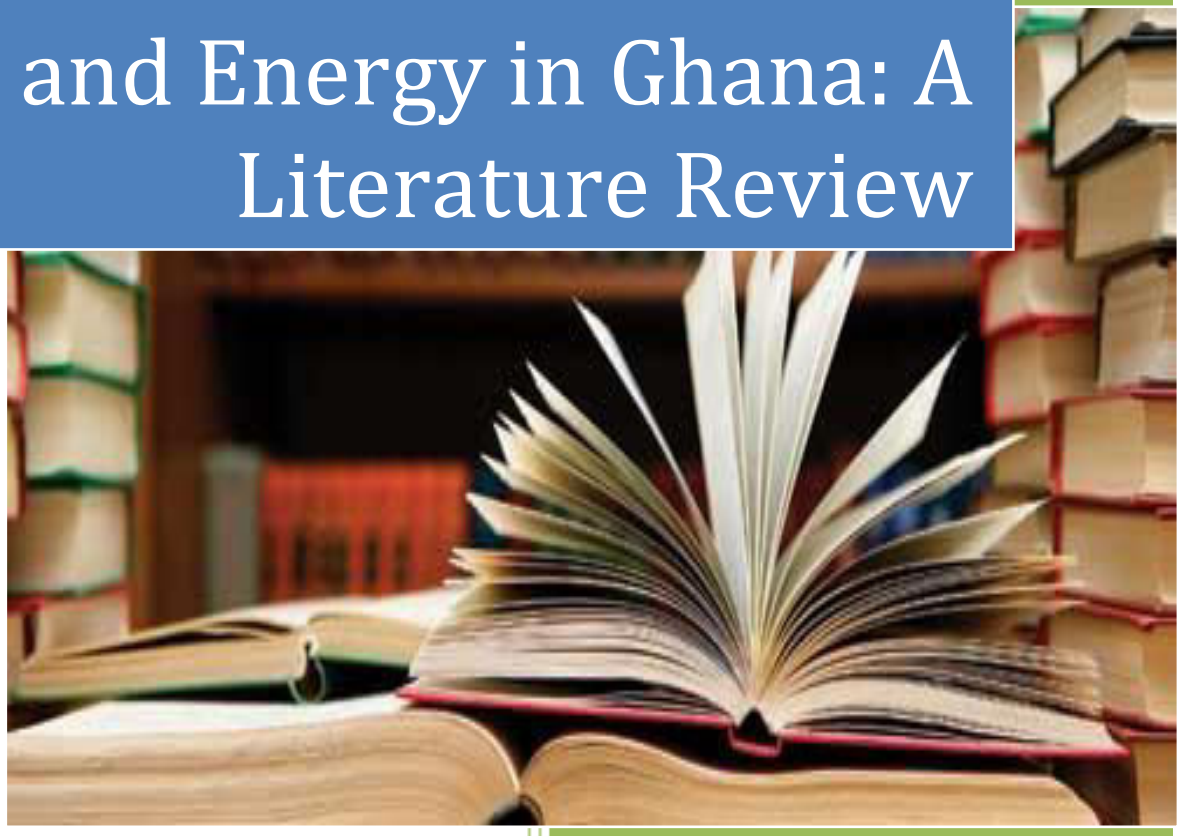
The Nexus between Urbanisation and Energy in Ghana: A Literature Review



Dr. Simon Bawakyillenuo

Mr. Innocent S.K. Agbelie

ISSER, University of Ghana

1.0 Introduction

Energy has been recognized as an indispensable resource for the promotion of economic activities and the enhancement of human welfare. This realisation has underpinned several research works in the field of energy and the environment in order to address socio-economic issues including, poverty, income disparity, energy availability, accessibility and affordability in urban and rural areas. Urban centers in Ghana were thought of in the past as being catered for in relation to energy supply, accessibility and affordability. There is better supply of energy in the urban areas compared to the rural areas, but it is also fraught with unreliability issues (Akuffo, 2007). Consequently, research works on energy in general and lighting in particular were until recently focused on the rural areas, in a bid to empower rural folks to better their livelihoods. In order to track the transitional paths regarding the forms of energy used generally in Ghana and specifically in urban Ghana and the issues underpinning the patterns of usage, it is imperative to review thoroughly the extant literature on energy in the country. This literature review shall focus on the energy situation in the urban Ghana, even though an overview of the general case for the whole country will be addressed. More importantly, the literature review shall be guided by the following research questions:

a) *What evidence exists on the forms of energy supply and demand across various sectors in urban Ghana?*
b) *What are the determinants of different forms of energy among urban demand sectors?*
c) *What are the linkages between urbanization and energy consumption in Ghana?*
d) *What is the general perspective of energy literature in urban Ghana compared with what exists in the rural areas?*
e) *What are the strengths and weaknesses of the institutional arrangements in relation to the provision of clean energy technologies in urban Ghana?*
f) *How useful are the major findings from the energy literature on urban Ghana to the promotion of sustainable energy transition paradigm in the country?*

The literature review is organized into four sections. Following the introductory section is an appraisal of literature on the current features of urban Ghana. In section three, existing energy literature across various energy demand sectors of the Ghanaian economy is reviewed.

Specifically, a considerable emphasis is given to the urban energy situation in Ghana compared with what exist in the rural settings. In addition, literature on institutional and policy frameworks that drive the energy sector in Ghana is reviewed at the final part of this section. Finally, section four takes a look at how the literature addresses the research questions through the identification of key issues from the literature.

