“Role of energy efficiency on sustainable development”

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Role of energy efficiency on sustainable development

Abstract

Most energy policies principal objective is energy efficiency hence energy consumption is a cornerstone for sustainable growth and advancement. The main purpose of this current paper involves determining the role of energy efficiency on sustainable development. Thus, the paper adopts a conceptual approach by using current literature on energy efficiency in evaluating its purpose in sustainable growth. The paper finds that energy efficiency plays multiple roles towards sustainable economic development. For that reason, it contributes to carbon reduction which results in minimized climate change. It also results in employment creation thereby reducing poverty which enhances sustainable livelihoods. The paper also introduces an additional approach that support energy efficiency termed "energy efficient strategy for urban residential setting sustainability" which further enhances sustainable growth.

Keywords: energy efficiency, sustainable development, carbon reduction, climate change, adaptation and mitigation, employment and poverty reduction.
JEL Classification: M14, Q01, Q42, Q54, Q56, Q57.

Introduction

Governments together with institutions are confronted with expanded pressure to improve on energy consumption, which has been regarded as a major component in sustainable development. Energy efficiency has specifically been linked to bringing down energy resource reductions along with decreasing amount of carbon emissions. If carbon offset strategies are implemented then impacts on climate change will be mitigated. Confirming this idea (Houghton et al., 1996), states energy associated carbon emission practices have the most influence on climate change. Thus it can be recognized that energy efficiency presents the most commanding along with cost effective method which address challenges on sustainable economic growth. It also works to reduce use of non-renewable sources of energy as well as alleviating energy poverty. Thus betterment on energy consumption should be the most prominent goal in erected energy frameworks and courses of action. Such being the case, this paper examines the role of energy efficiency on sustainable development.

1. Problem

Anthropogenic activities such as overexploitation of fossil fuels, fragile energy goals and frameworks along with continued use of incompetent technologies have led to increase in carbon emissions. Such practices do not support benefits associated with sustainable development. In line with this view, (Hsueh and Yan, 2011) reports that economic growth can be made more sustainable by introducing systems which drive carbon levels to zero benchmarks, implementing energy efficient practices which results in large energy savings as well as attainment of properly conditioned energy networks. Thus households, organizations and countries must embark on utilizing energy efficient activities in their everyday operative exercises so as to achieve significant zero carbon targets. Unsustainable human energy practices have led to environments being destroyed, together with increased incidence of pollution. Such practices allow carbon emissions to cause climate change which eventually results in global warming. Thus global warming is associated with creation and expansion of deserts, increased occurrence of droughts which cause acute food deficiencies as well as multiplication of diseases. Extended global pressure calling for total engagement of women in energy related matters have also been raised.

On that account (Karlsson and Oparaocha, 2003) hints that in year 2000, the UN Commission on Sustainable Development (CSD-9) congress in New York saw the ENERGIA organization and its associates making presentations on increased involvement of women in top management positions on energy issues and also advocated for the safe well-being of women and minors within sustainable rural energy projects. The same institution also supported the idea to provide solutions to energy involved problems women encounter in remote areas as well as how to promote women organization's which work towards sustainable energy advancement and growth strategies at community level.

Therefore the major question in this research is: How does energy efficiency contribute to sustainable development? Thus the paper aims to determine the role of energy efficiency on sustainable development.

This paper is arranged as follows. The next section examines energy efficiency. This part is followed by an analysis on sustainable development. Evaluations on energy efficiency and sustainable development focusing on carbon reduction, climate change along

with employment and energy poverty reduction then follow. An additional strategy on energy efficient strategy for urban residential setting sustainability is also presented. A comprehensive conclusion on the paper is also outlined.

2. Energy efficiency

Global concern on continued exploitation of non-renewable resources, use of inefficient technology in the production process, employment of weak structures and policies in energy consumption has been raised if an ideally sustainable future is imperative. Thus energy efficiency refer to different policies, technologies and strategies that are aimed at solving issues related to energy use whether at residential, commercial, industrial and national capacities so as to minimize emission of greenhouse gases which cause global warming together with reducing financial costs. Consequently, this practice on energy efficiency must be applicable in every sector of the economy and ultimately at national level.

Therefore, as a result of clear cut absence of monitoring and control mechanisms involving energy efficient practices in governmental institutions, authors (Dai et al., 2009) explain that a properly constructed system must be adopted by all responsible governments to regulate and address this looming crisis. This introduces the need for national decision makers to develop frameworks that account energy consumption for overall economic development of the country. Naturally, trends in choosing energy tools and policies in Canada, the United States, Switzerland, Sweden and Denmark reveal that the instrument selected had strong bearing on ruling government values and beliefs, present regulative frameworks, past experiences in successful implementation of such instruments as well as general populace support (Varone and Aebischer, 2001). Therefore, whatever instrument that have been identified to account energy efficiency for any country, the resultant energy use indicators are of great importance since they are the one that denotes how a nation achieves sustainable energy development over prescribed years. The presence of many irregularities in policy and strategy of selected energy consumption instruments can work to the detriment of that country.

