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ENERGY ACCESS AND DEVELOPMENT INDICATORS

Case Ghana

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ABSTRACT

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Energy has become the main driver for development as industries grow, agricultural sectors become more modernize, economies boom and countries become wealthy. That notwithstanding, there are still vast majority of people living under the poverty line especially in the developing countries including Ghana. This study was intended to find out how energy use, electricity access and consumption have impacted on poverty reduction and some selected world development indicators generally and vis a vis Ghana.

The study used the world development indicators data from the World Bank and where the data was not available, other data sources were used for the 16 West African countries, Brazil, Russia, India, China and South Africa (BRICs) and 10 selected European countries with some World Bank categorizations.

A regression analysis was used in the data analysis when energy use. The results revealed the significant impact energy use generally has on the world development indicators.

It was concluded that to reduce poverty in all forms, energy must be at the center of development policy planning in both developing countries and Ghana.

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1. INTRODUCTION

The interconnectedness between energy access and poverty reductions has been the top subject for multinational organizations, governments, and economists the world over. An idea of the link between energy access and income growth is important for policy formulations (Michael L.P et al., 2013).

"A life without access to energy is a life of drudgery. Despite the availability of technical solutions, two in every five people still rely on wood, charcoal, or animal waste to cook their food, and one in five people lack electricity (IEA, 2012). This is a global technology injustice" (Practical Action, 2013).

Poverty is the greatest challenge for sustainable development of the world and has been at the center of discussion for the World Bank and other multinational associations. One method of reducing poverty is access to sustainable electricity (Kanagawa M. et al., 2008).

United Nation Advisory Group on Energy and Climate Change stated in 2010: "Energy is at the heart of most critical economic, environmental and developmental issues facing the world today. Clean, efficient, affordable and reliable energy services are indispensable for global prosperity. Developing countries in particular need to expand access to reliable and modern energy services if they are to reduce poverty and improve the health of their citizens, while at the same time increasing productivity, enhancing competitiveness and promoting economic growth". The UNDP and WHO (2009) estimates put the number of people without access to energy globally at a little over 3 billion; the IEA (2009) also put the number at 2.5 billion.

About 500 million people without access to modern energy live in sub - Saharan Africa.

Available data on Africa's income since the late 1980s show the share of African's living on less than a dollar a day is on constant increase, the number of poor in Africa has shot up five times more than the figure for Latin America, and twice that for South Asia., (Stephen Karekezi, 2002).

The prevailing towering levels of poverty in sub-Saharan Africa are shown in the consumption pattern of modern energy. From 1990 to 1997, per capita consumption of modern energy in sub-Saharan Africa has stood low and dropped a little from a mean of 248 kg of oil equivalent (kgoe) to 238 kgoe—around 50% of the world average. The little levels of modern energy consumption widespread in sub- Saharan Africa are even more worrying when electricity availability is taken in to

consideration. Except South Africa, per capita consumption of electricity drops from 447 to 126 kWh (Karekezi, 2002).
The study is intended to explore the relationship between energy access and poverty for Ghana.

1.1 Objectives

The objectives study which will be the basis for conclusions and possible recommendations are:

1. To explore the relationship between energy access and poverty.

2. To explore the relationship between energy access and poverty in Ghana.

1.2 The research question

To meet the objectives outlined, the study attempted answering the following questions:-

1. What is the relationship between energy access and poverty, and its indicators?

2. What are the key development issues facing Ghana due to lack of access to energy?

1.3 Methodology

To meet the study objectives and answer the questions asked, the following methods were used for the study:-

1. A literature review of existing work on the energy access and poverty reduction.

2. A desktop research on the energy access and poverty in Ghana and efforts been made to alleviate them.

3. In data analysis, a regression method will be used to establish the relation between energy access and poverty and other development indicators.

1.4 Limitations

1. Due to the large extent of research that has been done on the topic, literature was reviewed but not exhaustively.

2. The World Bank data was used largely for the analysis, where the data is not available, other sources were used, and as a result, there may be little variations in the result.

3. The data used in the analysis are the macro economic variables, which are different from the micro economic variables and this may make the results differ a little from the realities in the various cases.

4. It would have been good to interview some officials and beneficiaries of some government of Ghana interventions to reduce poverty, but time and finance were limited, making it impossible to get that part in to the research.

1.5 Outline of the Study

The study has 7 chapters; chapter 1 outlines study objectives, the study questions, the methodology and the limitations of the study. Chapter 2 presents the literature review on energy access, poverty and development issues. The chapter 3 outlines the study framework. Chapter 4 provides the methodology of the study. Chapter 5 presents the analysis and discussion of the study outcomes and chapter 6 stated the findings of the study, the conclusions drawn from the analysis. Chapter 7 outlines recommendations based on the study analysis and findings.

2. ENERGY ACCESS AND POVERTY

This chapter provides the review of existing literature and the definition of the main terminologies of the study.

2.1. Energy Access

There is no single definition adopted globally for access to energy or modern energy. For instance the UN Secretary General's Advisory Group on Energy and Climate Change defines energy access "to a basic minimum threshold of modern energy services for both consumption and productive uses. Access to these modern services must be reliable, affordable and sustainable where feasible, from low –GHG – emitting energy sources (WEO, 2012).

"Affordable in this context refers to price to the consumers that is commensurate with their income and not more than the prices of traditional fuels" (AGCC, 2010).

"Modern sources of energy include fuels such as natural gas, liquid petroleum gas (LPG), diesel and biofuels such as biodiesel and bioethanol. Technology, such as improved cooking stoves, can also enable cleaner and more efficient delivery of traditional fuels" (AGCC, 2010).

GIZ proposes an assessment based on specific indicators for lighting, communication and cooking and defines electricity access based on five levels corresponding to a certain package and kWh per capita consumption (WEO, 2012).

The International Energy Agency (World Energy Outlook 2012) defines modern energy access as "a household having a reliable and affordable access to clean cooking facilities, a first connection to electricity and then increasing levels of electricity consumption over time". The United Nations Development Program defines energy poverty as the "inability to cook with modern cooking fuels and the lack of a bare minimum of electric lighting to read or for other household and productive activities at sunset" (Sovacool, 2012).

The Asian development bank took a wider dimension and defines energy poverty as “the absence of sufficient choice in accessing adequate, affordable, reliable, high-quality, safe and environmentally benign energy services to support economic and human development” (Sovacool, 2012).

2.1.1. Energy Access defined in various contexts

There are many ways of determining energy access or poverty, from the energy needed for basic cooking and lighting. Some methods assess the income levels of low income earners in a particular country. The common method in assessing energy poverty includes “energy ladders” for heating and cooking. In assessing energy poverty based on how much of the income is spent on energy, it is generally held that a family that spends between 10% and 15% of monthly income on energy or where energy use is same as the income is energy poor (Sovacool, 2012).

The energy ladder is defined as “the percentage of population among the spectrum running from simple biomass fuels (dung, crop residues, wood, charcoal) and coal (or soft coke) to liquid and gaseous fossil fuels (kerosene, liquefied petroleum gas, and natural gas) to electricity”. The concept suggest that the basic types of energy used in developing countries can be arranged on a “ladder” with the most “traditional” fuels and sources, such as animal power, candles, and wood, at the bottom with the more “modern” fuels such as electricity or refined gasoline at the top (Sovacool, 2012). See table. **1**

Table 1 The horizontal energy ladder for household energy use

Energy service	**Developing countries (Households)**			**Developed countries**
	Low income	Middle income	High income	
Cooking	Wood (including wood chips, straw. Shrubs, grasses and bark), char-coal agri-cultural residue and dung	Wood, agricul-tural residues, coal, kerosene and biogas	Wood, kerosene. Biogas, LPG, natural gas and electricity	Electricity and nat-ural gas
Lighting	Candles, kerosene (sometimes none)	Kerosene and electricity	electricity	electricity
Space heating	Wood, agricultural residues, and dung(often none)	Wood and agri-cultural residues	Wood, coal and electricity	Oil, natural gas, or electricity
Other appliances	None	Electricity and batteries	Electricity	Electricity

Sovacool B.K. (2012)

2.1.2. Energy Access by Incremental Levels of Access to Energy

The main obstacle facing the world is lack of single definition for energy access, therefore the UN Secretary General's Advisory Group on Energy and Climate Change has simplified the definition of universal access to energy as "access to clean, reliable and affordable energy services for cooking and heating, lighting, communications and productive uses. For over two centuries, the increasing growth in the use of modern energy has been linked to upsurge in prosperity and economic advancement in the world. In spite of this, there is huge gap in the global distribution of access to modern energy service. Sub Saharan Africa has the lowest energy per capita as compared with the developing countries. In this case the urgent energy priority for the African nations is to increase access to meet the basic needs of cooking, heating, lighting and economic advancement (Sokona et al., 2012) See fig 1.

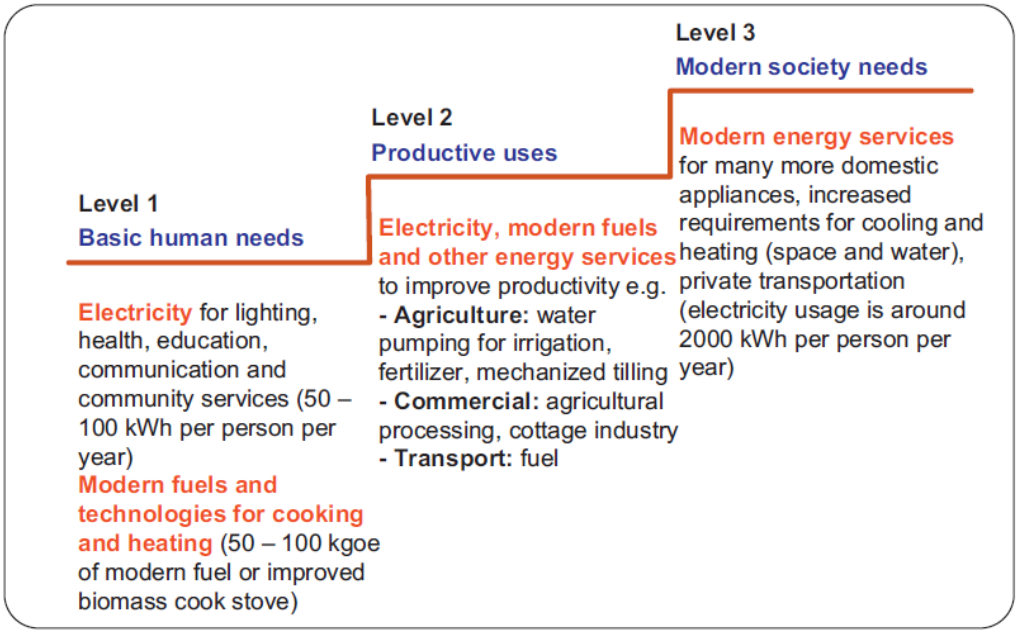


Figure 1 Incremental levels of access to energy services.

AGECC (2010)

2.1.3 Energy Access and Energy Transitions

Energy transitions are basic to the growth and development of modern societies; they include the structure, the quality, quantity, supply and the final use of the energy resource. They have a direct relationship between technological, socio- economic, political changes (Sokona et al., 2012).

O'Connor (2012:2) defines energy transitions as 'a particularly significant set of changes to the patterns of energy use in a society, potentially affecting resources, carriers, converters, and services'(Sokona et al., 2012).

The focus of the goal in increasing access to modern energy services for cooking, lighting, for basic human needs and pumping for production is on modern methods of energy production and carriers (Sokona et al., 2012).

Traditional and renewable sources of energy would be significant in the energy transition period depending on the affordability and availability. Despite contributing about 65% of global GHG emissions, the urgent need to increase access and reduce poverty makes fossil fuels indispensable in the near future, due mainly to the availability and known carriers and converters (Sokona et al., 2012) See fig.2

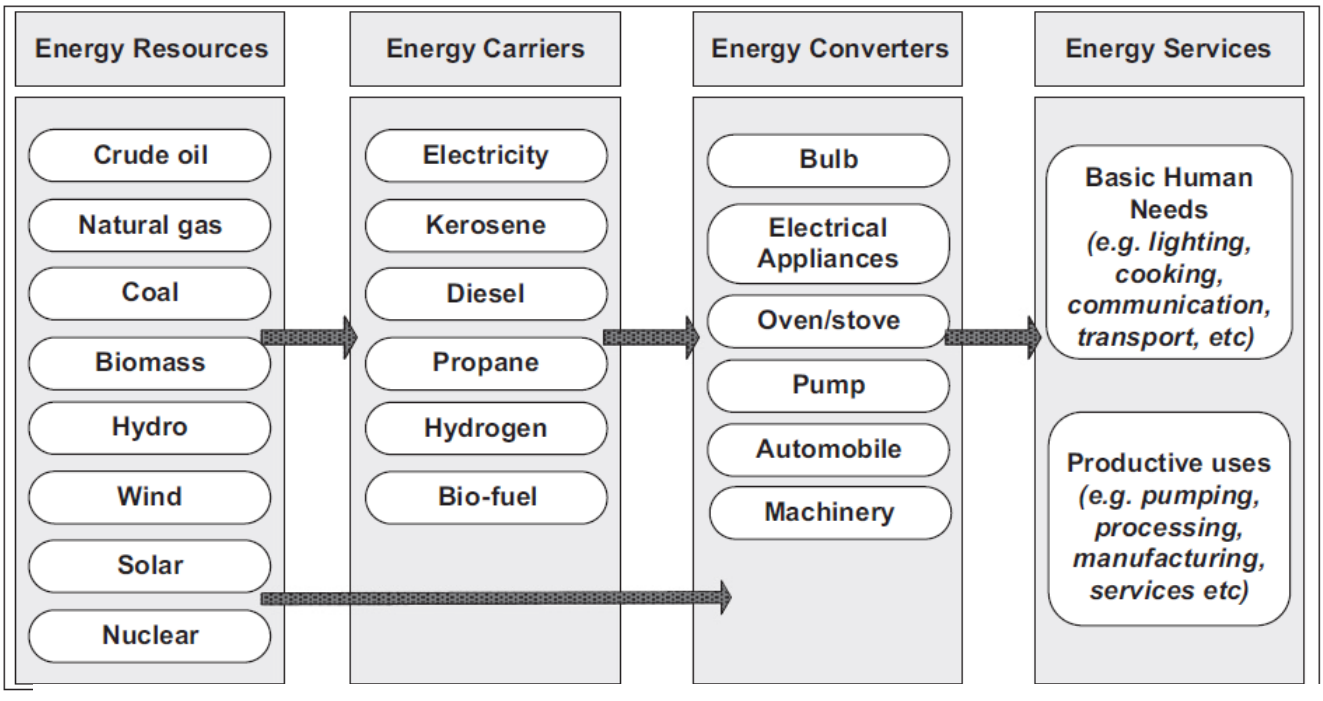


Figure 2 Modern energy and energy services

Sokona Y. et al. (2012)

2.1.4 The Multi-Tier Approach to Energy Access

The definition of energy access is closely related to how poverty issues are tackled (PPEO, 2013). Energy is critical for human and socio – economic advancement. The general health and environmental conditions in developing nations is increasing by the year and it is estimated that about 2 million people die a year from indoor pollution related than malaria (Practical Action, 2013).

The Poor people's energy outlook assesses the critical influence energy access has on the changing the lives of the "poor" and proposes a new look at the energy access definition.

This prioritizes "household energy", "energy for a living" and "energy for community services" See fig. 3.

Figure 3 Total energy access: for household, earning a living and community services. PPEO, (2013)

The various definitions of energy access provide basic elements of any access discussions. In the context of the definitions, energy access, means, energy that meets the fundamental human needs and provides the opportunity for people to earn an income that is life sustaining.

2.1.5. The Global Energy Access Situation

The international energy agency estimated that in the absence of targeted world action to increase energy access by 2035, there will be about 2.7 billion people without access to electricity and clean cooking fuels. It has estimated also that if no commitment is made to achieve universal access to energy by 2030, there will be an excess of 1.5 billion premature deaths per year as a result of pollution from burning wood and dung due to lack of fundamental sanitation and healthcare. Advanced energy sources are necessary to attain these challenges (World Coal Association, 2013). See fig.4

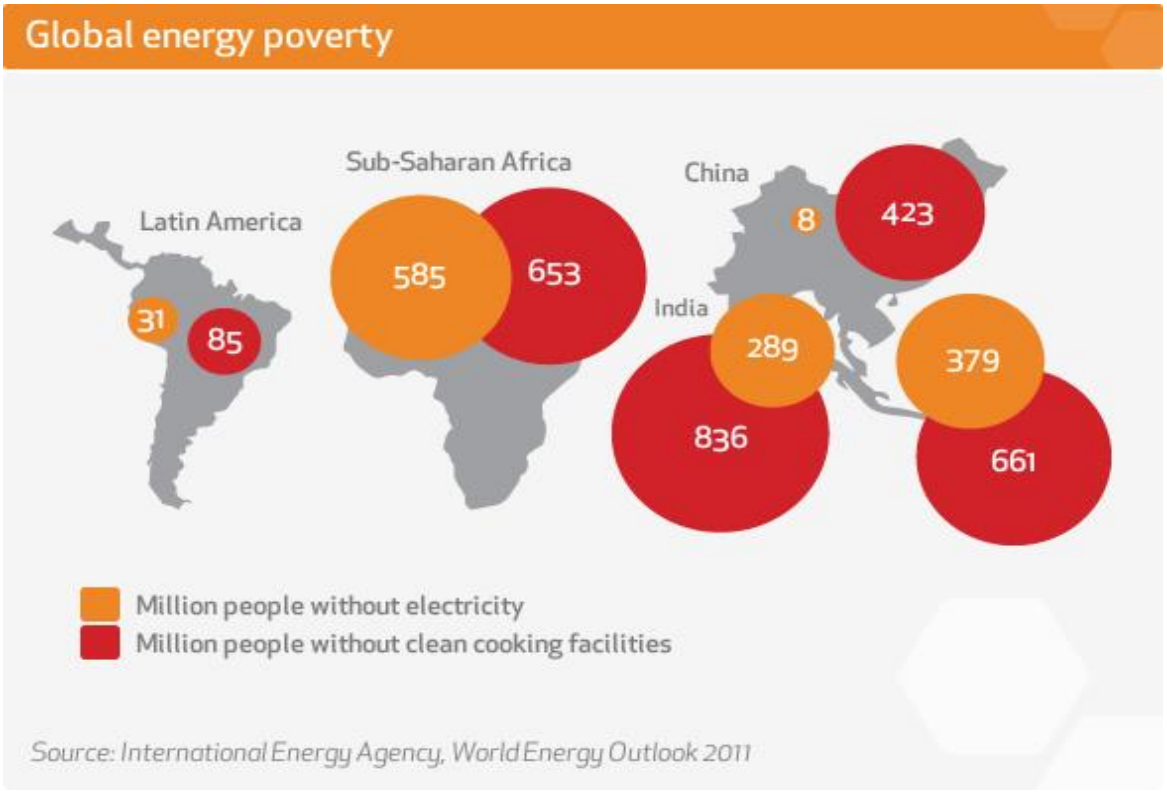


Figure 4 Global energy poverty.

IEA, WEO 2011

Apart from the households and individuals, energy access is very critical in the wider spectrum of economy and society and it the main reason why the developing world needs improved access to modern energy services.

2.1.6 Energy Access, the African situation

In comparison with other nations, the Sub - Saharan Africa nations have the highest percentage of population using the traditional biomass for cooking. Some nations, such as Tanzania, Burkina, Niger, Togo, Guinea Bissau and Liberia have as high as 95% of their population depending on the traditional biomass for cooking and heating. In the east African areas less than 30% of household energy depends on LPG or modern stoves.

Senegal and Ghana both in the West African region have more than 20% and less than 10% their populations relying on LPG. The high traditional biomass use is linked to the per capita incomes, which does not increase significantly from switch to modern and clean energy sources (Brew - Hammond, 2010).

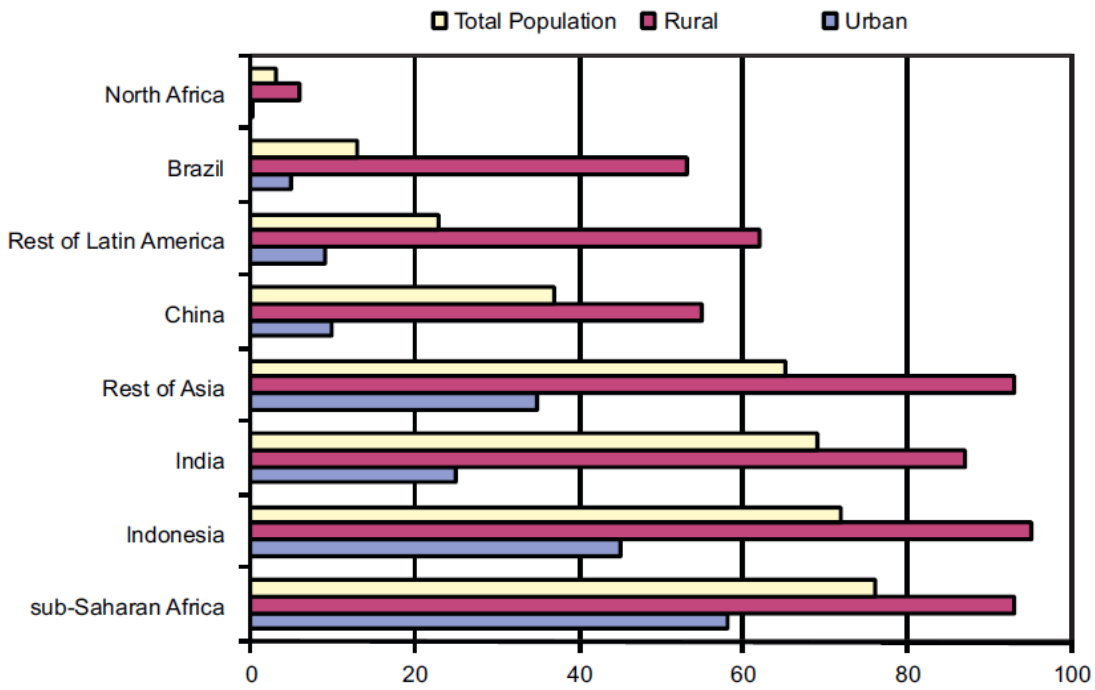


Figure 5. Proportion of population dependent on traditional biomass for cooking

Brew – Hammond (2010)

North Africa with the population of more 200 million has less than 10 million people dependent on traditional biomass. (See Fig. 6.) The number of people dependent on traditional biomass in sub Saharan Africa is estimated to increase from the current 600 million to 700 million in 2030 (Brew – Hammond, 2010).

Over 77% of rural Africa has no access to electricity with West Africa having a total of 10% rural electricity penetration (Azoumah et al., 2011). See table 2.

Table 2 The electricity access in 2008, the regional aggregate

Region	**Population without electricity (million)**	**Electrification rate (%)**	**Urban electrification rate (%)**	**Rural electrification rate (%)**
North Africa	2	98,9	99,6	98,2
Sub Saharan Africa	**587**	**28,5**	**57,5**	**11,5**
Africa	**589**	**40,0**	**66,8**	**22,7**
China and East Asia	195	90,2	96,2	85,5
South Asia	614	60,2	88,4	48,4
Developing Asia	809	77,2	93,5	67,2
Middle East	21	89,1	98,5	70,6
Latin America	34	92,7	98,7	70,2
Developing Countries	1453	72,0	90,0	58,4
Transition Economies and OECD	3	99,8	100,0	99,5
World	**1456**	**78,2**	**93,4**	**63,2**

(WEO 2009)

Electricity access differs significantly depending on the data source, for instance, the World Bank and the International Energy Agency reported the following figures 12% and 19% and 8% and 14% for Zambia and Kenya respectively.