2.0 The Current features of Urban Ghana

The face of most Ghanaian towns has changed since independence and some of the underlying reasons identified by Adarkwa (2012) and Adarkwa and Poku-Boansi (2011) include increased population, enhanced economic circumstances, rapid expansion in the area extent of most towns, better distribution of employment opportunities than existed in the past and increase in vehicle ownerships. With the increase in population and unprecedented increase in demand for the limited housing units within the urban areas, most people displaced by the housing market have sought to move outside towards the peri-urban communities where land prices and property values as well as rents are relatively cheap. However, for those who cannot afford to pay rents nor acquire plots of land, they end up 'squatting' in uncompleted buildings or living in unathorised areas without basic amenities, eventually creating slums. The UN-habitat (2003) observes that today's true builders and planners of cities in developing countries are the urban poor who build houses and establish legal or illegal settlements where they can to make life comfortable at all cost. Accordingly, slums have been a major source of shelter for low-income people in most cities as it is less expensive to live there and very accessible to the poor (UN-habitat, 2003). The development of slums such as Old Fadama, Amui Dzor and Akwatia Line in various cities in Ghana attest to this assertion. Other city folks are compelled to live in particular areas because of recurrent forced actions such as demolition of unauthorized structures at unauthorized locations by the city authorities (Yeboah and Obeng-Odoom, 2010). Considering that the spatial structure of towns has remained essentially the same, most Ghanaian towns now experience congestion on virtually all their roadways (Adarkwa, 2012). Okyere (2012) and Adarkwa and Poku-Boansi (2011) for instance, have warned that if the private means of travel is not discouraged, the transportation system will be unsustainable in the future.

Due to the increase in overall demand for urban land uses especially, for offices and residential facilities, vertical development of structures should now be the norm to ensure optimum utilisation of the scarce land in most large cities in Ghana. However, lateral development is still dominating, resulting in the creation of the urban sprawl phenomenon in most metropolitan and municipalities in the country. This situation is partly attributable to the inability of planning authorities to successfully control physical development in the country. The environmental sanitation (cleanliness) in most Ghanaian towns has also declined tremendously in the wake of rapid increases in population and the inability of local governments to manage the situation adequately (Awortwi 2006, Oteng-Ababio, 2010). Aside the prevalence of heaps of solid waste across most residential areas, there is now a widely held view that Ghanaian cities particularly Accra, is engulfed in filth (Obour, 2012). Unfortunately, the Local Government Reforms since the 1980s, including the creation of many Metropolitan, Municipal and District Assemblies, appear to lack the potency in tackling these urban challenges partly due to lack of professional personnel, financial resources and political commitments necessary to empower these structures adequately (Adarkwa 2012).

3.0 Energy Literature on various Sectors in Urban Ghana

3.1 Residential Sector

Ardayfio (1986) identified that since the 1980s energy needs in the residential sector of Ghana have been mainly domestic particularly regarding lighting and cooking. A technical paper by the Energy Sector Management Assistance Programme (ESMAP) in 2006 covering four countries including Botswana, Ghana, Honduras and Senegal revealed that households in Ghana use a great variety of fuels and energy sources ranging from candles, car batteries and crop residue. However, fuelwood is the dominant energy (constituting about 84.4%) being used in the rural areas for cooking and water heating, whiles charcoal dominates in the urban areas for cooking and water heating; a result also confirmed by Rupp (2013) after studying the politics of energy in some urban centres of Ghana. Deforestation is estimated at around 65,000 ha/year and results in an annual cost of degradation of about 3.5 percent of Ghana's GDP due to over-exploitation of the trees for timber and wood fuel; illegal logging in reserve forests; mining activities; and rampant bushfires (World Bank, 2006).

A survey conducted by Brew-Hammond *et al*. (2011) within three slums in Ghana including, Old Fadama, Amui Dzor and Akwatia Line identified that slum dwellers in the urban centres use a wide range of energy resources for several purposes including, lighting and cooking. The study unveiled that charcoal use accounted for 73.9% of households' total energy consumption for cooking at the domestic level in the slum and the use of firewood and sawdust accounted for 10.6% and 0.5%, respectively of the total energy-mix for domestic cooking. The survey identified only charcoal pots of different types as the technology used by households for the conversion of charcoal to heat energy for cooking at home while firewood was used in the traditional three-stone stoves (92%) and "improvised stoves" made from iron rods (8%) in the three slums. Despite the Ghana Government's goal to encourage the use of modern cooking fuels such as Liquefied Petroleum Gas (LPG), the contribution of LPG to the total household cooking fuel mix was just 4.6% in the three slums. The situation is further compounded by the preference, which households have for charcoal relative to the modern forms of cooking fuel such as LPG and electricity, due to the high cost associated with them. However, a higher proportion of households which use various forms of energy fuels for cooking in the three slums revealed in the survey that they would prefer to use electricity and LPG as fuels for cooking if their affordability is enhanced. This conforms with the pattern of preferred fuels and fuel transition choices revealed by the ESMAP (2006) report, which showed that Ghana is gradually moving from woodfuel to charcoal and gas energy sources for domestic activities such as cooking and heating water.

