Regional Green Market Opportunities for Clean Technologies and the Case of Kenya

Dr Mary Wanjiru Kinoti
Senior Lecturer
Department of Business Administration
School of Business
University of Nairobi, Kenya

Abstract

The twentieth century witnessed the democratization of consumption, rise of the mass market and unprecedented expansion of global material wealth. However, this unprecedented economic growth, rapid population growth, and technological changes among others pose several challenges among them climate change, resource depletion, and ecosystem damage. These challenges have brought opportunities similarly for global, regional, national and individual players who are willing to slow or reverse the consequences of climate change while meeting the increasing demand for environmental friendly products globally. There is therefore, enormous global market for green initiatives especially for clean technologies. The market for clean technology in the year 2011/2012 was estimated to $5.5 trillion globally. This market is forecasted to grow at approximately 4.1 Percent annually until 2015/2016. Clean technology investment in developing countries rose by 19 percent in 2012, while global investment declined by 12 percent overall in the same period. This suggest a shift of investment toward developing economies. The green technologies opportunities are largest in the wastewater treatment sector, which makes up about one-third of the total, with small hydro, water treatment, onshore wind power, solar PV, geothermal and bio-energy in that order. Opportunities are also available across the entire clean technology value chain, particularly in equipment manufacture, installation, civil works, retailing, and operations and maintenance (O&M) activities and these opportunities can be exploited both by large and small organizations across regions in bid to exploit the green market opportunities. This paper explores through review of literature how different region globally namely Africa, Europe, Asia, Latin America and Kenya are particularly exploiting the growing opportunities in green and clean technologies globally with a view of dealing with resources depletion and environmental damage caused by unsustainable economic development practices of the past and current generations.

Keywords*:* green markets, green initiatives and green products, and clean technologies.

Introduction

The twentieth century witnessed the democratization of consumption, rise of the mass market and unprecedented expansion of global material wealth. However, this unprecedented economic growth, rapid population growth, and technological changes among others pose several challenges among them climate change, resource depletion, and ecosystem damage (Belz and Peattie, 2013). Greening global economic growth is the only way to deal with these challenges and at the same time satisfy the needs of today`s population as well as 9 billion people by 2050 without compromising the needs for the future generation.

Nevertheless, green global growth is unimaginable without innovation and technology. What innovation does is that it allows production of more output, newer, and more environmentally-friendly outputs with fewer input. Innovation therefore helps to decouple growth from natural capital depletion, environmental pollution and result in more resource efficient besides cleaner technologies. Green technologies comprise a vast collection of considerably different technology that support wealth creation and at the same time achieve more efficient, clean and resilient growth. Clean technology which is associated with pollution reduction and resources efficiency in building industry include among others thermal insulation and new materials, heating, energy-efficient lighting. Further In production processes the clean technologies comprise new uses of waste and other by-products from firms into production inputs.

Technologies regarding climate change mitigation comprise cleaner energy supply such as wind, solar, geothermal, marine energy, biomass, and hydro-power, waste-to-energy, and hydrogen fuels among others (Dutz and sharma, 2012)There is therefore, a huge global market for green initiatives especially for clean technologies. The market for clean technology in the year 2011/2012 was estimated to $5.5 trillion globally. This market is forecasted to grow at approximately 4.1 Percent annually until 2015/2016. Clean technology investment in developing countries rose by 19 percent in 2012, while global investment declined by 12 percent overall in the same period. This suggest a shift of investment toward developing economies. The green technologies opportunities are largest in the wastewater treatment sector, which makes up about one-third of the total, with small hydro, water treatment, onshore wind power, solar PV, geothermal and bio-energy in that order. Opportunities are also available across the entire clean technology value chain, particularly in equipment manufacture, installation, civil works, retailing, and operations and maintenance (O&M) activities and these opportunities can be exploited both by large and small organizations across regions in bid to exploit the green market opportunities.

