

Energy Efficient buildings: Policy and Practice landscapes in Ghana

Abstract

Majority of building codes in most African countries including Ghana were developed and, in some cases, a few ideas copied from developing countries without making consideration to the local context. But the concern here is that most of these codes do not mainstream energy efficient standards. This paper critically reviews the various policy instruments that are relevant to both the building and energy sectors in Ghana and presents an empirically based, qualitative insight into the types of buildings real estate developers are constructing. The data used involved a total sample size of 30 interviewees comprising of 8 policymakers, 12 Real Estate Developers and 10 homebuyers. The project revealed that majority of the developments by real estate developers in Ghana are not mainly geared towards eco-construction though a few energy efficient strategies are adopted in some instances. Existing building codes and policies have also not considered energy efficiency standards and strategies. It is expected that the findings from the study will provide further insight towards the full development of energy efficient buildings in the country by mainstreaming energy efficiency standards in Ghana's existing building codes and energy policies.

Keywords: Energy, Policy, Buildings

1. Introduction

Recently, several concerns have been raised over the usage of energy largely due to the increasing energy demands against finite energy resources (Kemauser et al. 2011). Various reasons including urbanization, increase in per-capita income, changing consumption habits, rise in the number of buildings amongst others have accounted for the increasing energy demands across the globe (Saidur 2009; Avila et al. 2017; Balabam & Puppim de Oliveira 2017). Various research that have attempted to discuss energy use and sustainability, energy efficiency, equity in energy access have examined its intersection with urbanization, per capita income, consumerism etc. However, limited research has attempted to interrogate how recent rise in buildings across developing urban areas have influenced energy efficiency (Wang et al. 2012; Zhou et al. 2013; United Nations Environment Program 2014). The International Energy Agency has estimated that the demand for electricity in developing countries had increased by 45% from 2000 to 2012 and expects the total energy demand to rise at an average of average rate of 4% a year until 2040 (IEA 2014). Similarly, Chan et al. (2009) also revealed that such rise in the development of buildings will bring with it an increase in energy consumption and its associated Green House Gases.

According to Essah (2011), the building industry is energy intensive, however, it has yet to radically embrace the idea of green technology and energy efficient systems. One major way to improve the building industry energy efficiency is the nature and structure of its building codes or regulations. Building regulations set standards for the design and construction of buildings, primarily to ensure the safety and health of people in or around those buildings, but also for energy conservation and access to and about buildings (Communities, 2010). This is because building codes or regulations in general address many of a society's most important concerns which includes public health and safety and environmental protection (Barlett et al., 2003). On the other hand, building codes also address cost efficiency and investment value since some energy standards are written in mandatory, enforceable language, making it easy for jurisdictions to incorporate the provisions of the energy standards directly into their laws or regulations.