In sub – Saharan Africa, the situation of lack of access to electricity is projected to increase from 400 million to 600 million in a decade and half, almost the same as the traditional biomass users despite the expected increase in electricity penetration to 51% by 2030. See Fig 6. Access to electricity differs in the urban and rural areas. In the East African region, about 40% of the urban households have access to electricity while the rural enclaves have 5%. The data source, however, was silent on the quality of the electricity services provided even at the low penetration. South Africa and Ghana a slightly high penetration rate have erratic supplies, pushing the respective governments to resort to power rationing (Brew – Hammond, 2010).

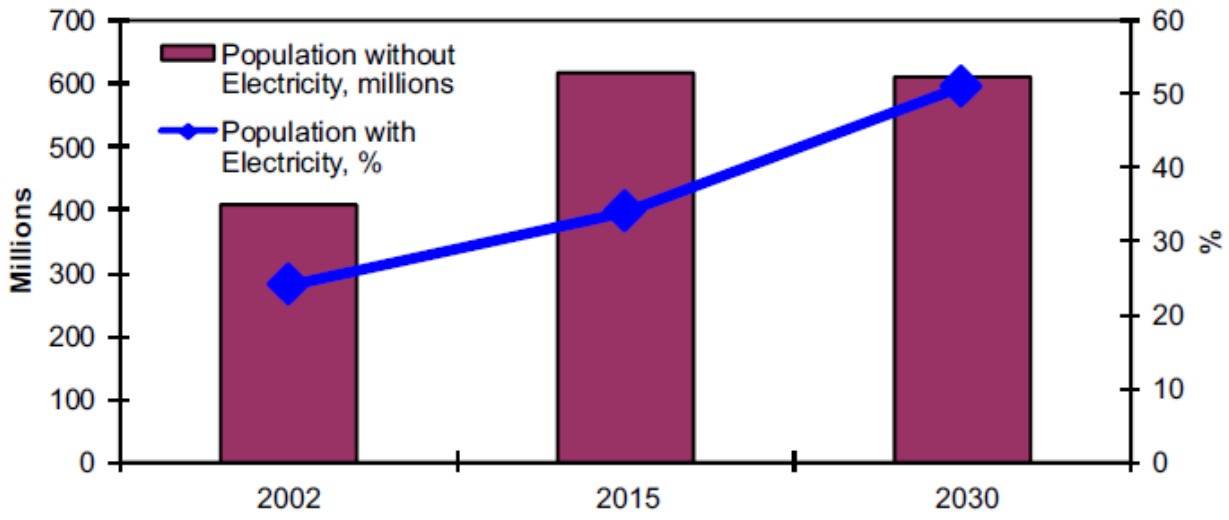


Figure 6 projection for population with and without access to electricity in sub Saharan Africa

Brew – Hammond (2010).

2.2. Definition of Poverty

Like energy access, there is no single definition for poverty as conditions in countries vary considerably. However the United Nations (1998) defines poverty as

"Fundamentally, poverty is a denial of choices and opportunities, a violation of human dignity. It means lack of basic capacity to participate effectively in society. It means not having enough to feed and clothe a family, not having a school or clinic to go to; not having the land on which to grow one's food or a job to earn one's living, not having access to credit. It means insecurity, powerlessness and exclusion of individuals, households and communities. It means susceptibility to violence, and it often implies living on marginal or fragile environments, without access to clean water or sanitation"

At the World Development Summit in Copenhagen, Denmark (1995), nations accepted a declaration to end what was termed overall and absolute poverties.

Absolute poverty was defined as "a condition characterized by severe deprivation of basic human needs, including food, safe drinking water, sanitation facilities, health, shelter, education and information. It depends not only on income but also on access to services".

Overall poverty has various forms, such as "lack of income and productive resources to ensure sustainable livelihoods; hunger and malnutrition; ill health; limited or lack of access to education and other basic services; increased morbidity and mortality from illness; homelessness and inadequate housing; unsafe environments and social discrimination and exclusion. It is also characterized by lack of participation in decision making and in civil, social and cultural life. It occurs in all countries: as mass poverty in many developing countries, pockets of poverty amid wealth in developed countries, loss of livelihoods as a result of economic recession, sudden poverty as a result of disaster or conflict, the poverty of low wage workers, and the utter destitution of people who fall outside family support systems, social institutions and safety nets (Gordon, 2005).

The United Nations Development Program's Human Development Report affirms that poverty is not static but multi-faceted condition that includes the intake of calories, life expectancy, housing, literacy, energy access and many considerations. If you earn less than $2 a day, you must be considered "poor" (Sovacool, 2012).

3. ENERGY ACCESS AND DEVELOPMENT INDICATORS:- A CONCEPTUAL FRAMEWORK

In this chapter, the conceptual framework of the relationship between energy access and poverty indicators is presented. In the first part, a proposed model of energy access and poverty indicators is introduced.

In the subsequent sections, the components of the framework are discussed separately.

3.1. Energy Access and Poverty Indicators

Socio – economic development has been at the center of the world donors and efforts have been made in improving such areas as, education, health, gender, shelter and food. These indicators are directly connected to one another (Kanagawa et al., 2006).

Energy to a larger extent impacts on those indicators. The Energy and Mining Group of the World Bank established the connection between economic prosperity, sustainable income, health, education, women and children (Kanagawa et al., 2006). The study is framed on four key indicators that are linked to energy access. They are health, education, income and environment. See fig. 7

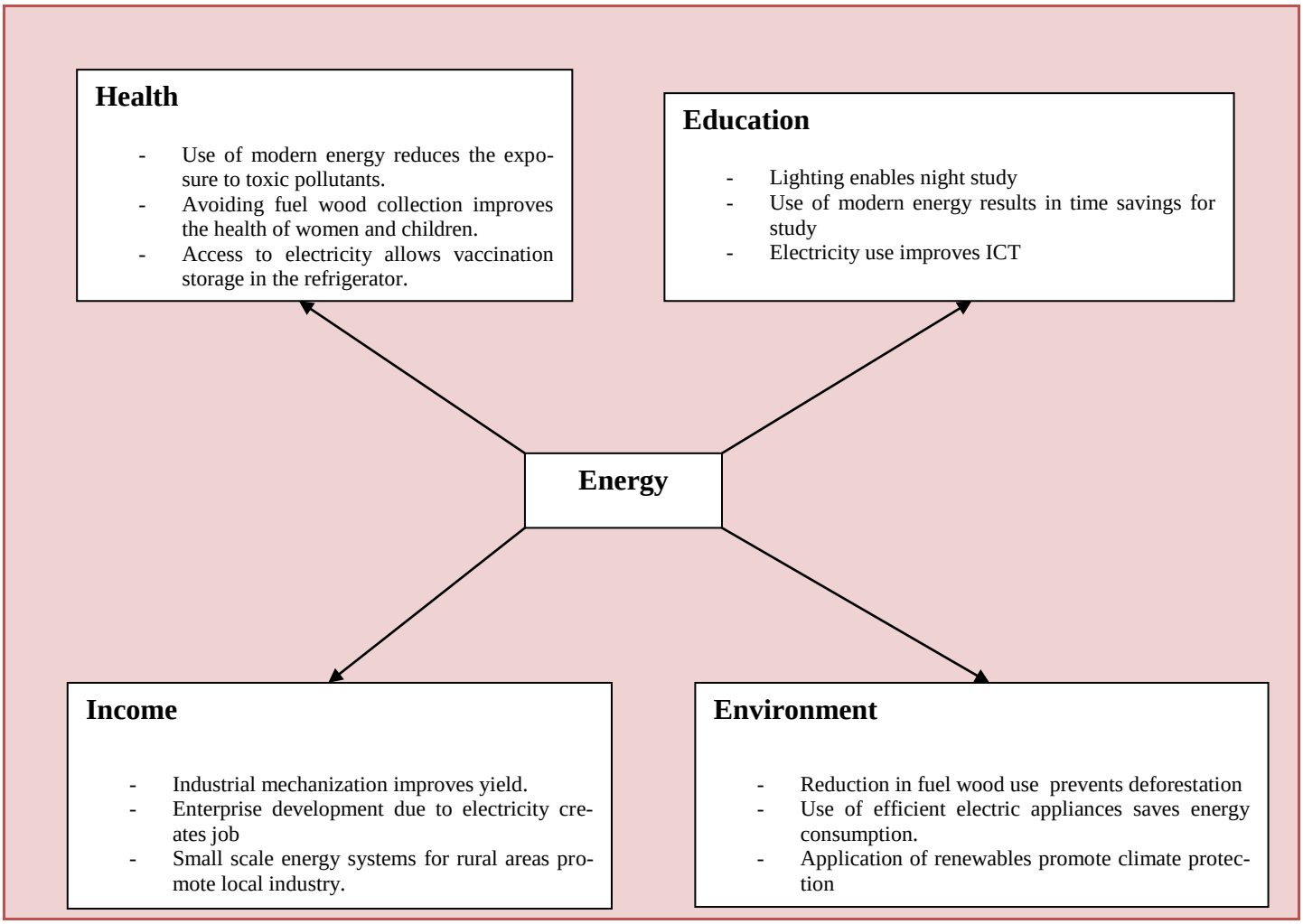
3.1.1 Energy Access and Health

The United Nations Millennium Development Goals (MDGs) 4; 5; and 6 reads: Reduce child mortality; improve maternal health; and combat HIV/ AIDS, malaria and other diseases.

Many foods need cooking and the application of modern cooking facilities reduces significantly indoor pollution, therefore limiting respiratory and other lung diseases. Access to modern energy services enables homes to heat water, thus reducing waterborne infections. Sustainable energy access, - support the running of medical facilities such as hospitals and clinics (IEA, UNDP and UNIDO, 2010).

Access to energy enables medical facilities to serve the people after dark, to power the communications gadgets and retrieve clients' information.

Figure 7 Linkage between energy and development indicators



Kanagwa and Nakata (2006)

The World Health Organization (2006:8) reported: The inefficient burning of solid fuels on an open fire or traditional stove indoors create a dangerous cocktail of not only hundreds of pollutants, primary carbon monoxide and small particles, but also nitrogen oxides, benzene, butadiene, formaldehyde, polyaromatic hydro carbons and many other damaging chemicals" (Sovacool, 2012).

Lack of energy access therefore has dare public health alarms, due mainly to inhaling of pollutants during indoor cooking, injury during fuel wood gathering, lack of safe storage of medication (refrigeration) and electricity access for medical facilities(Sovacool, 2012). The population dependent on traditional biomass as a fuel is expected to increase from 2.7 billion from now to 2.8 billion in 2030. The WHO (2010) projected that the household air pollution as a result of the biomass burning

in the ineffective stoves would lead to more than 1.5 million early deaths in a year, more than 4,000 a day, in 2013. These projected deaths are more than deaths expected from malaria, tuberculosis or HIV and AIDS (IEA, UNDP and UNIDO, 2010). See table 3 and Fig 8.

Table 3 Number of people without access to electricity and dependent on biomass as fuel, 2009 (millioIEA, UNDP and UNIDO (2010).

	Number of people without access to electricity	Number of people dependent on traditional biomass for cooking.
Africa	587	657
Sub – Saharan Africa	585	653
Developing Asia	799	1937
China	8	423
India	404	855
Other Asia	387	659
Latin America	31	85
Developing countries	1438	2679
World**	**1441**	**2679**

The traditional biomass means the fundamental method used, such as the three stone fire cook stoves.

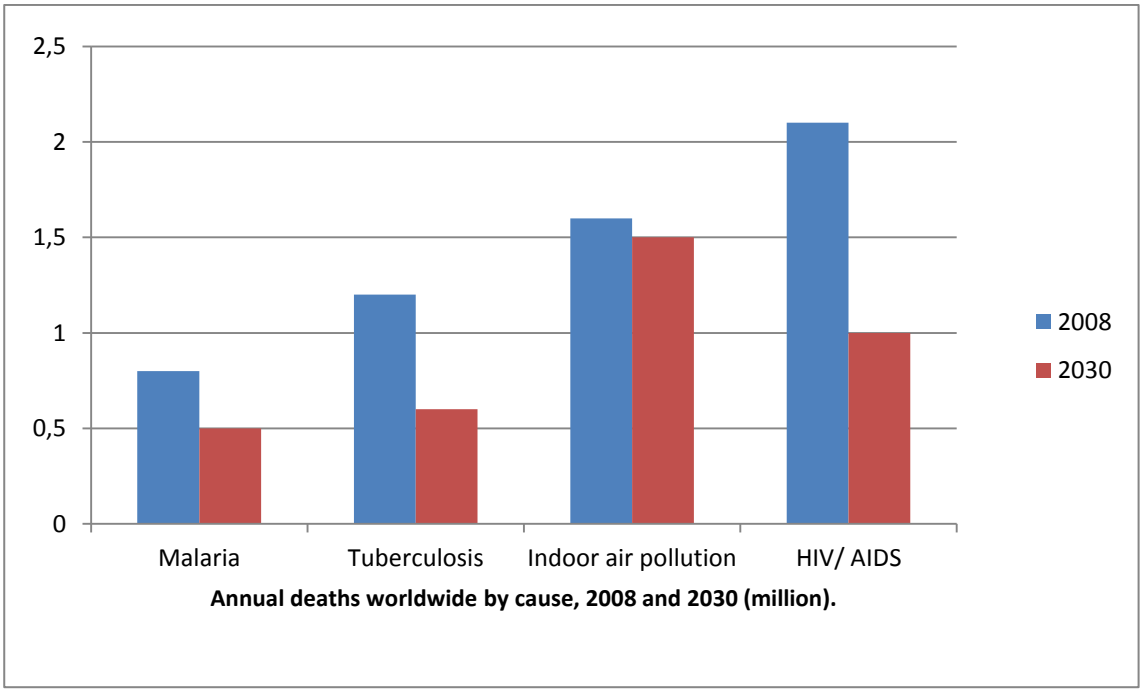


Figure 8. Annual deaths worldwide by cause, 2008 and 2030 (million)

Sovacool (2012)

The World Health Organization (2012) estimated that about a population of 1 billion globally has access to health facilities without any form of electricity and about 800 women die daily due to pregnancy and labor mainly due to childbirth complications that could have been avoided. The reports state that over 90% of childbirth deaths occur in third nations with deplorable health posts (Practical Action, 2013).

Available figures on the indoor air pollution indicate that in Gambia, children under five years have six times higher risk of lung infection when carried by their mothers during meal preparation than cigarette smoking (Gaye 2007). In sub – Saharan Africa, about 10 million women and children may die from indoor air pollution between 2005 and 2030 (Sovacool, 2012).

The ability to afford medication is dependent upon the income levels of households. Komives et al (2001) states that electricity access leads to increase in monthly household income. Electricity access has a positive correlation with per capita GDP which influences the lifestyle of people through the use of modern electrical appliances (Cook et al 2004).

From the information above, an improved energy access will improve health delivery and medication storage.

3.1.2 Energy Access and Education

Lack of access to energy has adverse effects on educational chances to humanity, both adult and children. These effects include irregular school attendance due to sickness. Many medical researchers have established links between air pollution due mainly to ineffective indoor cooking stoves and severe respiratory problems amongst children, these results in absence from school (Sovacool, 2012). Achieving universal primary education is the MDG 2 of the United Nations. Children in poor rural areas spend majority of the time fetching firewood, and water. Access to modern energy services will facilitate cooking and allow time for school. Electricity is crucial for education since it improves communication and information sharing. It also enables lighting (IEA, UNDP and UNIDO, 2010). Quality education is a prerequisite for increase economic activities and to larger extent the social wellbeing of the individual because one's income is mostly dependent on the level of education. Energy access enables schools to remain open at night so that students can saty and learn, it also allows communities to organize literacy lessons for the adults thereby improving their reading and writing skills.

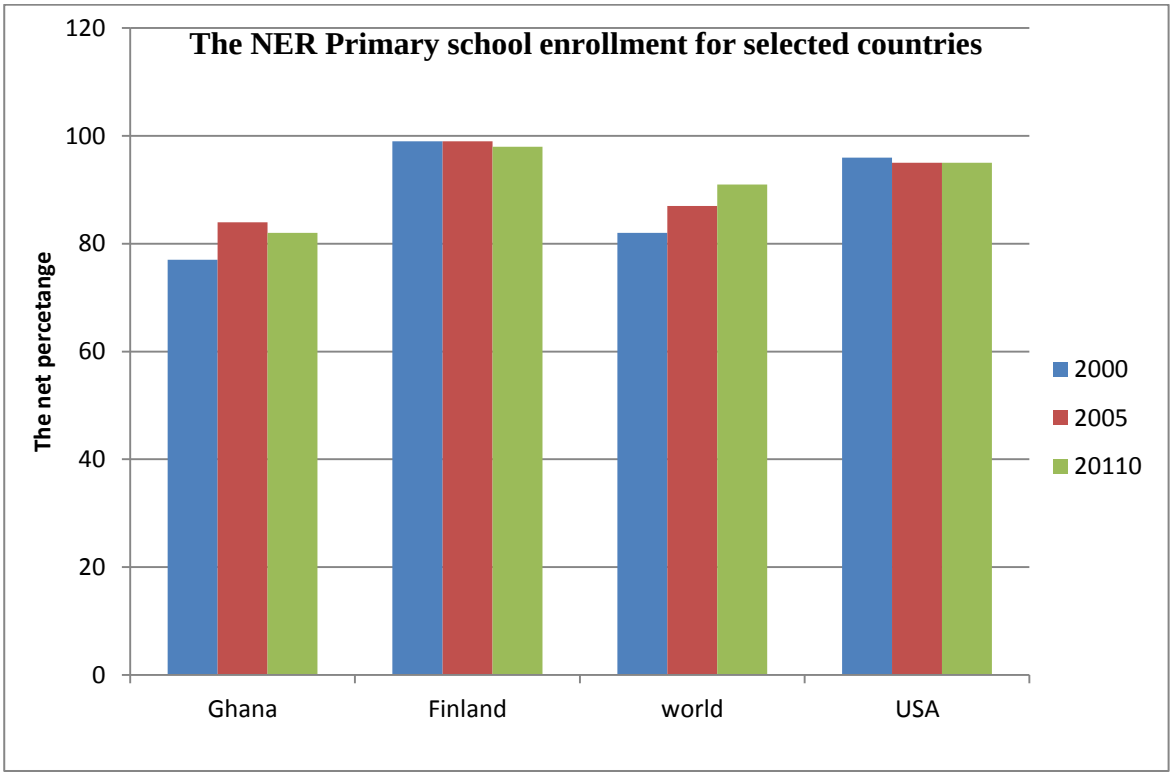


Figure 9. The NER primary school enrollment for selected countries

World Bank Data, (2011)

It is also imperative to note that energy access can influence education. For example, the non-formal education system in Ghana where those without formal education are trained to read through evening classes can be improved with access to electricity.

3.1.3 Energy Access and Productivity and Economic Growth

Modern energy services help to increase income earning activities and can significantly support poverty alleviating methods. A world assessment posited that between 20% and 30% of the yearly incomes of poor people is used on energy and an additional 20% to 40% is remotely used the use of the energy (Sovacool, 2012).

A reliable supply of efficient heating, lighting, cooking and transportation is vital and modern energy sources are the key to that need. Researchers, academics and practitioners have accepted the

strong positive relations between access to energy and income levels. It is evident that nations with poor population also have less access to modern energy sources (Practical Action, 2013). See fig. 10

An increased income is mostly accompanied by increased access to modern energy services. Electricity access is not only the outcome of economic development; it contributes significantly to the economic development (Practical Action, 2013). According to Jones (1989) and Lee (2005) urbanization leads to increased energy consumption and energy use also increase GDP growth. Rural electricity consumption equally increases agricultural growth in Fan et al., state (2005).

There is another strong relationship between energy access and economic development. It is therefore important that for countries to develop, every effort must be made to increase access to not only electricity but modern energy facilities. In making an effort to increase access to electricity and modern energy, attention must be given to the quality, reliability, quantity and the sustainability of the modern energy sources. See fig. 10.

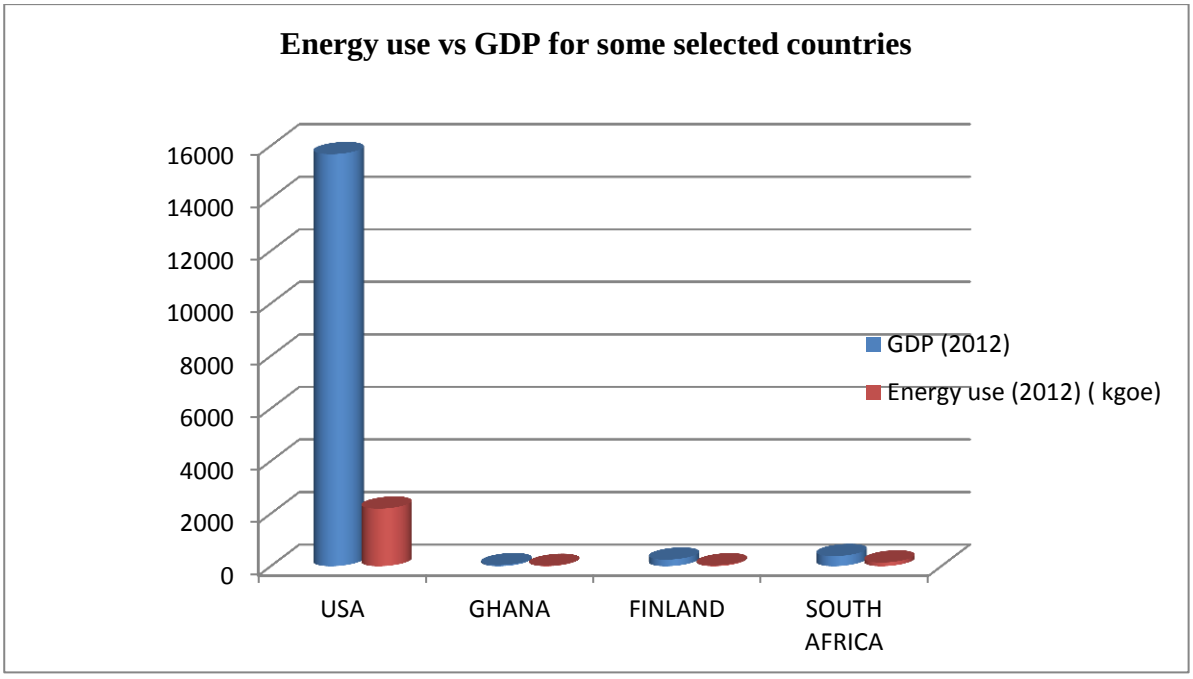


Figure 10. Energy use Vs. GDP for some selected countries

World Bank Data, (2011)

Women and children usually spent majority of their times fetching fuel wood, water and preparation of food. It is estimated that rural women in India spent about 3 hours a day preparing food and extra 2 hours in the food processing (Sovacool, et al., 2012).

The United Nations Millennium Development Goal 3 is to promote gender equality and empower women. Access to quality electricity and modern energy sources will decrease the effect of fire wood carrying on women and children and making time available for economic opportunities (Practical Action). It is calculated that in India, a woman typically spends 40 hours gathering fuel wood in a month in 15 different journeys and may walk as long as 6 kilometers in a complete journey (Sangeeta, 2008). This totaled to some 30 billion hours in a year with a monetary value of some $6.7 billion annually (Reddy et al., 2009).

Cook et al say that (2004) household electricity access results in reduction in income poor and per capita energy expenditure also leads to reduction in extreme poverty. Since women and children spent much time gathering fuel wood, an increased access to electricity will free up time for women and children.

Largely, energy access influences the desire by the United Nations to promote gender equity and empower women as enshrined in the MDG 3,- It is therefore very necessary that maximum attention is given to access to energy in order to meet the targets.