Considerable progress has been made in transitioning to green growth. Global investment in renewable energy in 2011 increased with upto 17% on 2010 to US$ 257 billion. This represented a six-fold increase from 2004 and was 93% higher than in 2007. Developing countries are also playing a growing role in scaling up green investment. Cross-border and domestic investment originating from non-OECD countries grew 15-fold between 2004 and 2011 at a rate of 47% per year, compared with 27% per year for OECD-originating investment (world Economic forum report, 2013). The purpose of this paper is to review the regional green market opportunities for clean technologies and what Kenya is doing to exploit the growing market opportunities.

Theoretical foundation

This paper is grounded on three theories namely neo classical, sustainability and natural capitalism. The neoclassical growth theory posit that income is a function of the levels of capital (K) and labor(L), the returns to each one of them (β and 1-β) and exogenous technological factor

$$Y_t = A_t K^{1-\beta} L^{\beta}$$

This theory does not include natural resources as limiting factor of production. This implies that technology can substitute for even non-renewable resources. This theory is appropriate for this paper because its explains why conventional economic development has resulted to resources depletion and environmental degradation (Solow, 1994). The Sustainability model attempt to broaden the concept of growth and development by incorporating natural environment, the economy and the society as interconnected. Accordingly, each element has its own capital stocks which must be sustained with a view of producing quality of life. These capital stocks include manufactured capital (man -made stock), stock of natural resources (natural stock), and human skills and knowledge, and social capital. This theory advocates for maintenance or enhancement of different types of capital. Jonathan and zerbe(1995)further proposes element of sustainability as economic, environment and social capital. The Natural capitalism proposes four forms of capital; natural, human, Manufactured and financial capital stocks. According to this theory life sustaining environment cannot be treated as equal factor of production but as a limiting factor underlying all productions. This argument is critical as the environment is the base upon which other forms of stocks are created. In summary neoclassical does not treat natural resources as a constraint because first prices adjust to encourage efficient use of scarce resources and secondly technology change can create new uses and efficiencies as it has done in the past. However, both sustainability and natural capitalism theory disagree with the two principles of neo classical theory fundamentally (Green Wood ,2001). Sustainability and Natural Capitalism theories explains why Globally In differing magnitudes green practices particularly in clean technologies are being adopted.

Waste to Energy (WtE) Clean Technologies

The quantity of solid waste generated is expected to grow more rapidly than the rate of urbanization rates in the forthcoming decades, reaching 2.2 billion tons/year by 2025 and 4.2 billion by 2050 (World Bank, 2012; Mavropoulos, 2012). If this solid waste is managed properly it offers big opportunity in the energy sector whose demand for clean energy is growing rapidly. In 2012, the global market for waste-to-energy technologies was valued at USD 24 billion, an average annual increase of 5% from 2008. The waste to energy market is expected to reach a market size of USD 29 billion by 2015(Frost & Sullivan, 2011).

Waste-to-Energy (WtE) technologies consist of any waste treatment process that creates energy in the form of electricity, heat or transport fuels (e.g. diesel) from a waste source. These technologies can be applied to several types of waste: from the semi-solid (e.g. thickened sludge from effluent treatment plants) to liquid (e.g. domestic sewage) and gaseous (e.g. refinery gases) waste. However, the most common application by far is processing the Municipal Solid Waste (MSW) (Eurostat, 2013). The main drivers for this growth could be summarized in an increasing waste generation, high energy costs, growing concerns of environmental issues, and restricted land filling capacities. WtE would help solve these issues by reducing the waste volume and cutting down on greenhouse gas emissions. Moreover, legislative and policy shifts, mainly by European governments, have significantly affected the growth of WtE market as well as the implementation of advanced technology solutions (World Energy Council, 2013). Despite the recent economic crisis, the global market of waste to energy has registered a significant increase in the past few years and is expected to continue its steady growth till 2015. Despite the environmental challenge caused by Solid waste generated globally if finance is set aside to convert the waste to energy the challenge can be turned around to an opportunity especially in renewable energy sector. Both developing and developed economies should continuously invest in conversion of solid waste to energy to mitigate resources depletion. It is worth noting that solid waste will always be generated globally and therefore if managed properly it can ensure continuous supply of renewable energy.

