snr High	39.60	0.50
	Tertiary	18.80	0
	Total	**95.90**	**4.10**
		Pearson chi square(3) = 9.611	**P-value = 0.022**

Source: Field Survey, 2018.

The relationship between formal education and knowledge of green energy technologies indicates that a total of 76.6% of respondents that have attained some level of formal education have knowledge of green energy technologies which depicts the majority. For respondents that have no formal education, their knowledge of green energy technologies is 19.3% (see table 4.9). Respondents with some level of formal education are more likely to have knowledge of green energy technologies than those without formal education given a green energy knowledge gap of 57.3% and a p-value of 0.022 which is less than the significance level of 0.05 indicating that there is a significant relationship between level of education and knowledge of green energy technologies. For those without knowledge of green energy technologies, respondents without formal education recorded the highest (2.6% of the 4.1%).

From table 4.10, respondents were asked to indicate whether they have ever used any green energy technology. Of the 197 valid responses, 44.7% of the respondents have ever used green energy technology and the majority of the respondents have never used any green energy technology before representing 55.3% of the total respondents. The usage of green energy technology among respondents is low (44.7%) given 95.9% knowledge of green energy technologies by respondents. The low usage affirms a study by Cox et al. (2007), where they asserted that consumers are wary with regards to the adoption of a new technology due to the perceived associated risks and benefits. Without knowledge of the potential gains and losses of green energy technologies usage, respondents will be aware of these technologies and yet refuse to adopt them.

Table 4.10: Green Energy Used and Adoption Consideration

Green Technology Energy Used			**Adoption Consideration**	
Yes	44.70		57.90	
No	26.98		42.10	
Total	100		100	
		Adoption Consideration		
		Yes	No	Total
	Yes	30.98	13.70	44.70
Green Energy Technology Used	No	26.98	28.40	55.30
	Total	**57.90**	**42.10**	**100**
		Pearson Chi square(1) = 8.553	**P-value = 0.003**	

Source: Field Survey, 2018.

Of the total respondents of 197, 57.9% are considering adopting solar energy technology as an alternative source of energy and 42.1% for respondents who are not considering adopting solar energy technology. Though the majority of micro and small businesses are considering adopting solar energy technology, the adoption of a technology is often influenced by institutional arrangements within a certain jurisdiction (La Nkwantanang-Madina Assembly). According to Brukhardt el al., (2014), solar energy technology cost has experienced a declined over the past decade, but the institutional cost of adoption has not experienced the same decline and difference in the institutional setup (regulations, by-laws, and permits) can affect the adoption of solar energy technology by 8% in terms of price.

Of the total respondents that have ever used any green energy technology (44.70%), 30.98% are considering a switch to solar energy technologies as an alternative source of energy whilst 13.70% do not consider adopting solar energy technologies as an alternative source of energy. Out of the 55.30% of the respondents that have never used any green energy technology, 26.98% are considering adopting solar energy technologies as an alternative source of energy. In assessing the relationship between use of green energy technology and adoption of solar energy technologies using Pearson chi square, a p-value of 0.003 which is less than the significance level of 0.05 indicating a significant relationship between green energy use and switching to solar energy technologies as alternative source of energy by micro and small businesses in La Nkwantanang-Madina.

With regards to institutional setup permitting or restricting the adoption and utilization of solar energy technology through by-laws by micro and small businesses or individuals, this is what a key informant said via an in-depth interview:

‘‘...you don’t need a permit from us to mount your solar panels on your roof. But if this is a large scale operation, you definitely need to come for a permit from us and without the permit, you cannot continue with your operation .....’’ (KII B)

With the absence of by-laws that restricts the adoption and utilization of solar energy technology within the La Nkwantanang-Madina Municipality, the 8% institutional cost asserted by Brukhardt el al., (2014) has been avoided. Also, in an attempt to ascertain the existence of an internal policy that promotes solar energy technology in La Nkwantanang-Madina through a through key informant interview, this is what a respondent said:

“....there is no direct policy that promotes solar adoption but there is a provision for the adoption of technologies to increase productivity in the medium term development plan (2018–2021) in all sectors of the Assembly....’’ (KII A)

