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RENEWABLE ENERGY PROVISION IN AFRICA

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ABSTRACT

This paper reviews the renewable energy situation in Africa and how it fits in as a solution for combating energy poverty in the continent. Despite the abundant renewable and non-renewable energy resources the continent is endowed with, millions of people do not have access to modern energy services. The level of renewable energy development varied among the various regions of the continent. The crude oil rich North African region seems to be ahead of other regions in solar energy development while East African region leads in large and small scale hydropower. In West African region, potential sites of small scale hydropower have been identified with some functioning already. In addition, solar PV projects have been embarked upon by some countries in West Africa. Countries in Southern Africa region especially South Africa and Mozambique have embarked on projects aimed at integrating wind and hydropower into their energy supply mix.

Keywords: Africa, renewable energy, energy provision.

1. INTRODUCTION

Energy is the lifeblood of the global economy, a crucial input to nearly all of the goods and services of the modern world (Eberhard *et al*. 2008). There is a link between key global challenges facing the world today and energy production. In view of this, the development of sustainable solutions for meeting the various energy challenges is of great importance to all developing countries and countries in Africa in particular (UNIDO, 2009). The African continent is endowed with vast non-renewable and renewable energy resources. The hydropower potential of the continent is estimated at 1, 750TWh (Terawatts Hours) and about 14, 000 MW (Mega Watts) of geothermal potential (OECD, 2004). Despite the large potential of renewable and non-renewable energy resources in Africa, it still continues facing critical energy challenges. According to IEA (2008), supply of energy in Africa has been in insufficient quantity, at a cost, quality and form that has restricted its consumption to majority of the population. Africa's per-capita energy consumption has remained low over the years. Thus, the continent records the lowest per capita consumption of 0.5 Tons of oil equivalent (TOE) compared to the global average of 1.2 toe (African Energy Commission, 2012). With a population estimate of about one billion which is expected to double by the middle of this century, the continent needs massive investment in energy in order to grow economically and meet the increasing challenges of lifting its people out of poverty (OFID, 2010). About 60% of the population in Africa lacked access to electricity and this is expected to rise due to imbalance in electricity generation and population growth (IEA, 2011). Due to the high cost of modern fuels such as liquefied petroleum gas and kerosene used for coking, the use of biomass fuels dominates household fuel mix. The major characteristics of African energy situation is over reliance on low grade traditional energy sources (fuelwood, charcoal, crop residue) and on the other hand, low consumption of high quality modern fuels (LPG, electricity).The household sector consumes more than half (59%) of total energy in Africa (ECA, 2011). In most Sub-Sahara Africa countries, biomass use by households accounts for over 80% of energy consumption especially in rural areas (IEA, 2011). Majority of this energy is used for cooking (Fall, 2010), leaving very limited supply to other income generating activities (ECA, 2011). Biomass fuels are consumed using poor energy efficient traditional three stone stoves. This inefficient use puts pressure on biomass resources (Davidson *et al*., 2007). Due to high reliance on biomass fuels by household sector in Africa, energy efficiency in the continent is low when compared to other regions of the world (UNIDO, 2009). In Africa, there is concern over the negative impact climate change would have on the environment which will displace millions of people and create social upheaval (Tadesse, 2010). This paper reviews the current state of renewable energy in Africa and the barriers. The paper argues that proper harnessing of the renewable energy resources the continent is endowed with and good policy at regional and continental level would help in reduction of energy poverty and sustainable development.

2. RENEWABLE ENERGY SITUATION IN AFRICA

Renewable energy provides a major solution to the climate change issue in Africa. In this era of climate change, utilization of renewable energy resources in Africa particularly hydro, wind, solar, biomass and geothermal offers the continent the opportunity to become a leader in mitigation of climate change (Babu, 2010).The need to diversify into renewable energy despite its environmental, economic and social advantages has not really got a unanimous response from African leaders (Guarnacci, 2010). In this regard, support for renewables is lukewarm on the part of energy experts and representatives of oil-exporting African countries such as Algeria, Angola,