According to Inkoom *et al.* (2010) LPG is identified with the residential sector particularly, in the urban centres of Ghana. Ardayfio (1986) pointed out that, unlike in the urban areas where education, fuel price, location, housing designs and cooking equipment are favourable for the use of modern forms of energy like electricity and LPG, social and economic conditions in the rural areas limit the choice of energy to woodfuel. Having sampled women from three settlements; Jankama, Botianor and Ashale Botwe, the study of Ardayfio (1986) found that developmental processes in the country, educational level of the household head, women's income-earning activities, the social organization of the household, the frequency and the types of food cooked affect fuel types used. The findings of Adam *et al.* (2013) in their study confirm the hypothesis that, access to modern forms of energy increases as income levels increase. Their results show

that the number of households using electricity as the main source of lighting increased with increasing income levels whereas kerosene had a decreasing trend. In the same vein, charcoal and gas were also observed to be the fuels of choice as their usage increased with increasing income, unlike wood use, which was observed to decrease as income levels increased. Similar trends were observed at the regional level where, apart from the three northern regions, all the other regions in Ghana had a clear trend with an increasing number of households using electricity as the main source of lighting, and charcoal and gas as the main fuel for cooking, as the income quintile levels increased. The findings of Mensah and Adu (2013) also lend support to the energy ladder hypothesis that household income is a major determinant of household energy choice in Ghana. Further, social and demographic factors as well as access to energy supplies are key determinants of cooking fuel type in Ghana. They recommend intensification of income poverty reduction programs to boost households' incomes so as to move the majority of households towards the upper rungs of the energy ladder, that is, away from over dependence on biomass to clean and modern energy sources such as LPG and electricity.

The ESMAP report (2006) and the Ghana Statistical Service (2008) identified that electricity is the main source of lighting for close to 79 per cent of urban households in Ghana. Brew-Hammond *et al*'s (2011) work in the three slums lends support to this assertion. Further analyses of the study showed that an average of 56.4% of the households acquired their electricity connection from the Electricity Company of Ghana (ECG) and thus had electric meters. Though 'illegal', the remaining households (43.6%) acquired their electricity connections from their neighbours, and sometimes directly from electricity poles erected in the slums resulting in some estimated GHS888, 858 annual losses in revenue to ECG. The study further identified that about 9.5% and 2.3% of the households in the slums used kerosene and candles, respectively, as their main forms of energy for lighting because they did not have electricity connection in their dwellings.

Meikle and Bannister (2003) used the Sustainable Urban livelihood (SUL) framework as an analytical tool to explore the energy and poverty linkages among poor urban households in Indonesia, Ghana and China. The results indicate that the economic crises experienced in the 1980s clearly affected energy policy in Ghana leading to increase in the price of energy, the policy of stepped tariffs related to volume of electricity consumed and so on. These issues have

had both direct and indirect impacts on the availability of energy for the urban poor. Governments usually target energy policies to benefit the poor, yet the poor have failed to reap the benefit of these policies. According to the study, this is largely a consequence of the policy of stepped electricity charges in Ghana, whereby the unit cost of electricity is tied to the amount consumed (i.e. the higher the amount used, the higher unit cost). Although intended to benefit low electricity consumers and thus the poor, this strategy fails to take into account the energy management strategy of the poor, many of whom share the cost of one electricity connection, in order to save money. This means that the combined electricity consumption quickly reaches the higher unit cost rate. The study further stressed that, almost all urban poor group themselves to share cost of electricity connection. This has often resulted in conflicts over the payment of electricity bills especially in shared accommodations yet they do all possible to avoid disconnection since that attracts penalty and reconnection fees as revealed by the study. The study concluded that households' long-term aspirations and investment were curtailed, in Ghana by the shock of energy price rises. Poor households adopted three main strategies to accommodate these energy changes: switching to cheaper energy options; reducing the overall consumption of energy and reducing their expenditure on non-energy goods.

Electricity, though highly consumed for domestic lighting purposes especially in urban Ghana, is barely sufficient in supply for the growing demand. The 2011 annual installed capacity of energy generation (i.e. 1960 MW) must be increased to 9,405.59 MW, assuming 85% plant availability, to be able to cope with the growing demand and to ensure countrywide access as well as support commercial and industrial activities for the growth of the economy (Essah, 2011). Currently, hydro and thermal facilities generate about 67% and 33% respectively of the electricity in the country to meet the estimated 66% electricity demand (Energy Commission, 2012), with marked persistent rolling blackouts (Rupp, 2013). Quartey (2010) analysed the welfare effect of alternative energy sources used during the 2007 power crises by computing income lost by having to spend on alternative energy for lighting by households from two cities; Kumasi and Wa in Ghana. There was a decline in the welfare of households as a result of the power outages and the poor were the worst affected losing about 10% of their average monthly incomes as a result of alternative arrangements for lighting. The "*better-off*" by Ghanaian standards were the least affected losing only 0.33% of their average monthly incomes.

Essah's (2011) study recommends research into other sources of energy especially environmentally friendly, more sustainable and renewable energy sources as supplements to the existing power sources. Dadzie (2012) and Ennison and Dzobo (n.d) are of the view that the best alternative source which can be used to address the energy supply problems in Ghana is nuclear energy, proposing a medium sized pressurized water reactor (PWR) with 300MW to 700MW capacity as the most favourable type of reactor to be used in Ghana. On the other hand, Ndzibah (2011) proposes renewable energy for Ghana coupled with the adoption of the Robin Hood and Donkey[1] principles as ways of distributing and transfer of electricity cost to both the urban and rural consumers. Additionally, Painuly and Fenhann (2002); Government of Ghana(2004); Abavana (n.d); Akakpo (2008); Obeng and Evers (2009) have identified solar energy as the most cost-effective means to extend power to rural areas that are inaccessible by the main grid system.