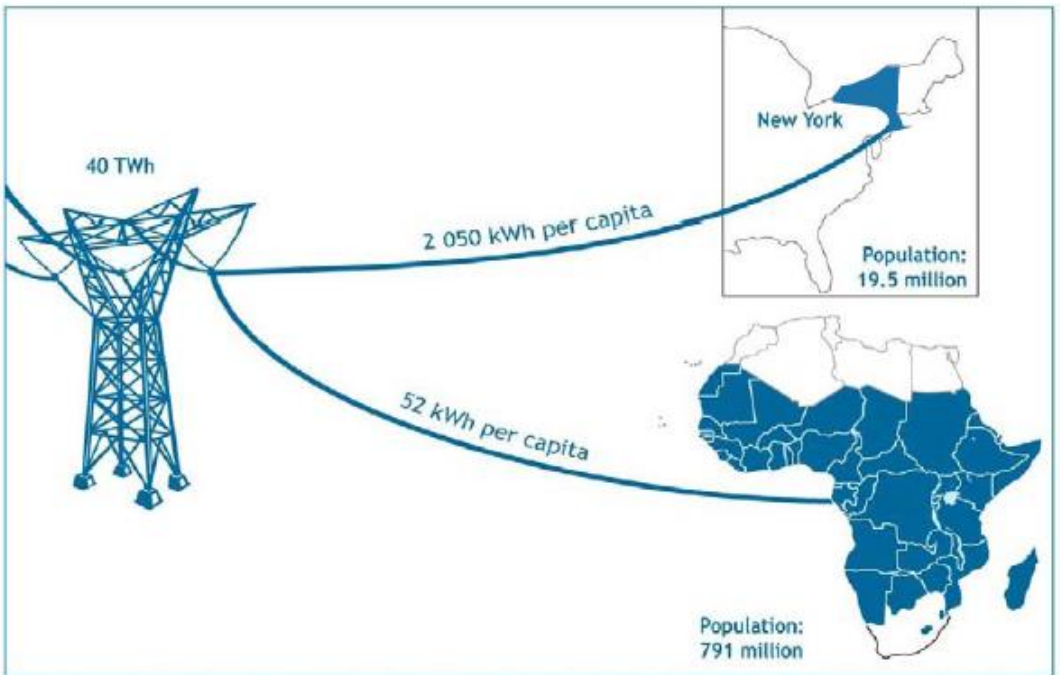


Figure 11. Electricity consumption in New York and Sub Saharan Africa. IEA, UNDP and UNIDO (2010)

3.1.4 Energy access and the environment

The environmental effects of lack of energy access include destroying forest zones, changing the landscape and greenhouse pollutants. The World Health Organization (WHO, 2006) projected that about 2 billion people are dependent upon the traditional biomass for space heating and cooking and burn about 2_million tons of biomass daily. Whereas the wood is in limited supply and population growth is high, the rate of replenishing the trees are slow, thereby resulting in the deforestation and affecting the environment (Sovacool, 2012).

The connection between firewood fetching and deforestation is not true for all nations; a study revealed that many times, people fetch firewood not from the forest reserves but the "invisible trees"- A second study also revealed that only in Africa fetching firewood significantly result to deforestation. However many researches indicate that firewood fetching is the largest contributor to land degradations and depleting forest zones (Sovacool, 2012).

A study conducted on the forest reserves of some 34 developing nation cities concluded:

"The per capita consumption of biomass fuel persists at a relatively high level until the advanced stages of the energy transition, and the aggregate consumption of biomass fuels does not necessarily decline with income growth. The total biomass energy consumption continuing at a high level as cities develop, the demand pressure on the surrounding forested land will continue even after cities have reached the later stages of modern fuels transitions"_ (Barnes et al., 2004)

The Asian development bank has indicated that:

"While deforestation may have many causes other than fuel wood collection that are more important contributors, such as logging, commercial charcoal production, conversion of land to agricultural use, etc., studies show that continued fuel wood harvesting can accelerate such depletion while also diverting biomass away from soil conditioning that can aid vegetative re-growth. Although conditions resulting in deforestation and their underlying determinates may be complex and location specific, there is little doubt that reducing biomass fuel dependence among the poor can help relieve the pressure on such natural resources and improve their sustainability".

(Masud et al.,- 2007)

It is therefore necessary that to save the environment from degradation and pollution, energy access is improved in all forms.

3.2. The Energy Access and Development Indicators of Ghana

Ghana is ranked by the World Bank (2010) as a Lower Middle Income country and one of the fastest growing economies in the world. That notwithstanding the country has lower energy per capita (230 kWh) compared to the United Nations threshold of about 250 kWh for rural areas' basic energy requirement and 500 kWh for the urban areas.

3.2.1 Energy Access

Ghana's energy mix is predominantly traditional biomass with more than 70% of the total primary energy and the petroleum and hydro providing some 20% and 6% respectively. About 60% of the country's electricity is produced from the Akosombo and Kpong hydroelectric dams with the remainder coming largely from thermal power plants (Mahu et al., 2011). See fig.11 & 12.

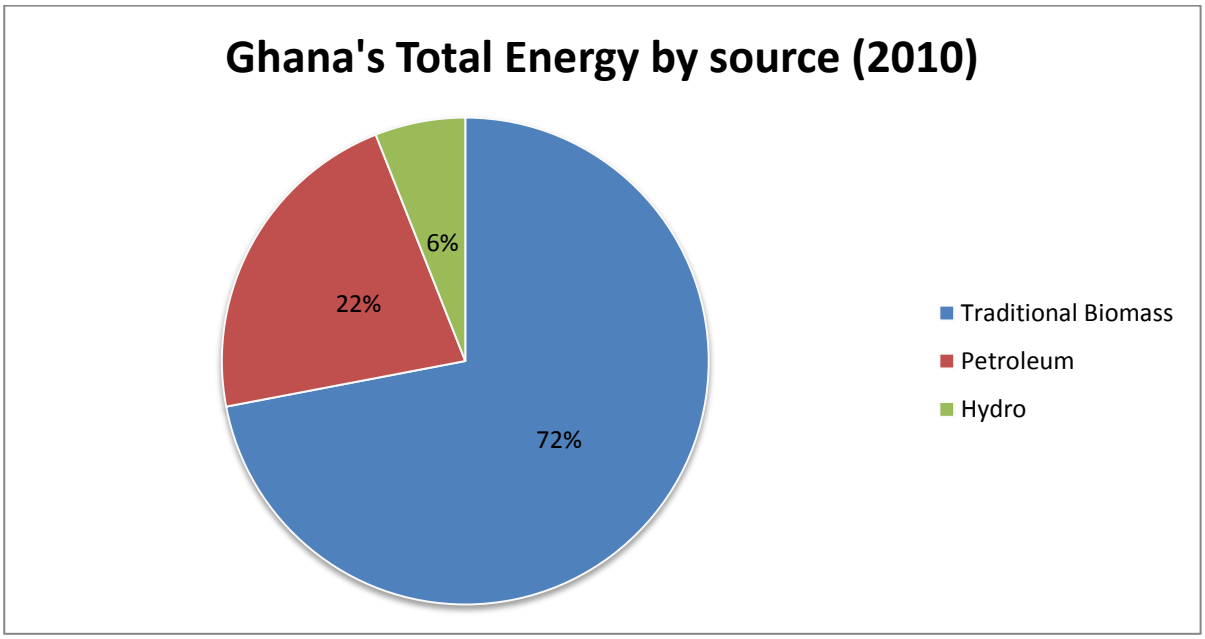


Figure 12. Ghana's total energy by source, (2010)

Mahu and Essandoh (2011)

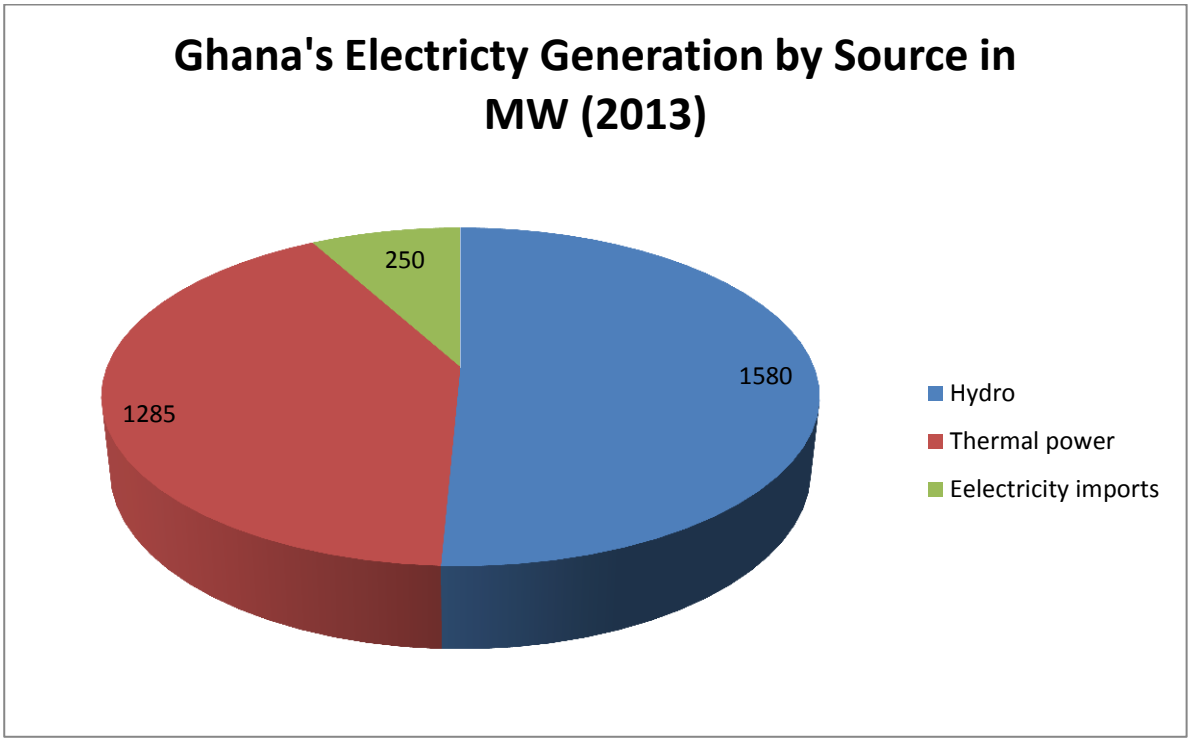


Figure 13. Ghana's electricity generation by source

Mahu and Essandoh (2011)

In (-2010-) Ghana had electricity access of some 67 % nationwide with the following regional breakdown. The Upper West 32%, Upper East 30%, Northern 44%, Brong Ahafo 63% , Ashanti 80% , Eastern 62%, Western 59%, Volta 58%, Central 55% and Greater Accra 96% (Ministry of Energy, 2010).

3.2.1.1 Household Energy

The total household energy use includes heating that is met by biomass. The biomass accounts for 95% of the rural household energy source which is mainly wood and the urban families largely rely on charcoal which is also three times less efficient (Abavana, 2004).

About 64% of the families use electricity as the source of lighting about 18% depends on kerosene and close to 16% use torch lights (Ghana Statistical Service, 2010). See Fig 13.

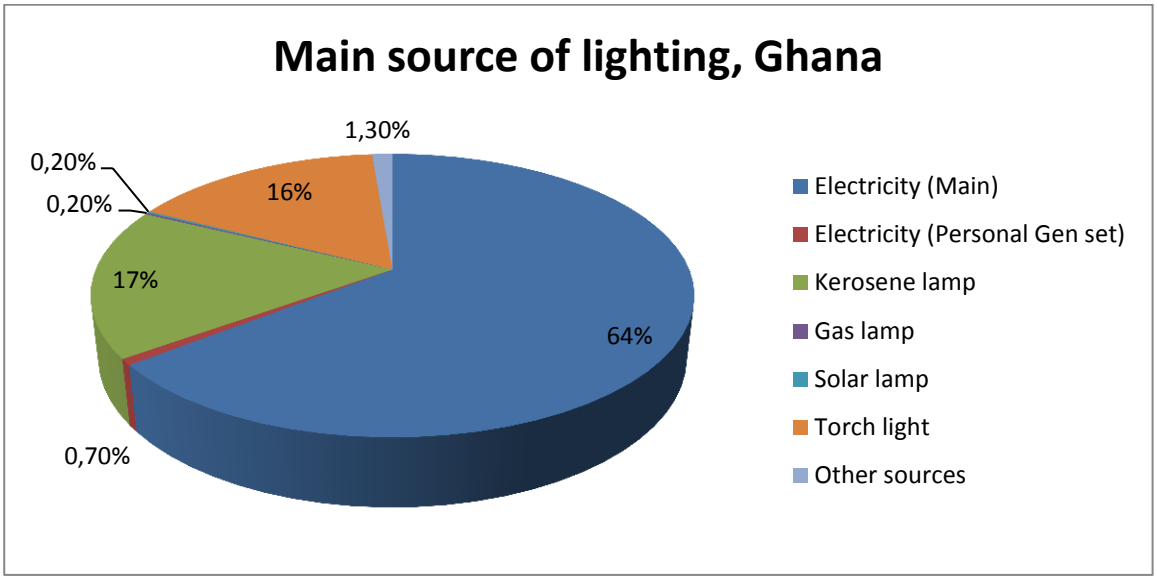


Figure 14. Main sources of lighting in Ghana, (2010)

Ghana Statistical Service (2010)

Ghana's energy consumption is mainly firewood with a whopping 66% and petrol chemical products have some 25% and electricity has a paltry 8%. See Figure 14.

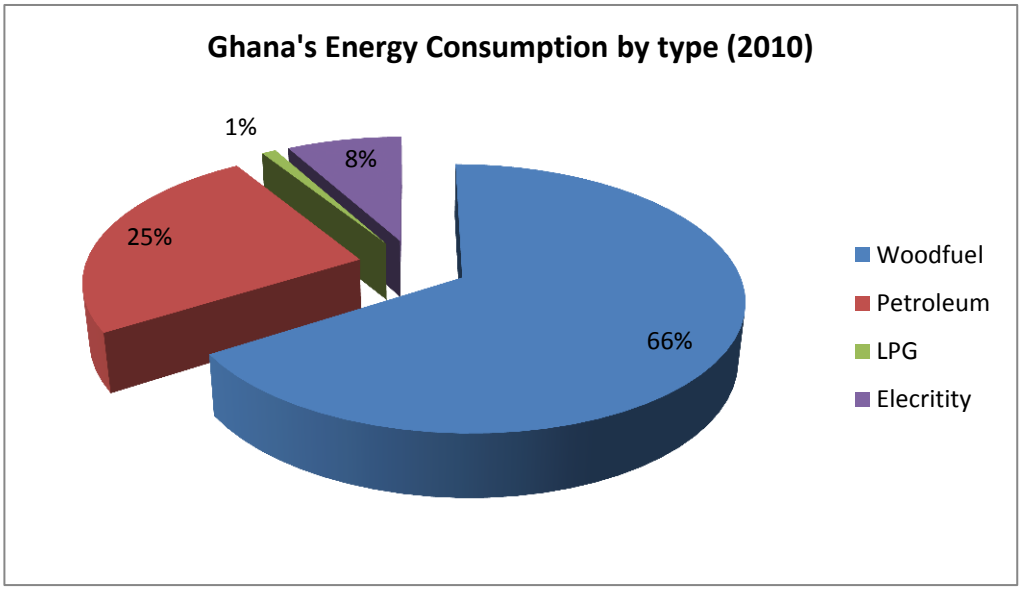


Figure 15. Ghana's energy consumption by type (2010).

Mahu and Essandoh (2011)

It is worthy of noting that while Ghana has some 67% of national electricity penetration, wood fuels constitute the largest share of energy consumption and only 8% of the consumption was attributable to electricity. The population distribution of the country also show that almost half of Ghanaians live in the rural areas, though there are few region regions where the majority of the population live in the cities, the overall distribution reveals a staggering numbers in the rural areas. See fig. 15.

It is therefore worthy of noting that the electricity penetration in Ghana is predominantly in the urban areas.

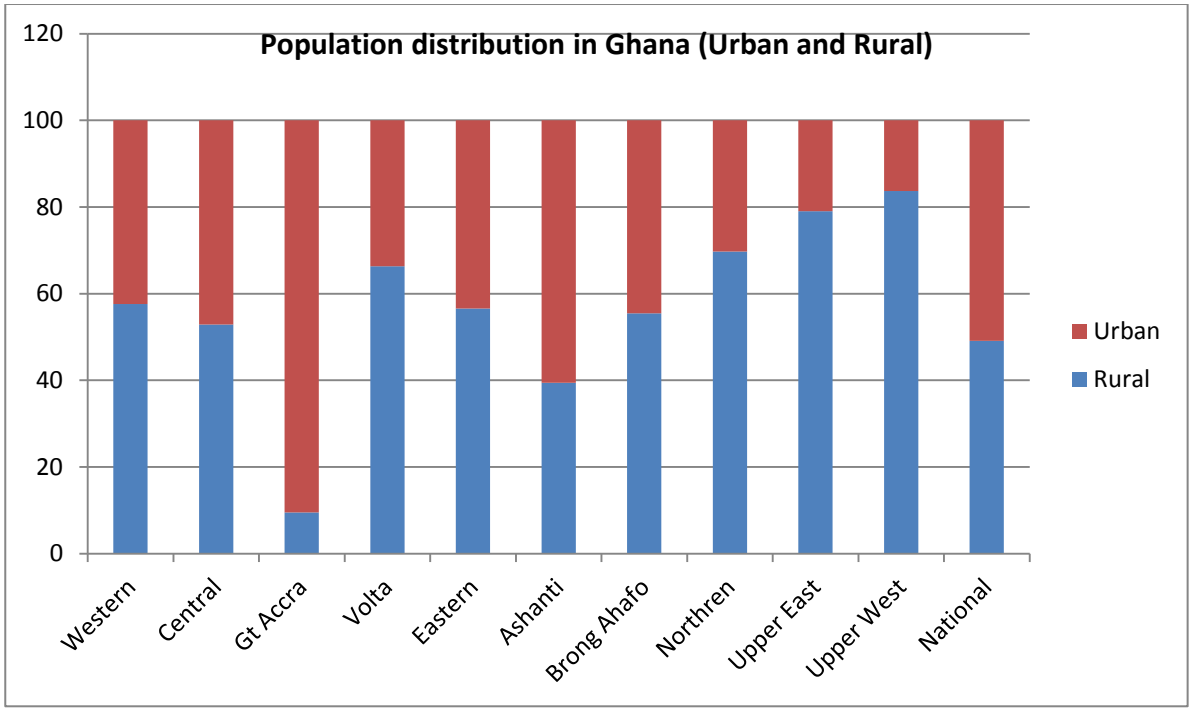


Figure 16. Population distribution in Ghana

Ghana Statistical Service (2012)

3.2.2. Energy Access and Health

In 2003 the government of Ghana established the national health insurance scheme by an act of parliament to provide quality basic health care to the citizenry. The scheme has a mission " to pro-vide financial risk protection against the cost of quality basic health care for all residents in Ghana, and to delight our subscribers and stakeholders with an enthusiastic, motivated and empathetic professional staff who share the values of honesty and accountability in partnership with all stakeholders " (NHIA, 2011).

The scheme's membership has grown year by year and has an active membership of 33% of the national population. The regional membership, however, differs considerably (NHIA, 2011). See fig.17.

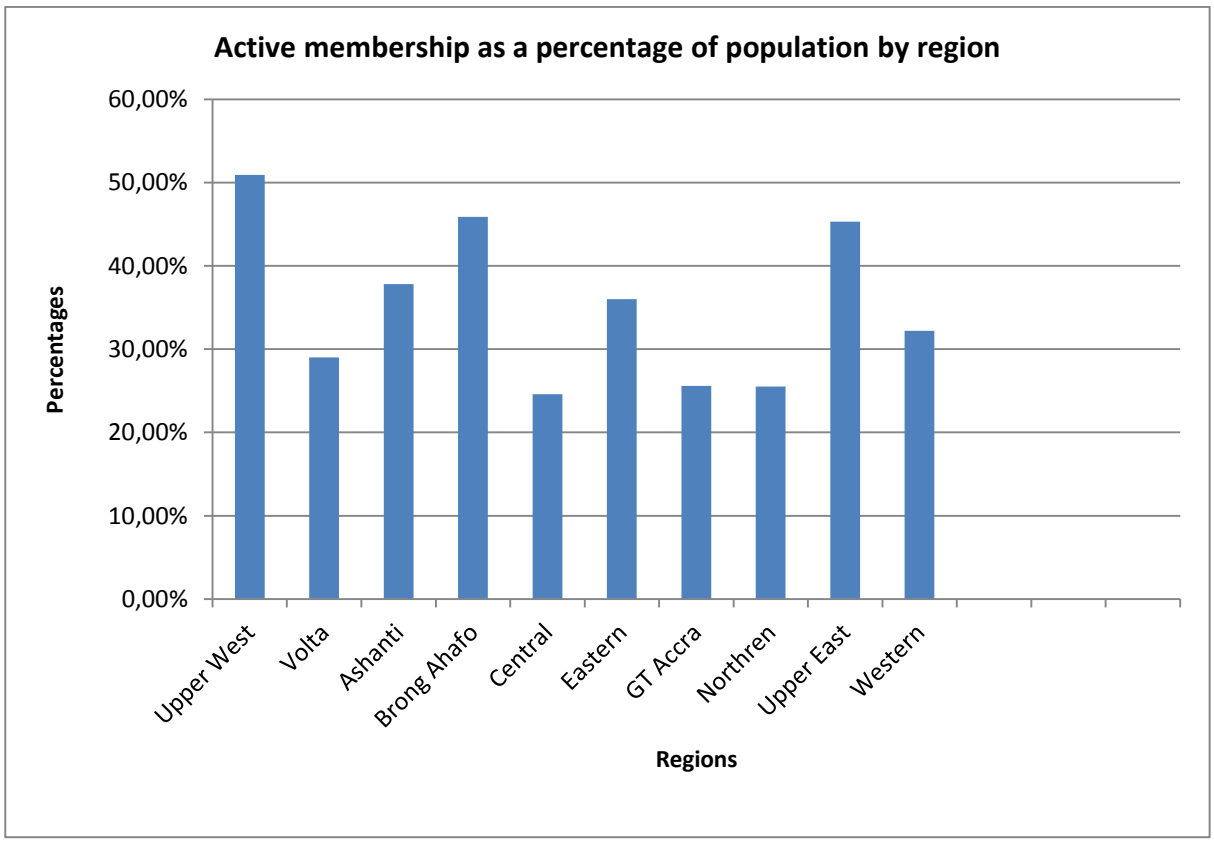


Figure 17. Active membership as a percentage of the population by region in Ghana

National Health Insurance Authority, 2011

Insurance premiums are contributed annually by the members to cover basic health service delivery. Members range from the various sectors of the Ghanaian economy with categorical requirements for each segment. See Figure 18.