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Nigeria and Libya (Karekezi, and Kithyoma 2003). Though renewable energy technologies cannot be said to be totally free in terms environmental impacts, their impacts are far less than those of fossil fuels and nuclear power (EREC, 2005). Almost half of African countries have undertaken national resource assessments for one or more renewable energy sources. Solar and wind assessments exist for at least 21 countries, biomass assessments in at least 14 countries, and geothermal assessments are on-going in seven countries (IRENA, 2010). Even though renewable energy has been found to be economically better than other sources of electricity generation, obtaining financing for it in Africa is currently more difficult than fossil-fuel plants. In part, this could be ascribed to the relative lack of knowledge of renewable energy technologies (IRENA, 2010). Unlike most of the developed and some emerging economies, energy sector in Africa is haunted by centralized coal, petroleum and large hydro. Although some political statements have been made at several forums by African leaders on renewable energy development, actual investments have been very little over the years. Petroleum is big money in Africa and renewables have not been able to stimulate appetites of leaders in the same way that oil has (Hankins, *et al*. 2012). Renewable energy will serve as a solution for meeting the growing energy demand in the continent; while at the same time combat climate change. The level of progress made in renewable energy development across the various regions in the continent is examined in the next section.

2.1 North Africa

The rapid growth in North African region has placed an increasing demand on energy especially electricity in the order of 6 to 7% annually. Thus, providing energy has become a major task facing leaders in the region. Given that 70% of electricity generation in the region is from fossil fuel (natural gas), considering the rising prices of oil and gas and the climate change debate on energy consumption and CO_2 emissions, countries in the region have started reviewing their energy polices with emphasis on incorporating renewable energy into their energy supply mix (UNECA, 2011). All countries in this region, except Morocco are blessed with crude oil and natural gas reserves. Thus, power generation has mainly been from natural gas except for Morocco that depends on coal-fired plants. The share of renewables in the energy supply mix excluding hydro-electricity and biomass fuels among countries in the region is marginal (UNECA, 2011). Except for Egypt, Morocco and Tunisia that have incorporated wind energy into their energy supply mix, other countries rely on gas and hydropower for their electricity generation (Figure-1).

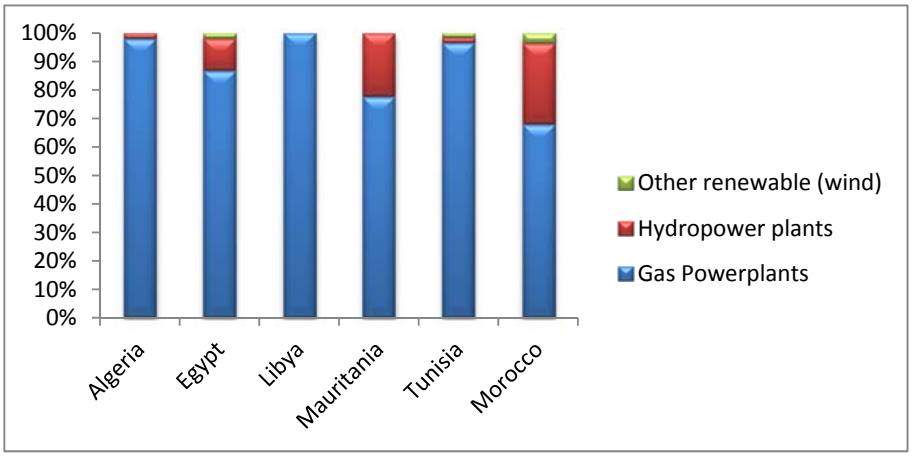

Figure-1. Structure of power generation stock and renewable energy share in 2009.
Data sources: COMELEC, bulletin statistics 2009 pour les pays de l'UMA, Egyptian Electricity Holding Company 2009, Arab Union of Electricity (Sudan)

Due to the locational advantage, many parts of Tunisia especially southern and central parts are exposed to influence of strong winds. Thus, about 2000MW of electricity is being generated from wind farms. In Morocco, electricity generation from wind is estimated to increase from 253MW in 2007 to 2GW in 2016 (ONE, 2008a). Majority of this expansion is expected to occur along the country's Atlantic coastline in the South where wind conditions are favourable (CDER, 2007). The total installed capacity of hydropower plants in Morocco is 1360MW (RENI 21, 2011) In Egypt, the development of wind power potential has been given priority. The wind capacity of several regions in the country that are conducive for high power wind plants is estimated at 20, 000 MW (Ubi France, 2009). However, about 7200MW is expected to be explored before 2020 (Egypt Electricity Holding Company, Annual Report 2009/2010). Hydropower accounts for about 12% of Egypt's electricity generation. The country's hydropower potential is estimated at 3664MW (RENI21, 2011). Compared to its North African neighbours, Libya has a