In assessing the level of education against switching to solar energy technology from table 4.11, respondents that have attained senior high school education are the majority with 15.8% adoption consideration and also the majority that does not consider adopting solar energy technology as an alternative source of energy with 24.4% of the responses. With a p-value of 0.000 which is higher than the significant level of 0.05. Hence, there is a significant relationship between the level of education and switching to solar energy technology. This affirms a study by Bawakyillenuo (2012) on the diffusion of solar photovoltaics in Kenya and Zimbabwe where education was regarded as a causal factor of diffusion or adoption of solar energy technology. Also, Jacobson (2007) study in Kenya on the adoption of solar photovoltaic indicates that individuals with a high level of education adopt solar energy technology more than individuals with a low level of education. The rate of adoption was attributed to the higher income that comes with high educational attainment.

An assessment of the adoption of solar energy technology across the various sexes indicates a surprisingly the same percentage of 28.95% across the various genders of the respondents that consider switching to solar energy technology. In determining the association between sex and adoption of solar energy technology, the p-value is 0.933 which is greater than the significant level of 0.05 depicting that there is no significant relationship between sex and adoption of solar energy technology as an alternative source of energy.

Table 4.11: Level of Education, Sex and Adoption Consideration

		Adoption Consideration	
		Yes	No
	None	6.10	15.70
	Jnr High	8.60	10.70
Level of Education	Snr High	15.70	24.40
	Tertiary	7.10	11.70
		Pearson chi square(3) = 29.718	**p-value = 0.000**
		Adoption Consideration	
		Yes	No
	Male	28.95	20.75
Sex	Female	28.95	21.30
	Total	57.90	42.10
		Pearson chi square(1) = 0.007	**P-value = 0.933**

Source: Field Survey, 2018.

4.3.2 Economic and Technical Factors that Influences the Adoption of Green Energy Technologies (photovoltaic system) by Micro and Small Businesses as an Alternative Source of Energy

This section assesses the economic and technical factors that influence the adoption of green energy (solar) technology as an alternative source of energy. It takes into account the relationship between knowledge of green energy technologies and business type, business type, business value, cost of electricity and switch to solar energy technology, the willingness to pay for solar energy technology and technical issues respondents will consider before adopting solar energy technologies.

Table 4.12 indicates that knowledge of green energy technologies is 45.7% in the retail business which is the majority of knowledge of green energy technologies and services is the second majority with 32.5% whilst manufacturing is the least with 1.52% of the knowledge of green energy technologies. In determining the relationship between knowledge of green energy technologies and business type, a p-value of 0.170 was obtained through Pearson chi square which is above the significance level of 0.05 indicating that there is no relationship between knowledge of green energy technologies and business type.

In assessing the adoption consideration of solar energy technology across the various business types, the retail business recorded the highest adoption consideration with 17.80% followed by service business with 10.7%. Although retail business records the highest adoption consideration, it is also the business where most respondents do not consider switching to solar energy technology as an alternative source of energy with 31.5% which exceeds adopting solar energy technology in that business type by 13.7%. The lowest switch consideration is a manufacturing business with 0.51%. For further assessment of the relationship between business types and solar energy technology adoption, Pearson chi square was used where the relationship is significant given a p-value of 0.023 which is less than the significant level of 0.05. This contradicts Jacobson (2007) study in Kenya on the adoption of solar photovoltaic where he asserted that the adoption of solar photovoltaics is not determined by the occupation of potential adopters.

Table 4.12: Economic Factors Influence on Green Energy Technology Adoption

			Business Type			
		Service	Retail	Manufacturing	Service and Retail	Total
	Yes	32.50	45.70	1.52	16.24	95.90
Green. Tech. Knowledge	No	0.51	3.50	0	0	4.10
	Total	**33.01**	**49.20**	**1.52**	**16.24**	**100**
		Pearson chi square (3) = 5.022			**P-value = 0.170**	

Source: Field Survey, 2018.