An example in Europe was given by Eyre (1998) who supports this argument by asserting that liberalization of markets in the UK that deal with energy, has negative effects on future of energy efficiency. The impacts of such an action includes price decreases that lower incentive inducements, abandonment of regulative practices along with suppliers being given the opportunity to sell energy units in bundles, which have negative consequences on a lasting energy usage scheme (Eyre, 1998). It can be seen that freeing energy markets from government regulation through instituting supply and demand forces on the market cannot achieve sustainable energy economic emancipation as profit oriented behaviors, most of which are uneconomical and unsustainable have been promoted. Some authors have supported the idea that overall integrative energy policies at national level are capable of bringing considerable benefits to customers and the government.

As observed in India, energy efficiency projects results in improved customer gains from energy savings plus public service corporation's incentive systems are able to reduce risks of unprofitable long run gains (Abhyankar and Phadke, 2012). Energy consumption frameworks at national capacity also identify sectors that are inefficient along with outlining potential threats and challenges that can be encountered in their implementation which allow governments to adapt suitably viable sustainable energy policies and tools. Sebitosi (2008) elaborates this point by saying that in South Africa, documented proposal to achieve energy savings of 12% by 2015 was deeply affected by energy crisis deficiency of 10% experienced in 2008 which required the nation to institute measures such as complete change in behavior and use of electricity by everyone, adoption of solar and other renewable sources of energy, applying energy saving methods as well as increased use of low carbon appliances. Whiles energy consumption at national level is significant for overall economic advancement of a country, the residential sector's energy usage as a sub-component of the entire system need to be examined.

To that end Turiel (1997) comments that energy efficiency monitoring and performance standards in households have gained worldwide recognition from international interest groups to governmental legislative obligations in countries such as the US, China, Mexico, Canada, Philippines and Korea. Thus, it is vital for national energy efficiency standards to be supported but is also very important to supervise energy efficiency in residential sectors since they contribute to national energy consumption totals. Therefore methods, tools and operations that monitor energy use in residential areas of any country must be supported. Bird and Hernández (2012) explain that in the US, poor households use a lot of energy when compared to other occupants hence a well-planned adopted approach which integrates on-bill financing whereby landlords make long run investment practices on their properties to improve energy consumption standings is desirable. These activities propel landlords to realize high value

gains from such investment exercises. Consequently, when applied in residential areas, energy behavior techniques in form of energy use reduction and consumption strategies along with energy modelling systems signify opportunistic ways to achieve energy efficiency (Lopes et al., 2012). Energy consumption techniques have also led to various economic benefits, reduction in fuel hardships and improved health status.

Such being the case, economic gains which include improved health statuses, comfort advantages, low carbon levels as well as greater energy savings in Irish households are a result of implementing cost benefit evaluations on energy use (Clinch and Healy, 2000). As for good health levels, research conducted in Ireland demonstrates economic betterment in thermal well-being of households post-retrofit to be 10% of the full projects benefits when valued economically using computer models (Clinch and Healy, 2003). This implies advantageous private and external gain from such activities. Improved thermal health statuses of modern buildings also require developing old infrastructural buildings with advanced energy structures which optimally make use of expended energy. To support this idea Morrissey and Horne (2011) note that in Australia's households, thermal well-being is very low plus the countries energy achievement criterions reveal poor yardsticks when compared with other nations so comprehensive ways involving upgrading existing energy systems is desirable. The initiative to improve energy structures in residential sectors have also been observed in Lithuania, as Kazakevičius et al. (2002) utter that the Energy Efficiency Housing Pilot Project (EEHPP) was specifically designed for all buildings in private, public sectors plus residential areas in efforts to reduce energy consumption and its adoption contributes to 50% in energy savings. Thus improving energy consumption in Heating, Ventilation and Air Conditioning (HVAC) mechanisms in buildings show a "subsystem initiative" supported by producing energy savings and also ameliorated energy regulations that entails doing away with HVAC service schemes that are highly linked to cooling plus heating standards (Pérez-Lombard et al., 2012). Whilst high regard has been recognized on residential areas energy use; the industrial sector is also very important since this section accounts for most energy consumption scales for any country primarily owing to the presence of large energy intensive operations associated with heavy industries.