Bensah and Brew-Hammond (2010) reviewed biogas installations in Ghana and investigated the challenges facing their design, construction and operation. According to their findings after surveying 50 biogas installations, 58% belonged institutions, 28% were household installations in various urban centers and the remaining 14% were community plants. 44% of the 50 plants were found to be functioning properly whiles 32% were not functioning or abandoned. Having revealed that sanitation was the main motivational reason for people using biogas plants, the study recommended the development of a national biogas programme with focus on three major areas: sanitation, energy, and agricultural fertilizer production and also support the development of standardized digester models. The study of Arthur *et al.* (2011) concluded that, there are vast biomass resources including organic waste in Ghana that have the potential for use as feedstock for biogas production to reduce the over reliance on woodfuel and fossil fuel.

Despite the overarching potential of renewable energy in the country, this source of energy remains one of the least tapped energy resources in Ghana (Energy Commission, 2010; 2012). Painuly and Fenhann (2002) identified some barriers associated with the installation and usage of solar water pumps (SWP) and biogas in some urban households in Ghana. According to their study, the most important barriers identified for solar technology in general and SWP in particular are the high initial cost and a general lack of information. Resource (dung and water)

[1] Principles advocating equitable distribution of electricity as well as ensuring that the rich in the urban areas, take part of the energy cost of the poor in the rural areas.

unavailability, the absence of favourable promotion policies and financial schemes and the unwillingness of people to use biogas for cooking remain the main barriers to biogas implementation in urban Ghana. Lack of technical know-how in the various bioenergy companies, economic conditions and supply chain coordination were identified by Gabienu (2012) as the factors affecting the bioenergy industry in Ghana. Nevertheless, Dafrallah et al. (2010) noted that, with respect to the development of biofuel as an alternative energy source in Ghana, an estimated 2.7 million hectares of land are either under cultivation or have been earmarked for jatropha cultivation, representing 11% of total land area and 19% of total agriculture land respectively.

3.2 Non-residential sector

According to the Centre for policy Analysis (CEPA) and the Energy Commission of Ghana educational institutions and hospitals account for a small proportion of woodfuel (firewood and charcoal) consumption for cooking in Ghana, but the use of LPG is widespread in these institutions for cooking especially in the urban areas. For lighting purposes, electricity from the hydro power is the single dominant energy source for educational institutions and hospitals across the nation (Energy Commission, 2002). Based on results of fieldwork covering households and enterprises in 2009 in Accra, Koforidua, Kwahu and Kumasi, Rupp (2009) concluded that Ghanaians always move between different energy sources as a coping strategy in response to the unreliable energy supplies in the country.

The transportation and haulage sub-sectors are very dependent on petroleum products and have been greatly affected due to constant shortages in petroleum products, petrol and LPG in particular (Nnadikwe, 2007; Rupp, 2013). Nnadikwe (2007) showed the extent to which Ghana is vulnerable to oil price shock due to her extreme dependence on this energy resource. By analysing the effect of changes in crude oil import price and currency exchange rate on the prices of the various petroleum products used in Ghana, the study indicated that prices of petroleum products are very elastic to increases in crude oil price and much more elastic to fluctuations in currency exchange rate. The vulnerability indicator employed in the study revealed that 2.47% and 8.49% of Ghana's GDP was spent offsetting high prices of crude oil in 1999 and 2006 respectively. Currently, Ghana is still 100% dependent on imported crude oil irrespective of the discoveries of oilfields offshore. However, once the gas processing plant is completed in the

Western region of Ghana, the country will have sufficient processed gas and, its importation will curtail.

In recent times, the clarion calls for nations to shift to the use of more environmentally friendly and sustainable energy sources are getting the attention of most world economies including, Ghana due to their inherent climate change mitigation as well as job creation potentials (Vilar, 2012). Kumi and Brew-Hammond (2013) for instance, investigated the potential design of a 1Mega-Watt grid-connected solar PV system for Kwame Nkrumah University of Science and Technology (KNUST) in Ghana to boost the mix of renewables in the institution's energy consumption. The study used a procedure that is aimed at developing a standard procedure for the design of large-scale institutional grid-connected solar PV systems using the roofs of buildings and car parks. The preliminary analyses of the simulation results showed that solar PV electrification has numerous benefits for the Ghanaian economy. The results showed that the project is socially beneficial to the University, with an annual energy yield of about 1,159MWh, representing about 12% of the University's annual electricity consumption. Besides, the process of electricity generation from solar PV saves about 792 tonnes of CO2 per annum, which is promising news for greening the Ghanaian economy. The results of Obeng and Evers' (2009) work lent support to the assertion of the great potentials of solar PV electrification in Ghana. The results illustrate the intersectoral linkages of solar PV electrification with sectors such as education, health, information acquisition, agriculture and micro-enterprises in rural areas.

3.3 Industrial/Production Sector

Ghana has a fairly large and vibrant industrial sector, which contributes about 24% of the county's Gross Domestic Product (Ghana Statistical Service, 2012). The industrial sector is made up of mining, lumbering, manufacturing, aluminum smelting, food processing, cement and small commercial ship building (CIA World Factbook, 2011) and is mainly concentrated in the municipal and metropolitan areas in southern Ghana.

In 2002, Centre for policy Analysis (CEPA) and the Energy Commission of Ghana jointly carried out a survey on energy consumption among production firms across urban centres in Ghana. The study used the following sampling approach: a total of one thousand, one hundred and eighty four (1,184) firms, comprising of six hundred and fifteen (615) industrial firms; from

the Non-Special Load Tariff[2] (Non-SLT) customer list of the ECG, twelve (12) high-voltage power consuming firms and five hundred and fifty seven (557) firms on the Special Load Tariff (SLT) customer list of the ECG. Results from the survey indicated clearly that diesel fuel is the most widely utilized of the fuel types across economic activities in all three sub-populations (high-voltage power-consuming firms supplied directly by the Volta River Authority (VRA), the SLT and Non-SLT customers of the ECG), while in the case of gasoline (petrol) whose use in the Services sector, particularly in the Transport and Haulage sub-sector, supersedes all.