Although today, the bulk of MSW is generated in developed countries (North America and European Union). Nevertheless, the fastest growth in MSW generation for the coming decade is expected mainly in emerging economies in Asia, Latin America and South Africa. In terms of waste composition, there is a shift towards an increased percentage of plastic and paper in the overall waste composition mainly in the high-income countries (UNEP, 2010). It is expected that both middle- and low-income countries would follow the same trends with the increase of urbanization levels and economic development in these countries (World Energy Council, 2013).

Wind energy clean technologies

Technology has brought down the cost of renewable energy drastically particularly solar and wind energy. This presents opportunities to high and low-income countries and more so to low income countries which account for 12% of the world population but consume only 1 % of total global energy. The reason for low global consumption rate is lack of access to modern energy among others due to high cost of conventional energy (World Bank report, 2012).

According to Roney (2012) the wind energy electricity generating capacity in 2011 stood at 238000 megawatts, with 80 countries and above harnessing wind. The installed wind power capacity worldwide could meet residential electricity needs of 380 million people at European consumption levels. China led for three consequent years all countries in annual wind power installations in year 2011 with installations of 18,000 megawatts for a total wind capacity of 63,000 megawatts. This country doubled its wind capacity each year from 2005 to 2009, due to this, China surpassed the United States in 2010. The United States installed 6,800 megawatts of wind generating capacity in 2011. The United States wind capacity in 2011 was just about 47,000 megawatts across 38 states, enough to meet the electricity demand of more than 10 million homes. Europe leads all regions of the world with close to 100,000 megawatts of wind capacity. India, which has become one of the world's leading wind turbine manufacturers, in 2011 installed 3,000 megawatts of wind. It remains fifth in the world wind rankings, with 16,100 megawatts total, with the government hoping to double the figure within five years. Pakistan on the other hand, wind capacity potential stand at 350,000 megawatts more than sufficient amount to meet its electricity needs 10 times over.

Other counties particularly in Latin America, Africa, and the Middle East have also taken advantage of wind resources. Brazil, in Latin America installed 1,500 megawatts wind capacity in 2011 leading the way in the fast expanding Latin American market, a 63 percent increase over 2010. In sub-Saharan Africa, the long-awaited 300 Megawatt from Kenya Lake Turkana wind farm was expected to break ground in northwestern Kenya in April 2012. Ethiopia brought its first wind farm online in 2011, and both Nigeria and Mauritania were poised to do the same in early 2012. It is worth to note that renewable sources of electricity are argued to be too expensive to compete with nuclear or fossil fuel power plants. However, wind is already cost-competitive, and the costs are projected to fall further, with the average wind farm being competitive by 2016, Global wind power capacity is projected to at least double between 2011 and 2016. All this effort being made all over the world is to shift from finite and costly fossil fuels to renewable sources with the aim of avoiding the disastrous consequences of climate change moving forward (UNDP, 2012).

Solar Photovoltaic clean technologies

The Investment in clean energy grew at an average rate of 33% per year between 2004 and 2011, with solar sector registering the highest growth rate. The Rapid growth in the industry is partially attributed to the reduced cost of wind and solar power combined with more generous subsidy programmers. Further clean energy technologies have experienced dramatic cost reductions, due to among others adoption by many countries of clean energy policies and frameworks over the past decade growth in emerging markets, beneficial economic stimulus packages favoring clean energy investment and rising costs of fossil fuels. Bloomberg New Energy Finance estimates that small-scale solar projects (less than 1 megawatt) alone attracted US$ 22 billion in the second quarter of 2012, 13% up from the same quarter in the previous year. Over 2011, solar module prices fell by 50%, and by the end of 2011 it was also clear that installed renewable energy had surpassed overall installed nuclear capacity by 50% globally.