Under these circumstances, the United States industrial sector expend 37% of energy reserves in the country and the behavior can rise if current practices are allowed to continue. Hence, an integrated system which considers various distinguishing attributes of the industrial sector from management, engineering mechanisms and industrial subdivisions is desirable to realize energy efficiency (Price and Worrell, 2001). Further condemning industrial systems as main attributors to abnormal energy use (Eichhammer et al., 2011) emphasize that the existing bottom-up framework for industrial energy needs used worldwide, present constraints to use energy efficient systems because of differences in markets, organizations consent to incur additional expenses besides involved costs in appraisals together with huge dissimilarities in technology being used in industries. Thus, it is essential to include top-down structures which involve summing up energy use of various parts of the economy by applying yardsticks on energy intensities together with identifying specific energy consumptions. Such practices establish energy efficiency patterns as well as track down particular areas that require improvements. And also, more government involvement and supervision of industrial energy needs is vital, rather than allow independent estimates to measure industrial energy consumption. Placing the importance of more stakeholder participation in accounting energy efficiency, Backlund et al. (2012) note that beneficial savings in energy can be recognized through using efficient systems, unceasingly revised and supervised energy operations along with enforced regulations adopted from linked partners rather than undertaking continued practices which seek to close the energy efficiency gap.

2.1. Sustainable development. The subject of sustainable development has been hard to interpret because of many unclear meanings and explanations it has blanketed. A historical and abstract examination emphasizing on symbolic, presuppositions and foundations of these definitions could produce solid information on this issue (Mebratu, 1998). Thus in 1987 the Brundtland Commission report unveiled it as development that meets currents needs of the present generation without depriving the needs of future generations to cater for their own needs. This shows that accountability by governments, institutions as well as individuals on how they manage their natural resources is important so that over exploitation and extinction of these resources cannot take place.

Necessarily, Strong (1999) further defines it as an established, high powered and co-operative venture done by different institutions in formulating critical tools and scientific principles which predicts the future of this complex world together with restoring natural environments. This concept highlights the need to exercise control in handling available re-

sources by introducing particular measures and monitoring patterns in resource use as well as introducing quality standards that aim to continually improve use of renewable resources. Hannoura et al. (2006) further gave weight to this approach by stating that an idealized sustainable development structure comprise of quantifiers that propel resource growth, measure trends in resource advancement and locate exercises which supervise water quality. It also investigates availability of measures that evaluate environmental impacts as well as establishing a management and analysis model. For this reason, optimal use and sustainable exploitation of natural capital must be supported in ways which do not harm the environment in addition to satisfying stakeholder concerns. Though considerable worldwide progress has been made in order to inform all stakeholders on the importance of sustainability, observed surveys still show weak structures and passive resistance in practice.

As matters stand, Harding (2006) argues that the objectives of sustainable development have received spotlight attention by many stakeholders but the issue on practice has remained a struggle and a weighed down contentious subject. Thus most organizations along with some governments have not prioritised this subject as a top agenda in their main policy and strategic plans, so the initiative has been done on a very small scale. Ultimately, the blame is mostly laid on reluctant behavior of institutions top management teams as well as nations decision makers. On that account, Málovics et al. (2008) explain that sustainability practices of many organizations are still heavily embedded in their internal structures which is also done at a local scale with little or no progress in external focus. Therefore, appreciating together with widening the scope of sustainable development spearheaded by institution heads is of great importance. For this reason, sustainable development is imperative when widespread agreement on the advancement of a complete socio-environmental fabrication and the individuals attached to it has been recognized (Graaf et al., 1996). The aspect of sustainability also revolves around a system which does not favor short term goals but a framework which consider long term impacts of organizational operations. Top managers and governments must be prepared to forgo immediate gains by devising plans which benefit their institutions future position.

Thus, Newman (2006) unfolds that long run impact of sustainable development is admissible in its ability to continually develop and progress, focusing on lasting goal powered methodologies rather than short term operated objectives. In everyday life of many businesses, short-term goals are usually profit oriented hence are given first preference than long term targets. If organizations along with other stakeholders can do away with short-term financial benefits then sustainable development is promoted. On that account Drummond and Marsden (1995) demonstrates that sustainable development is a continuous process that is highly unpredictable and rigorous hence regulation models in capitalist endeavours which include environmental and social measures must be introduced to administer viability of their motives at any point in time.

3. Energy efficiency and sustainable development

A critical analysis on these major concepts of energy efficiency on sustainable development can be viewed in light of carbon reduction, climate change, adaptation and mitigation as well as employment and poverty reduction.