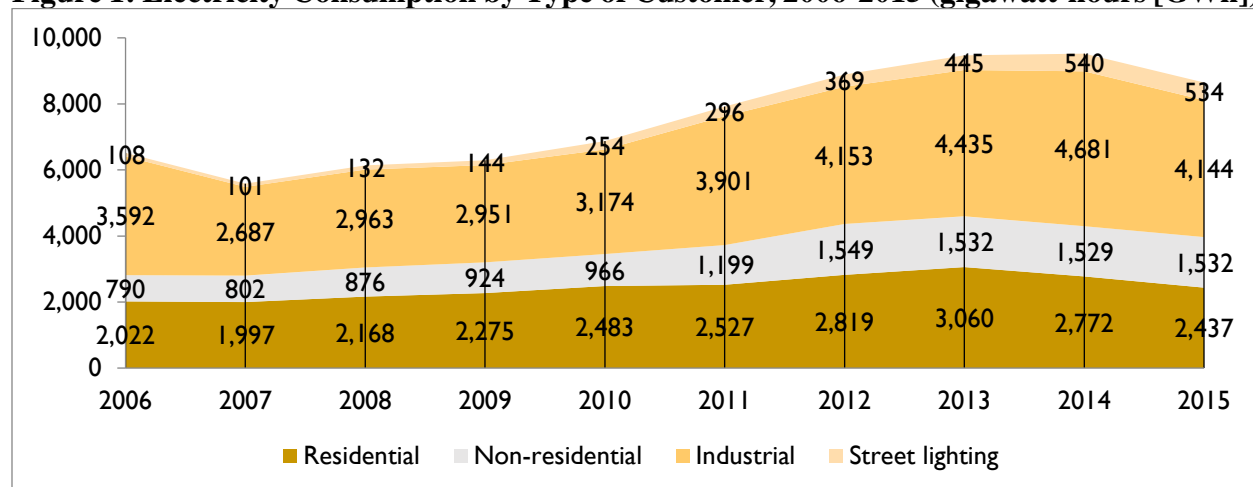
The nature and structure of building codes or regulations which influence energy demands is pre-determined by the climate of a given context. Ironically, majority of modern structures in some African countries with tropical climates are exact reproduction of building designs from European countries with cold and temperate climates. The UN-Habitat (2016) states that building codes or regulations in most African countries were developed and, in some instances copied from the European building codes with limited consideration to the local context. Majority of these building codes and regulations are prescriptive and do not have reference for energy efficiency. This makes it extremely difficult for implementing and adopting energy policy mix that can ensure energy efficient buildings in the industry in Ghana. In a rapidly developing urban building industry, to what extent are the existing energy efficient policy-mix capable of transforming the building industry into efficient energy ecology? Secondly, what are the constraints private sector operators in the building economy face to adopt energy efficient building codes? This research paper asked the above question to contribute to the literature on urban energy efficiency.

The article is divided into 5 parts. The first section introduces energy use in buildings. The second, presents the conceptual literature. It also discusses the possible constraints that deter developers from putting up energy efficient buildings in Ghana and elsewhere. Section 3 addresses the research approach while Section 4 discusses the key results and discussions. The final section presents the policy implications if energy efficient buildings is mainstreamed in existing building codes and regulations.

2.1 Ghana's Energy demand

According to the Energy Commission of Ghana, residential and industrial users account for approximately 70 percent of electricity consumption, and they experience adverse effects from the erratic power supply and price increases (figure 1). In 2014, residential consumption of electricity grew 2.4 percent, while industrial consumption grew 2.5 percent. Power outages in 2015 reduced consumption by 12 percent for residential users and 11 percent for industrial users.

Figure 1: Electricity Consumption by Type of Customer, 2006-2015 (gigawatt-hours [GWh])



Source: Based on data from Energy Commission (2016).

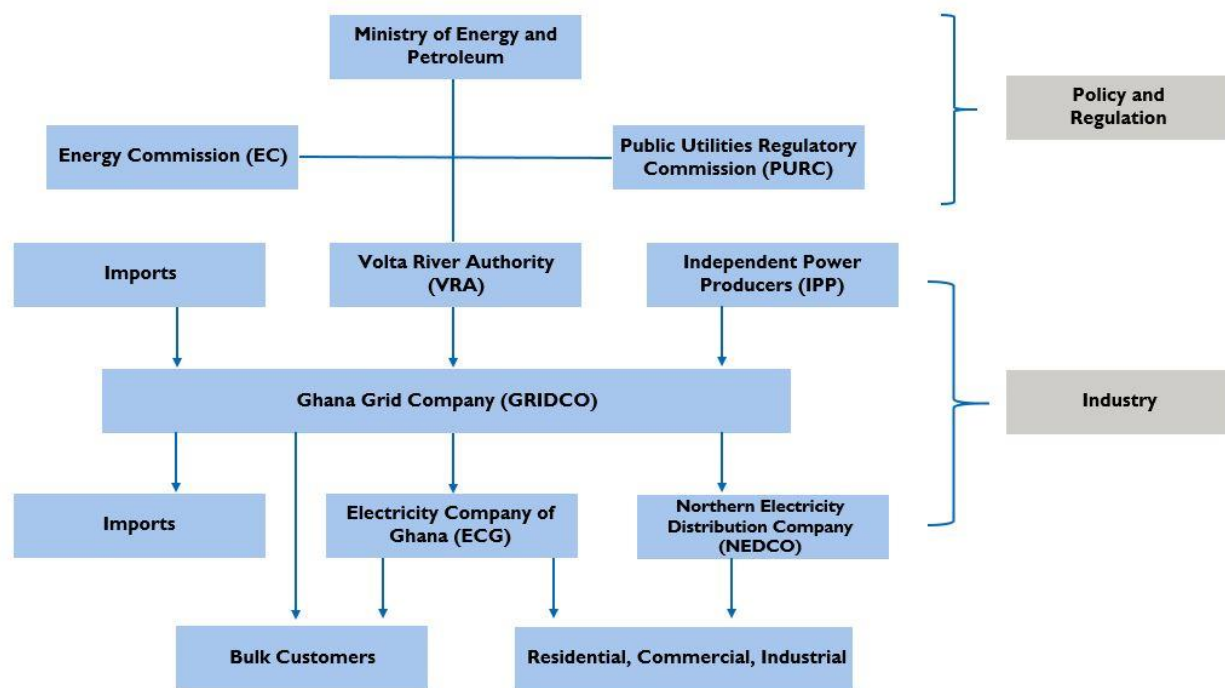
For Ghana to attain accelerated growth in the energy sector, it is critical through a mix of demand- and supply-side options to provide a cost-effective solution. Over the years, the country's energy has mainly focused on alternative renewable energy such as the efficient use of solar and wind in the national energy mix. However, to date, the share of renewables in the energy mix is below 5 % of the total energy generated. Ghana's energy policy must create and harness diversity of