poorly-developed hydropower, as could be seen from Figure-1, all the electricity generation is from gas stations. Unlike Libya, Tunisia is making effort at constructing new hydropower plants. In 2008, 62MW was added and in 2011, hydropower contributed 17Ktoe of primary energy balance (RENI21, 2011). Although Mauritania has limited hydropower resources, efforts are being made to develop the existing ones in order to improve the country's energy supply mix. It is projected that hydropower will contribute about 13% of the electricity generation by 2015 in Mauritania (Round table for Mauritania, Plans for and capacity of the Electric Sector, 2010). Africa is endowed with solar energy potential. Solar energy has for a long time been used for drying animal skins and clothes, preserving meat, drying crops and evaporating seawater to extract salt (Karekezi and Kithyoma, 2003). North Africa lies in the Sahara desert region with high solar radiation. Komendantova *et al*. (2011) observed that concentrated solar power (CSP) is the only technology that appears most promising for generating electricity in the desert. Countries in the region have embarked on several solar power projects. For example, Algeria has embarked on a solar power project in order to increase her energy supply mix. Solar power is expected to contribute 5% of its national generating capacity by 2015, while in Morocco, a programme has been launched to electrify over 150, 000 households living in isolated off-grid locations (Meisen and Hunter, 2007). In addition, the government of Morocco has marshaled out a concentrated solar power (CSP) plan. In order to achieve this, a multi-billion Euro investment programme was initiated in 2009 targeting 2 GW CSP plants (Moroccan Agency for Solar Energy, 2010). Tunisia seems to be modest in its solar project when compared to that of Morocco and Algeria. Only 120MW will be added through new projects in CSP and photovoltaic (PV) plants until 2016 (Brand and Zingerle, 2011). In Libya, PV applications are used for pumping water in remote areas, electrification, and communication. A total of 970 units of PV with total power of 1525 KWp have been installed as at 2005 (Saleh, 2006). The development of solar energy in Egypt is still at infancy stage. Investments are still at an experimental stage and have not reached a sufficient mass level to achieve significant economies of scales (Patlitzianas, 2011). All countries in North Africa are endowed with solar energy potential; however, political, economic, social and technical barriers need to be removed in order to harness the full potential. Mason and Kumetat (2011) observed that a major barrier to the development of low-carbon futures in North Africa is the low level of regional cooperation on renewable and nuclear energy technologies.

2.2 West Africa

The West African region with a population estimate of 300 million, accounts for about one third of Africa's total population. The energy sector in the region has similar characteristics. These include: (1) low access to electricity (2) high reliance on biomass fuels by majority of households and (3) little availability of modern fuels especially in rural areas. The use of biomass fuels accounts for about 80% of total energy especially for cooking (WACEE, 2013). Access to electricity across the region is about 20% (ECREEE and UNIDO, 2013). Only six countries have a significant national access rate to electricity greater than 30% as at 2009. The countries are Cape Verde (87%), Ghana (66.7%), Nigeria (50%), Côte d'Ivoire (47.3%), and Senegal (42%). For the rest countries, only 18% of the average population had access to electricity (Elayo *et al*. 2012). In terms of renewable energy, its share in the electricity supply mix is expected to increase to about 10% in 2020 and 19% in the following decade (2030). This will translate to additional 2.425MW of renewable electricity capacity by 2020 and 7.606MW by 2030 (ECREEE and UNIDO, 2013). Among the countries in the region, Republic of Benin has the highest number (99) of potential sites for small scale hydropower followed by Nigeria (97), Ghana (85) and Togo (39) while others have between 4 to 30 sites (Table-1). The feasible small-hydropower potential in West Africa is estimated at more than 5, 700 MW (UNIDO, 2010).

Table-1. Small Scale Hydropower (SSHP) potential sites.