3.1. Carbon reduction. Global statistics prove that 1.4 billion people of the world's population do not have electricity and the majority are in rural areas of Sub-Saharan Africa. Hence, whiles adopted approaches are on course to meet such challenges, measures that will effect adequate transformation systems and build clear management networks using current energy appliances must be established to control energy use (Kaygusuz, 2012). In this case, many people who have poor access to viable energy sources exploit available non-renewable sources of energy without care and even if programmes are integrated to alleviate such challenges, hurried projects and unsustainable distribution networks lead to further increase in greenhouse gas emissions. Thus, it is vital for countries and other stakeholders to consider negative environmental impacts caused through employing energy sources whether non-exhaustible or exhaustible. Using a suitable example in Sub-Saharan Africa which is Burkina Faso Tatsidjodoung et al. (2012) implicate unpredictable oil prices and associated environmental damage as a national threat, so the country now prefers setting up biofuel projects at national capacity. These biofuel practices minimize greenhouse gas emissions, create energy self-sufficiency as well as offer new job opportunities to local people (Tatsidjodoung et al., 2012). Clean Development Mechanism (CDM) practices have been linked to assisting both third world and economically advanced nations to attain sustainable growth and minimize carbon emissions.

Accordingly, Olsen and Fenhann (2008) express that Clean Developing Mechanisms (CDM) are frameworks designed to answer global warming issues since they aim to minimize carbon emissions

to acceptable levels at very low costs. In that way, CDMs support sustainable growth of the whole economy though they fully function when they are classified in ordered groups for accurate assessment purposes (Olsen and Fenhann, 2008). Supporting the idea to meet CDM demands by grouping them in their respective classes so as to realize true results (Karakosta et al., 2009) elaborates further by noting that assessments completed on Kenya, Chile, Thailand, Israel and China shows that Clean Development Mechanisms (CDM) practices on sustainable energy emancipation should focus on specific electric generation schemes that are currently in operation rather than categorising these CDM initiatives overally at national capacity. Confirming China's CDM initiatives, (Zhang et al., 2011) assert that pressure has been put on China to develop energy efficient technologies and strategies together with making use of renewable fuels so as to accomplish considerable decreases in energy intensity and reduced carbon scales of 40-45% by 2020. Buildings also need to monitored and upgraded to sustainable levels where they are capable of accomplishing energy efficiency which reduce carbon.

For this reason, Hao et al. (2007) disclose that China in its pursuit to preserve and save energy along with its objective to curtail detrimental environmental hazards has designed Building, Cooling, Heating and Power (BCHP) systems in buildings. BCHP frameworks reduce carbon dioxide emissions and preserve energy hence ensure continual supply of energy which does not harm the environment (Hao et al., 2007). If buildings are not energy efficient, Omer (2008) proves that they will consume 40% of global energy consumed so measures to meet such constraints could be improving the comfort of buildings by allowing natural atmospheric weather elements to assume their role (environmental quality). Use of electrical appliances that minimize energy consumption as well as reducing financial costs associated with energy exploitation are ideal measures which can also be considered in minimizing energy use in building's. Confirmation from finished research in China on professionals in the building industry who are architects, engineers and surveyors as documented by Lo et al. (2006), shows that these qualified personnel views pertaining energy sustainability in Hong Kong and Shenyang evidenced energy conservation and saving as important whiles depletion of natural resources as worrisome. The presence of efficient energy frameworks, strong strategies and policies as well as innovative technology in making use of renewable fuels make carbon reduction an easy problem to overcome.

In this manner, Williams (2001) states that effectual systems focused on renovating energy frameworks to assess economic viability of electricity and environmental markets in first and third world countries have helped in improving creation of innovative energy efficient machines and strategies. Thus in Japan, an island nation in East Asia, demonstrates use of energy efficient frameworks along with efficient machines as accomplishing zero carbon benchmarks. Matsuhashi et al. (2010) confirm that the Japanese government declared its intentions to reduce carbon levels by 25% which was viewed as a difficult task. Hence, analysis conducted by sustainability experts on its technological and economic energy strategies predicted that supporting increased use of energy efficient technology in people's homes and industries without employing soaring carbon taxes will achieve desired outcomes (Matsuhashi et al., 2010). Therefore, objectives which aim to improve energy efficiency bring positive results by attaining zero-carbon yardsticks so the practice has also been widely adopted by many European countries.

Accordingly, Ghersi and McDonnell (2007) announce that the use of IMACLIM-R and POLES energy trends frameworks in the European Union (EU) transport sector will bring down greenhouse gas scales to 60-80% by year 2050 and has to date recognized energy consumption substantially improving in the sector. Whiles energy consumption practices are very important in various parts of the economy, high regard is also put on non-coerced energy use projects.

On that account, Streimikiene et al. (2009) explain that analysis finished in Baltic States observes that if voluntary energy efficiency practices are instituted by organizations then sustainability can be realized which further foster creation of joint sustainable business ventures between the private and public sector. No wonder why some organizations and countries in Europe have resorted to making huge investments in employing renewable sources of energy, on course to replace non-renewable sources of energy so as to minimize carbon emissions. Furthermore, Midilli et al. (2006) expound that exhaustible energy resources such as fossil fuels, must be substituted with green energy approaches such as tidal, nuclear, wind, photovoltaic or biomass energy so as to visualise a better environment and a brighter tomorrow.