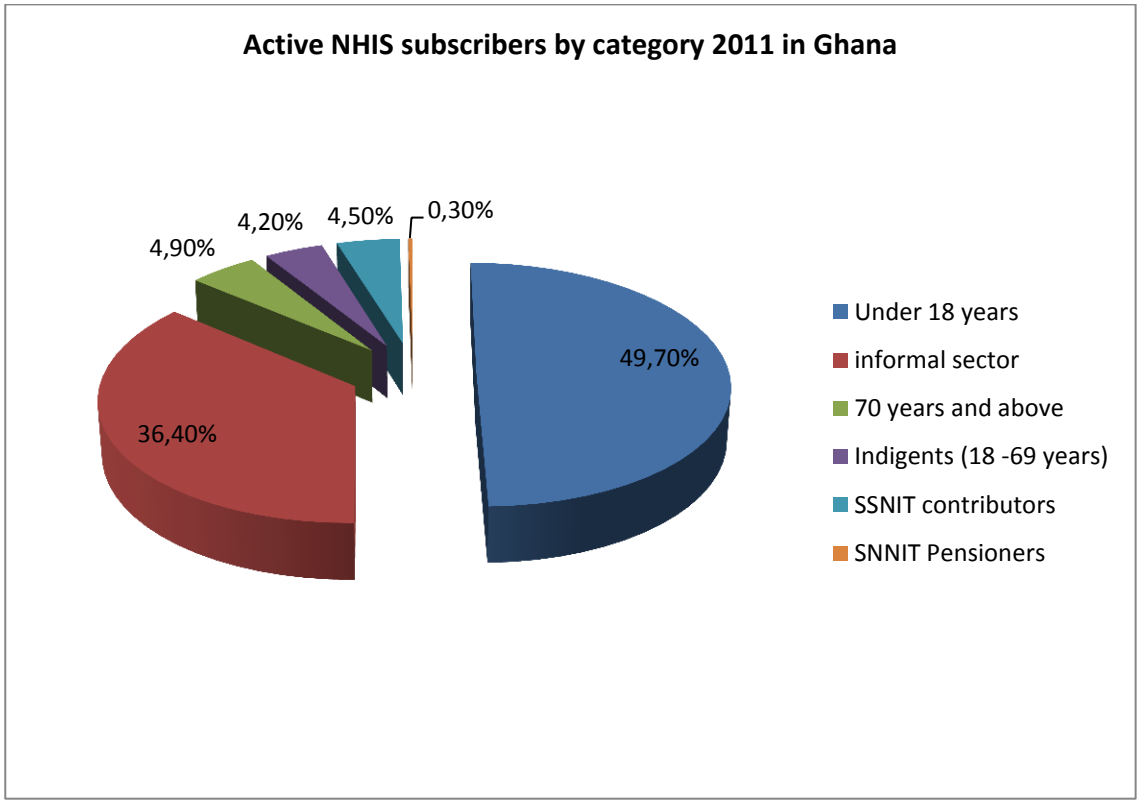


Figure 18. Active NHIS subscribers by category in Ghana, 2011

National Health Insurance Authority, 2011

The health insurance policy invention by the government may have been a step in the right direction but due to the largely informal sector of Ghana's economy, it is important for government to intensify coverage in the informal sector. The main source of funding for the scheme is the social security and national insurance trust contribution by the formal sector workers and the aged (70 years and above) are exempted from the premium payment and children less than 18 year pay a paltry sum of money as premiums. This may be a source of burden to the scheme, therefore an alternate funding must be arranged in the near future to sustain the scheme.

Ghana has a high maternal death ratio despite of the efforts made to improve health service delivery. Some of these deaths were a result of power outages during Caesar section operation on women during the child birth. See fig. 19.

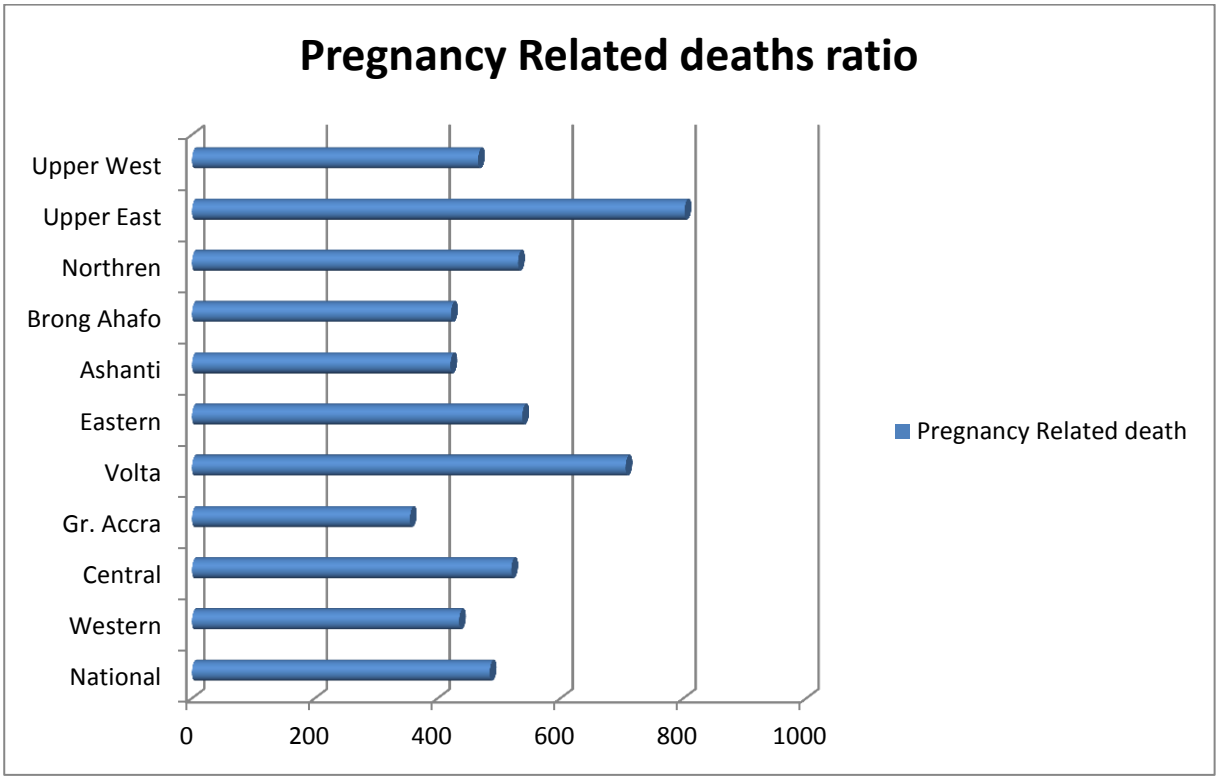


Figure 19. Maternal deaths per 100,000 live births in Ghana

Ghana Statistical Service, 2012

To improve health service delivery, reduce maternal and infant mortality in Ghana, energy access must be improved. Hospitals and rural health facilities need energy to store drugs, access clients information, perform lifesaving operations on pregnant mothers, diagnose health conditions of clients and provide basic medical attention needed by the people. Energy has therefore become an indispensable component of health service delivery.

3.2.3. Energy Access and Education

Article (-38-) subsection (-2-) of the Fourth Republican Constitution of Ghana reads: “The Government of Ghana shall, within two years after Parliament first meets after the coming into force of this constitution, draw up a programme for implementation within the following ten years, for the provision of free, compulsory and universal basic education.” The subsection 3(a) of the Constitution also states: “the state shall, subject to availability of resources, provide equal and balanced access to secondary and appropriate pre university education, equal access to university or equivalent education, with emphasis on science and technology.”-

In line with the constitution and to meet the Millennium Development Goal 2 of the United Nations by 2015, The Ministry of Education and Sport prepared the education strategy plan in 2003. The strategy prioritized education and set out measures such as capitation grant to public schools, preschool education and feeding and other initiatives to narrow the gap in gender education as part of the universal basic education programme (Adamu et al., 2007).

Since the inception of the programme, education enrolments in basic, primary, secondary and tertiary education (Gross and Net) have increased drastically across regions in Ghana. See fig.20.

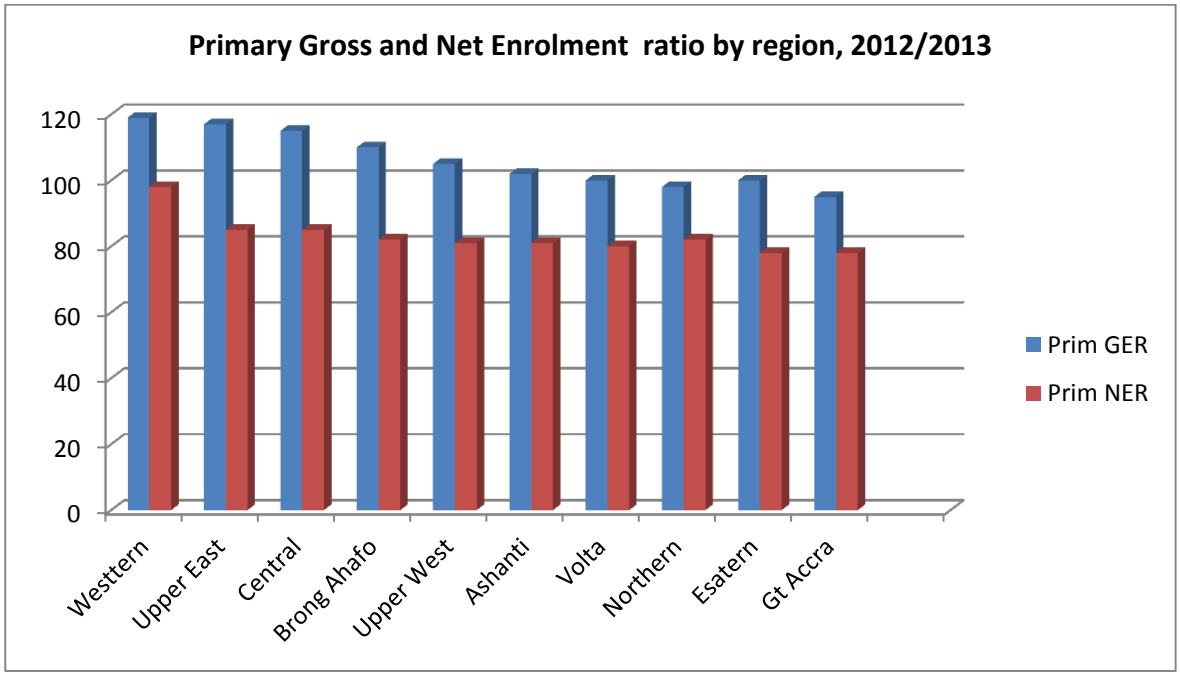


Figure 20. Primary Gross and Net enrolment ratio by region in Ghana, 2012/2013

Ministry of Education, 2013

Ghana may be on the path to attain the universal access to basic education by 2015, what is worrying is the quality of the basic education as the teacher pupil ratios and the textbook to pupil ratios show a staggering difference. The challenge to the government of Ghana to universal basic education and general education is funding and lack of it will adversely affect the quality of the education. See fig. 21.

It important to note that the quality of education can be adversely affected by the level of investment made in it, while the investment is critical, there appears to be less attention given to infrastructure and modern equipment in the sector.

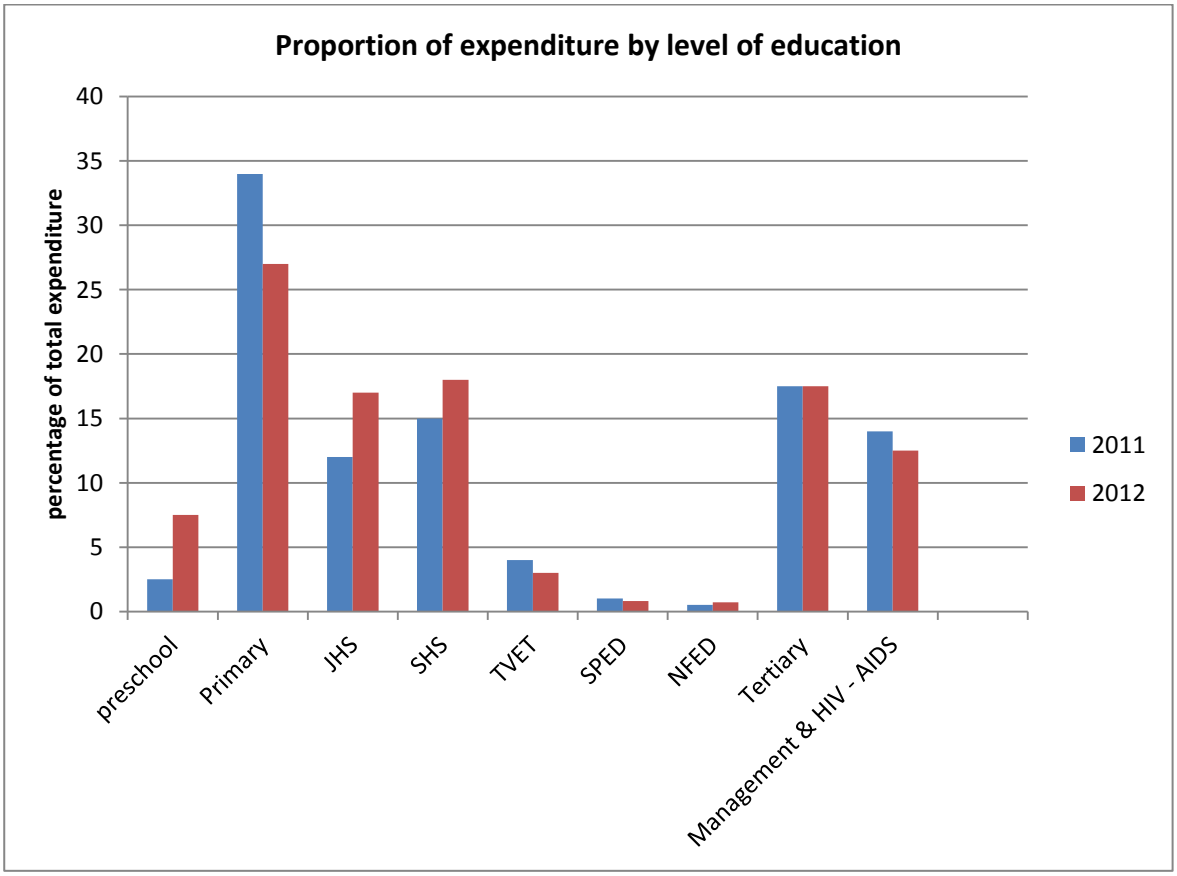


Figure 21. Proportion of expenditure by level of education in Ghana

Ministry of Education, 2013

Over Ghc 6bn expended on the educational sector in 2012, compensations accounted for a whopping 74% with a paltry 5% used on assets, including teaching and learning materials. Goods and services took 21%. See fig. 22.

Ghana may have been investing heavily in the education sector in order to meet the millennium development goal 2 and to reduce poverty, but the investment must be in the critical areas of the sector. While teacher motivation is one of the critical areas, a whopping 74% in a calendar year for a government whose budgetary allocation is also donor dependent.

To increase funding to the critical sectors of the economy including education is to increase access to modern energy services that are affordable, reliable, sustainable and adequate. In doing so, there will be need to increase productivity, improve transportation, agriculture growth and economic boom which to larger extent will increase government revenue.

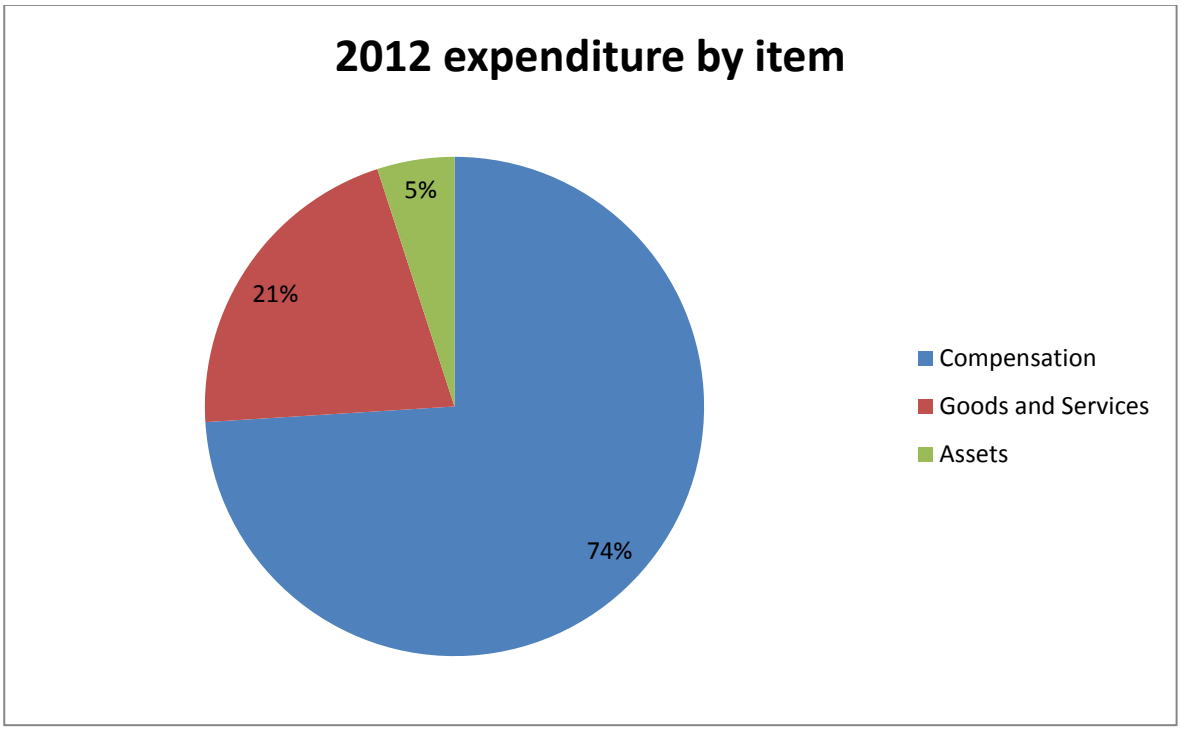


Figure 22. Education sector's expenditure, by item in Ghana, 2012

Ministry of Education, 2013

Ghana has 23 % of population aged 3 years and older that has never been to school, about 40% in school and 37% have been to school. Out of the population which has never been to school, 33% are in rural communities as compared to 14 % in urban areas (Ghana Statistical Service, 2012).

Ghana, however, has about 74% of the population aged 11 years and above as literates with some 67% able to read and write English. See fig. 23.

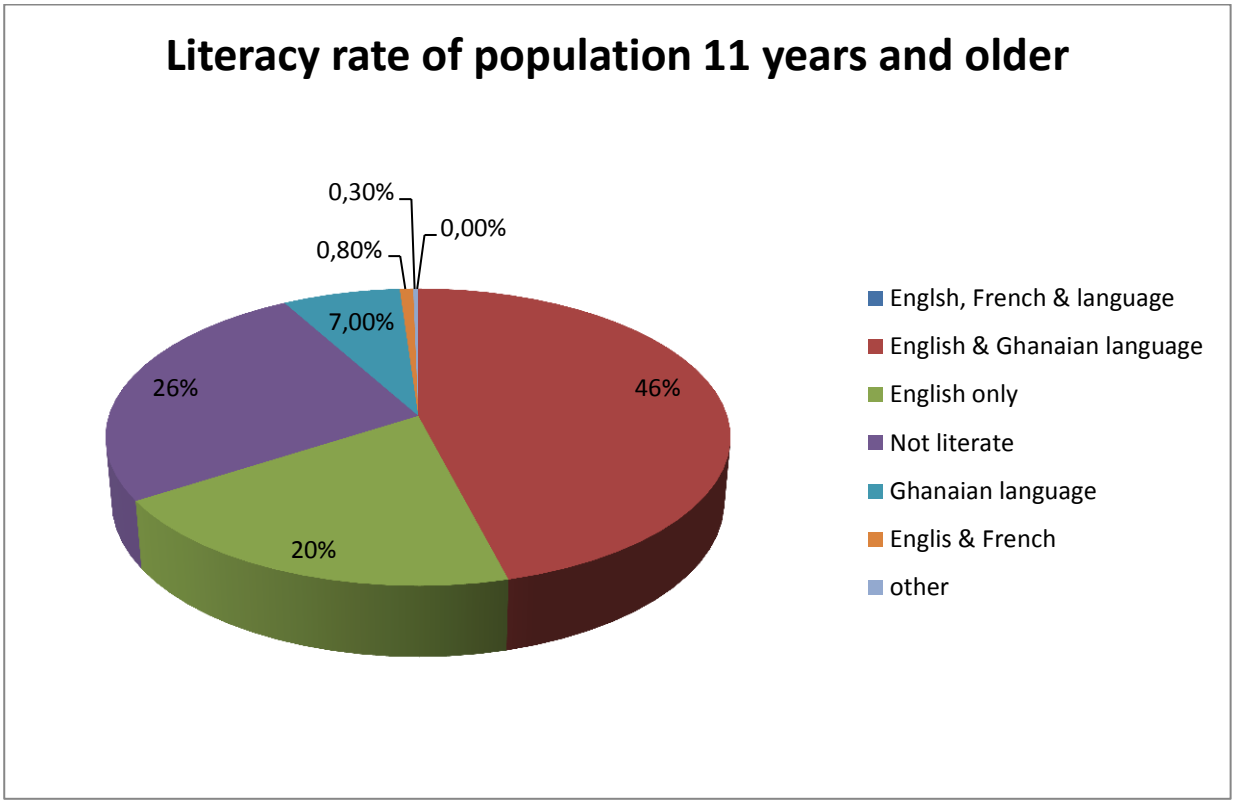


Figure 23. Literacy rate of the population aged 11 years and older in Ghana

Ghana Statistical Service, 2012

It is necessary to note that to increase access to education at all levels of the Ghanaian population, access to energy services that are reliable, affordable, and always available for consumption by the population such 24/7 electricity supply must be improved..

3.2.4 Energy Access and Income

In the mid-80s Ghana had a strong economic growth and attained middle income status by the 2010 (World Bank, 2010) following about 30 years of persistent work, due largely to stable political environment that attracted foreign investment (Rural Poverty, 2013).

The United Nations Development Programme's Human Development Index Report in 2011 ranked Ghana at 135 out of 187 countries in measuring the indicators, such as life expectancy, literacy, education and standard of living. While Ghana's total poverty has dropped, the northern regions have slight decline with poverty ratios more than two times the national average (Rural Poverty, 2013).

Ghana has a poverty gap of national poverty line of 9.6%, rural poverty line of 13.5% and urban poverty line of 3.1%. However, data available from the World Bank shows that some 29% of the national population lives below the national poverty line, with a whopping 39 % of the population below the rural poverty line and 10.8% below the urban poverty line.

Ghana has 52% of the total population at the poverty headcount ratio at $2 a day at the purchasing power parity and 29 % at $1, 25 a day. The World Bank defined the poverty headcount ratio at $1.25 Purchasing Power Parity a percentage of the population as "the percentage of the population living on less than $1.25 a day at 2005 inter-national prices".. See fig. 24.

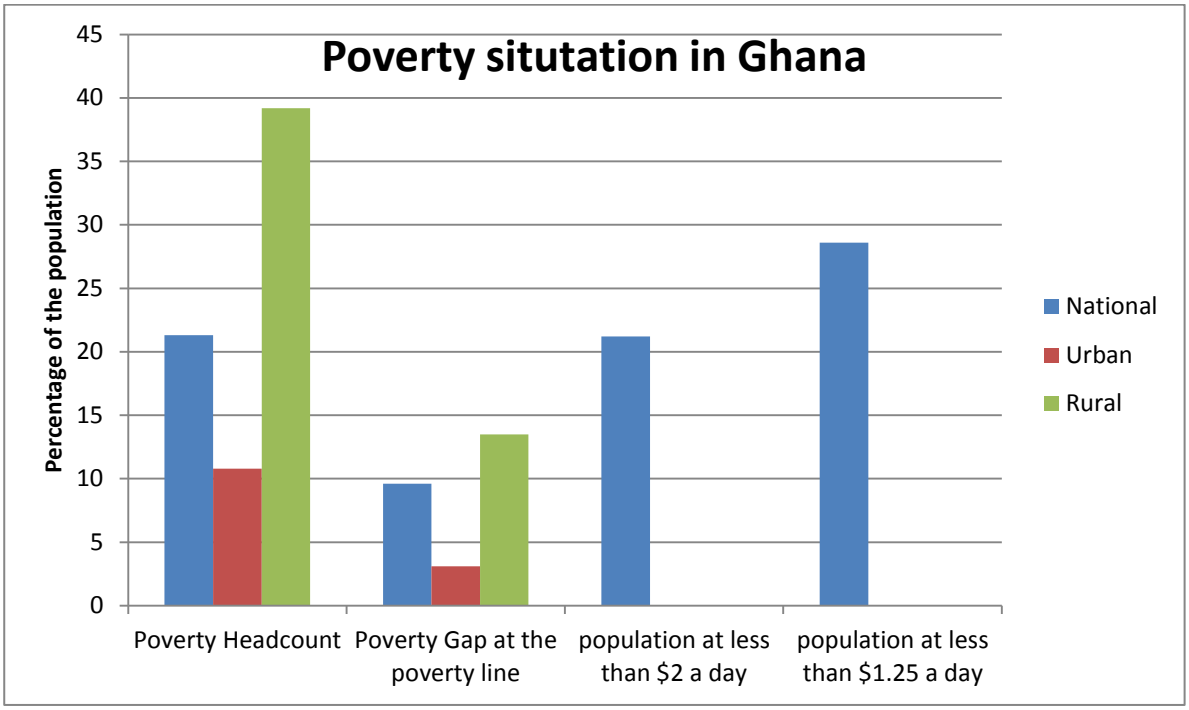


Figure 24. The poverty situation of Ghana

World Bank Data (2011)

The agricultural sector is the largest employer of the active workforce with about 42% and retailing and wholesale taking about 32 %. Available information shows that most of the active workforce is in self-employment (Ghana Statistical Service, 2012). The private sector remains the biggest employer with the formal and informal private sectors engaging a whopping 90+%. See fig. 25. While

more men are in employment than women, more women are self -employed and are also contributing to family income than men.