Country	**Number of sites**	**Capacity** (MW)
Republic of Benin	99	305
Burkina Faso	<70	52-138
Cote d'lvoire	5	59
Gambia	-	-
Ghana	85	110
Guinea	18	107
Guinea Bissau	2-4	>48
Liberia	30	86
Mali	16	117
Niger	4	5
Nigeria	97	414
Senegal	-	-
Sierra Leone	17	330
Togo	39	206
Total	483	1,882

Source: ECREEE, and UNIDO 2013

West Africa is endowed with conventional and renewable energy resources. However, energy consumption level in the region is among the lowest in the world, with per-capita electricity consumption of 88kWh (Quansah *et al*., 2012).The region accounts for only 1.7% of world energy consumption (ECOWAS, 2006) which is

very low compared with its population. With an average daily global radiation of 4-6.5kWh/m2, solar energy potential development and utilization holds a good prospect in West Africa. Countries in the region have embarked on photovoltaic (PV) project. However, the level of solar PV capacity varied among these countries. Mali is ahead of others in terms of estimated installed capacity followed by Ghana, Senegal, Burkina Faso and others (Figure-2). Solar PV has been used especially in rural areas for pumping water from deep wells, about 1000 of such systems have been installed in West Africa (REN21, 2008). In Nigeria, solar PV powered water pump accounts for more than half (52%) of PV projects (ESMAP, 2005). It has equally been used in household and street lighting, and operation of some appliances. In Senegal, it has been used in the telecommunication sector to power repeater stations and other installations (ENDA-TM, 2005). Lack of comprehensive and accurate solar data, cost of PV systems, lack of skilled manpower, high ambient temperature, theft and lack of standards and certifications affect the promotion of solar PVs in West Africa (Quansah *et al*., 2012). Although some countries such as Niger, Ghana, Nigeria and Senegal have integrated renewable energy into their energy policies, technical and non-technical barriers that impede its development must be addressed. Thus, strong political will is needed for this to be achieved.Africa is endowed with solar energy potential. Despite the abundance of solar energy potential in some parts of the continent, there has been low level of its utilization due to a lot of factors. For example, Karekezi and Kithyoma (2002) noted that solar PV projects in Africa have mainly benefitted the high-income segments of the society due to its high cost which makes it unaffordable to majority of the population.

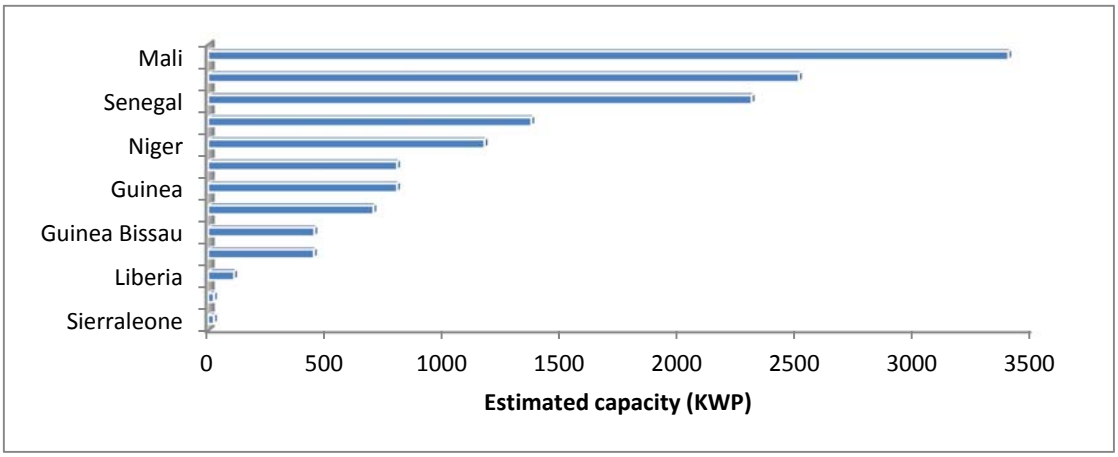

Figure-2. Estimation of Solar PV capacity among countries in West Africa. Data source: Quansah *et al.* 2012.