As a consequence, Gagarinski (1995) confirms that most countries in Europe's former United Soviet Socialist Republic (USSR) have resorted to implementing nuclear power energy projects since its sustainable and is capable of ensuring abundance of energy along with reducing considerable damages to the environment as it does not produce large quantities of greenhouse gases. This indicates commitment of many countries to replace unsustainable fossil fuels. Therefore, expansion to use hydropower, a

renewable fuel has also been promoted in Turkey. Yuksel (2010) interprets that Turkey shows progress in developing sustainable energy practices by economically using 125GW per year of hydropower from an aggregate amount of 433GW per year of hydro electricity produced and future expansions in the sector capable of allocating 36% consumption to economic production are underway. Thus growth in acceptance of hydropower in Turkey has also seen developments in solar power generation in Greece; all in efforts to replace fossil fuels which emit large quantities of greenhouse gases. Economou (2010) describes that Mykonos Island in Greece, now specializes on building projects that make use of solar energy which is renewable and environmentally friendly. In addition to solar projects being implemented in Greece, conservation initiatives aimed at restoring and preserving forests by establishing their growth and survival patterns, useable for sustainability matters have also been promoted. Kitikidou and Apostolopoulou (2011) comment that Elatia forests in Greece were studied using Diameter at Breast Height (DBH) techniques on their death patterns and rates of growth and the results showed that foresters can use this tool to evaluate forest quantities and capacity for sustainability at both regional and international levels. This is owing to the fact that huge forest covers reduce carbon gas amounts in the atmosphere.

3.2. Climate change, adaptation and mitigation. It must be emphasized that climate change, adaptive and mitigation processes along with sustainable development must not be treated in isolation since their alliance and integrative components enhance realization of a sustainable future. Pielke (2005) laments that the Framework Convention on Climate Change (FCCC) has defined "climate change" in a way which limits its scope, therefore social and political policies to mitigate carbon emission have been ineffectively implemented. Thus, he advocates for an extended perspective which embrace climate and energy objectives. Cohen et al. (1998) adding strength to this point echoes that the biggest problem facing the global village is that, climate change and sustainable development have been treated separately. Climate change deals with experimental analysis and investigative practices by scientists while sustainable development consider choice selections from diversified views of stakeholders about future directions. Therefore, an integrated evaluation framework should be championed so that climate change and sustainable development aspects are harmonized to establish social and political views of generated scientific models (Cohen et al., 1998). By not diverting his attention on the importance of combining climate change and sustainable development as one subject Gupta (2009) adds that the characteristic features and historical analysis of sustainable development and climatic change advocates for a merger of these subjects in co-operative efforts with special supporting views such as financial considerations, practicality of projects, disclosure requirements, logical reasoning, stakeholder analysis as well as solving third world country's issues. This brings the importance of business practice accountability on the environment as a result of their every operative practices which has significant impact on climatic change.

On that account, Goosen (2012) simplifies that as economic advancement usher businesses to prosper and enjoy large financial returns, some practices adopted have created unsound environments which have a huge impact on climate change and health status of a nation. These harmful activities include overexploitation of natural energy resources, uncommendable waste management principles, high pollution and undesirable water quality scales. Thus, to solve problems associated with climate change, schemes which sustain carbon reduction policies must be supported. Indeed, Klein et al. (2005) described that the United Nations Framework Convention on Climate Change (UNFCCC) has concluded that existing challenges on climate change are best solved by promoting zero carbon sinkage projects together with practically being highly responsive to climate change effects through joint and co-operative efforts. Consequently, collaborative alliances involving stakeholders in science, economic, political and social fronts must be encouraged to propel zero-carbon targets which will harmonize climate change. Supporting low carbon economies, Reddy and Assenza (2009) report that cutting emissions at community and international level could positively drive sustainable development forward.

This idea was put forward as a result of increase in current economic practices which leads to high carbon levels in the atmosphere. Thus hindrances in sustainable economic growth will be experienced if supervision and control plans regarding carbon have not been implemented. Pappas et al. (2012) also add the changing climatic outlook, characterized by huge greenhouse gas quantities, land and air pollution as a result of manipulative impacts of oil, natural gas and coal exploitive practices whiles the approval of nuclear and other non-exhaustible sources of energy will fundamentally lead to zero carbon economies. Consequently, large amounts of carbon gases emitted into the atmosphere result in global warming. Evaluating harmful effects of this phenomenon, Munasinghe (2010) comments that global warming has caused expansion and creation of deserts, rising sea waters owing to ice melting in

Polar Regions, generation of unproductive agricultural activities and loss of environmental biodiversity. Explaining further effects of global warming, Parry et al. (2001) added that worldwide populations have been made vulnerable because of serious dangers involved with climatic change and these are water deficiencies, increased malaria outbreaks, surge in coastal flooding as well as recurrent food shortages, so immediate practices to bring down carbon emissions should start. Given such destructive effects of climate change owing to global warming, some countries together with concerned partners have begun erecting instruments and ways that effectively promote sustainability.