Table 4.13: Economic Factors Influence on Green Energy Technology Adoption cont'd

		Adoption Consideration	
		Yes	No
Business Type	Service	10.70	22.32
	Retail	17.80	31.50
	Manufacturing	0.51	1.01
	Service and Retail	8.64	7.61
		Pearson chi square(3) = 9.530	**P-value = 0.023**
		Adoption Consideration	
		Yes	No
Business Value (GH¢)	2000-6000	5.70	17.50
	7000-12000	7.21	8.30
	15000-35000	14.94	26.30
	40000-70000	8.24	8.80
	80000-100000	1.55	1.54
		Pearson chi square(22) = 23.324	**P-value = 0.384**
		Adoption Consideration	
		Yes	No
Cost of Electricity (GH¢)	Very Expensive	4.60	17.25
	Moderately Exp.	4.10	4.60
	Expensive	19.82	29.42
	Not Expensive	9.15	11.20
		Pearson chi square(22) = 23.324	**P-value = 0.720**

Source: Field Survey, 2018.

In assessing the number of businesses that are considering the adoption of solar energy technology as an alternative source of power using the value of businesses, it was revealed that businesses that are valued within the range of GH¢ 15,000 – 35,000 has the highest switch consideration of 14.94% and surprisingly, businesses valued at GH¢ 80,000 – 100,000 which is the maximum value obtained from the field survey has the least adoption consideration of 1.55%. Although businesses valued at GH¢ 15,000 – 35,000 has the highest switch consideration, in terms of businesses that do not consider adopting solar energy technology as an alternative source of energy these businesses are the highest with 26.3%. In assessing the relationship between business values and the adoption of solar energy technology, a p-value of 0.384 was obtained which is above the significance level of 0.05 indicating that there is no significant relationship between business values and the adoption of solar energy technology as an alternative source of energy. The findings deviate from Leach (1992) assertion that individual's shifts from traditional fuels (fossil fuels) to more efficient fuel sources (solar energy technology) given the size of their wealth. For Farsi et al. (2007), the wealth or income of individuals serves as a barrier to the adoption of clean energy (solar energy technology) but the findings indicate otherwise given the value of the businesses.

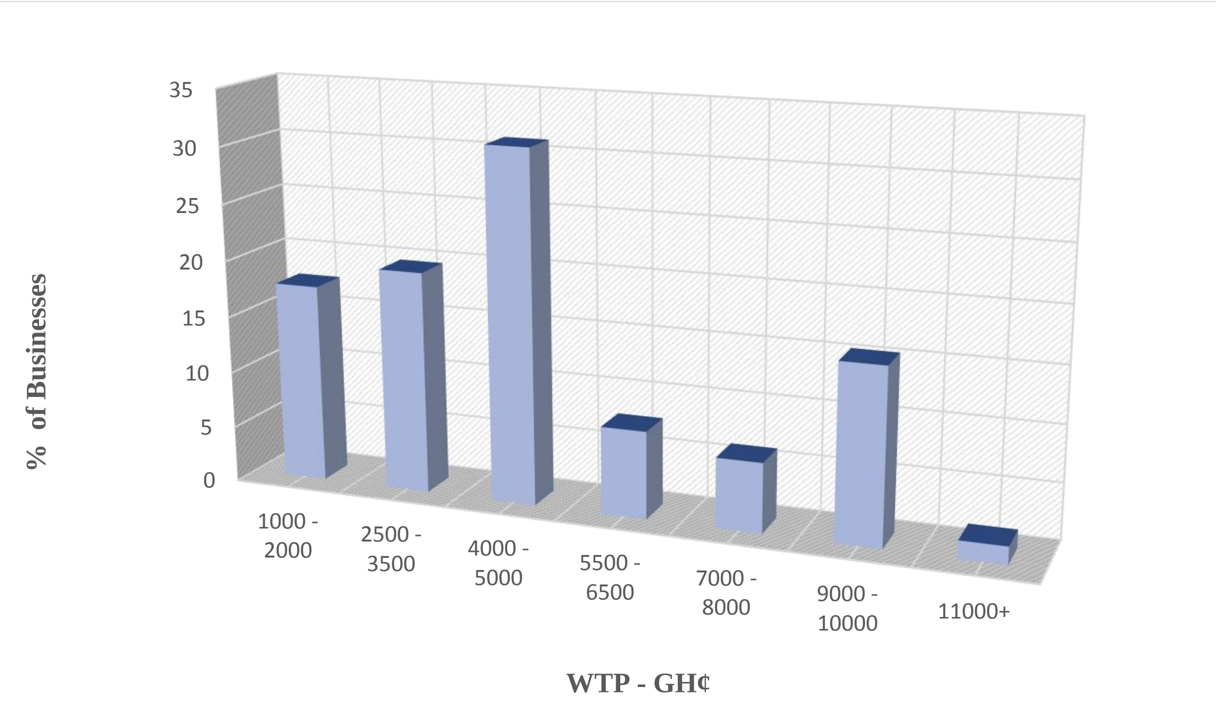
The motive of most businesses is to minimize cost and maximize benefits, hence the existence of an alternative to attain this will be embraced by businesses. To assess whether this postulation holds in terms of the cost incurred by businesses in La Nkwantanang-Madina as electricity cost and adoption of alternative source of energy, Pearson chi square was used to determine this relationship. The Pearson chi square test indicates a p-value of 0.720 which is above the significance level of 0.05, this indicates that there is no significant relationship between the cost of electricity and the adoption of solar energy technology as an alternative source of energy within micro and small businesses in the La Nkwantanang-Madina Municipality.