resources and to reduce delivery risks in these resources. It is clear that Ghana will have to expand its energy infrastructure and diversify its installed capacity to improve supply frequency and reliability in a way that is sustainable (Eshun and Amoako-Tuffour, 2016)

2.2 Existing Policy instruments

In years past, Governments have implemented quite a number of policies and regulations to enhance energy access as well as housing provision for the population. Amongst these are the National Energy, the Renewable Energy Policy, the National Housing Policy, the National Building Regulation. The relevant policies and regulations considered to address energy efficiency in buildings are; The National Energy Policy 2010, The National Housing Policy 2015 and the National Building Regulations 1999 (LI 1630). The National Energy Policy is meant to serve as a guide in the development and management of Ghana's energy sector. It implies that, the policy has focused on removing the obstacles that have constrained the promotion and implementation of energy efficiency and conservation measures yet does not categorically promote energy efficiency in buildings. The Housing Policy ultimately seeks to provide adequate, decent and affordable housing that is accessible to satisfy the needs of all people living in Ghana and also ensure that housing is designed and built to sustainable building principles leading to the creation of green communities. It is envisaged however that this policy will forge closer partnerships among the various Government Agencies, the private sector and the local communities to ensure effective implementation since the policy's key objectives are to ensure the promotion of private sector in housing delivery and provide more of social housing. Notwithstanding that, the policy seeks to upgrade and improve existing houses and as well involve the participation of local communities in implementing such initiatives. Ghana as far as the Building Code regime is concerned is governed by the National Building Regulations L1 1630 (1996) which is derived out of The Local Government Act of 2016 Act 936 (as amended). The primary objective of the National Building Regulations (NBR) like most building Codes provides guidelines for safety, Health and Governance. Since the Ghana National Building Code has focused mainly on the occupational health, safety and convenience of people and communities with no emphasis on energy efficiency, the regulation needs to allow for innovative approaches to achieving the effective use of energy in designing, construction and maintenance of buildings.

Figure 1. Stakeholders in the Energy Sector



Source: Energy Commission

Figure 2: Stakeholders in the housing sector

Traditional	Public/ Regulators	Private/industry
Artisans	Metropolitan, Municipal and District Assemblies	Universal banks
Chiefs	Ministry of works and Housing	Ghana Real Estate Developers Association
Clan Heads	State Housing Company	
Family Heads	Ministry of Local Government	Building/Architectural Firms/consultancies
Individual Households	Environmental Protection Agency	Mortgage Companies
Land or housing Agents	National Development Planning Commission	GHACEM
Queen mothers	Town and Country Planning Department	Steel/ Roof/appliance companies

Source: Population and Housing census (2010)

2.3. Constraints to energy efficient buildings development

Whiles various policies on Building Energy Efficiency have been introduced and extensively implemented globally, the practices of these have faced quite several challenges in some countries. Researchers have largely discussed social constraints to political, economic and technological (Nelson et al., 2010; UNEP. 2006; Wang et al., 2008). In developing countries, it however becomes

difficult to detect energy efficiency constraints independently from the characteristics of the country.