Woodfuels (charcoal and firewood) consumption, as reported in the survey, is not extensive across sectors of economic activity. The bulk is used in boilers of sawmills and in ovens in brick and tile and ceramic factories with charcoal consumption mostly common in small-scale restaurants and eating places. Kerosene is also limited in use across economic sectors of the economy whilst LPG is a heavily patronized energy fuel whose consumption is widespread across sectors of production and spans all three domains of the study. Finally, the survey indicated that the high-voltage power-consuming firms (Volta Aluminum Company (VALCO), the mines, Akosombo Textiles and Aluworks), and the Ghana Water Company Limited are the principal electricity-consuming firms in the country. Agriculture was found out to have the lowest energy intensities (0.04TOE/ ¢ million GDP in 2001) after the Service (1.02TOE/ ¢ million GDP) and the Industrial (0.4TOE/ ¢ million GDP) sectors.

The study of Apeaning (2012) presents a general overview of the energy efficiency and management practices in the Tema Industrial Area in Ghana. The major energy sources used for industrial purposes identified by the study include wood fuels, electricity and petroleum products (diesel, gasoline and residual fuel oil). Industrial energy in this sector is used by subsectors like mining, utilities, manufacturing, construction and VALCO, an aluminum smelting company. Deducing from the results, the study concluded that energy is poorly managed in the Tema Industrial Area; with a low implementation of cost effective energy efficiency technology in the respective industries studied. The majority of the industries (except 2 firms) surveyed had neither a standardized energy policy nor energy management system. This is attributable to the low priority given to energy efficiency investment by Ghanaian firms.

[2] Non-residential consumers with consumption levels not exceeding 2000 kWh per annum.

King *et al* (2012) interviewed 88 enterprise owners selected from three urban slums in Ghana including Old Fadama, Akwatia Line and Amui Dzor in order to understand the energy utilization dynamics in these settings. The study revealed that several enterprises that use energy services including, bath-houses, chop bars, restaurants, vulcanizing, mechanics, grinding mills, Forex bureau, petty trading electronic shops, oil filling stations and so on, are found in these slums, even though these places are disregarded in the energy planning process. Public bathroom, food preparation and vending enterprises each use firewood to heat water and prepare food, respectively. The food preparation and vending enterprise owners also use charcoal to prepare soup and stew. The public bathroom, groundnut paste producers, food preparation and vending enterprises use traditional cook stoves as the end-use technology for the conversion of firewood to heat energy. The rest of the enterprises (provision stores, hair dressing salons and groundnut producers) use electricity for lighting purposes with fluorescent, compact fluorescent and incandescent bulbs as the end-use equipment.

Besides lighting, hair dressing salons use electricity to power their hair dryers for their customers as revealed by King *et al's* (2012) study. Video centre operators also use electricity to operate their enterprises. However, due to frequent unannounced blackouts, the video centre operators use diesel/petrol standby generators. Scrap metal dealers use petrol and kerosene to burn off insulators to expose the metallic content. The scrap metal dealers also use LPG to cut heavy and bulky metals into portable sizes. The lack of attention by the energy authorities, according to the responses in King *et al* (2012) study, has perpetuated the illegal tapping of electricity in these slums. Findings of the study further revealed that, majority of households and enterprises in the slums would prefer to use modern energy sources like LPG and electricity for cooking and production if prices were affordable and supply reliable. Inkoom and Biney (2010) investigated the potential of LPG as a viable energy option for the industrial sector in Ghana. Using data collected through face to face interviews, observations, and discussions from a sample of 60 industries located in Tema, Ghana, the research identified a potential for increased LPG use in industries if safety concerns, price volatility, product availability, technical issues associated with boilers and furnaces, and policy issues were addressed.

Just like households, enterprises also suffer from persistent power cuts in many urban areas of Ghana. As a coping strategy, some institutions in the urban centres like the Energy Commission,

Valley View University at Accra and the Noguch Memorial Institute for Medical Research, University of Ghana have resorted to renewable energy technologies such as solar PV in order to complement their electricity consumption. Other institutions like Guinness Ghana Breweries Limited at Kumasi and Valley View University at Accra have also adopted biogas energy technologies to supplement their cooking energy sources (Bensah et al. 2010; Dafrallah et al. 2010; Arthur et al. 2011). According to Quartey (2010) enterprises in Kumasi and Wa suffered welfare losses in varying degrees during the 2007 power crises. The total payments for electricity by Micro, Small and Medium Enterprises (MSMEs) when there were no power outages was GH¢1,554 while the expenditure on alternative electricity sources was GH¢1,734 for lighting purposes. This left a deficit of GH¢180 per month for MSMEs. The results further indicated that the Total Willingness to Pay (TWTP) for the 2.4 million urban households in Ghana (GSS, 2008) stood at GH¢1,006,320 (US$628,950) for a 24 hour consumption of electricity from a reliable alternative source of electricity. Of great interest is the fact that respondents did not care about the source of the electricity, which may be an indication that a potential exists for the use of low carbon sources of energy by urban dwellers in Ghana.