2.3 East Africa

Despite large renewable energy resources such as small hydro, solar, wind, geothermal and biomass available in East Africa, majority of the population do not have access to electricity (ECA, 2013). Electricity generation capacity in the region is low, with negative impacts on households, industries and businesses alike. Only 23% of the urban population in the region has access to electricity (AICD, 2011). Although some efforts are being made by various governments to improve access to electricity, the sub-region's performance as a whole falls well below that of the rest of the continent; with firewood and charcoal still the most commonly used fuel for cooking (AFDB, 2013). In terms of renewable energy, the development of small scale hydropower and other renewable energy sources in East African region has been very slow due to the fact that governments often invest substantially in conventional large-scale energy sources rather than in renewables (ECA, 2013). The presence of River Nile and other numerous river basins has made large scale hydropower the pillar of electricity generation in most of the countries in the region. Majority of electricity generation in the region comes from hydropower and is expected to contribute about 79% of new additional generation capacity (ESI's Hydropower Africa, 2010). Hydropower accounts for more than 80% of electricity generation in Burundi, Ethiopia, Zambia, Mozambique and Malawi and also significant amount of electricity generation in Uganda, Zimbabwe, Tanzania, Madagascar and Kenya (Liu *et al*. 2013). Among the 14 nations in the region with small hydropower potential (Figure-3), Kenya topped the lead followed by Ethiopia, Mozambique and Tanzania. The hydropower potential in each of the remaining countries is below 250MW. Despite the large hydropower potential in some of these countries, harnessing them for electricity generation has been very slow as shown in the Table. For example, out of the 3000 MW of potential hydropower in Kenya only 33MW has been exploited. Similarly, Mozambique has exploited only 2.1MW out of 1000MW it is endowed with, while Ethiopia has harnessed only 6.15MW out of 1500MW. Quirke, (2012) has identified institutional and environmental challenges as some of the major factors that impeded development of the region's hydropower potential. According to the author, some of the challenges include:

drought, carbon issues relating to reservoirs, lack of capital and technical expertise in formulating energy plans and feasible projects and misguided focus on large-scale projects. In a bid to develop small scale hydropower, some governments in the region have started programmes to encourage private sector participation with Uganda injecting an extra 30MW into the grid through this method (Quirke, 2012). Harnessing the solar energy in most countries of the region has been slow. The major barrier to this is high cost of solar energy technologies and low per-capita income among majority of the population which affects their purchasing power. Solar radiation of between 4-6 kWh/m^2/day is experienced in most of the countries. Among the countries, Kenya has one of the most promising commercial photovoltaic (PV) systems market, with an installed capacity of about 4MW (Energypedia, 2014). An estimated 200, 000 rural households in the country have PV system. Van der *et al*. (2003) noted that the success recorded in proliferation of PV system in Kenya is due to the product's price which fits the purchasing power of rural households and its availability within the mobility range of potential customers. The adoption of wind energy is still at its infancy stage in East African region. However, countries like Ethiopia, Uganda, Kenya and Tanzania are taking the lead in exploitation of wind energy. For example, Kenya has installed about 365 wind turbines around Lake Turkana with a planned power output capacity of 300 MW. Similarly, Ethiopia's 83 wind turbines at Ashegoda Wind Farm is expected to supply about 120MW to the grid in northern Ethiopia while Tanzania has initiated plans to add about 100MW to its electricity generation output from two wind farms projects in the central Singida region (EAC, 2013).

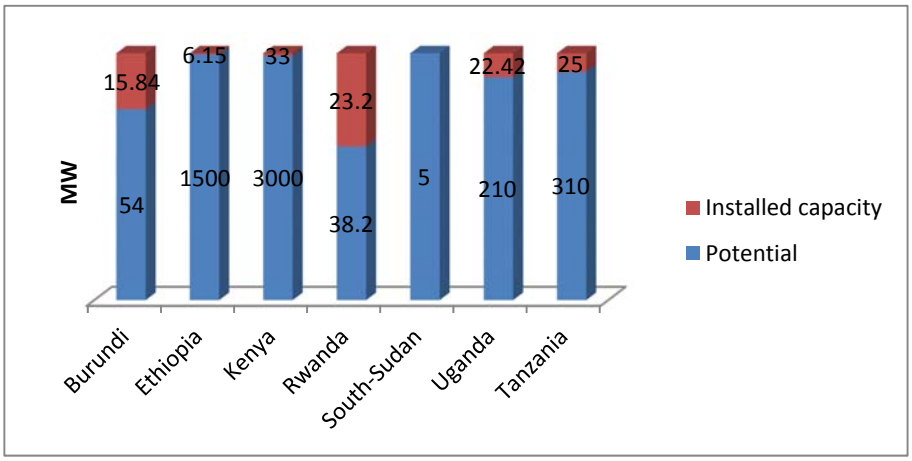

Figure-3. Small hydropower up to 10MW in East African Region. Data Source: Liu *et al*. 2013.