That notwithstanding, Ghana has made a significant progress towards poverty alleviating in more than 20 years with the main economic advancement activities geared towards the poor. Thus, Ghana is making a good progress in achieving the Millennium Development Goals by 2015 except for improved health service delivery (IMF, 2012).

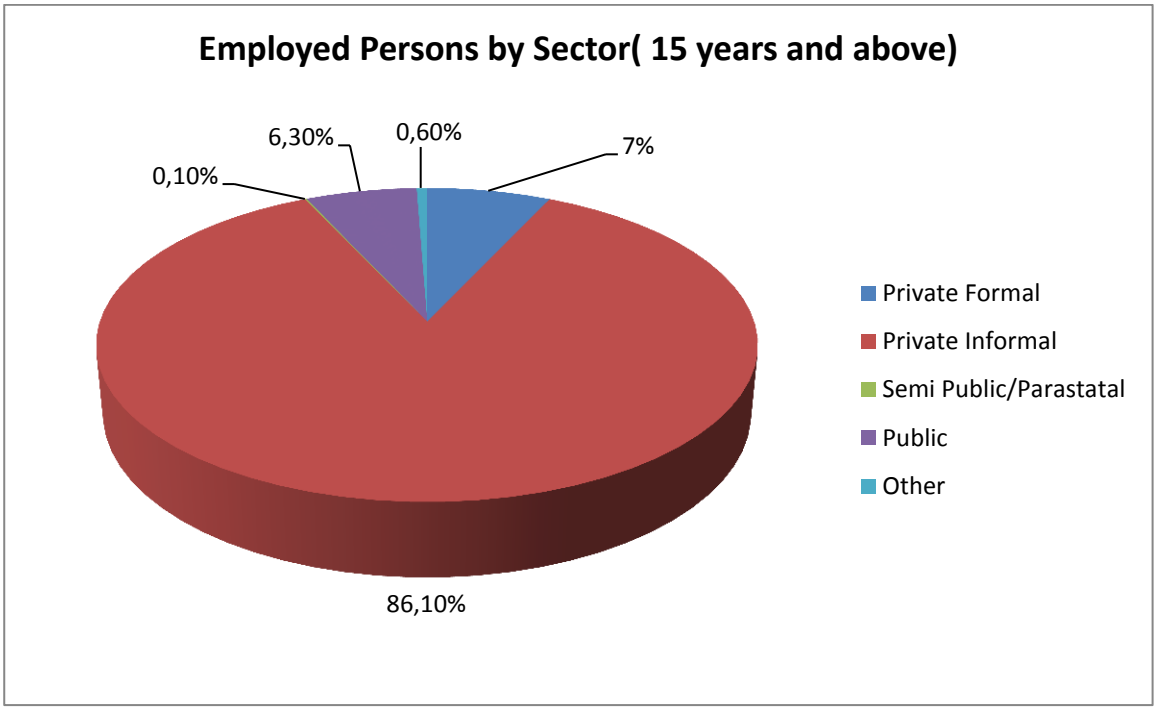


Figure 25. Employed persons by sector in Ghana (15 years and above)

Ghana Statistical Service, (2012)

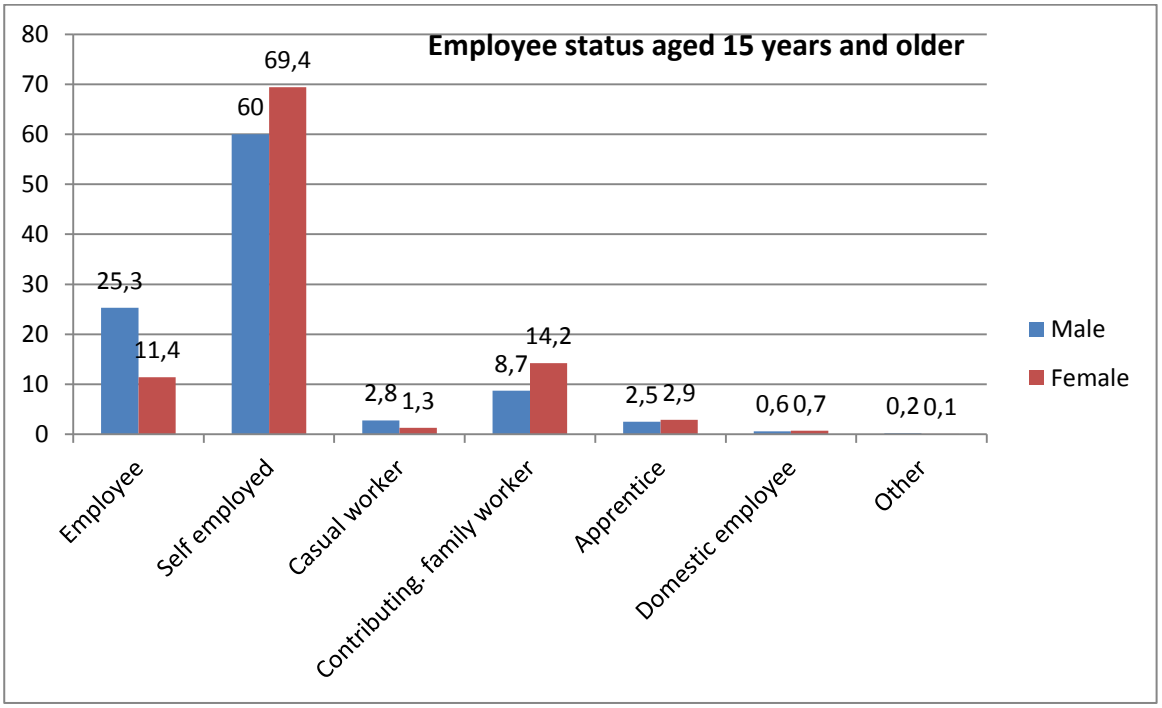


Figure 26. Employee status aged 15 years and older

Ghana Statistical Service, 2012

Ghana's economy is predominated by the agriculture and the private sector and largely informal. It shows that those employed are into petty trading or farming without access to modern equipment or energy services. This may be the reason for the high poverty rate at the rural areas where petty trading and farming are the main occupations. In admitting enormous efforts made successive by governments to alleviate poverty, there is still more to be done in achieving the Millennium Development Goals.

Poverty exists in many forms in Ghana in health, education, housing, agriculture, transportation, economic growth and telecommunications which are connected to access to modern energy services and efforts must be geared towards improving energy access thereby reducing all forms of poverty.

3.2.5 Some Governmental Actions to Increase Energy Access and Reduce Poverty in Ghana

In order to meet the energy needs of the population and meet the increasing demand for energy for productivity, improve health, education and the environmental considerations, the government of Ghana has prepared an energy policy and made some interventions over the years.

The governments of Ghana have made frantic efforts to increase electricity access and the reliability of energy supply to the citizenry through the national electrification programme 1989.

The programme effectively took off in 1990 with a 30 year time frame and has been the driving force behind the 2020 universal energy access of the governments. The main focus has been the extension of electricity to other parts of the country without access to electricity (Mahama, 2012).

The national electrification programme has a cost element of $2000 per household (Ministry of Energy, 2010). Some 90% of rural consumers are "lifeline consumers" whose consumptions are heavy subsidized by the government. Due to the high cost of grid extension, the distribution losses and to make energy more sustainable, the government has instituted some actions to meet the universal access to energy by 2020 (Mahama, 2012).

3.2.4.1 Energy Policy

The Government of Ghana has placed so much importance on development and in order to meet the developmental goals, the government has set out a vision for the energy sector of the economy. The vision is "ensure availability and access to energy services for all and for export". The government has set a target to also increase the total installed capacity of about 2000 MW to 5000 MW in 2020 in line with meeting the universal access to energy target (Ministry of Energy, 2009).

In the context of the vision of the energy sector, the government outlined the following goals.

1. Continuous availability of energy services
2. Improve accessibility through massive energy infrastructure development
3. To meet the international methods of energy production
4. Improve energy efficiency
5. Make energy affordable

To meet the goals outlined in the vision, the government has "strategic policy focus" which is to attract investment to enhance, increase the output of the existing network to be reliable in the short and long terms to become an exporter of electricity in the West African sun region To achieve universal access to electricity by 2020, the government is to increase finances for rural electrification

and assist the private organization in grid extension. The government of Ghana will arrange a funding mechanism which is reliable for rural lighting and provide subsidies (Ministry of Energy, Ghana, 2009).

Biomass is the largest energy source for Ghana (Mahu and Essandoh. 2011) and by the policy, "wood fuel prices will continue to be set by market forces and taxes and levies on wood fuel will be regulated by the appropriate national agencies or local authorities as may be necessary".

Ghana's energy policy almost in line with the international institutions' recommendations has provided a framework for the energy sector to drive the growth agenda set out by the government. While biomass (wood and charcoal) is the dominant energy source for Ghana, the market is largely unregulated. Liquefied Natural Gas is to become the main fuel for the power plants in Ghana due thanks to the relatively cheap price according to John Jinapor, Ghana's Deputy Energy Minister. At the inauguration of a feasibility study on the LNG for the Millennium development authority's fund allocation to the energy sector of Ghana.

Energy is the hub on which every development need revolves and Ghana is no exception. In acknowledging the importance of it the Deputy Minister said "I'm delighted the second com-pact is devoted solely to the energy sector; energy is a life wire of our economy, without a robust resilient energy sector, industry cannot function and if that happens, you can't create jobs to cater for the unemployment situation. This intervention by the United States through MDA couldn't have come at a better time," (Ministry of Energy and Petroleum, Ghana, 2013).

As indicated by fig. 14, half of Ghana's energy generation is from thermal power plant that run on light crude oil and the ever fluctuating fuel prices puts Ghana's energy sector at risk if alternate fuel sources are not developed. The government has set out a renewable energy target in the energy mix by 2015 with incentives and removing the barriers to its development (Ministry of Energy, Ghana, 2009).

To reduce the dominance of wood fuels in the energy mix in the universal access to modern energy forms by 2020, the energy sector set out the vision to increase the share of Liquefied Petroleum Gas (LPG) from the 1 % to some 25 % and electricity consumption from the 8 % to 20 %, thereby reducing the wood fuels from the 60+ % to 30 % (Mahu et al., 2011). See fig.27.

To increase LPG use from 1 % to 25 % and electricity use from 8 % to 20 % within 9 years is an ambitious target and the government of Ghana must work extra hard to meet that target.

It is worthy of noting that while the government is working to improve energy access and the capacity of the energy service providers, the government agencies are indebted to the service providers at the end of 2012 to the tune of Ghc 420 million or about $ 200 million (Ministry of Finance Ghana, 2013).

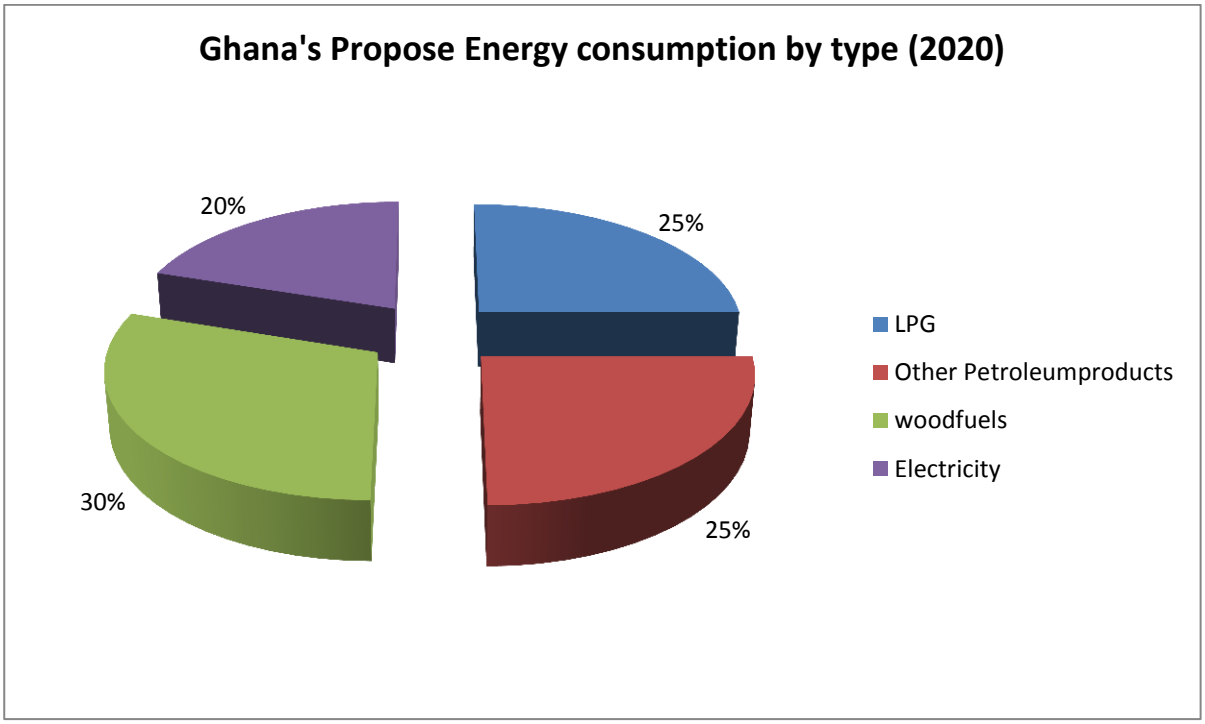


Figure 27. Ghana's proposed energy consumption by type (2020)

Mahu and Essandoh, (2011)

1. Ghana Energy Development and Access Project (GEDAP)

This project was instituted in 2005 to fast track electricity access in urban and peri - urban catchment areas by the grid extension and off - grid arrangements and to improve the sector management output. The project sourced funds from multilateral donor organizations (Mahu et al., 2011).

The project has two ended approach to increase energy access by the continuously extending the grid to urban and peri - urban areas and to engage private sector to create models on the off grid systems. The project target was to electrify all clinics, schools and other state owned facilities in

rural areas with solar PV energy sources and connect some 130,000 households to the grid. The project was supply some 10,000 households with solar home systems and 20,000 household with mini grids (Mahu et al., 2011).

The project had some $210 million committed to it.

2. Affordable lighting for all (ALFA project)

This project was instituted in collaboration with NGOs, the Dutch Government and Philips Electronics to provide affordable and reliable solar lighting and cook stoves for some 10 million households in sub – Saharan Africa and create a supply chain model for the products. It was based on the pyramid initiative targeted at some 4 billion people (Mahu et al., 2011). The project has two years duration and the market analysis of the project partners discovered that the price to the last user of the solar lanterns will be between $60 and $80, a mean cost of kerosene for a household in two years (Mahu et al., 2011).

3. ZEM Ghana -isolated mini grids initiative

The ZEM alliance was a collaboration of Ghana and Norway to deal with rural electrification and sustainable development in response to the "Internal Year of Sustainable Energy for All". The collaboration was targeted at the rural electrification with renewable energy micro grids and improved energy storage techniques (Mahu et al., 2011).

4. Self Help Electrification Scheme (SHEP)

This is a support scheme of the national electrification program to fast track access to electricity. Un-der this project, rural communities that within the reach of 20 km from 33 kV or 11 kV grid line can apply for electricity extension only when they purchase low tension electricity poles needed and have about 30% of the community well wired. If those conditions are met, the government is obliged to provide grid lines, transformers and all necessary for electrification (Abavana, 2004).

This project had 3 phases and by the year 2000 when the third phase was completed, some 2100 communities were connected to the grid with $130 million spent (Ministry of Energy, 2010).

The government of Ghana has made efforts and still making efforts with multi-faceted approach to increase electricity access as shown. However, much is still needed to be done as there are many

communities without access to electricity and this requires substantial investment both from government and private sector participation. See table 4.

While the government is making efforts to extend electricity to many communities, it remains to be seen the quantity and the reliability of the available electricity to these communities. The government in promoting LPG use in the energy mix has begun the distribution of some 1,500 cylinders to communities in the Garu Tempane District of the Upper East Region. Some 12, 105 solar lanterns were also distributed in over forty rural off grid communities in the country (Ministry of Energy and Petroleum, 2013).

Table 4 Estimated population needing access to electricity in 2010 and 2020 with cost estimates

Region	No. of towns	Est. population (2010)	Estimated population (2020)	Estimated cost (US$)
Ashanti	216	169,478	216,782	76,039,367
Brong – Ahafo	192	183,728	232,805	73,209,774
Central	177	135,603	173,503	61,751,131
Eastern	247	152,313	194,845	65,597,001
Gt. Accra	11	8,709	11,143	2,273,815
Northern	655	374,379	478,918	129,432,158
Upper East	301	257,716	329,756	54,765,364
Upper West	298	246,307	315,147	48,307,701
Volta	171	139,856	178,939	52,322,409
Western	295	398,558	510,046	157,959,177
Total	2,563	2,066,647	2,641,884	721,767,896

National Electrification Scheme Master Plan Review (2011 - 2020)

3.2.4.2 Livelihood Empowerment against Poverty (LEAP)

In the year 2008 the government of Ghana under the national social protection strategy launched the livelihood empowerment against poverty programme. The objective of the programme was to 'empower' the poor in the society by improving their ability to 'LEAP' out of abject poverty (FAO, 2013).

The cash dole out programme is being facilitated by the department of social welfare under the Ministry of Employment and social welfare. In 2008 the programme implementation year, 1,654 households in 21 districts benefited from it. By April 2012, the programme has expanded to 100 districts with 70, 191 households. The programme encourages social development that is integral with other services, as such education, health and agriculture with collaboration with the respective ministries for free health care, free school attires and some level of support for agriculture services and micro credit for the beneficiary households (FAO, 2013).

The selections of the beneficiaries are based on geographical means and the Ghana Statistical Service and National Development Planning Commission indicators of poverty in deprived communities. The procedure adopts locally oriented poverty identification criteria by accessing the prevalent health situations, the degree of health insurance registration, accessibility to fundamental social services and child labor. The programme however aims at extremely poor households with elderly aged 65 years and above and 'orphans and vulnerable' children (FAO, 2013).

The cash dole out starts from Ghc8.00 (US$ 4.10) to Ghc 15.00(US$ 7.70) for four dependents per month. The LEAP is another measure geared towards alleviating poverty in Ghana; however, Government budgetary constraints make it difficult for funds to be released on time, thereby worsening the situation of the beneficiary households. The programme however does not consider the household size since a typical Ghanaian household is more than four. It also worthy of noting that some 40% of Ghana's rural areas are poor (World Bank data, 2012), therefore the cash "handout" by the government may be good, but not a sustainable way of alleviating poverty.

3.3 Global Interventions to Increase Access to Energy and Reduce Poverty

The world is in search for lasting solutions to the energy needs of humanity and the sustainability of the energy resources taking into account the environmental impacts.

The United Nations Secretary General Mr. Ban Ki -moon launched the Sustainable Energy for All Initiative by 2030 and declared the year 2012 as the year for sustainable energy. At the launch he said: "Sustainable energy can revitalize our economies, strengthen social equity, and catalyze a clean energy revolution that benefits all humanity. Acting together, we can open new horizons today and help power a brighter tomorrow."

The Initiative has three main areas,

1. Ensuring universal access to modern energy services
2. Doubling the share of renewable energy in the global energy mix
3. Doubling the global rate of improvement in energy efficiency

In ensuring universal access to modern energy services, it is expected to improve health service delivery, increase agricultural productivity, and create job and meet the Millennium Development Goals (High- Level Group, 2012).

Doubling the share of renewable energy in the global energy mix will improve the off- grid access to energy, create jobs, reduce variable energy cost increase energy security and decrease fuel imports with consequential reduction in environmental effects. To improve energy efficiency, electrical gadgets that consume less power need to be deployed, efficiency of the traditional energy technologies need to be improved and reliability increased (High – Level Group, 2012).

3.3.1. Specific Actions Recommended

To meet the sustainable energy for all, stakeholder organizations must lead in the specific areas of the economy. There is a need to identify the links between the stakeholders (High – Level Group, 2012).

1. Central governments must design and implement policies that lead the change of the global energy systems.
2. Private sector participation is required to lead investment and help solve the energy issues
3. Civil society groups are important to maintain the change.

In the developing nations, governments must create an enabling environment with clear policy targets, regulation and incentives that drive energy investment from the private sector with very transparent and other conditions that promote renewable energy use (High – Level Group, 2012). The developed countries must improve efficiency and increase renewable energy in their energy mix to meet the three global objectives.

The United Nations Millennium Development Goal 1 which is eradicating extreme poverty by 2015 will not be attainable until a significant increase is made in energy access. To attain the goal by 2015, an extra 395 million people must access electricity and some 1 billion with clean cooking utilities. This demands a yearly capital of $41 billion between 2010 and 2015 (IEA, UNDP and UNIDO, 2010).

The International Energy Agency, the UNDP and UNIDO have also developed the universal modern energy access case which evaluates the total number of the population that need an access to modern energies and the amount of money required by 2030. See table 5

Table 5 Targets in Universal Modern Energy Access case. IEA, UNDP and UNIDO, (2010)

	2015		**2030**	
Category	Rural	Urban	Rural	urban
Access to electricity	257 million people with access to electricity	100% to grid	100% access, of which 30% connected to grid and 70% either mini - grid (75%) or (25%) off grid	100% access to the grid
Access to clean cooking facilities	Provide 800 million people with LPG stoves (30%), biogas systems (15%) or advanced biomass cooking stoves (55%)	Provide 200 million people with access to LPG stoves	100% access to LPG stoves (30%). Biogas systems (15%) or advanced biomass cook stoves (55%)	100 % access to LPG stoves.

Note: LPG stoves are used as a proxy for modern cooking stoves, also including kerosene, biofuels, gas and electric stoves. Advanced biomass cook stoves are biomass gasifier - operated cooking stoves which run on solid biomass, such as wood chips and briquettes. Biogas systems include biogas fired stoves.