2.3.1. Government controls

Nelson et al., (2010) believe that Government is a dominant force in the transition towards energy efficient buildings since their main function is to help overcome market barriers caused by the controversies between the costs faced in producing such buildings. Deringer et al., (2004) in a study outlined why policy instruments do not meet expectations as planned. They argued that governments in developing countries, due to issues of corruption and low policy enforcement have virtually no interest in the development of sustainable buildings. Andaloro et al., (2010) also assert that in most parts of the world, governments are often preoccupied with short term concerns rather than long term projects and moreover, the energy efficient buildings implementation is a long process and requires the involvement of several regulatory institutions.

2.3.2. Financial constraints

In most developing countries according to Carbon Trust (2005), the most common limitation is the issue of cost. They acknowledged the fact that energy efficient buildings require high initial capital for procuring more energy efficient equipment. Irrespective of the sector, barriers to energy efficient buildings are derived from the apparent contrast between the possibilities of reduction in the energy consumption and the real investments allocated by the concerned parties. A study conducted by the Rexel Foundation and Opinion Way (2013) in USA, UK, France and Germany showed that about 63% of residents had expressed that cost coupled with other financial considerations are deterring them to the adoption of energy efficiency strategies and practices in the industry. Similarly, Iwaro and Mwashia (2010) contend that high cost of equipment coupled with limited access to investments products and services can be described as other forms of financial barriers to the development of energy efficient buildings. Notwithstanding these, Chai and Leo (2012) state cost of maintenance in energy efficient buildings generate high costs especially in developing countries.

2.4.3. Social constraints

Social parameters for instance, behaviors and cultural dynamics limit the trend of development as far as energy efficient buildings are concerned (Wang et al., 2008). Often times according to Chan et al., (2009) actions that contribute significantly to reducing energy consumption in buildings are ignored by consumers. Li and Shui (2015) however posit that developers and individuals mostly ignore energy efficient practices and technologies which is sometimes caused by the difficulty of changing behavioral lifestyles. Smith et al., (2010) mention that financial barriers are the most significant yet there is the need to drive away social network effects and other forms of traditional barriers.

3.0. Research Approach

This paper is based on a qualitative research approach. The primary data was derived from an in-depth interview with Policy Makers, Real Estate Developers and home-buyers. The principal interviewees were 2 Policymakers each from the above listed Institutions. Further, the development trends were derived from Real Estate developers as case studies. These Real Estate companies included UT Properties, Devtraco, National Trust Holding Company (NTHC), Greenpath, Clifton Homes and Regimanuel Grey Limited. The interviewees were purposively

sampld considering their roles in their respective organizations. Homebuyers of these estate companies were also sampled to know their choice of buildings and the extent to which they considered energy efficient buildings before buying.

The secondary data is also gathered from policy documents and reports from the Energy Commission, Ministry of Energy, The Local Government and the Ministry of Works and Housing as well as other relevant literature. Identified policy instruments were analyzed qualitatively. This was to backup findings derived from expert judgements. The development trends for energy efficient buildings was also analyzed based on the interviews from the case studies. The interview findings were transcribed and categorized for analysis. Themes were identified and collated. Some narratives from the interviewees are used to support the discussion and arguments.

The tables below show the sample size and the study areas.