4.3.2.1 Willingness to Pay for Solar Energy Technology as an Alternative Energy Source

The method willingness to pay was used to assess the value micro and small businesses place on access to electricity and the cost they are willing to incur to have access to electricity through solar energy technology. Respondents were asked to state the amount they will be willing to pay for solar energy technology that will be able to satisfy their energy need.

Aggregating the responses concerning the amount respondents are willing to pay for a solar energy technology that can meet their energy demands indicates that 31.1% of businesses are willing to pay GH¢ 4000 – 5000 for a solar energy technology that will meet their energy demand. And only 1.6% of businesses are willing to pay GH¢ 11000+ for a solar energy technology that will meet their energy demand.

Figure 5.0: Willingness to Pay for Solar Energy Technology



Source: Field Survey, 2018.

To further assess the willingness to pay for solar energy technology based on the business value of respondents, Pearson chi square was used in determining the relationship between willingness to pay given the business value of respondents (**Pearson chi square (374) = 468.485 and p-value = 0.001**). The Pearson chi square indicates a p-value of 0.001 which is less than the significance level of 0.05, this indicates that there is a significant relationship between willingness to pay for solar energy technology and the business value in La Nkwantanang-Madina Municipality.

Using the willingness to pay for solar energy technology by respondents based on figure 5.0, only 23.37% of the respondents can pay for a simple system (grid-tied) and only 1.6% can pay for the off-grid system with table 4.14 and 4.15 as a reference point respectively. The findings is in convergence with Bawakyillenuo (2012) findings where Bawakyillenuo recognizes the low adoption of solar energy technology in Ghana as a result of the high cost of these technologies in Ghana as compared to Kenya and Zimbabwe where cost of solar technology is less and the determining factor is the type of solar energy available in these markets or economies.

Table 4.14: Cost of Solar Energy Technology by a Case Company

	Grid-Tied Solar System Invoice (GH¢)		
Item	Quantity	Price	Amount
3Kva Inverter System	1	2700	2700
Solar Battery 12v 100Ah	4	650	2600
Battery Cabinet for 4 pcs	1	500	500
Labour, cables, and switches	1	1300	1300
		Total	**7100**

Source: A Case Company, 2018.

Table 4.15: Cost of Solar Energy Technology by a Case Company cont'd

	Off-Grid/Solar System Invoice (GH¢)		
Item	Quantity	Price	Amount
3Kva Inverter System	1	3200	3200
Solar Battery 12v 100Ah	4	650	2600
Battery Cabinet for 4 pcs	1	500	500
Solar panels 275	6	790	4740
Labour, cables, and switches	1	1500	1500
		Total	**12540**

Source: A Case Company, 2018.

Regarding the cost of these products and the availability of payment plans for consumers that cannot make outright/full payment. Surprisingly, though these companies are aware of the cause of low demand, which is the high cost there were no payment plans for consumers that cannot make outright payment. The absence of payment plans confirms a study by Bawakyillenuo (2012), where the availability of payment plans in Kenya and Zimbabwe is resulting in increasing adoption of solar energy technologies whilst the absence of these payment plans in Ghana is hindering the diffusion of these technologies.

The high initial cost of solar energy technologies was seen as the result of import tariffs paid by case solar companies of the study which they considered as a barrier to sales. On the payment of import tariffs, this is what a one the case companies said:

".....my brother if you know the amount we pay before bringing in these products you will be surprised. These duties are making the market bad for us…." (A Case Company).