2.4 South Africa

The need to meet the energy needs of millions of people in Southern Africa has become a major policy priority for governments in the region (Mbirimi, 2010). Renewable energy resources are abundantly available in the region. Deichmann *et al*. (2010) observed that the renewable energy potential of many African countries is many times their current energy consumption. However, what the region and Africa as a whole lacks is the capacity to exploit these renewable energy resources (Mbirimi, 2010). For example, the overall hydropower potential in Southern African countries is estimated at about 1,080 terawatt hours per year (TWh/year) but capacity being utilized at present is just under 31 TWh/year. However, the Southern African Power Pool (SAPP) which is saddled with the responsibility of planning, generation and transmission of electricity in the region expects to achieve a renewable energy mix in the regional energy grid of at least 32 percent of the total energy produced by 2020 (SADC, 2013). Among the nine nations in the region (Table-2), Namibia recorded highest in terms of the estimated annual potential production from renewable sources (solar, wind, geothermal, hydro) to its current energy consumption. The potential production from renewable sources for other nations (Angola, Zambia, Mozambique, and Botswana) is more than twenty times their current energy consumption. For the remaining nations (Zimbabwe, Malawi, Lesotho, South Africa), their potential production is less than ten times current energy consumption. Even South Africa that is regarded as the most industrialized and highest emitter of CO_2 in the region has an estimated renewable energy potential of about 1.3 times its current energy consumption.

Table-2. Potential annual production of renewable energy in some Southern African countries relative to current annual domestic consumption.

Country	Renewable energy potential production
Namibia	100.5
Angola	27.9

Zambia	25.2
Mozambique	23.4
Botswana	22.4
Zimbabwe	8.0
Malawi	6.4
Lesotho	1.4
South Africa	1.3

Source: Deichmann *et al*. 2010

Mukasa *et al*. (2013) observed that North African region remains the leader in wind energy markets in Africa, but that countries in Southern and Eastern regions are expected to catch up. For example, Mozambique, South Africa and Namibia (Figure-4) have taken the lead in wind energy exploitation among the countries in the region. These countries are investigating the possibility of generating wind power from coastal areas. Namibia has carried out feasibility studies on how to generate power through wind energy in Ludritz (ECA, 2006).The southern African region, and in fact the whole of Africa, has sunshine all year round. The annual 24-hour global solar radiation average is about 220 W/m2 for South Africa compared with about 150 W/m2 for parts of the USA, and about 100 W/m2 for Europe and the United Kingdom. South Africa has made great success in harnessing its solar resource. The number of photovoltaic (PV) assembled annually totals to 5MW (Energy Department, Republic of South Africa, 2013). In the region, Mozambique seems to be ahead of other countries in harnessing hydropower resource for electricity generation (Figure-4), hydropower accounts for about 3 Mtoe of energy in the country (Buys, *et al*. 2007). Mozambique's greatest hydro potential lies in the Zambezi River basin at sites such as Cahora Bassa North and Mphanda Nkuwa with capacity of about 2,200 MW and other small hydropower potentials of about 190MW (Chambal, 2010). Wind energy holds a great promise for cheap, environmentally friendly and reliable electricity supply to millions of people in Africa that do not have access to electricity especially in rural areas. In terms of climate change, there is no emission of greenhouse gases associated with wind farms. South Africa accounts for the largest CO_2 emission in the continent and 12th largest contributor on a global scale (UNFCC, 2009). A large proportion of the country's emission is from coal-based electricity output in 2011 and is expected to increase with the ongoing construction of additional two plants (Mukasa *et al*., 2013). Going by Buys *et al*. 2007 data on annual wind energy in Southern Africa, Mozambique, South Africa and Namibia have potentials of offshore wind. However, South Africa has taken a bold step towards harnessing its wind energy resource; it has an installed capacity of 9MW.