Table 2: Policy Mechanisms and Institutions

	Institutions	Policy Mechanisms	Respondents (Departments)
3.	Energy Commission	National Energy Policy	Energy Efficiency Unit
4.	Local Government (La Nkwantanang Madina Municipal Assembly)	National Building Regulations or code	Town and Country Planning Department
2.	Ministry of Energy	National Energy Policy	Renewable Energy Department
1.	Ministry of Works and Housing	Housing Policy	Housing Department

Table 3: Selected Real Estate Developers

	Real Estate Company	Respondents (Departments)
1.	Devtraco	Facility Management Department
2.	Greenpath Estates	Facility Management Department
3.	NTHC	Estate Agency Unit
4.	Regimanuel Gray Ltd.	Development Office
5.	UT Properties	Facility Management Department

4.0 Results and Discussions

4.1. The Policy and Practice Congruence

4.1.1 Institutional and Policy frameworks

Various institutional frameworks within the public services ranging from the Ministry of Energy, Energy Commission, Ministry of Works and Housing, Town and country Planning Department have all proven effective in creating the enabling conditions for scaling-up of energy efficiency one way or the other in buildings.

Whiles the mission of the Ghanaian Ministry of Energy is to develop and ensure a reliable supply of high quality energy services at minimum cost to all sectors of the economy through the formulation, implementation, monitoring and evaluation of policies, the Energy Commission on the other hand, advises the Government on energy policies and other strategies that are proposed

by the Ministry of Energy. The Commission gets involved in the planning of all other energy systems as well as permitting operators in the sector. These activities by the Commission go a long way to educate citizens on updates on national plans to ensure that all reasonable demands for energy are met in a sustainable manner.

Finding from the study showed also that, the Government of Ghana through the Ministry of Energy intends to encourage competition within the energy market in order to achieve efficiency and also attract energy services provision by providing appropriate incentives while ensuring its supply and reliability. The success of mainstreaming energy efficient buildings in Ghana's building regulations effectively control the building industry to a greater extent if the relevant stakeholders involved advocate for structures that are environmentally responsible and resource-efficient throughout the building's life cycle i.e. from site definition to design, construction, operation, maintenance, renovation, and demolition. This requires close cooperation among the design team, the architects, the engineers, and the client at all project.

The Energy Commission which is currently playing a facilitating role as far as review of the existing building codes or regulations are concerned would ensure that existing buildings are retrofitted in order to meet the proposed requirements on energy efficiency since this would promote efficiency in buildings and also save energy. Other stakeholders from the various institutions such as the Town and Country Planning do not only develop a comprehensive risk list and recognize the causes of risks, but also contribute to effective decision-making and efficient communication in green building project management as well. As a result, developers and other contractors in the building industry are educated and advised to do away with glass houses, install energy efficient household appliances, use LED lighting systems and have standards for building designs since they save energy. The Ministry of Works and Housing, also a government institution responsible for the formulation and coordination of housing policies and programs coordinates and supervises the activities of both public and private developer responsible for shelter and other infrastructural projects, it is expected that they support the provision of sustainable, decent and affordable housing units. Planning Officers within the Town and Country Department are also expected to vet building designs and drawings before permitting since this will duly reduce buildings or structures that are not environmentally friendly.

Energy efficiency standards in building codes or regulations for new buildings are therefore among the most important single measures for buildings' energy efficiency. This is the case in times of high construction activity or in a fast-developing country like Ghana. The importance of energy efficiency standards in building codes go beyond new buildings. Often, the regulation serves as the efficiency target for refurbishment or other improvements of existing buildings.

With increased interest for efficiency in buildings, building codes or regulations are meant to spur the demand for refurbishment or general improvements of existing buildings.

4.1.2 Development Trends and Homebuyer's Choice of housing

Since the building sector has a major impact on the economic and social aspects of human activities but also on the natural and built environment, projects are often a key factor in sustainable development. Nevertheless, construction projects impact upon the environment in a number of ways, notably the change in land use, the consumption of materials and fuel, the production of waste, as well as noise, air emissions and health impacts.

Developers have established that the major part of the energy consumption in buildings which includes energy used for controlling the climate in buildings and for the buildings themselves, but also energy used for appliances, lighting and other installed equipment.

The above listed Real Estate Developers are mostly considered as successful models of estate developers in Accra and during the study, it was found that no policy statement on energy efficient buildings for these companies ever existed. However, it was found that majority of the interviewees had fair knowledge on the importance of constructing energy efficient buildings and gave specific projects and programs undertaken voluntarily.