For the World Bank (2001), access to solar energy technologies is constraint by the high initial installation cost which is not possible for the majority of Africans due to high importation cost or tariffs.

4.3.2.2 Technical Issues to Consider When Deciding to Adopt Solar Energy Technology as an Alternative Source of Energy by Respondents

This section assesses the factors that micro and small businesses will consider when deciding to adopt solar energy technology as an alternative source of energy.

Table 4.16: Technical Issues of Consideration by Respondents

Factors	Percentage
Installation and Maintenance Cost	100
Access to Spare Parts	66.50
The durability of the Technology	63.96
Access to Technical Personnel	55.84

Source: Field Survey, 2018.

As indicated in table 4.16 above, all the respondents consider "Installation and Maintenance" as factors that will influence their adoption of solar energy technology as an alternative source of energy, 66.5% of respondents consider "Access to Spare Parts" as a factor that will influence their adoption of solar energy technologies as an alternative source of energy. Also, 63.96% of the respondents see's "Durability of the Technology" as a determinant of their adoption consideration and 55.84% considers "Access to Technical Personnel" as a determining factor of solar energy technology adoption. A 100% response indicates the significant role cost of solar energy technologies plays in their adoption by potential adopters. With regards to access to technical personnel, there were periodic training workshops for personnel's of the all the three case companies sampled and this was done to enhance their technical know-how of solar energy technologies.

Another technical issue that was assessed was the efficiency of the green energy technologies used by respondents. Respondents that have ever used any green energy technology were asked to rate the performance of these technologies in relation to the satisfaction they derived from their usage. Of the total 44.7% usage, 32.5% rated the performance of the technology they have used high in terms of the satisfaction they derived from it whilst 12.2% rated the performance as low. Assessment of the relationship between the efficiency of the technology and adoption of solar energy technology indicates a significant relationship given a p-value of 0.016 which is less than the significance level of 0.05.

Table 4.17: Efficiency of Green Energy Technologies and Adoption Consideration

	Technology Efficiency	**Percentage**		
	High	32.50		
	Low	12.20		
	Total	**44.70**		
		Adoption Consideration		
		Yes	No	Total
	High	46.50	23.40	69.90
Technology Efficiency	Low	11.40	18.70	30.10
	Total	**57.90**	**42.10**	**100**
		Pearson Chi square (1) = 5.791	**P-value = 0.016**	

Source: Field Survey, 2018

Karakaya and Sriwannawit (2015), the durability, efficiency, safety, and complexity of solar energy technologies affect their adoption which is evident from the findings.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

This section is divided into three subsections: a summary of the findings of the study, conclusions, and recommendations with regards to the findings of the study.

The study assesses the prospects of green energy technology (photovoltaic system) as an alternative source of energy. La Nkwantanang-Madina was chosen for this study because is one of the Municipalities in Greater Accra Region with a high concentration of micro and small businesses. The objectives of the study are to: examine the extent to which socioeconomic, institutional and technical factors that influence the adoption of green energy technology and assess the prospects of green energy technology (photovoltaic system) adoption as an alternative source of energy among micro and small businesses in La Nkwantanang-Madina.

For the achievement of these objectives, quantitative and qualitative data was used. The rationale for the adoption of such an approach is to strengthen the comprehension of the problem under study. The study also made use of primary and secondary data: the primary data was elicited from micro and small businesses, the Municipal Assembly of the study area and case solar companies via questionnaires and in-depth interviews (with the aid of an interview guide). For the secondary data, certified documents, scholastic documents, online information and varying official records concerning green energy were used.

5.1 Summary of the Findings of the Study

With regards to the assessment of the socioeconomic, institutional and technical factors that influence the adoption of green energy technologies (photovoltaic system) in La Nkwantanang-Madina as an alternative source of energy, the study revealed that a proportion of 95.9% of the total respondents had knowledge of green energy technologies and the cost of this information was incurred by respondents via electronic and print media according to the respondents i.e. internet, television, radio and newspaper. Of the knowledge of green energy technologies, a gap of 2.52% was realized between the various genders, where males had knowledge of green energy technologies than females. This gap suggested that more males are likely to have knowledge of green energy technologies than females.