3.4 Literature related to Institutional, Energy Policies and Programmes in Ghana

Bawakyillenuo (2009) argued that the role of the state in developing an appropriate institutional and policy framework is crucial for enhancing the development of energy. The study of Apeaning (2012) revealed that, the Government of Ghana has over the years made significant efforts to improve energy efficiency and management in Ghana through formulating policy instruments and initiating energy efficiency schemes and programs. However, there still remains a huge 'efficiency gap' in the industrial sector as government's efforts to improve energy efficiency has been directed towards residential and commercial sectors of the economy. Access to electricity has increased significantly since the National Electrification Programme in 1989, from 28% in 1988 to 43.7% in 2000 and about 66% in 2010. However, while household access in urban areas is81% rural households' access is 24.9% (Energy Commission, 2012).

Government of Ghana (2004) affirmed the assertion that the first tier step on the energy ladder after woodfuel for the rural poor is the move to charcoal. By the time they are in the second tier they are into modern fuels, starting with kerosene. The next quantum jump takes them into LPG. For the rural poor, electricity is never an option for cooking due to the high cost that comes with

it as well as non-availability. Accordingly, the Government of Ghana embarked on the Rural Kerosene Distribution Improvement Program (RDDIP) to improve on availability and accessibility of this fuel (ESMAP, 2006; Mensah and Adu, 2013). The Government of Ghana's LPG promotion as an alternative to woodfuel in 1990 has had significant impact on LPG consumption in Ghana and urban centres in particular. The consumption of LPG doubled by 1992 and was almost ten times higher by 2004, mostly in the urban centers (also confirmed by Mensah and Adu (2013). Obeng *et al* (2009) noted that the need to secure future energy in the forms of electricity and other modern cooking fuels is recognized as critical to the achievement of the MDGs.

Despite the significant progress, both the Volta River Authority (VRA) and the Electricity Company of Ghana (ECG) have been burdened by under-investment in their power distribution system, overloaded transformers and distribution networks, and the continued use of obsolete equipment, all of which resulted in high distribution system losses, poor electricity supply, and unreliability issues (World Bank & MIGA, 2004; Energy Commission of Ghana, 2006). The poor fiscal management is evidenced by the 144.9 million USD debt relief that was granted to the VRA and 95.06 million USD to ECG in 2004 (World Bank & MIGA, 2004).

Sawin (2004) notes that a sustained renewable energy market can be developed quickly and efficiently if the right combination of policies is adopted (cited from Bawakyillenuo, 2009). Using two case studies, Bawakyillenuo (2009) contextualized the link between inadequate government institutional and policy frameworks and the low level of Photovoltaic Solar Home System (PV/SHS) dissemination in rural Ghana. The study found that effective institutional, regulatory and policy structures act as 'stimulants' to solar PV/SHS dissemination. After reviewing energy institutional arrangements for Ghana, the study revealed the non-existence of a dedicated national institution solely for the development and promotion of solar PV and other Renewable Energy Technologies (RETs). Similar findings were obtained when Bawakyillenuo (2012) revealed that a gamut of socio-economic and political antecedents informed the varied dissemination outcomes of PV technology in Ghana, Kenya and Zimbabwe.

4.1 Key Issues from the Literature

- Modern forms of cooking energy are available in the urban areas of Ghana, but are inaccessible to majority of urban poor who live in slum areas and peri-urban areas. The majority of these urban poor still depend heavily on woodfuel for cooking with very few adopting the improved cook stoves. Government promotion of modern cooking energy including, LPG, biogas and improved cookstoves in the urban areas seems to be yielding little result among these people, even though they wish to transition to such forms of cooking energy.
- Choice of cooking energy in urban Ghana depends on a number of factors including household income, supporting the energy ladder hypothesis. The literature confirms that access to modern forms of energy increases as income levels increase. Other determinants include developmental processes in the country, educational level of the household head, income-earning activities of the household members, the frequency and the types of food cooked in the household and the prices of the modern forms of energy. The literature has recognized the need for clean sources of energy in the urban areas. Various forms of renewable energy and energy efficiencies measures are advocated in the literature as the means that can help achieve universal access to clean energy as well as ensure energy sustainability.
- Energy for lighting in urban Ghana is predominantly electricity dependent. It is available to almost all urban dwellers, but is inaccessible to the urban poor who still depend on candles for lighting or get connected illegally from their neighbours. Though available in the urban centres, the supply of electric power is also very unreliable, marked by persistent power fluctuations and black-outs. As a result, many people have resorted to the use of diesel generators, with high pollution levels, to satisfy their energy electricity needs.
- Households and enterprises in the urban areas have shown high willingness to pay for alternative power sources irrespective of their pollution status. This is evident from how quickly most enterprises and some households switch onto diesel powered generators in case of power outages in the cities. Notwithstanding the high willingness to pay for alternative power sources especially, renewable energy technologies, this potential has not been maximised. Government has made little attempt in terms of appropriate policies and institutions to provide supplementary “greener” energy sources in order to take advantage of the willingness of Ghanaians to adapt to more reliable energy sources.

- Institutional arrangements to promote clean energy technologies in Ghana have improved over the years. What is perhaps missing is the lack of strong and sustainable institutional and policy support to enhance clean energy technology development. Education, awareness creation and provision of incentives for technologies such as solar PV and improved cook stoves are insufficient or non-existent, resulting in their low patronage. Local governments lack sufficient resources to exert adequate control over the growing towns and cities in Ghana. Subsequently, they have little say on the supply of different forms of energy as well as how urban dwellers consume such forms of energy due to the lack of professional personnel and financial resources.
- The transport, town and county planning authorities, aside being poorly resourced, also lack the political will to efficiently plan and develop the cities. This has given way to the development of urban sprawls and slums that are actually defining the shape of Ghanaian cities. The transportation system in the urban centers is unsustainably managed. Congestion on virtually all the roadways due to the increasing number of private cars has put immense pressure on the exiting transport facilities in the country.