Interviewees from the respective divisions seek to provide electricity to the constructed estates by linking various houses to the national electricity grid for power supply.

One of the facility managers interviewed mentioned that, in order to ensure adequate electricity supply, there had been installations of step up electricity transformers to help in transportation of power to the low voltage distribution lines within the estates. Some other real estate developers opined that occupants are encouraged to install solar panels on their rooftops if only they can afford it. It was also discovered that developers who directly engaged in the maintenance of the estate houses took into consideration the installation of energy efficient appliances since the cost of utility bills are on the increase. The facility manager stated,

‘We have realized it saves cost and saves the company a lot of money’

From the interviews conducted, it was also unearthed that some estate developers had realized old Air- Conditioners were consuming greater amount of electricity and as a result led to high cost of electricity bills. Such practices had resorted the developers to replacing such fixtures with energy efficient ACs in order to reduce electricity cost. In a similar manner also, sensor lighting systems had been installed in some estate houses since it saves energy also. Other energy efficient strategies adopted by developers included the use of energy efficient light bulbs and other technologies adopted from Asian countries where such practices are common.

On the other hand also, the homebuyers and renters of estate houses provided by these developers will often compare the new and existing structures did not have preference for energy efficient technologies. From the interviews conducted, it was discovered that majority of the interviewees had fair knowledge on the importance of energy efficient buildings and went further to state some benefits; saves cost since by using energy saving bulbs and other appliances.

The few checked for energy efficiency in buildings before they purchase from developers because of the high cost of utility bills associated with the normal buildings. One indicated,

‘I have been to several housing fairs where I have had the opportunity to see energy efficient buildings in the screens by some developers’

Another also stated that

‘I wish the buildings have well-positioned windows and doors since these are essential in reducing energy consumption’

It was also found out that some developers who are not involved in the maintenance of the estates were not concerned about energy efficiency unlike those that are directly involved in. Once the developer handles the maintenance of the buildings, energy efficiency measures are put in place, one mentioned. Another revealing story was the fact that majority of the homebuyers are sometimes not the occupants of these buildings, so they hardly considered energy efficiency standards before buying. This was since the occupants will incur future costs of electricity bills and not the homebuyer.

Residential demand for energy although had a smaller percentage of the total consumption rate, it is rising steadily since there is an increase in grid-connections through the penetration of appliances. In higher income Ghanaian households, lots of energy is wasted because majority of households utilize more energy than expected. From the study, it was established that it is so because old and inefficient appliances and other equipment are mainly used, and this eventually

leads to wastage of energy in buildings. Aside that, intensive use of incandescent light bulbs is primarily dominant in most of these buildings. Some officers interviewed also attributed that to the high cost of LED bulbs or energy saving bulbs. Another mentioned that occupants on a usually have cultivated the habit of switching on both indoor and outdoor lighting systems throughout the day even in their absence. Another major concern raised was the act of industrial activities in households. It was also established that some occupants of such estate houses engaged in small enterprises in their homes and as result consume so much energy. This kind of practice becomes unhealthy according to one of the developers because most of the appliances used are not energy efficient. Non-functional meters, simultaneous usage of appliances and inefficient heating systems in some homes also contributed to massive energy consumption in buildings.