In relation to the influence of socioeconomic factors on the adoption of solar energy technology. It was realized that respondents that had a formal education are more likely to have knowledge of green energy technologies than those without formal education and respondents that had a formal education are more likely to adopt solar energy technologies than respondents with no formal education. Also, an assessment of the adoption of solar energy technology across gender indicated surprisingly the same percentage, where 28.95% of males and 28.95% of females are considering adopting solar energy technologies. Furthermore, an assessment of the relationship between knowledge of green energy technologies and solar energy technologies adoption consideration indicated that there was no significant relationship between these variables in La Nkwantanang-Madina.

In assessing solar energy technologies adoption consideration across the various business types, the retail business recorded the highest adoption consideration at the same time the business where most respondents do not consider adopting solar energy technologies. Also, the study found that there is a significant relationship between business type and the adoption of solar energy technologies but there existed no relationship between the value of a business and the adoption of solar energy technologies. Another issue that was realized was the absence of payment plans for consumers who cannot make outright payment although the cost of solar energy technologies was considered high and this is resulting in low adoption.

In relation to the influence of the institutional setup of La Nkwantanang-Madina on the adoption solar energy technologies, there was no direct policies or mechanisms that promote the adoption of solar energy technology as an alternative source of energy and there was virtually no legal restrictions for the adoption of solar energy technologies in La Nkwantanang-Madina.

The influence of technical factors in relation to solar energy technologies adoption was evident. The study indicated that the adoption of solar energy technologies is significantly related to the efficiency of solar energy technologies with regards to the satisfaction of the energy needs of the potential adopter. Micro and small businesses are more likely to adopt high performing solar energy technologies. Also, access to spare parts, technical personnel, and durability of the technologies were factors that respondents regarded as influencing factors that will determine their adoption decisions.

5.2 Conclusion

This study aimed to assess the prospects of green energy technologies (photovoltaic system) through the assessment of the socioeconomic, institutional and technical factors that influences the adoption of solar energy technologies in La Nkwantanang-Madina Municipality. From literature, these factors exert some level of influence on the adoption decisions of consumers. However, the study revealed that the bulk of these factors do not exert influence on the adoption decisions of micro and small businesses but some subfactors under these broad factors (socioeconomic, institutional and technical) exert some level of influence on the adoption of solar energy technologies in La Nkwantanang-Madina Municipality.

Assessment of the influence of the broad factors revealed that subfactors like the level of education, business type and the efficiency of solar energy technologies in the satisfaction of the energy needs of micro and small businesses were significant in influencing the adoption decisions of businesses. These subfactors solely cannot spur the adoption of solar energy technologies given the significant role in the cost of solar energy technologies plays in the adoption decisions of potential consumers. The cost of solar energy technologies is recognized as a significant factor both in literature and this study as influencing the adoption decisions of potential consumers, where high cost stifled the adoption of these technologies and these costs were seen as an outcome of import tariffs incurred.

The study, therefore, concludes that the prospects of solar energy technologies as an alternative source of energy is appreciable but for the adoption of these technologies to be significant there is the need for institutions and measures to address the factors that have a significant influence on the adoption decisions of respondents in the La Nkwantanang-Madina Municipality.

5.2 Recommendations

- Tax Reforms and Subsidies

Given the central role cost plays in solar energy technologies adoption, the government should initiate tax reforms that will provide waivers on the importation of solar energy technologies. The initiation of these reforms will decrease the cost of solar energy technologies through low import tariffs paid by importers. Also, subsidies and financing schemes should be made available to businesses that consider adopting solar energy technologies.

- Standardization of Imported Photovoltaic Systems

Considering the influence of technological efficiency on solar energy technologies adoption, an assessment of solar energy technologies should be carried out to ensure the efficiency of these technologies before they are allowed into the country. The government should set a standard for all categories of solar energy technologies to ensure their rate of efficiency.

- Gender-Focused Educational Policies

Findings indicated a link between formal education, knowledge of green energy technologies and the adoption of solar energy technologies. Though formal education has a link with these variables, there was an educational gap between the various genders of the study. There should be the initiation of gender-focused educational policies to bridge this existing gap.

5.3 Areas for further studies

a. The effects of the perception of solar energy technologies as an alternative source of energy on the adoption decisions of potential consumers.

b. The influence of financing schemes on solar energy technologies adoption.

c. The influence of traditional energy sources on solar energy technologies adoption as an alternative source of energy.