4.2 Conclusion

It is empirically evident from the literature that different forms of energy exist across the various energy sectors of the economy ranging from woodfuel to LPG and candles to electricity for cooking and lighting among urban residents. Petroleum products are dominant in the non-residential sector with the transport sub-sector consuming the bulk while woodfuels, charcoal and electricity are widespread in the residential sector of urban Ghana. The empirical pattern of changes in preferred fuels and fuel use transition shows that Ghana is gradually moving from woodfuel to charcoal and gas energy sources for domestic activities such as cooking and heating water in urban areas of Ghana. Some institutions in the urban centres such as schools and hospitals are also adopting renewable energy technologies such as solar energy to complement their electricity consumption and biogas energy technology to supplement the cooking energy sources.

All the energy demand sectors in Ghana and in the urban areas particularly, switch between different forms of energy due to their unreliability. Besides, the preference for more reliable energy is high among consumers in urban Ghana, yet little has been done to provide more reliable and environmentally friendly forms of energy such as renewable energies. The review has demonstrated that the institutional arrangements and policy frameworks have been inadequate to steer a robust development of modern forms of energy in urban Ghana. Against this backdrop, there is a need to build the capacity of various institutions in urban Ghana to help facilitate the pathways to sustainable energy transition in the growing municipalities of the country.

References

Abavana, C. G. (n.d); Renewable Energy for Rural Electrification: The Ghana Initiative. Renewable Energy Services Project (RESPRO), Accra-Ghana.

Adarkwa, K.K. and M. Poku-Boansi (2011). "Rising vehicle ownership, roadway challenges and traffic congestion in Kumasi", University Printing Press (UPK), KNUST, Kumasi.

Adarkwa, K. K. (2012). The changing face of Ghanaian towns. *African Review of Economics and Finance*, Vol. 4, No.1, Dec 2012.

Adam, F. W., Brew-Hammond, A. and Essandoh, E.O, (2013). Relationships Between Energy Use and Income Levels, for Households in Ghana. Mechanical Engineering Department/The Energy Center Kwame Nkrumah University of Science and Technology (KNUST), Kumasi

Akakpo, J. (2008). Rural Access: Options and Challenges for Connectivity and Energy in Ghana. International Institute for Communication and Development (IICD) and the Ghana Information Network for Knowledge Sharing (GINKS)

Apeaning, R. W. (2012). Energy Efficiency and Management in Industries – a case study of Ghana's largest industrial area. Master thesis-TQMT 30 LIU-IEI-TEK-A--12/01311 SE. Institute of Technology, Linkoping University.

Ardayfio, E. (1986). The Rural Energy Crisis In Ghana: It's Implications For Women's Work And Household Survival. World Employment Programme Research working Paper. Rural Employment P o l i c y Research Programme. WEP 10/WP. 39.

Arthur, R., Baidoo, F. M. and Antwi, E. (2011). Biogas as a potential renewable energy source: A Ghanaian case study. Renewable Energy. *An international journal. Volume 36 Issue 5 May 2011. Issue 0960-1481.*

Awortwi, N. (2006). "Technology and Institutional Arrangements in the Delivery of Public Sanitation and Solid Waste Services in Ghanaian Cities". *International Journal of Technology Management and Sustainable Development,* Vol. 5 (3), pp. 221-239.

Bawakyillenuo, S. (2009). Policy and Institutional Failure: The Bane of Photovoltaic Solar Household System (PV/SHS) Dissemination in Ghana. *Energy & Environment* · Vol. 20, No. 6, 2009.

Bawakyillenuo, S. (2012). Deconstructing the dichotomies of solar photovoltaic (PV) dissemination trajectories in Ghana, Kenya and Zimbabwe from the 1960s to 2007. Energy Policy 49 (2012) 410–421. Elsevier

Bensah, E. C. and Brew-Hammond, A. (2010). Biogas technology dissemination in Ghana: history, current status, future prospects, and policy significance. International Journal of Energy and Environment. *Volume 1, Issue 2, 2010 pp.277-294*

Brew-Hammond, A. and Kemausuor, F. (2007). Energy Crises in Ghana: Droughts, Technology or Policy? Kwame Nkrumah University of Science and Technology (KNUST) – College of Engineering, Kumasi, Ghana, 2007. ISBN #: 9988-8377-2-0

Brew-Hammond, A., Akuffo, F. O., King, R., Quansah, A., Dapaah, S. O., Amponsah, O., Eshun, D. and Antobere, A. (2011); Energy Access and Productive Uses for thr Urban Poor. Energy Sector Management Assistance Program (ESMAP), The World Bank; Final Report on the Ghana Scoping Study.

Centre for Policy Analysis (CEPA) 2002; Energy Intensity Survey of Modern Sector, 2002

Dadzie, I. K. (2012) Nuclear Energy for Ghana: A must and Urgent need for the people.

Dafrallah, T., Edjekumhene, I., Edze P., Ngom A. and Ommer V. (2010). Bioenergy for Rural Development in West Africa: The case of Ghana, Mali and Senegal. ENDA Energy, Environment, Development.