Promoting energy efficient buildings is primarily to mainstream strategies and measures into existing housing policies, building codes and other related policy mechanisms. Review of the building codes in Nigeria and some other West African countries showed how they integrated energy and resources efficiency measures in their already existing policies (Oyedepo, 2012). As a way of responding to the increasing demand for energy use in structures, basically, stakeholders which includes policymakers need to take into consideration various policies and strategies that aims to minimize energy usage in buildings and thereby mitigate the adverse impacts of climate change (Hui, 2009). Although the real estate industry in Ghana is less interested in energy efficient buildings, participatory planning is not a practice right from the project inception through to its maintenance. Over the years, the country's energy has mainly focused on alternative renewable energy such as the efficient use of solar and wind in the national energy mix. However, to date, the share of renewables in the energy mix is below 5 % of the total energy generated. Ghana's energy policy must therefore create and harness a diversity of resources and to reduce delivery risks in these resources. Ghana will have to expand its energy infrastructure and diversify its installed capacity to improve supply frequency and reliability in a way that is sustainable. Presently, a national energy policy is being implemented to provide a concise outline of government's policy directions, challenges, and actions in order to facilitate the effective management and development of the sector, and to provide the public with information about the government's policy goals. The policy addresses the poor quality and unreliable supply of electricity and the poor financial performance of the utility companies and helps them raise the finance needed for infrastructure. Moreover, the availability and ability to access building professionals is crucial since it is a procedure for the development of policy mechanism. This statement is reinforced by Bagheri et al. (2013). In their research, they focused on energy professionals to do the evaluation. As well, Yang et al. (2010) utilized professionals in building energy to conclude their research.

Even though, the main energy efficient programs undertaken by the Energy Commission have concentrated on household appliances (ACs and Refrigeration) being used and standards for lighting systems. This is because this practice tend to reduce the demand of energy in buildings and save cost on the long run. With households that complied with the above-mentioned standards duly qualified to benefit from a project implemented by the Commission named, 'the free solar PV panels for residential facilities/ homes under the national rooftop solar program'. This particular program is run by the Energy Commission and the Government of Ghana. For a household to qualify, they needed to change all lamps in the house to LED lamps, use only solar PV installers licensed by the Energy Commission for all the installation works and also be willing to purchase the Balance of System components such as inverter, batteries and charge controllers.

4.2. Constraints that hinder the development of energy efficient buildings in Ghana

The critical challenge in Ghana's housing sector is the disconnection between public policy and the stakeholders involved in the delivery of housing. This is because public policies and regulations on housing do not consider the capacities and needs of households and informal institutions. The study found that to be a major constraint to achieving energy efficient buildings in the country. Although various policies targeting at buildings and the energy sector in general have been promulgated by the Ghanaian government in the past, after analyzing the existing policies, it was realized that the National Energy Policy contributes greatly to the generation of Power towards national development yet it inhibits the construction of energy efficient buildings; there is no policy statement on energy efficient buildings. For instance, the only energy efficient project with respect to buildings undertaken by the Ministry of Energy is the 'Energy Efficiency for households and Small Medium Enterprises' (SMEs). This project was piloted in selected suburbs of Accra namely; Madina, Adenta and East Legon). It was revealed that this project involved the distribution of timer-switches to households and SMEs that consistently used freezers throughout the day. The interviewee also mentioned that the Ministry does not give tax incentives to developers who voluntarily adopted energy efficiency standards in their construction. Deringer et al., (2004) then argues that in developing countries where building codes or frameworks are not implemented, they are often only documented due to insufficient implementation programs and enforcement exercises. Having discovered some constraints that deter developers from adopting energy efficiency measures in their buildings, it can be established that policies are important in the development of energy efficient buildings and for many Governments energy efficiency is often a first measure in minimizing energy intensity.

Building codes and regulations according to Communities (2010) may play a vital role since it sets the minimum standards for green designs and construction. Going further, such codes should outline requirements for new developments and renovations or retrofitting. The essence of energy efficient policies in this era of climate change can be viewed as a practical means of mitigating climate change in order to reduce carbon dioxide emissions hence, energy efficient buildings therefore become a highly recognized government policy. However, evidence from the field suggested that the situation in Ghana may remain for a longer time to come if critical policy interventions are not put in place to reverse the trends of development in the building sector since developers are not quite interested in the construction of such buildings for their buyers.

In arguing for an effective energy policy, Clift (2007) suggested that greater efforts should be initially contributed to a reduction in energy demand and an enhancement in energy efficiency improvements in buildings. After analyzing the responses, improving energy efficiency in buildings is important for protecting competitiveness, energy security and other environmental and social benefits. Promotion of renewable energy sources is also of essence here but the relevant government agencies in the building sector should mainstream this best practice in their dealings with housing and real estate developers.