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APPENDIXES

Appendix 1: Introductory Letter

UNIVERSITY OF GHANA
INSTITUTE OF STATISTICAL, SOCIAL AND ECONOMIC RESEARCH

ISSER
Knowledge for Development

Ref. No.:-----------------------------------

21st March, 2018

TO WHOM IT MAY CONCERN

Dear Sir/Madam,

INTRODUCTORY LETTER- MR. SAMAD IDDRISU

This comes to introduce to you a Master of Arts in Development Studies student, Mr. Samad Iddrisu, with student ID No. 10637328 at the Institute of Statistical, Social and Economic Research (ISSER), University of Ghana, Legon.

Mr. Iddrisu has chosen to conduct his research on: **"Assessing the prospects of green energy technologies as an alternative source of energy. A case of Madina in the La Nkwantanang Municipal Assembly"**

We would therefore be grateful if you could provide Mr. Iddrisu with the requisite assistance.

All data collected will be used solely for academic purposes and treated with the strictest confidentiality.

If you have any queries about this, please do not hesitate to contact me on +233208212828 or ecclesandoh@ug.edu.gh

We hope we can count on your kind co-operation.

Thank you.

Yours sincerely,

Ms. Eccles Andoh
Administrative Secretary

INTEGRI PROCEDAMUS

COLLEGE OF HUMANITIES

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Appendix 2: Questionnaires for Micro and Small Businesses

INSTITUTE OF STATISTICAL, SOCIAL AND ECONOMIC RESEARCH (ISSER)

MASTER'S OF DEVELOPMENT STUDIES (2017/2018)

UNIVERSITY OF GHANA, LEGON

FOR BUSINESS OWNERS

This questionnaire is for a research study concerned with green/renewable energy technologies adoption as an alternative source of energy within the La Nkwantanang Municipality (Madina).

All information gathered through this study is completely confidential and anonymous. It will only be used to assist in this research and will be destroyed once completed. No one other than the researcher will know your individual responses to this questionnaire.

Please do you consent to participate in this interview? Yes☐ No☐

Questionnaire number ………………..

Socio-demographic characteristics

1. Please what is your age? …………………

2. Please indicate your gender/sex.

   Male ☐ Female ☐

3. Please what is your marital status?

   Single ☐ Married ☐ Divorced ☐ Widowed ☐ Cohabitation☐

4. How many people live in your house? ....

5. Please who takes care of your house expenses?

   I do ☐ My Partner ☐ Both of us ☐ Others……………………

6. What is your highest level of education?

Junior High School □ Senior High School □ Tertiary Level □ Middle School □
O'level □ HND□ First Degree □ Master's Degree and Above □

Business background

7.

Business type or description	**Answer (tip applicable)**
Service Business	
Merchandising or Retail Business	
Manufacturing Business	

8. When was the business establish or how old is your business? ……………….

9. How many trainee's or apprentices do you have? …..................

10. How many employees do you have? ………………..

11. What is the total monetary value of your business assets?
GH¢......................................
12. How much do you spend in purchasing or buying supplies for the business in a month? GH¢…………………..

13. Please how much revenue do you make in a month? GH¢ …………………….

Energy Consumption

14. What is your source of electricity power?
National Grid (ECG) □ Generator□ Plant □ Other……………………..

15. Which of the above sources do you use the most?
……………………………………

16. How much do you spend on electricity in a month? GH¢..........................

17. On a scale of 1- 5, how will you rate the cost of electricity? Where 1 is the highest and 5 the lowest.

Very Expensive ☐ Moderately Expensive ☐ Expensive ☐

Not Expensive ☐ Not Expensive At All ☐

18. What do you use the electricity for? (Please select all that apply).

Powering of machines/equipment's ☐ Lightening ☐ Cooling (refrigeration, air conditioning etc.) ☐ Others ……………………………………………

19. How many times do you experience power outage in a week? ………………………

20. How long does it take for the power to be back? ………………..

21. In case of the power outage, what alternative do you resort to in an attempt to have access to power?

Petrol/diesel powered generator ☐ Petrol/diesel powered Plant ☐ Solar ☐

Others ……………………………….