Energy Commission, Ghana, 2006; Strategic National Energy Plan 2006-2020. Annex I of IV Energy Demand Sectors of the Economy

Energy Commission , Ghana 2010. 2010 Energy (Supply and Demand) Outlook for Ghana. April 2010

Energy Commission , Ghana 2012. 2012 Energy (Supply and Demand) Outlook for Ghana. April 2012

Energy Sector Management Assistance Program (ESMAP), (2006). *Energy Sector Reform and the Pattern of the Poor: Energy Use and Supply, a Four Country Study: Botswana, Ghana, Honduras and Senegal.* ESMAP Technical Paper. 095

Ennison, I. and Dzobo, M. (n.d). Nuclear Power and Ghana's Future Electricity Generation. IAEA-CN-164-1P01.

Essah, E. A. (2011). Energy generation and consumption in Ghana. West Africa Built Environment Research (WABER) Conference, 19-21 July 2011, Accra, Ghana, pp. 391 401. Available at http://centaur.reading.ac.uk/20973.

Gabienu, F. (2012). Critical Factors in Bioenergy Implementation in Ghana. Vaasan Ammattikorkeakoulu University of Applied Sciences Kansainvälinen Energia teknologia

Ghana Statistical Service, (2008). *Ghana Living Standards Survey Report of the Fifth Round (GLSS 5),* Accra, Ghana Statistical Service.

Government of Ghana (GOG) 2004. Ghana: Energy and Poverty Reduction Strategy. EU Energy Initiative. Facilitation Workshop and Policy Dialogue Ouagadougou, Burkina Faso.

Inkoom, D.K.B. and Biney, B.S. (2010): The potential of Liquefied Petroleum Gas (LPG) as a viable energy option for the Industrial Sector in Ghana. Journal of Sustainable Development in Africa (Volume 12, No.6, 2010)

King, R. S., Amponsah, O. and Quansah, D. A. (2012). Productive Uses of Energy in Enterprises in Slums in Ghana. International Journal of Social Science Tomorrow Vol. 1 No. 5. ISSN: 2277-6168

Leach G. A. (1988). Residential Energy in the Third World. Annual Review Energy. 1988.13.47 65

Meikle, S. and Bannister, A. (2003). Energy, Poverty and Sustainable Urban Livelihoods. Working Paper No. 126 ISSN 1474-3280

Mensah, J. T. and Adu, G. (2013). An Empirical Analysis of Household Energy Choice in Ghana. Sveriges lantbruksuniversitet, Institutionen för ekonomi. Swedish University of Agricultural Sciences, Department of Economics. ISSN 1401-4068. ISRN SLU-EKON WPS-13/06-SE

Ndzibah E. (2011), Robin Hood and Donkey Principles: renewable energy proposals for Ghana; Energy End-User Efficiency (EEE) Issue; World Renewable Energy Congress 2011 Sweden, 8-13 May 2011, Linkoping, Sweden.

Nnadikwe, K. (2007): High Oil Dependence in Ghana: To what extent is Ghana vulnerable to Oil Price Shocks? University of Dundee, Scotland.

Obeng, G. Y. and Evers, H-D. (2009). Solar PV Rural Electrification and Energy-Poverty: A Review and Conceptual Framework with reference to Ghana. ZEF Working Paper Series, ISSN 1864-6638 Department of Political and Cultural Change Center for Development Research, University of Bonn.

Obeng, G. Y., Kemausuor, F., Brew-Hammond, A. and Duker, A. (2009). GIS-Based Energy Access Pproject: A Review of Trends, Policies and Plans for Increasing Energy Access in Ghana. The Energy Centree, KNUST.

Obour, S.K. (2012). "Accra Sinks under Filth". *The Mirror,* Saturday, September 15, 2012, pp.24.

Okyere, D.K (2012). *Sustainability of the Urban Transport System of Kumasi*. M.Phil Thesis Submitted to the School of Graduate Studies, Kwame Nkrumah University of Science and Technology, KNUST, Kumasi Ghana.

Oteng-Ababio, M, (2010). "Private Sector Involvement in Solid Waste Management in the Greater Accra Metropolitan Area in Ghana". *Waste Management and Research*, Vol. 28(4), pp. 322-329.

Painuly, J. P. and Fenhann, J. V. (2002). Implementation of Renewable Energy Technologies Opportunities and Barriers. UN Collaboration Centre on Energy and Environment, Riso National laboratory, Denmark. ISBN: 87-550-3013-0

Quartey, J. D. (2010). The demand for Energy and Economic Welfare in Ghana. Department of Economics, Kwame Nkrumah University of Science and Technology Kumasi, Ghana.

Schramm, G. (1990). Electric Power in developing countries: Status, Problems, Prospects. Annual Review Energy 1990. 15:307-33

Rupp, S. (2013). Ghana, China, and the Politics of Energy. African Studies Review, Volume 56, Number 1, April 2013, pp. 103-130 (Article). Cambridge University Press *DOI: 10.1353/arw.2013.0015*

UN-Habitat (2003): The Challenge of Slums; Global Report on Human Settlements 2003 (United Nations Hum a n Settlement Programme)

Vilar, (2012) "Renewable Energy in Western Africa: Situation, Experiences and Tendencies; Ecowas Centre for renewable Energy and Energy Efficiency (ECREEE)

World Bank (2004); Multilateral Investment Guarantee Agency (MIGA) Annual Report.

World Bank. 2006. Ghana country environmental analysis. Report No: 36985-GH. Available at: http://siteresources.worldbank.org/INTRANETENVIRONMENT/3635842-1175696087492/21919456/Ghana_CEA.pdf . [Accessed: 3 October 2011].

Yeboah, E. and F. Obeng-Odoom (2010). "We are not the only ones to blame': District Assemblies' perspectives on the state of planning in Ghana", *Commonwealth Journal of Local Governance*, Vol. November (7), pp. 78-98.