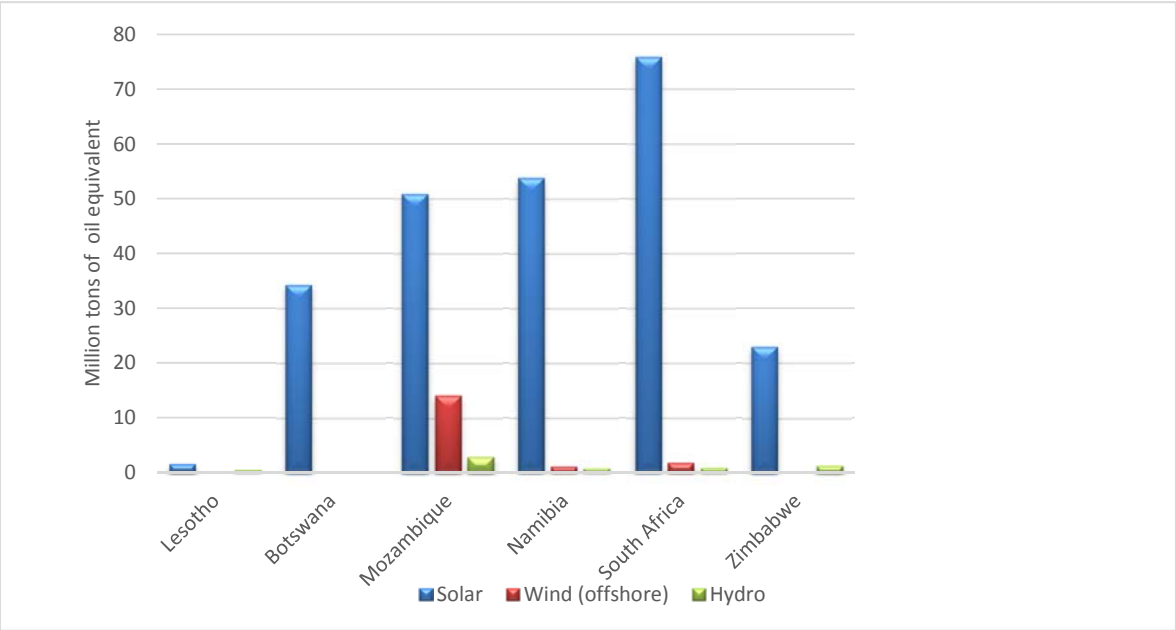

Figure-4. Annual Energy from renewable resources: hydro, solar, wind (Millions tons of oil equivalent. Source: Buys *et al*. 2007.

3. BARRIERS TO RENEWABLE ENERGY DEVELOPMENT IN AFRICA

The inability of many African countries to harness their renewable resources is one of the major impediments to energy access, economic and human development in the continent. Renewables when compared to other sources (fossil fuels, coal) has least impact on earth's climate. However, the development of renewable energy in the

continent is faced with myriad of problems ranging from institutional, economic and social factors. Giovannetti and Ticci (2011) highlighted some of the factors that impede the development of renewable energy in Africa as:

- Costs and financing barriers
- Low competition, monopoly or oligopoly market structure
- Low awareness of benefits, information barriers, lack of human capital
- Social barriers
- Inability of integrating renewable energy with the current energy system

For most African countries, inadequate financial resources and competing needs from other sectors of the economy has affected investment in renewable. For example, Kaggwa *et al*. (2011) noted that the unit production cost and price attached to renewable energy in South Africa is quite high and unrealistic when compared with international prices. According Kaggwa and colleagues, African economies have solely been dependent on foreign technologies. And as a result, the burden of licensing and other intellectual property requirements has been a barrier that frustrates the adoption of technologies needed to migrate to renewable energy. DOE (2011) report shows that the cost of harnessing energy from renewables is higher than that of fossil fuels. Beck and Martinot (2004) noted that though lower fuel and operating costs may make renewable energy cost look attractive on a life cycle basis, high initial capital investments cost could make it less attractive than conventional energy sources. In majority of the countries in Africa, energy and power sectors are monopolistic in nature (i.e. under state control). Thus, independent power producers and investors might find it difficult in penetrating the market due to centralized infrastructure, institutional arrangements and prevailing standards, which are conceived for concentrated market structures (Giovannetti and Ticci (2011). In Nigeria for example, the federal government in 2013 took a bold step towards solving the energy crisis by privatizing the state owned utility company (Power Holding Company of Nigeria). Government's decision to deregulate the power sector was to encourage foreign investment and enhance efficiency, development of renewable and conventional energy resources in the country. Socio-cultural factors have been identified as one of the challenges to renewable energy adoption (Zuk *et al*., 2007, Bailis *et al*., 2009). Brohmann *et al*. (2007) noted that cultural factors relate to historically shaped traditions and beliefs that influence the ability of people to accept or resist new ideas. Studies have shown that customs and traditions have strong influence on renewable energy and energy efficient technologies adoption in Africa. People's response generally towards renewable energy is positive. However, it challenges an existing system which may lead to conflict. For example, adoption of solar cooker may be considered off point by a household, because it is perfectly contented with the taste of food prepared using biomass fuels (Hoystad *et al*., 2009). In addition, technical barriers inhibit the potential of renewable energy technologies (Painuly, 2001). A major element of this is the lack of skilled personnel which is very common in rural areas where most of the renewable energy projects in Africa are sited. For example, Karekezi *et al*. (2005) in their study on the potential contribution of renewable energy in Tanzania observed that lack of technical personnel for installation and maintenance services affected the promotion of wind pumps in rural water supply.