That being the case, Lior (2012) demonstrates that owing to damaging environmental hazards such as global warming caused by fossil fuel consumptions, there is need to use suitable machines and frameworks at increased product expense, impose strict governmental statutes as well as consider nuclear and other renewable sources of energy for current and future development priorities. Algeria in North Africa, has recognized the importance of these facts when Himri et al. (2009) articulated that the country's climate and environmental policy has acknowledged legislative practices which focuses on supporting adoption of solar, geothermal, wind and biomass renewable sources of energies in its existing and future goals through dialogues such as Concentrating Solar Power (CSP) and Global Market Initiatives (GMI). Thus the plan to build bioenergy and other renewable plants in Algeria, presents fundamental ways to sustainable growth of the country. For this reason, Kartha (2001) exposes that bioenergy possess two distinct sustainably conforming qualities, which are the ability to monitor and attain zero carbon emissions. In that manner, such characteristics restrain climatic change therefore motivation projects for bioenergy exploitation should be popularized. Indeed, efforts to minimize the continual production of emitted carbon gases have been promoted by employing renewable fuels together with establishing zero-carbon standards.

On that account, Biermann et al. (2012) teach that social investigative reports have identified governments and institution's not doing enough in supporting sustainability matters, hence a complete change in attitude and culture by humans themselves is important to drive and address earth's environmental issues such as energy efficiency, carbon reduction, water and food. From these indications, it is quite clear that more involvement and inclusion of government departments and the private sector is fundamental in realizing a zero-carbon economy which mitigates climate change. In line with this argument using surveys done in the UK, Cosford (2009) echoes that since climate change impacts pose dangerous health problems in the short term as well as the future, calls have been made to the UK national health system to observe and integrate sustainable energy development operations such as measuring and disclosing its carbon footprint, use energy efficient sources and technologies, be highly responsive to health condition of its employees as well as recycle waste. Proposing tools in which governments such as the UK and other interested organizations can use so as to realize zero-carbon benchmarks. Knox et al. (2012) explained that use of satellite systems and Micro Electro Mechanical systems (MEMs)-based sensor technologies widen the scope in managing and supervising the level of pollution. This is because pollution pose large negative effects on the atmosphere, environment and on people's health so continual planning and investigative processes on this aspect is important for sustainable development.

Giving more substance to this point, Bertinelli et al. (2012) communicated that innovative and recent technology has been proven to be environmentally compatible since it controls the level of pollution. Not surprisingly, old machines producing a lot of pollution as they cannot cope with the pressure exerted in production process. Thus climatic and environmental quality of a country will heavily depend on investment targets that it puts towards designing new technology.

3.3. Employment and poverty reduction. Energy efficient practices have led to creation of employment which enables people to receive regular income. As local people acquire more disposable income they are then empowered to meet their basic needs constraints which inevitably lead to poverty alleviation. Supporting this idea, Srivastava and Rehman (2006) notes that India, a South Asian country with population totals above 1000 million rated 43.5% of its families having electricity hence the government devised sustainable energy technologies and strategies which would further strengthen agricultural production, health facilities, water industries and environmental outlook besides providing local societies with electricity which enhance them to live better lives. Valuing the importance of electricity, the government and other stakeholders in India as noted by Bose et al. (2012) illustrates that, the Lighting a Billion Lives (LaBL) initiative by The Energy and Resources Institute (TERI), involve distributing solar energy appliances to large populations in its rural areas because it is clean, renewable and it enhance improved lighting. This project has also been associated with supporting education of the

younger generation through provision of conducive night study facilities and also grants opportunities for employment to indigenous people which makes such activities guaranteed of strong financial control systems that can be used to maintain future schemes.

For reasons given, the Indian nation has embraced efficient use of selected fuels that reduce greenhouse gas emissions. Upholding this idea, D'Sa and Murthy (2004) convey that surveys in India opted for Liquefied Petroleum Gas (LPG) in place of kerosene energy sources because of minimized pollution which ensure good well-being of the people, high energy efficiency, reduced deforestation, reduced prices on the market along with reputable arrangement of marketing and distribution networks available. Supporting LPG schemes in rural areas, (McDade, 2004) substantiates that the LP Gas Rural Energy Challenge project sponsored by the United Nations Development Programme (UNDP) and the World LP Gas Association apply to rural areas of mostly third world nations by seeking to reduce energy constraints such as poor electricity provisions, reducing premature births and heavy afflictions on pregnant women carrying loads of firewood together with minimizing incidences of women being raped and infected with HIV/AIDS virus whiles collecting fuel wood. Bioenergy consumption has also been supported in India by substituting exhaustible fuels such as kerosene.