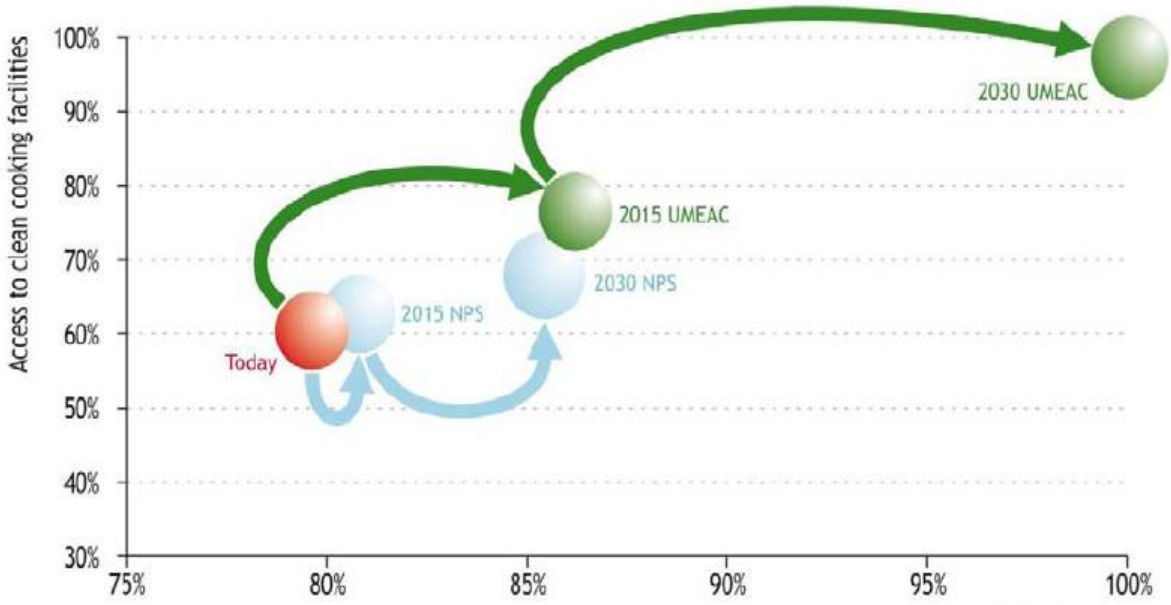


Figure 28 Access to modern energy services in the New Policy Scenarios (NPS) and universal modern energy access case (UMEAC). IEA, UNDP and UNIDO, (2010)

The need to extend electricity access to some 1, 2 billion people would need an extra total expenditure of $700 billion between 2010 and 2030 in the new policy scenario which otherwise would lack an access to electricity in 2030. In order to achieve the universal access to clean cooking facilities for 2.8 billion people a cumulative extra $56 billion would be needed during 2010 - 2030. These put the total investment required to achieve the universal access to electricity and clean cooking facilities at $756 billion by 2030 (IEA, UNDP AND UNIDO, 2010). See fig. 28.

The information provided shows that a lot is yet to be done and it requires the efforts of national, international, nongovernmental organizations and civil society organizations to meet the daunting task of the universal access to modern energy and electricity to humanity.

Table 6 Generation requirement for universal access to electricity by 2030 (TWh)

Region	**On -grid**	**Mini - grid**	**Isolated off - grid**	**Total**
Africa	196	187	80	463
Sub - Saharan Africa	195	187	80	462
Developing Asia	173	206	88	468
China	1	1	0	2
India	85	112	48	245
Other Asia	87	94	40	221
Latin America	6	3	1	10
Developing countries*	379	399	171	949
World**	380	400	172	952

IEA, UNDP and UNIDO, (2010)

The High- Level Panel proposed a road map to attaining the sustainable energy for all by 2030. See table 7.

Table 7. Illustrative action area metric towards sustainable energy for all

Action Areas	Immediate term	Short term	Long term
	(by Rio+ 20)	**(to 2015)**	**(2015 to 2030)**
Country action	**Developing countries**: Develop or update national energy plans started. **Developed countries**: Mobilize support locally for international steps towards the SE4 All.	**Developing countries;** ➢ National and regional energy policies must be tailor made. ➢ Build capacity and be investment ready **Developed countries:** Policies and programmes to meet specific objectives	**Appropriate policies** Legal, fiscal and regulatory framework and standards implemented at all stages to achieve the national specific goals. **Substantial numbers of people with access to modern energy services**.
Sectoral action	Flagship initiatives instituted to each action area led by multi stakeholders.	Measureable progress on the flagship initiatives Significant growth in the number of actions on - going Identifying the key synergistic sectors. Increase stake by the grassrrot.	Initiatives integrated into constant improvement process Increasing investment Fiscal and institutional capacity building
Enabling action	Commit resources to attain the flagship initiatives Manage knowledge	Reliable financing Access to experts for technical support	Public and private funding to meet the goals.

United Nations Energy, Sustainable energy for all, 2012

The actions set out have some supporting activities towards meeting the goals. These include accountability and mechanism to monitor progress of the targeted initiatives. Public engagement is important in creating awareness and canvassing support for the sustainability of the actions initiated to meet the objectives set out (High – Level Group, 2012).

The objectives set out in the Sustainable energy for all and the universal modern energy access case provided the benchmark upon which the energy policy and actions of national and regional governments would be measured.

Ghana is the first country to make a commitment to the universal modern energy access case brought forward by the International Energy Agency, UNDP and UNIDO.

4 RESEARCH METHOD

This chapter discusses the methodology adopted for the study. The variables are some selected world development indicators (WDI) for the sixteen West African Countries, ten selected European Countries and the BRICS (Brazil, Russia, India, China and South Africa). The variables also include that of the upper middle income, lower middle income, lower income and low income categories as defined by the World Bank.

The desktop research method was used in the data gathering from the relevant institutions both national and international. The choice of the data source was as a result of the limited resource that would have enabled primary data source.

Earlier studies used various methods in arriving at their conclusions, a staff working paper published by the United Nations industrial development organization (UNIDO, 2007) shows Jones, (1998), Lee, (2005) and Komives et al., (2001) with the regression method.

Michael L. Polemis and Athanasios S. Dagouma, (2013) use the co-integration techniques and the vector error correction model to establish the relation between electricity consumption and economic growth in Greece. To establish the relationship between energy use and CO2 emissions, Phetkeo Poumanyvong and Shinji Kaneko, (2010) used the STIRPAT model.

The study used the linear regression method to analyze the data and derive the regression coefficients of the variables. A bivariate regression method is used in the study.

A bivariate regression shows the relationship between one independent variable (X) and a dependent variable (Y). The regression coefficient (R^2) indicates how well the values fit the data.

It is important to recognize that bivariate relationship and the results of the study do not indicate a one – to one relationship; other factors would need to be considered to obtain the whole picture. However, the results obtained using the bivariate relationship suggests the main relationship when looking at energy access and development indicators.

5 Analysis, And Discussions

This chapter provides the analysis and discussions on the data used for the studies.

Analysis and discussions

To explore the relationship and the impact of the other world development indicators selected and energy access, the variables were each plotted with energy use or electricity consumption and the regression coefficients derived

5.1 Energy Access and Health

Researchers, Fan et al., Jones (1989) state that energy access leads to GDP growth as established in the literature by. The health sector expenditure is expressed as a percentage of GDP, therefore an increase in GDP,- will be accompanied by an increase in the health expenditure. An increase in the health expenditure due to energy use which increases GDP will influence life expectancy. The result in fig.28 shows the relationship between electricity consumption and life expectancy in the selected countries and categories

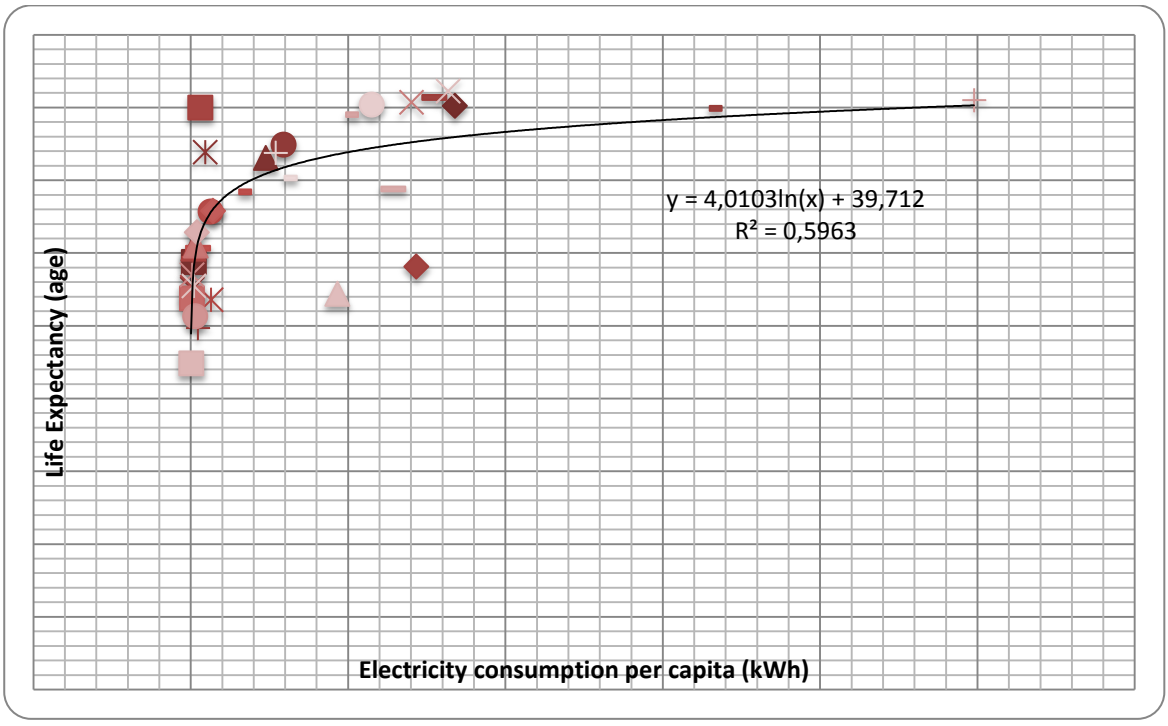


Figure 29 Electricity consumption per capita and life expectancy for countries and categories

The relationship has a coefficient of 0.5963, which means almost 60% of the life expectancy in the cases is dependent on electricity consumption per capita.

The trend was generally the same for the West African countries as shown in fig.29. However the coefficient was 0.4677 as compared with that of fig. 30.

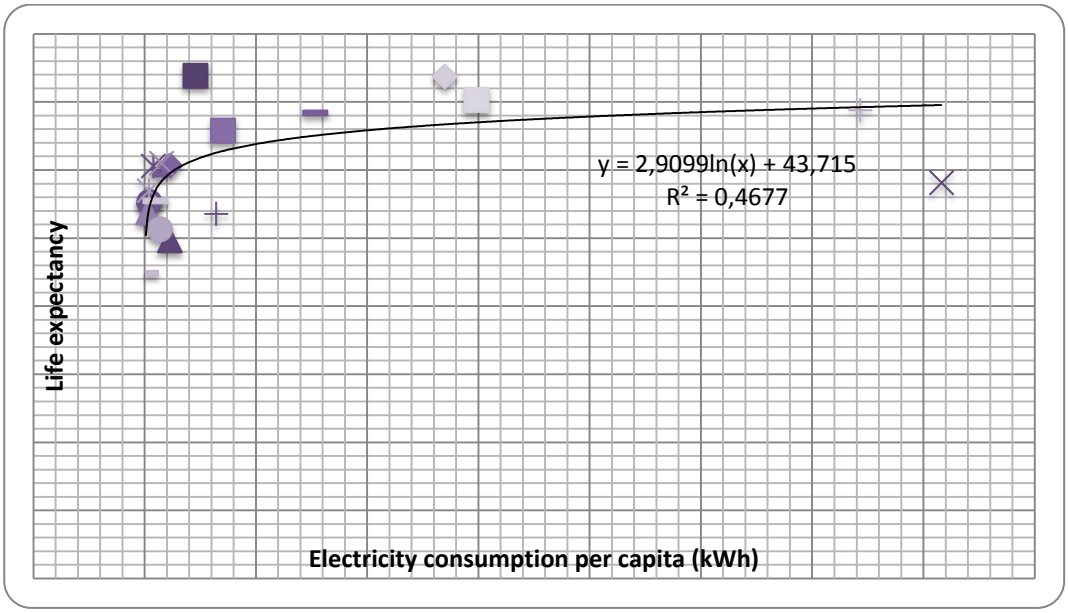


Figure 30 Electricity consumption and life expectancy in West Africa

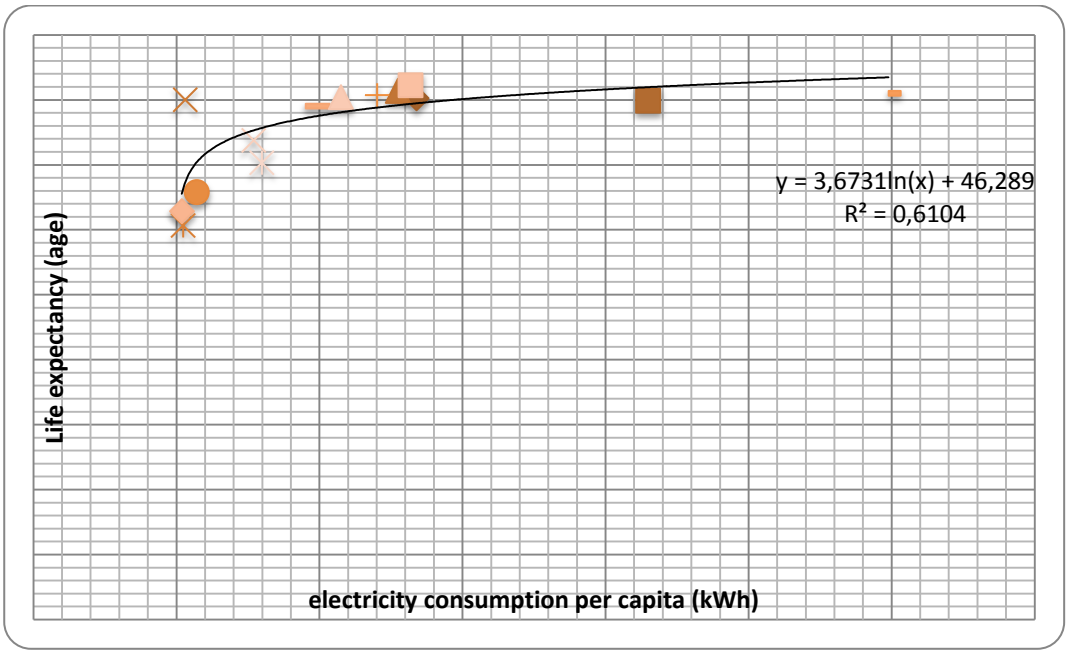


Figure 31 Electricity consumption per capita and life expectancy in the selected European countries

The results of the selected European countries show the same trend as in figures 29 and 30, with a coefficient of 0.6104. This is an indication that life expectancy in the selected countries is 60% dependent on electricity consumption per capita. Therefore, an increase in electricity consumption per capita will be accompanied by an increase in life expectancy. See fig.31

The result for the BRICS countries show same trend with a coefficient of 0.1639

5.2 Energy Access and Education

The result shows the relationship between the impact of electricity access and literacy rate for the selected countries and categories. See fig. 32

It reveals that an increase in the electricity access will improve literacy rate in the scenarios selected. It is imperative to note that the access to electricity can enable people to read at night, schools to remain open for long after dark and thereby providing opportunities for pupil, student and teachers to study.

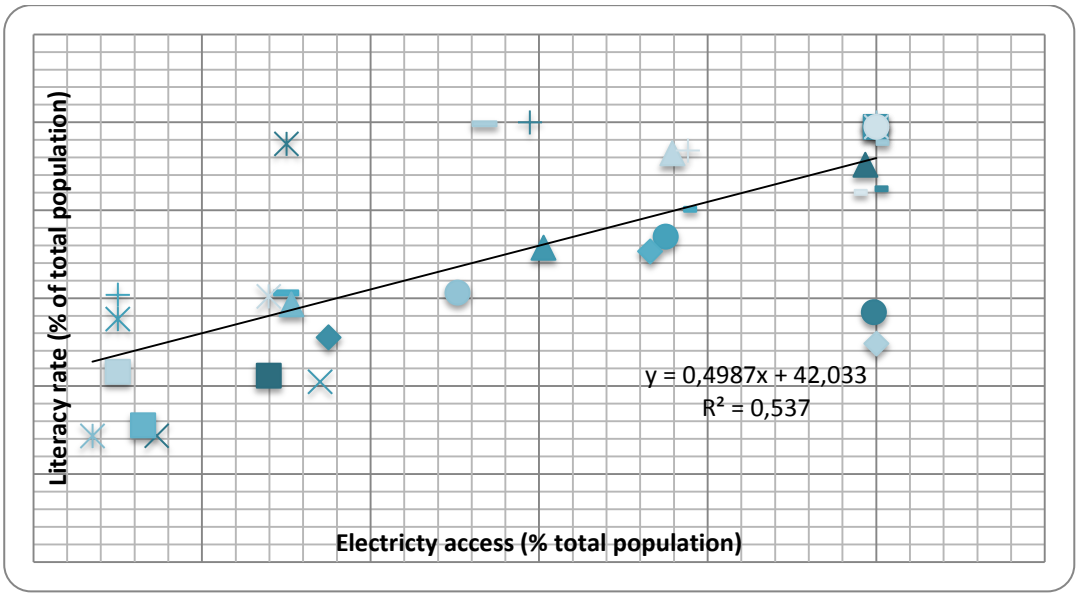


Figure 32 electricity access and literacy rate for the selected countries and categories

The result also has a coefficient of 0.537, meaning that the literacy rate is about 54% dependent upon electricity access. The positive coefficient shows that an increase in electricity access, will improve literacy rate. See fig. 32.

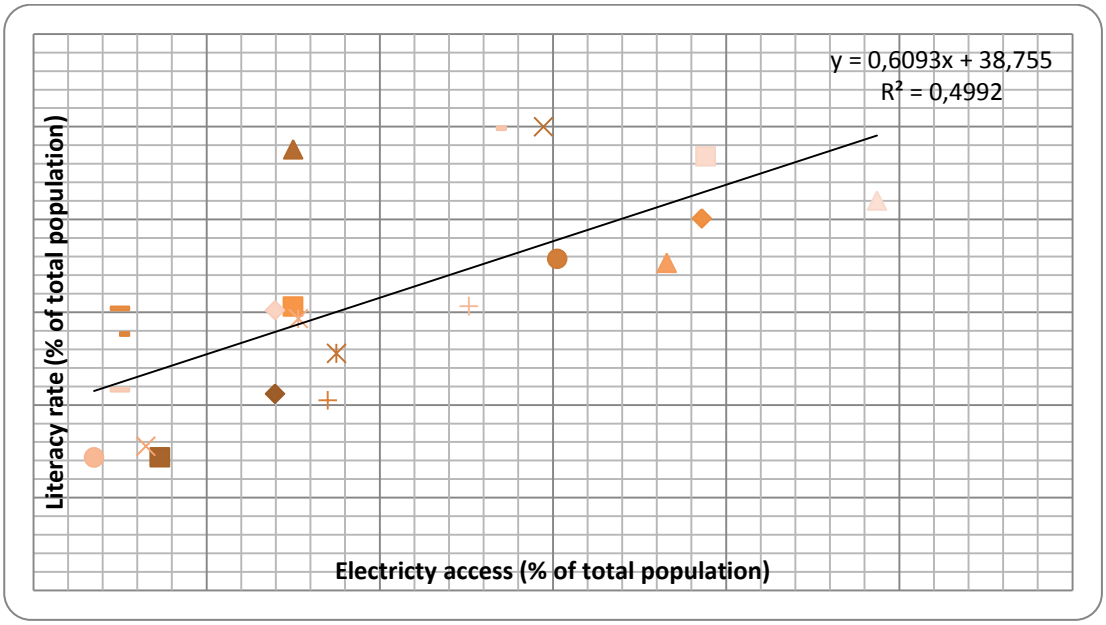


Figure 33. Electricity access and literacy rate in West Africa

For the West African countries, the result shows a similar trend with a coefficient of 0.4992. The coefficient shows that about 50% of literacy rate in West Africa is dependent on electricity access, therefore an increase in the access to electricity will increase literacy rate. See fig. 33. In the selected European countries, there was almost 100% electricity access and 100% literacy rate, confirming the theory that an increased access to electricity will lead to increased literacy rate. See fig. 34.

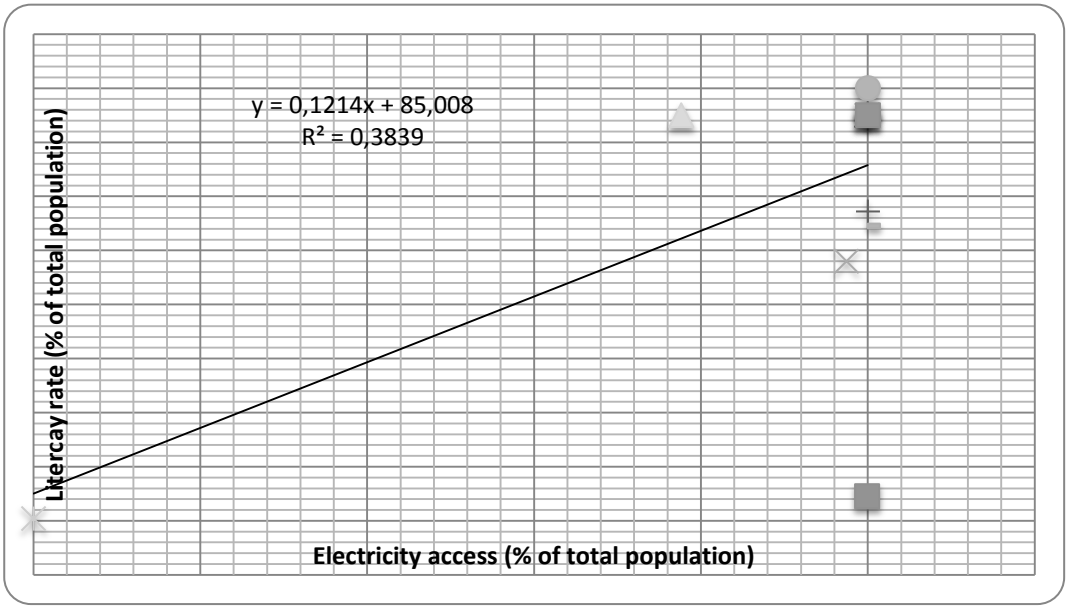


Figure 34. Electricity access and literacy rate in the selected European countries

In most developing countries, the access to educations is directly linked to the ability of government to build schools, provide the needed logistics and the modern equipment to make teaching and learning easier. To do that also depends on the availability of funds for the government to carry -out development projects. It was established earlier that energy use leads to the GDP growth and since education expenditure is expressed as a percentage of GDP, it is possible to link the GDP growth to the educational expenditure. It therefore suggests that when the GDP grows, the expenditure on education is most likely to grow. Fig. 35 shows a declining public expenditure on the GDP growth, it literally means that, if the same percentage of the expenditure is maintained, funds needed for educational purposes will be attained faster with a growth in the GDP. The results show a coefficient of 0.3697, which is a reflection of the GDP growth on education expenditure.