4. CONCLUSIONS

The review conducted so far gives an insight into the renewable energy situation in Africa, prospects and challenges. Renewable energy potential, development and utilization varied among the regions in the continent. This variation could be attributed to (1) geographical location (2) availability of non-renewables (crude oil), (3) energy policy of various countries and (4) level of economic development. In the North African region, the share of renewable energy in the energy supply mix of countries is marginal because most of them have crude oil reserve. Thus, electricity is mainly generated from gas plants. In East Africa lies a region with abundant hydropower resources such as River Nile and other numerous river basins. Despite this, access to electricity in the region is low due to the inability of countries to harness the vast potential of renewable energy resources. However, majority of electricity generation in this region still comes from hydropower. Countries in the West African region are blessed with both small hydro and wind energy potentials. Harnessing these renewable energy resources have been a major challenge. Millions of people do not have access to electricity even in crude oil rich country like Nigeria. The level of renewable energy development is not at par with resources the region is endowed with. Countries in the southern African region are blessed with hydro, wind and solar potentials. In comparison to other regions, it could be said that the level of renewable energy development is high in Southern African region. Even South Africa that has the highest coal fired power plant in the continent, efforts towards incorporating renewables such as wind and solar in its energy supply mix over the years is quite impressive. African continent faces major energy challenges in the coming years, thus ensuring adequate supply of energy in a sustainable manner would enhance human development and industrial growth. Investment in renewable energy and energy efficient technologies will facilitate the achievement of this. African countries could make a leap from their current minimal energy service situation directly to high efficient energy economies. However, any leap requires a stable energy policy framework (Koskimäki, 2012). The Economic Commission for Africa (ECA) in its 2011 working paper on renewable energy and climate change policies noted that Africa should develop energy policies that encourage the integration of low carbon renewable energy supplies. Three key areas that need to be addressed according to this report are: (1) democratising access to the

grid for independent power providers (2) increase the share of renewables in the energy portfolio (mandatory and incentive based) and (3) make renewable energy technologies price-competitive. In most of the African countries, electricity generation from the grid is under state control; hence bureaucracy, corruption and bad management impede the growth of electricity generation. Renewable energy must be incorporated into all stages of the energy policy development. Karekezi (2002) noted that energy analysts and policy makers in Africa are preoccupied with how to meet the short and long-term energy needs with less concern on the impact energy consumption and production would have on the environment. This has to change taking into account the impact climate change has had on the continent over the years. Millions of people have been displaced as a result of flooding, most parts of East Africa have experience severe drought leading to death of animals, humans and loss of vegetation. The potential of renewable energy technologies (RETs) in meeting energy needs where conventional energy supply options have failed has been established (Davidson *et al*. 2007). The authors noted that the cost of RETs is declining with technology improvements and economies of scale in production. According to Renewable Energy Policy Network for the 21st Century (RENI21) (2005), solar and wind power costs are now half of what they were in the mid-1990s. Detailed feasibility studies have established that Africa has great potential for concentrated solar thermal power generation from desert areas like the Sahara and Namib (UNIDO, 2009). Therefore, policy makers in the continent should search for ways of harnessing the renewable energy potentials such as wind, hydro, solar and biomass resources the continent is endowed with. In order to enhance energy access in Africa, there is need for all stake holders to come together and fashion out an enduring renewable energy policy. Such policy must take into account variation in culture, weather condition, geographical location and the available renewable energy potential at different regions in the continent. Although some attempts have been made by some regional bodies in the continent to chart a new course for the development of renewable energy potentials, such effort would be more effective and enduring if it is articulated within a broad base continental body. The policy must thus combine renewable energy and energy efficient technologies together as both have their different roles towards enhancing efficient energy use and climate change mitigation. Larger mitigation outcomes and access to clean energy could be enhanced through renewable energy technology.

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