For that reason, Batliwala and Reddy (2003) comment that a Biogas project was erected in Pura, a rural settlement in India in order to assist alleviating energy problems women encounter which enable them to become business minded and increase their involvement by becoming managers. The challenges women faced included expending lots of time finding fuel wood, discharging jobs that cause back damages and they were also exposed to fuels such as firewood which cause serious health respiratory problems. Moreover, Larson and Kartha (2000) named bioenergy the "the poor woman's oil" since it offers favorable income-producing conditions, women are no longer assuming difficult tasks such as carrying water and firewood, crushing grain using hands and cooking in smoky places. It has also been involved with championing the well-being of the environment through reduced emission of greenhouse gases, minimized deforestation, waste from the plant can improve agricultural soil nutrient contents by stabilizing its alkalinity and adding vital nutrients. In that way, adopting cheap fuel from bioenergy results in associated energy poverty issues being alleviated. In pursuit to determine the degree to which energy consumption has led to reduction in energy poverty matters, different scientists have developed suitable frameworks. Solid evidence from projects that aim to diminish poverty associated with energy access on the South American continent has also been pinpointed.

Pereira et al. (2010) establishes that projects in Brazil aimed to correct social energy poverty deficiencies encouraged minimized government involvement, supported building up of energy regulatory frameworks, relaxation of energy market forces along with establishing autonomous entities mandated to supply rural electric power. Consequently, the country's effort to attain sustainable energy growth led decision makers to devise sustainable national policies on energy. Soares et al. (2008) stress that the National Energy Outlook (NEO) 2030 in Brazil indicates that the country possess great potential in exploiting non-exhaustible sources of energy that will propel positive effects on access to energy by its people thereby raising their standards of living, offering employment which improve financial status as well as increase innovation of productive energy components. In Europe, policies and strategies which seek to address energy poverty matters have also been enforced.

Under these circumstances, Bouzarovski et al. (2012) approve that the European Union guiding principles and courses of action associated with reducing energy poverty include designing suitable energy and directive paths, erecting unified energy frameworks as well as establishing a European Energy Poverty Monitoring Center. By adopting some of these objectives Poland have benefited from sustainable energy practices. Szymańska and Chodkowska-Miszczuk (2011) make clear that Poland's rural locations optimize crop waste through developing bio-energy which allows movement of knowledge and expertize to other parts of the country or even internationally in addition to creating jobs for the youths who have become very innovative and highly productive. This growth in utilizing energy consumption by making it sustainable has also recognized substantial positive benefits for the German economy. Schlör et al. (2012) specifies that investigative reports in Germany illustrated that sustainable energy frameworks and strategies result in improved distribution of income, high quality of life, better social union between the government and people together with achieved good image in international obligatory duties when championing such projects. In Africa and other parts of the world recognizable benefits which results from reduction in energy poverty levels have also been ascertained.

On that account, Ogola et al. (2011) informed that the effects of Geothermal projects on Millennium Development Goals (MDGs) in Kenya's villages of Baringo lowlands have been substantiated as increased supply of electricity to households and educational institutions, improved local people entrepreneurship, availability of substitutable sources of income so girls aren't

given out for marriage at young ages, empowers health and other business institutions, promotes zero carbon emission targets and allow global transfer of scientific innovations and practices. Thus such developments promote overall growth of the economy. Supporting the role of renewable sources of energy towards complete advancement of a nation, Michalena and Tripanagnostopoulos (2010) says that that adoption of solar energy frameworks on Mediterranean Islands achieved the purpose to positively transform the tourism industry. Therefore, by meeting tourist's expectations, boost in local community development through created employment opportunities together with increased entrepreneurship of indigenous people is achieved which ultimately reduces poverty.

3.3.1. Suggested additional strategy – energy efficient strategy for urban residential setting sustainability. The aim of the extra approach on sustainable development entails achieving energy efficiency by building major energy planning fundamentals that must be shown in development plans pertaining urban areas since they consume much energy than rural communities. This approach is referred to in this paper as developing energy efficient urban residential settings and presented graphically on Figure 1 below.