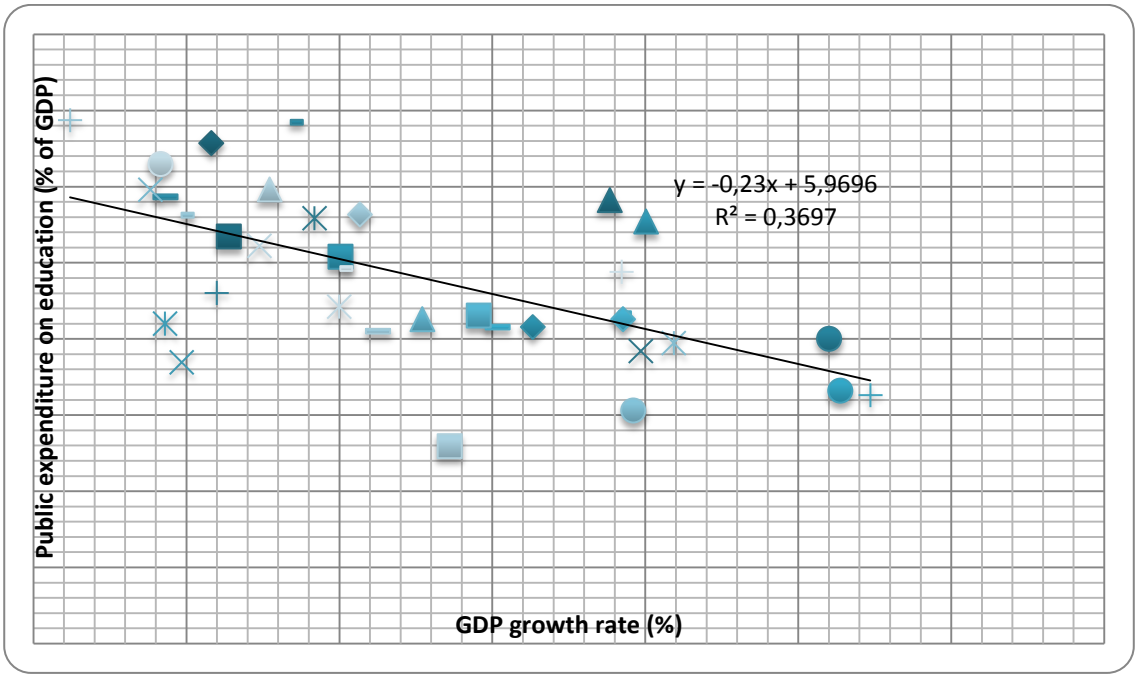


Figure 35 GDP growth and public expenditure on education in the selected countries and categories

The trend of the analysis holds true for the West African countries, except for a coefficient of 0.085. See fig. 36

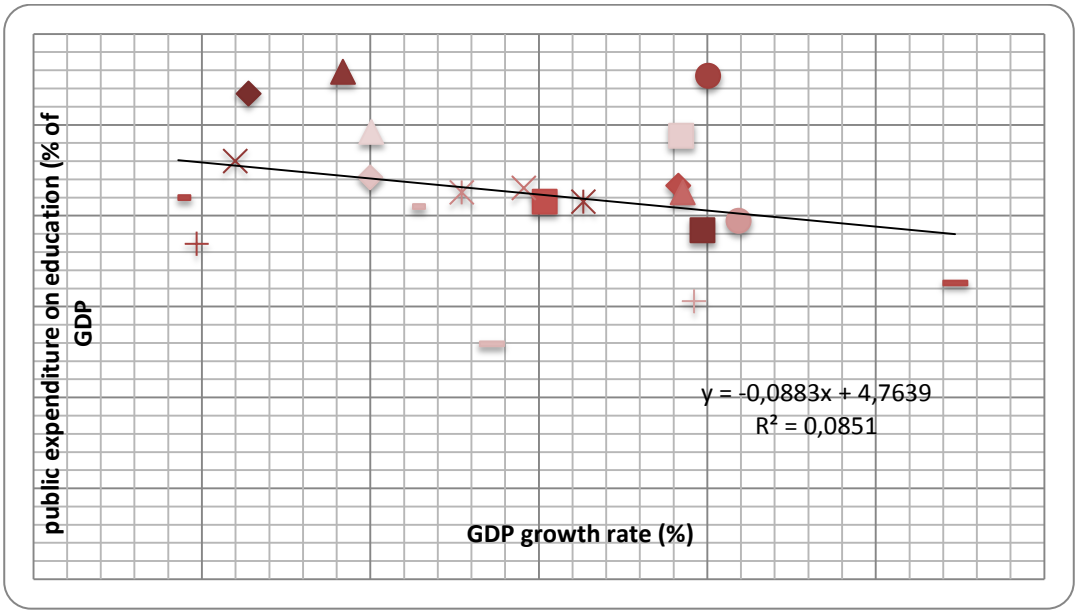


Figure 36 GDP growth rate and public expenditure on education in West Africa

In the selected European countries, the results show a relationship and impact of the GDP growth rate on the public expenditure on education. The results show a coefficient of 0.6198. Refer to fig. 37.

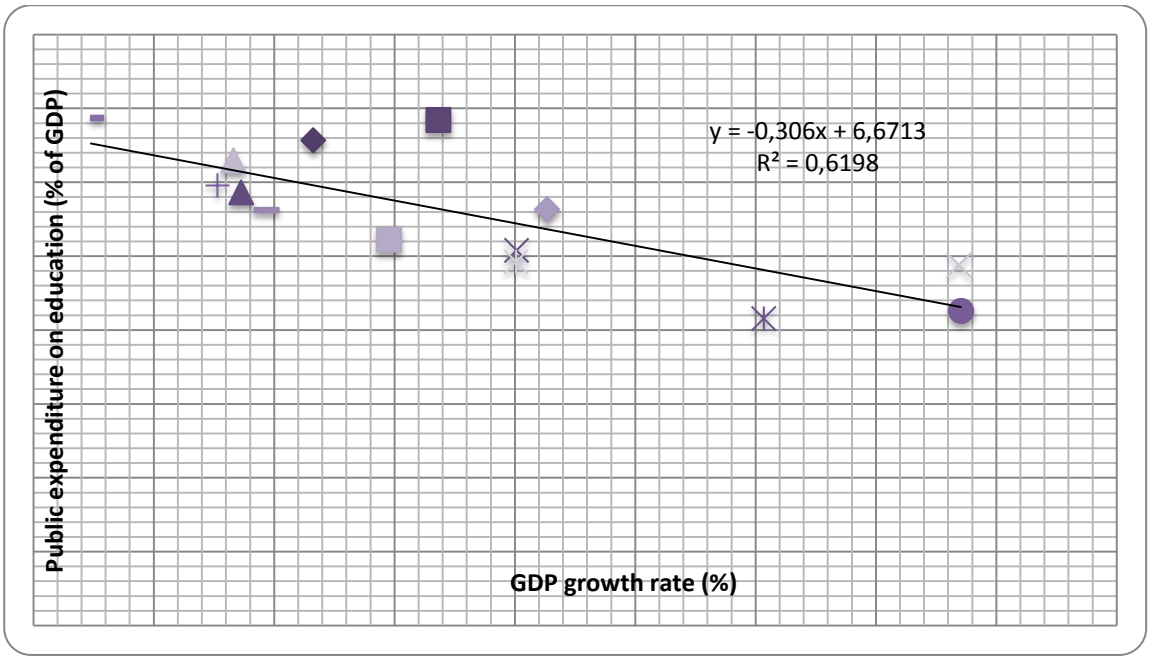


Figure 37 GDP growth rate and public expenditure in the selected European countries

In the BRICS countries, the relationship is linear just as the others; however, the effect as shown by the coefficient is 0.5492. This also shows that an increase in the GDP growth, will lead to the reduction in public expenditure on education if the same levels are maintained. See fig. 38.

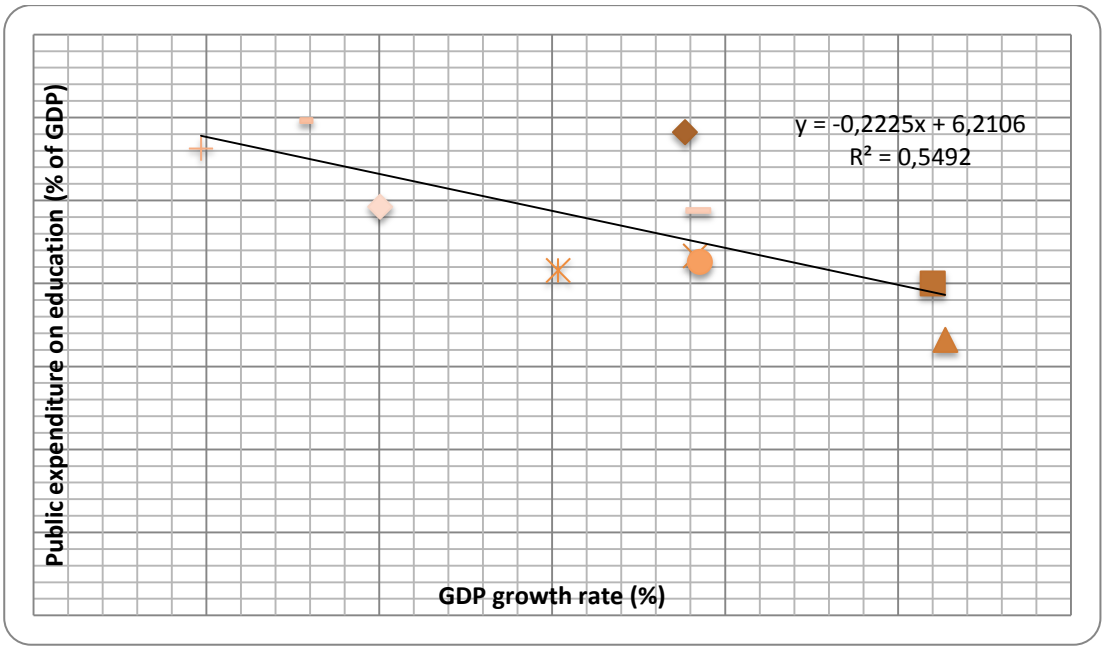


Figure 38 GDP growth rate and public expenditure for the BRICs countries

It is generally obvious that energy access, energy use, electricity access and electricity consumption have a relationship with poverty and general development indicators. It was equally clear that not only did a relationship exist between them but the effect as well - as shown by the coefficients.

It is therefore necessary to improve general energy access, use and electricity consumption in order to improve the general wellbeing and order development indicators as shown by the analysis.

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5.3 Energy Access and Income

The relationship and the impact of energy use per capita on the GDP per capita was analyzed with regression and plotted for the selected countries and categorizations and the result is shown fig. 39

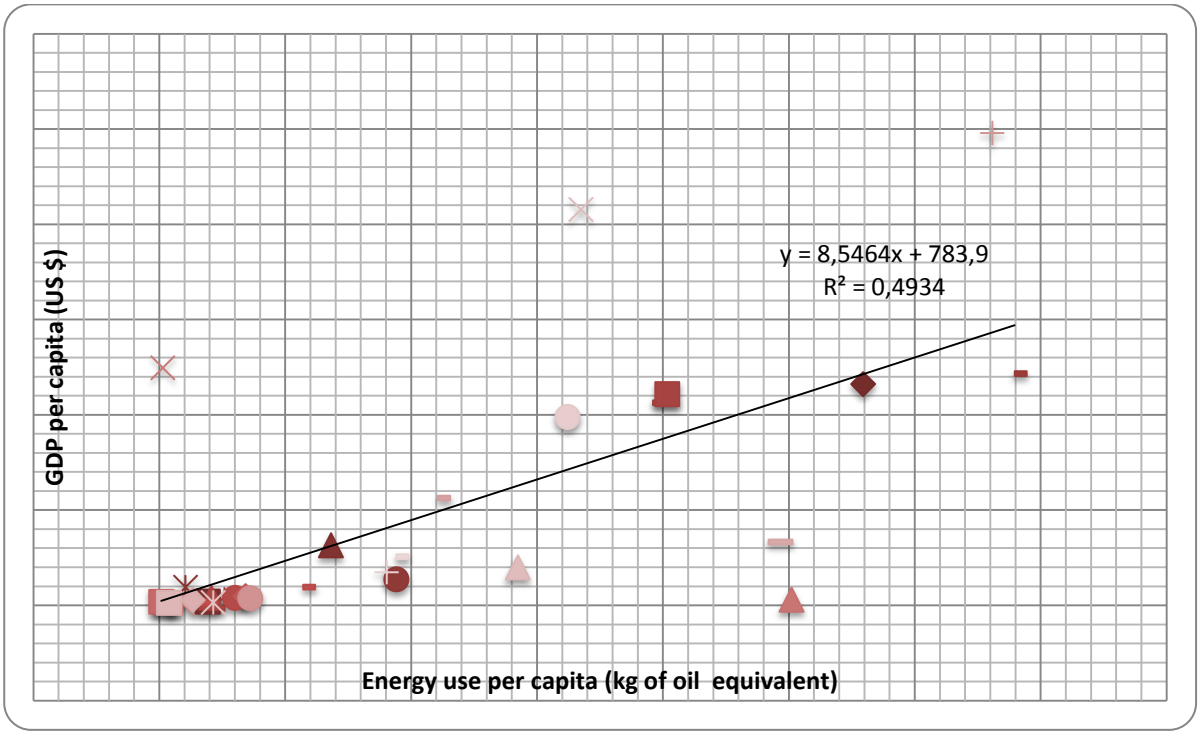

Figure 39 Energy use per capita and GDP per capita for all countries and categories

The result shows the relationship between the energy use per capita and the GDP per capita are well related with a coefficient of 0.4934. It means that the over 49% of the variables are dependent on electricity consumption. It shows that when energy use per capita is increased by a unit, the GDP per capita will grow by 49%.

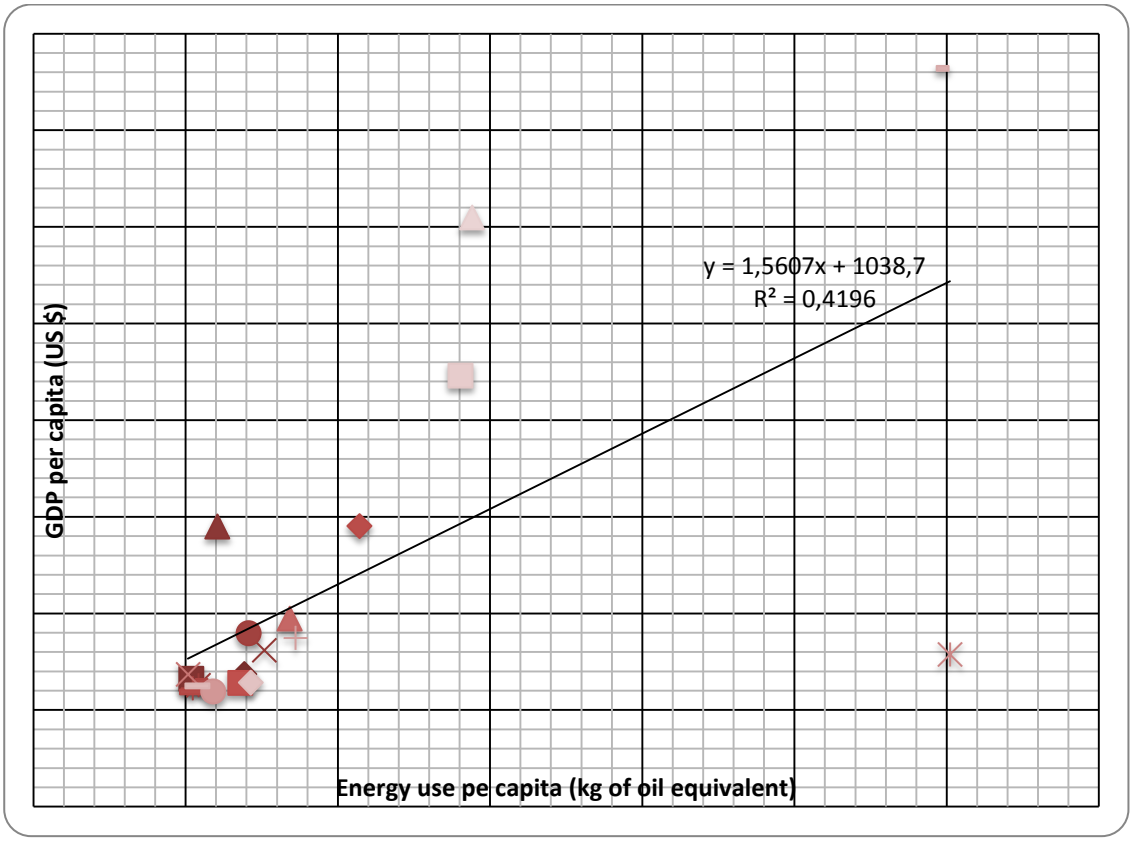

Figure 40 Energy use per capita and GDP per capita in West Africa

The result shows the relationship and the impact of energy use on the GDP per capita in the West Africa countries. See Figure 40. The relationship has a coefficient of 0.4196, which is a reflection of the relationship and impact of energy use on the GDP per capita of the total selected sample, as shown in Fig 39**.**

The result shows a relationship between the energy use and the GDP per capita as shown for the selected European Countries. The result shows a coefficient of 0.4891, which is the general trend for the total sample selected. See Figure 41.

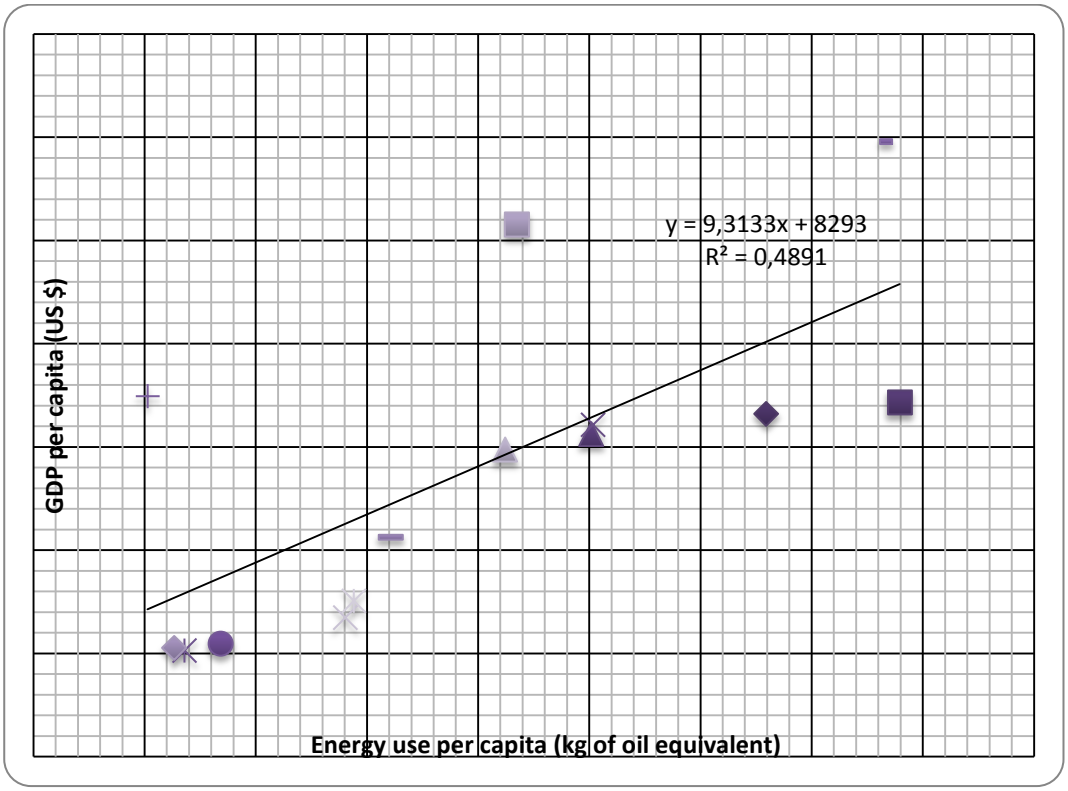

Figure 41 Energy use per capita and GDP per capita in the selected European countries

For the BRICS countries, the relationship and impact of the energy use per capita and the GDP per capita continues in the same line as the rest of the categories. The result shows a linear relationship with a coefficient of 0.4036, as shown in fig. 42.

In general, the relationship between energy uses per capita influences the GDP per capita in all the categories and a coefficient of 0.40 in average. The results show that more than 40% of the GDP per capita was dependent upon the energy use per capita.

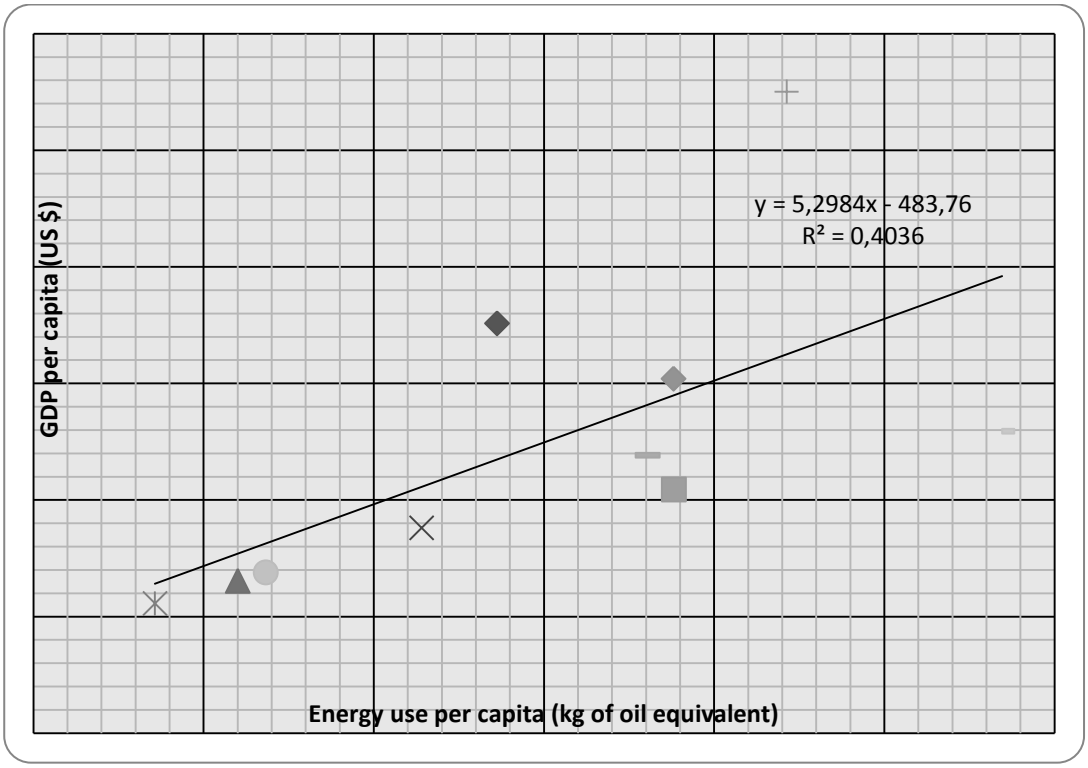

Figure 42. Energy use per capita and GDP per capita in the BRICs countries

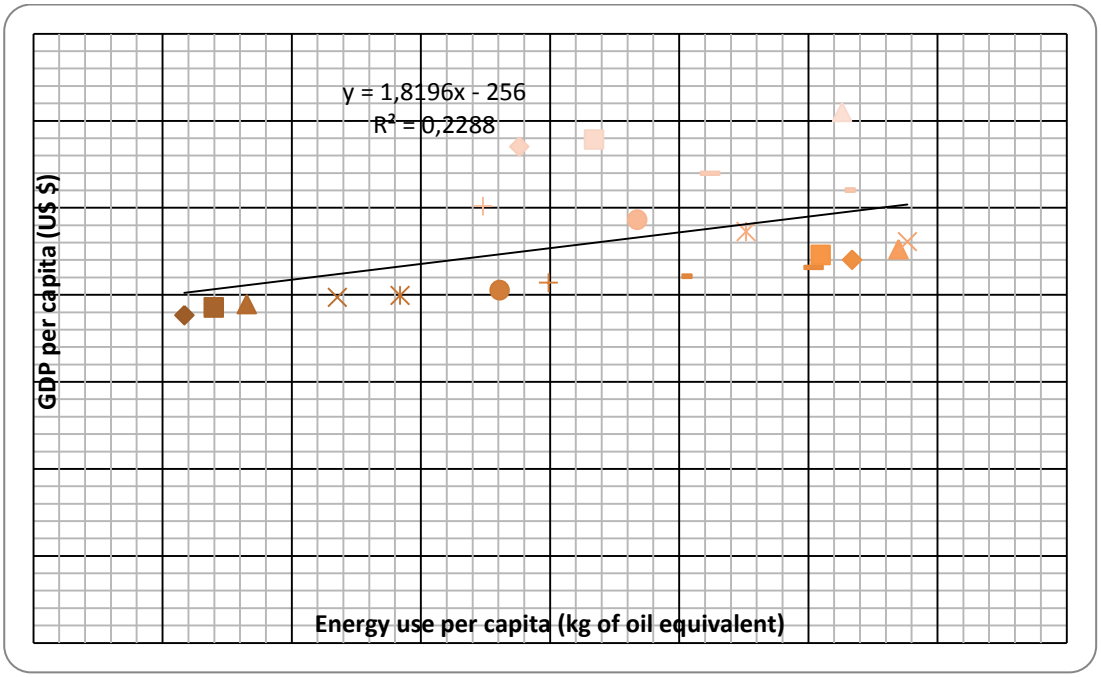

Figure 43. Energy use per capita and GDP per capita in Ghana (1990 - 2010)

The result shows the same trend, confirming that an increase in the energy use,- leads to the GDP growth. However the severity for Ghana was 0.2288, which is almost half of the average value for all the categories. See fig. 43. For Ghana, a unit increase in energy use will increase GDP by 22.88%. The coefficients showed 22%, 64.5% and 37.4% of the energy use per capita in the selected European countries, the BRICS countries and the West African countries as a result of the rate of urbanization.