Not only that, but lack of information and experience among some building professionals is also another barrier since such individuals lacked knowledge and skills in the area of energy efficient buildings. Results from the interviews indicated that, few were not aware of some of the country's emerging policies and even existing ones. Even though some of the interviewees agreed to the above assertion, others also opined that ignorance on the part of the management to adopt such practices is another challenge facing in the industry. One of them stated that, lack of expertise and funds have made it practically impossible for the ministry to discharge strategies effectively. This

however means, Professionals are not usually engaged right from the project designs through the maintenance. Overall, these barriers reduce the effectiveness of existing policies and slow the introduction of new initiatives aimed at strengthening the existing policies.

That notwithstanding, the government agencies that are supposed to assist the developers tend to be too bureaucratic in their activities. For instance, before an estate could be developed, a housing provider must visit government agencies such as Lands Commission, Lands Valuation Board, District Assembly, Survey Department, Town and Country Planning Department, Environmental Protection Agency etc. for documentation. The bureaucratic nature of these agencies discourages many potential developers. One of the interviewees mentioned that because the cost involved at every stage of the permitting process is expensive and there are no incentives attached for compliance, they end up building structures that are expensive yet not sustainable.

It was also established that presently the high cost of constructing energy efficient buildings deters developers from putting up such structures as well as the government in its bid to protect and safeguard the citizens' interest in the housing market tends to put a lot of controls yet none is made for energy efficient buildings in the country. Shen et al., (2016) opine that various technologies are needed to aid in the construction of such buildings in a cost-effective manner. In order to meet the energy needs of buyers, policy mechanisms which is geared towards energy efficiency should however be pursued by the relevant government and other stakeholders as a way of reducing the energy consumption.

Table 4. Summary of constraints

Policy enforcement and implementation	Financial Controls	Stakeholder consultations
Weak monitoring and enforcement of government policies]	High initial cost of energy efficient buildings	Lack of information and experience among professionals
Local government fails to create practical regulations to support energy efficiency improvements	No incentives from government	Lack of innovation, inadequate sensitization
Overlapping responsibilities of government Agencies and institutions		Permitting/licensing

5.0 Conclusion and policy implications

Households consume majority of electricity generated, the implication is that, the industrial and service sectors that are supposed to be energy intensive through the use of advanced technologies and the major drivers of economic growth are to develop their full capacity to be able to drive the expected growth in the country. Electricity supply becomes the power form of choice for use in homes due to its convenience compared to other forms of energy and since the residential sector accounts for more than 40 % of total energy consumed in the country, it becomes fundamental to the growth of every society. Buildings can be one of the most cost-effective and expedient opportunities for GHG mitigation, since proven and often inexpensive technology can deliver significant gains in energy efficiency, with considerable co-benefits. The findings of the study provide useful information for policymakers as well as practitioners in the building industry. The

study is therefore needful and timely as Ghana seeks to meet the energy demand especially through mainstreaming energy efficiency in buildings. Also, as a response to the rapid urbanization taken place mainly in Ghana and some parts of Africa, and to the limited access to energy coupled with the aim of addressing the Sustainable Development Goal 7 and climate change.

In responding to the challenges, there should be a review of the existing building code and relevant policies which will allow Ghana to reduce their energy demand in buildings. Eventually, this will in turn reduce their carbon footprint as such buildings contribute significantly to the greenhouse gases emission. As a way of ensuring that, building permit requirements from the local government shall include environmental design strategies. Further, as a response to the increasing trend of energy use in residential buildings, policymakers need to deploy economic incentives to motivate homebuyers as well as occupants. It is worth noting that energy cannot be stored in very large quantities, its transmission and distribution losses are inevitable, electrification system is highly capital intensive, and the capacity of generation plants have their carrying capacities. These characteristics of the system imply that measures and initiatives on energy efficient buildings are inadequate in addressing the current gap hence, mainstreaming energy efficient buildings in existing policies and building codes becomes paramount. Energy saving can often be obtained at lower costs when other construction take place; in some cases, additional improvements require only small or no additional funding if the basic construction requires work or equipment is replaced, in other cases it can save construction costs, scaffolding etc. Requirements for energy efficiency by refurbishment are therefore an important issue which should be included in building codes.

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