Knowledge on green/renewable energy technologies

22. Have you heard of green/renewable energy technologies?

Yes ☐ No ☐

23. If yes to question (22), where?

Radio ☐ Television ☐ School ☐ Newspaper ☐ Internet ☐ Family ☐ Friend ☐

24. Can you list any green/renewable energy technology source?

Yes☐ No☐

25. If yes to question (24), list any………………………………………..

26. What factors would you consider when deciding whether to switch to solar energy technology as alternative energy source (please select all that apply).

Installation and maintenance cost □ Access to spare parts □ Durability □
Appearance □ Access to technical personnel □ Opinions of family and friends □

27. How much will you be willing to pay for a solar energy technology that will be able to satisfy your energy need for a period of 5 – 10years? GH¢.......................................

28. Have you ever used any green/renewable technology?

Yes □ No □

29. If yes to the above (28), select all that apply

Solar Powered Lantern □ Solar Power Bank □ Solar Powered Stove □
Solar Powered Fan □ Solar Powered Radio or Television □
Others……………………………………………..

30. On a scale of 1-4, how will you rate the performance of that solar energy technology? Where 1 is the highest and 4 is the lowest.

Extremely High □ Very High □ High □ Low □

31. Are you currently using any green/renewable energy technology? Yes □ No □

32. Do you consider adopting solar energy technology? Yes □ No □

THANK YOU FOR YOUR TIME

Appendix 3: Interview Guide for Municipal Assembly

INSTITUTE OF STATISTICAL, SOCIAL AND ECONOMIC RESEARCH (ISSER)

MASTER'S OF DEVELOPMENT STUDIES (2017/2018)

UNIVERSITY OF GHANA, LEGON

INTERVIEW GUIDE

FOR THE RESOURCE PERSON(s) AT THE MUNICIPAL ASSEMBLY'S OFFICE

This interview guide is for a research study concerned with green/renewable energy technologies adoption as an alternative source of energy within the La Nkwantanang Municipality (Madina).

All information gathered through this study is completely confidential and anonymous. It will only be used to assist in this research and will be destroyed once completed. No one other than the researcher will know your individual responses.

1. Please is there any internal policy or initiative that promotes green/renewable technology adoption?

   Yes ☐ No ☐

2. If yes, how efficient do you think it is in the promotion of green energy technology adoption?...
   ....
   ....
   ....
   ....
   ....
3. If no, are there plans to initiate such policies or initiatives in relation to the promotion of green energy technology adoption?...
   ....
   ....
   ....
   ....
   ....

4. Are there any by-laws restricting the adoption of green energy technologies by individuals and businesses within the municipality? Yes □ No □

5. If no, (i) what are the procedures to be followed by individuals and businesses before accessing green energy technologies in the municipality?
(i)……………………………………………………………………………………
……………………………………………………………………………………
……………………………………………………………………………………
……………………………………………………………………………………
……………………………………………………………………………………
……………………………………………………………………………………
(ii) If Yes, why the restrictions?..
....
....
....
....
....

6. Have the municipal assembly administration ever embark on green energy technology adoption campaign or workshop of any kind? Yes □ No □
7. If no to the above question (6) are there plans for green energy adoption in the future?
……………………………………………………………………………………
……………………………………………………………………………………
……………………………………………………………………………………
……………………………………………………………………………………

THANK YOU FOR YOUR TIME

Appendix 4: Interview Guide for Solar Energy Companies

INSTITUTE OF STATISTICAL, SOCIAL AND ECONOMIC RESEARCH (ISSER)

MASTER'S OF DEVELOPMENT STUDIES (2017/2018)

UNIVERSITY OF GHANA, LEGON

INTERVIEW GUIDE

This interview guide is for a study purpose concerned with green energy technologies (solar) adoption as an alternative source of energy within the La Nkwantanang-Madina Municipality. All information gathered through this study is completely confidential and anonymous. It will only be used to assist in this study and will be destroyed once completed. No one other than the researcher will know your individual responses to this questionnaire.

Please do you consent to participate in this interview? Yes☐ No☐

1. What kind of solar energy technology products do you deal in?
2. Please how demanding are these technologies?
3. How will you rate the performance of these technologies?
4. Can the average income earner purchase these technologies?
5. Are there any payment plans for individuals who cannot make full payment?
6. As a solar energy technology company what are some of the challenges you face?
7. What measures are you or should be taken to address these challenges?
8. What should the government do to promote solar energy technology?

THANK YOU