The results show a consistency with Lee (2005) who also established a relationship and positive impact between the energy use and the GDP.

5.3.1Energy Use and Extreme Poverty

To verify the relationship and impact of the energy use on poverty reduction, the energy use of the categories were analyzed with the population under $1.25 by the World Bank.

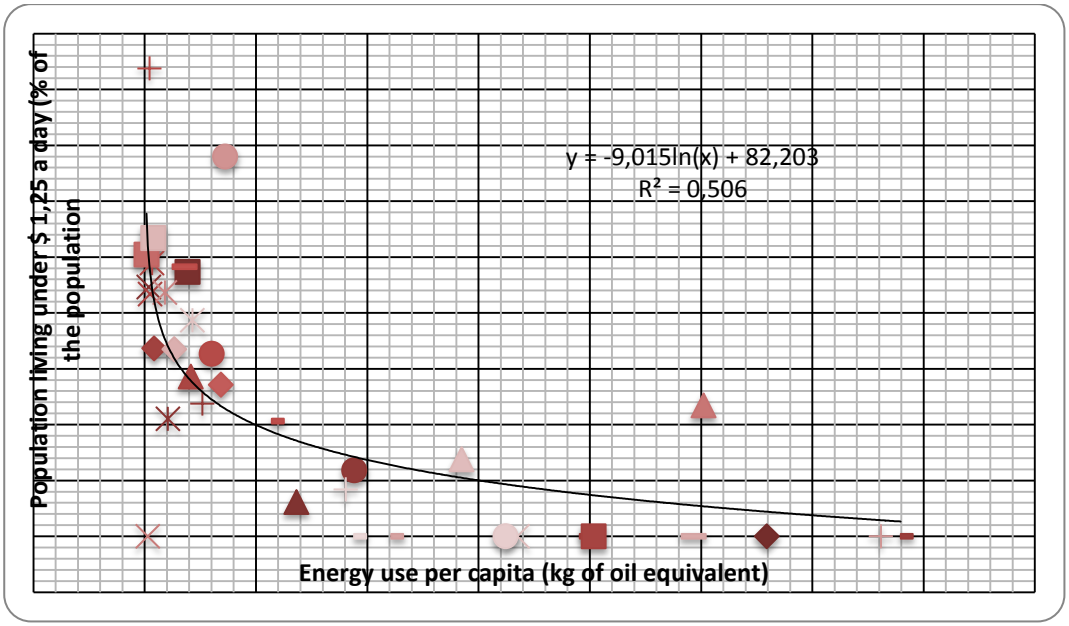

Figure 44 Energy use per capita and population under $1.25 a day for all countries and categories

The results show a negative effect with a value of 0.506. This indicates that when energy use increases by a unit, the population under $ 1.25 a day will decrease by 50.6%. The World Bank defines the population under $1.25 as the population under "extreme poverty"

To reduce extreme poverty by 50.6% energy use must increase from the current levels.

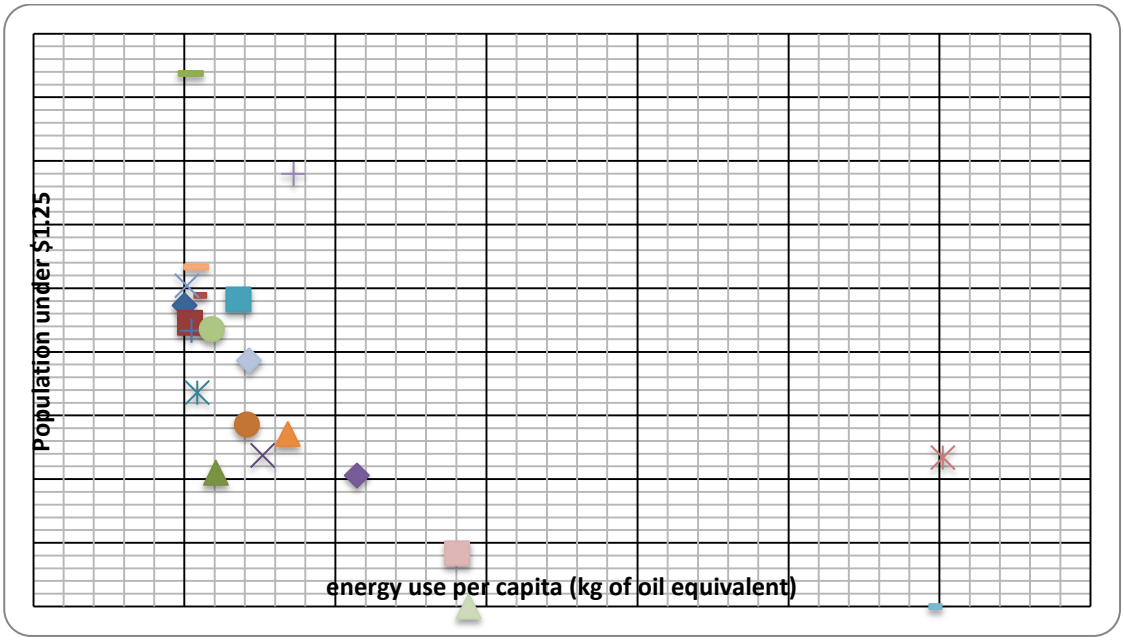

Figure 45. Energy use per capita and population under $1.25 in West Africa

The analysis for the West African countries produced the same pattern of result, with a negative effect and a coefficient of 0.4384. See Figure 45

The result shows that when the energy use increases in the West African countries, the population under $1.25 or extreme poverty will reduce by 43.84%.

These results are consistent with Komives, et al (2001) who also established a relationship and negative impact between the energy use and extreme poverty.

It is shows that energy access, energy use, electricity access and electricity consumption have relationship with poverty and development indicators. It was clear that not only did a relationship exist between them but effect also, as shown by the coefficients.

It is therefore necessary to improve general energy access, use and electricity consumption in order to improve the general wellbeing and order development indicators as shown by the analysis.

5.4 Energy Access and Environment

Environmental laws and considerations require that while the access to energy increases and the GDP grows, the impact on the environment should not be overemphasized.

The result shows the relationship between energy use and CO2 emissions.

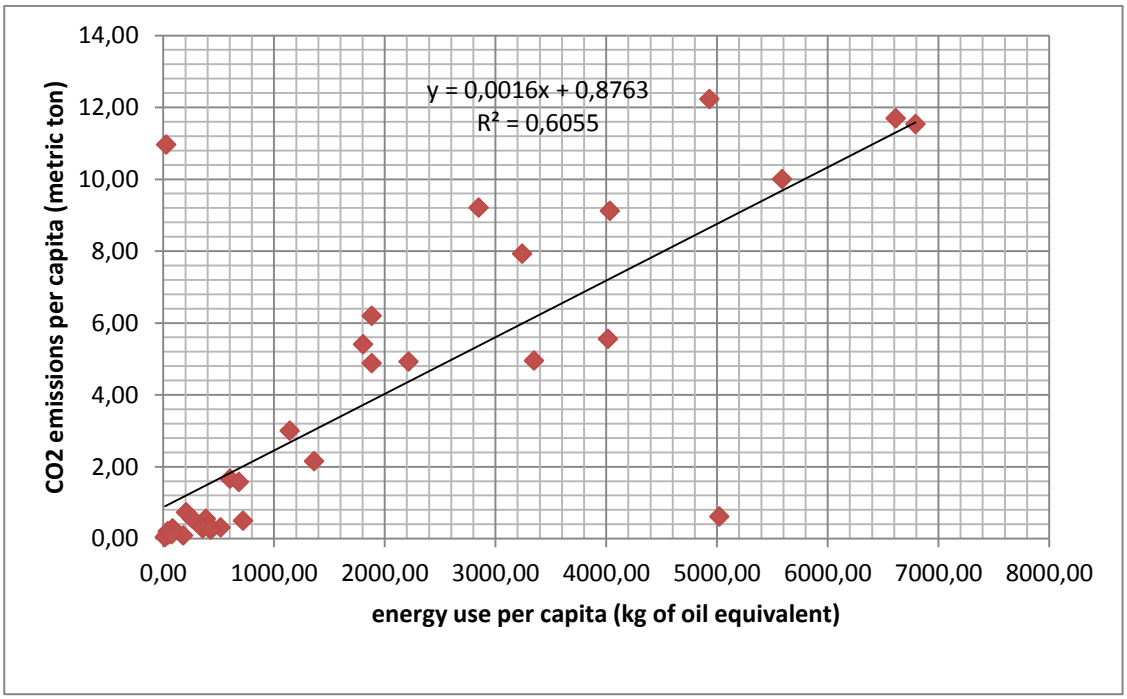

Figure 46. CO_2 emissions per capita and energy use per capita for all countries and categories

The energy use per capita growth is associated with an increase in CO_2 emissions per capita with a positive effect with a coefficient of 0.6055. Since CO_2 emissions are results of energy use, it is consistent with the analysis that an increase in energy use will lead to high CO_2 emissions. See fig. 46.

To maintain the GDP growth and reduce CO_2 emissions, industries must deploy the latest technologies that are efficient in burning fuels thereby reducing energy use for the same amount of output.

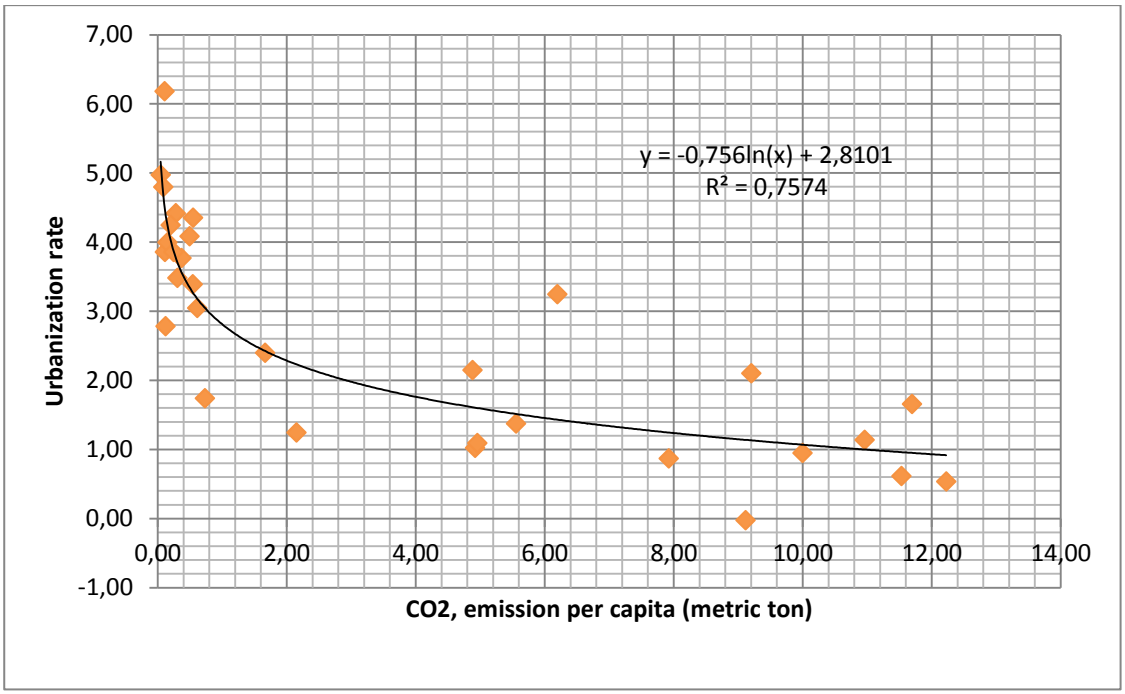

Figure 47. CO_2 emissions and urbanization for all countries and categories

The relationship between urbanization and CO_2 emissions is shown in fig. 47. The results reveal that urbanization reduces CO_2 emissions and the effect is negative. The results confirmed the relationships established between energy use, GDP, and urbanization.

The reduction in energy use as a result of urbanization which also leads to reduction in CO_2 emissions could be attributed to the use of new technologies in burning fuels and modern and efficient cooking facilities that are more likely to be used in urban cities than rural areas.

6 FINDINGS AND CONCLUSIONS

This chapter provides the finding, conclusions and some recommendations from the studies. The data analysis revealed the following results.

6.1. Findings

Energy access, health and life expectancy produced positive impacts in all categories with coefficients of 0.5963, 0.4677, 0.6104 and 0.1639 accordingly for all countries and categories, the West African countries, the selected European countries and the BRICS countries. The results showed that any increase in energy access will increase life expectancy by the factors shown.

For electricity access and literacy rate, for all the categorizations, it was found that an increase by a unit in the electricity access will improve the literacy rate by 0.537 or some 54%, a unit increase by a unit in the access to electricity will also increase literacy rate in the West African countries by 0.4992 or about 50%. The trend was the same in the remaining categories in the selected European countries with the rate 0.0134 or some 1.3%. The public expenditure on education which is expressed as a percentage of GDP analysis shows a negative effect in all categories and countries.

On electricity consumption and GDP, the results showed a consistent pattern, it was found in the all countries and categories an increase by a unit in the electricity consumption will lead to about 0.5 a increase in the GDP. The West African countries, the selected European countries, and the BRICS countries had .4196, 0.4891 and 0.4036 respectively. These results show a positive impact. The same result for Ghana with two decades of available data shows a negative effect with a factor of 0.6639. For Ghana, any increase in urbanization will reduce the GDP per capita by 66%.

The relationship between the GDP per capita and CO2 emissions and the effect analysis produced a positive effect with a factor of 0.525 for all categorization and countries. An increase in GDP per capita will increase CO2 emission by 52.5% with the same technologies. In the urbanization and CO2 emissions analysis, the relationship was linear with a negative effect. When urbanization is increased by a unit, CO2 emissions will increase by 72.6% in all categories and countries. Energy use and extreme poverty produced a negative effect with a coefficient of 0.506 for all categories and countries and 0.4384 for West Africa. The results show that in the categories, an increase by a unit in the energy use will reduce extreme poverty by 50.6% and 43.84% for the West African countries.

The coefficients of the analysis of the study are shown in table 8.

Table 8. Energy access and poverty indicators regression coefficients

Dependent variable	Independent variable	category	Coefficient	Results*	Studies
Energy Access and Health					
Life expectancy	Energy use	All	0.5963	+	N/A
Life expectancy	Energy use	West Africa	0.4677	+	N/A
Life expectancy	Energy use	Selected EU	0.6104	+	N/A
Life expectancy	Energy use	BRICs	0.1639	+	N/A
Energy Access and Education					
Literacy rate	Elect. access	All	0.537	+	N/A
Literacy rate	Elect. access	W. Africa	0.4492	+	N/A
Literacy rate	Elect. access	Selected EU	0.0134	+	N/A
Public expenditure on education	Energy use	All	0.3697	-	N/A
Public expenditure on education	Energy use	W. Africa	0.085	-	N/A
Public expenditure on education	Energy use	Selected EU	0.6198	-	N/A
Public expenditure on education	Energy use	BRICs	0.5492	-	N/A
Energy access and GDP (income)					
Electricity consumption	GDP	All	0.4934	+	Lee (2005)
Electricity consumption	GDP	West Africa	0.4196	+	Lee (2005)

Electricity consumption	GDP	Selected EU	0.4891	+	Lee (2005)
Electricity consumption	GDP	BRICs	0.4036	+	Lee (2005)
Electricity consumption	GDP	Ghana	0.228	+	Lee (2005)
Population under $1.25	Energy use/capita	All	0.506	-	Komives et al (2001)
Population under $1.25	Energy use/capita	West Africa	0.4384	-	Komives et al (2001)
Energy Access, GDP and Environment				+	N/A
CO2 emissions	GDP per capita	All	0.5245	+	N/A
CO2 emissions	Urbanization	All	0.7268	-	N/A

* The sign of the result shows the effect the causality factor has on the dependent variables, + sign mean the factor increases the dependent variables and - sign means a decrease in the dependent variable.

A high level panel in the United Nations has proposed a roadmap to attaining sustainable energy for all by 2030. Ghana has been undertaking many policies to improve the energy access:- the study benchmarked the policy action taken by the government of Ghana with the proposed action areas by the high level panel. It was seen that where Ghana has been doing well in some areas, the two most critical factors at ending the actions and achieving sustainable energy for all is lacking. These are financing and technical expertise. See table 9.

Table 9. Comparison of proposed actions globally and Ghana's actions

Some proposed policy actions globally			Some of Ghana's action	Remarks
Year	(by Rio+ 20)	(to 2015)		
Country action	Developing countries: Develop or update national energy plans	➢ Developing National and regional energy policies must be tailor made. ➢ Build capacity and be investment ready	➢ Ghana has national energy policy but can't be qualified as been tailor made ➢ Capacity building and investment not ready	Ghana 's capacity building for the energy industry is still lacking behind and the laws and bureaucratic processes are delaying investment
Sectorial action	Flagship initiatives instituted to each action area led by multi stakeholders.	➢ Measureable progress on the flagship initiatives ➢ Significant growth in the number of actions on - going ➢ Identifying the key synergistic sectors. ➢ Increase stake by the grassroots.	➢ Some progress is been made, though the quality and reliability cannot be assured ➢ More actions ongoing ➢ Not available ➢ No or little grassroots	Ghana is making progress in some key action areas, the reliability of the actions are yet to be tested No or little grassroots stake in the

			intake	power sector
Ending action	Commit resources to attain the flagship initiatives Manage knowledge	➢ Reliable financing ➢ Access to experts for technical support	➢ Ghana has unreliable financing on the action area ➢ Lack of technical expertise	Ghana's financial commitment to the actions areas are not enough and the lack of technical expertise is hindering the actions.

6.2 Conclusions

Life expectancy can be improved by increasing the access to energy as shown by the analysis, and for the Ghana and West Africa to attain the average life expectancy of the categorizations; the access to energy must be increased.

The selected European countries have an average life expectancy of 80 years with the energy access of nearly 100% and the average in West Africa is 50 years with the 40% energy access average.

The access to electricity can also increase literacy rate with a significant proportions as there will be lights for schools to extend their opening hours after dark and also enable reading and learning at homes after dark. To improve literacy rate, electricity access must also be improved. The analysis was further confirmed by the selected European countries with the nearly 100% access to electricity and 100% literacy rate. Though no factors related to literacy rate were analyzed, electricity access can also increase literacy rate.

Public expenditure on education is expressed as a percentage of the GDP and any increase in the GDP should be accompanied by an increase in education expenditure. However the analysis produced a negative effect, which suggests that for a fixed amount of expenditure on education, when GDP increases, then there will be a reduction in the percentage of the GDP to meet the education expenditure.

In the developing countries, especially West Africa and Ghana, where public expenditure on education is always insufficient and in arrears, the GDP growth will lead to increase in expenditure on education which may result in modern teaching and learning facilities acquisition.

The analysis of the relationship between electricity consumption and GDP growth has established a positive impact. It is an indication that an increase by a unit in the electricity consumption will produce a 40% GDP growth. It is therefore important that to increase the rate of GDP, electricity consumption or access will have to be improved. Poverty is measured by the income level of countries which is based on the total GDP and the GDP per capita of the countries. Therefore if the energy use increases THE GDP growth, then energy holds the key to uplifting countries from poverty to prosperity, assuming all things are equal.

Ghana's result produced the same pattern and relationship with a 0.228 coefficient. Therefore, to attain the average of 40% increase in THE GDP growth, Ghana needs to increase her electricity access from the current levels to the average of the categories and countries.

When GDP grows, the energy use energy use per capita will increase and this may lead to growth in CO2 emissions. When the technologies for burning the fuels are improved to make them efficient, less energy will be consumed for same results; therefore less CO2 will be emitted

Development indicators, such as life expectancy, literacy rate, GDP growth and quality of life are directly or remotely connected to the access to electricity, electricity consumption, the access to energy and energy use. Therefore for Ghana and West Africa to meet the demanding needs of development and reduce poverty, energy must be at the center of policy planning.

All the policy interventions put in place by the government of Ghana to help eliminate poverty are connected to energy use, electricity consumption and access to electricity, therefore for each policy to work in achieving the target, energy in all forms must be at the center of government policies.

While electricity access is not consumption, it is the first step towards meeting the energy needs. Where there is an access to electricity, efforts must be made to increase consumption, not only for the domestic use but for industries also.

The relationship and the severity for Ghana's energy use and GDP growth was 0.22 which is half of the average sample size, this figure could be attributed to that fact that Ghana's energy consumption is largely by domestic and services sectors, since Ghana's manufacturing industry is nonexistence and agriculture, which contributed about 29% to Ghana's GDP, uses less than 2% of the energy.

To end extreme poverty as proposed by the World Bank and the United Nations, every action must be geared towards energy use by the developing countries and Ghana. To increase energy use is to increase power installations and industrialization, therefore for Ghana to reduce poverty, improve education, life expectancy and other development indicators;- government must work on energy use, electricity access and consumption.

7 RECOMMENDATIONS

This chapter presents the recommendations made based the study findings.

1. It was established that energy use increases GDP growth when the critical sectors of the economy uses energy. Therefore to increase the GDP growth which will translate to a higher GDP per capita, Ghana's energy use must be in the sectors that contribute to the GDP growth. When the GDP grows, and there is equitable distribution of the wealth, poverty will be reduced.

2. To reduce poverty, and improve conditions of living, energy use, electricity access and consumption must be improved to the average of the consumption level of the sample size for the study. When the access to electricity and consumption is guaranteed, the life expectancy increases. So to increase the average life expectancy in Ghana, electricity access and consumption must be improved and sustained at least to the average electricity access and consumption rate by the selected European countries.

3. To improve literacy rate which in a way affects the income levels of people, there must be an access and reliable supply of electricity which will enable reading and learning after dark. This will also allow schools and centers of learning to remain open for studies which can also enable evening classes for workers who wish to further their education

4. While efforts are made to increase the energy use, electricity access and consumption in Ghana, the use of cleaner cooking facilities must be encouraged to improve the efficiency of the burning technologies and reduce CO2 emissions.

5. Energy use can reduce extreme poverty by 50% and 43% for the sample and the West Africa respectively, it is therefore recommended that every effort targeted at reducing poverty by Ghana, should have energy use, electricity access and consumption at the center.

For Ghana to attain sustainable energy for all by 2030 as proposed by the high level panel, the two most important actions which are financing and technical expertise must be taken seriously.

It is recommended that in order to confirm or further prove the findings, a further study should be done and an advanced method of analysis used.

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