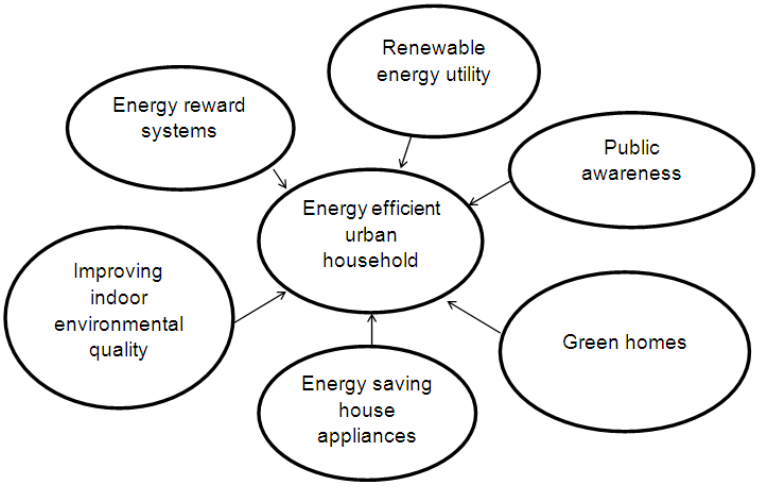

Fig. 1. Energy efficient strategy for urban residential setting sustainability

3.3.2. Energy reward systems. These refer to payoffs done on households that show worthy energy behavior and consumption. The main purpose of such honours is to motivate residents to develop attitude and conduct that propel energy efficiency. Thus it is the duty of energy providers to award residents who excel on energy matters. Such a framework can be devised over a monthly or annual basis. On that account, it is important to give good and valuable prizes to winners so that other residents are stimulated to adopt energy efficiency behavior which produces increased competition among energy them thereby achieving sustainability.

3.3.3. Improving environmental quality. These are practices that allow all weather components to actively assume their role in homes. These weather elements are temperature, humidity and wind. For these elements to optimally exercise their function, urban households should be built with natural resource material since they are environmentally friendly. Thus energy regulation in the house can be maintained during both winter and summer times thereby accomplishing energy efficiency.

3.3.4. Green homes. It is increasingly important to introduce systems that promote a low carbon environment in urban households. Thus, planting small trees, plants, flowers and lawns assist in absorbing carbon quantities in the atmosphere inevitably improving energy performance. Roofs and walls of houses can also be put earth soil and then green lawns will be planted which further moderate temperatures within the house which achieve energy efficiency.

3.3.5. Public awareness. Governments through their energy providers must introduce structures that will improve people's knowledge on energy saving matters. Some household are ready to adopt energy efficiency practices but they lack knowledge on how to integrate such activities in their everyday lives. It is the duty of government to erect frameworks that will realize people acquiring adequate education and training on energy issues through attending conferences, undergoing energy based courses as well as embarking on extended energy public alertness campaigns.

3.3.6. Energy saving house appliances. These are practices that ensure that kitchen, lounge, laundry and bedroom electric equipment such as stoves, washing machines, geysers, lamps, microwaves and refrigeration devices minimize energy consumption. Therefore, energy efficiency is achievable through switch-

ing off equipment that is not in use. And also, improved time management in using household gadgets could help considerably in saving and optimising available electricity as it will not result in wastage. It is therefore, advisable to purchase electric equipment that is fitted with timers. Additionally, households can purchase aluminium made kitchen tools since they absorb heat faster when cooking then use earthenware tools to warm the food since they are able to retain heat for a long period of time which save a lot of energy that can be consumed. Furthermore, centralizing house facilities in one place can also assist in saving energy. For instance, entertainment appliances such as televisions can be put in a single place instead of distributing them across the house.

3.3.7. Renewable energy utility. It involves introducing electricity in homes using technology that is supported by non-exhaustible sources of energy. For example, use of solar powered panels help to minimize carbon emission since they produce clean energy. Electricity from solar powered panels can also assist in load shedding conventional electricity from energy providers. Moreover, solar power can be utilized during the day and then latter substituted with the normal electricity services during the night (where consumption is also monitored) so as to optimize generation of clean electricity.

Conclusion

Energy efficiency undertakes major functions on sustainable emancipation of institutions and countries. It has become very important to substitute fossil fuels with renewable sources of energy as they have been linked to significant reduction in carbon emissions, mitigate climate change as well as solve many challenges associated with energy poverty. However, it must be emphasized that exploitation of non-exhaustible sources of energy is only sustainable if they are consumed in ways that do not cause damage to existing environments. Thus, weak energy policies as well as inefficient energy technology contribute to unsustainability even when renewable sources of energy have been adopted. Additionally, an important energy efficient strategy towards improving residential area sustainability involve instituting energy reward systems, improving environmental quality, establishing green homes, energy saving house appliances, renewable energy utility and improving public awareness on energy matters. On that account, a sustainable future is imperative when sound structures that address energy consumption matters have been established, implemented and adequately furnished with clear monitoring and regulative frameworks.

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