According to market buzz (2012) solar photovoltaic (PV) worldwide market installations reached a record high in 2011 of 27.4 Giga watts (GW), an increase of 40%. In the year 2011 demand for solar photovoltaic systems went up and it was expected to rise even higher throughout the world in 2012. Countries that were outside the 2011 top 10 were also expected to steal market share from the top 10. According to Hill (2012) the detailed picture of the market opportunities for solar PV globally were as follows in terms of numbers; In 2011 the PV industry generated $93 billion in global revenues, up 12% year over year with Solar cell production worldwide reaching 29.5 GW in 2011, up from 23.0 GW in 2010.Production from China and Taiwan accounted for 74% of global solar cell production, up from 63% in 2010. In terms of growth in solar production China soared from seventh place in 2010, with a year over year increase of 470%, to take third place. The global aggregated demand for solar PV was expected to increase from 20% in 2011 to 32% in 2012. While Germany, Italy, China, the United States and France were the top five PV markets covered by Market buzz, making up 74% of global demand in 2011.The demand for solar PV in the European market accounted for 68% --- or 18.7 GW of world demand in 2011, down from 82% in 2010. However, Germany, Italy, and France collectively accounted for 82% of European market demand. The European market share is projected to fall below 42% by 2016 as North America and other Asian markets continue to grow. For instance, China, itself, is expected to reach 17% of global demand by 2016.

Africa and Green and Energy Technologies

The level of economic and energy sector development differs widely across Africa 54 countries, in fact energy resources, whether fossil or renewable, are not distributed evenly. Decisions concerning the development of the African energy sector will have long-term implications for individual welfare, national economic development, and greenhouse gas emissions because investment in energy infrastructure spans several decades. However, recent technological advancements and cost reductions, the large-scale deployment of renewable energy offers African countries a cost-effective path to rapid, sustainable and equitable growth. Africa's renewable energy power potential is substantially larger than the current and projected power consumption of the continent. Local geothermal, solar thermal and bioenergy resources have an important role to play in covering future heat demand. Renewable resources are plentiful; demand is growing, technology costs are falling. The moment is right for a rapid scale-up of renewable energy in Africa. Further Africa's renewable energy power potential is substantially larger than the current and projected power consumption of the continent. This is therefore, evident that Africa has the potential to produce renewable energy from various sources namely bioenergy, geothermal, hydro, marine, solar, and wind to exploits green market opportunities in the Africa as well as the rest of the world because its potential is higher than the continent consumption(IRENA, 2012).

However, Investors, as well as the energy industry, need to understand and limit the risks of investing in renewable energy projects. They need long-term guarantees to ensure reasonable returns over the lifetime of the project, as some investments last for decades. It is worth to be cautious because the revenues of many African public utilities suffer due to the underpricing of power, in line with the low purchasing power of the population; poor revenue collection; and high transmission and distribution losses. While tackling inefficiencies in the performance of public utilities remains a priority, stronger regulatory frameworks are needed in this sector. Green market opportunity for renewable energy especially for 1.6 billion people who lack electricity and the 'energy poor' that spend around US$17 billion a year on costly inefficient oil-based lighting is evident. If developing countries could rely more on renewable energy, they would spend less on importing petroleum in addition there would be greater reductions in poverty (science for environment report, 2011).

The East and South Africa clean energy corridor

According to IRENA Report (2012) electricity demand in East Africa was expected to increase approximately four times. Ethiopia, Kenya and Tanzania have identified about 15GW of cost effective geo-thermal potential and 40 GW of cost effective hydro potential with a view to exploiting the increasing demand. In addition, substantial wind potential exist of which 8GW has also being identified as competitive economically. As a matter of facts typical costs of USD 0.03 to 0.08 per Kwh for large-scale Hydro, USD 0.05 to 0.10 for geothermal, and USD 0.05 to 0.14 for wind power are competitive with current electric tariffs which range from USD 0.06 to 0.17 in East Africa. In South Africa the power needs are also of higher magnitude and growing. The prevailing electric tariffs are also as high as USD 0.13 to 0.16 in South Africa (IRENA, 2012).

Mozambique: Fundo Nacional de Energia (FUNAE), A best rural electrification fund

This project has implemented numerous successful solar, wind, and hydropower projects which have enabled electricity access to several hundreds of schools, clinics and villages. FUNAE has also developed operations and maintenance capacity as well as a programmer to train solar technician in all provinces of that country. This Project was so successful that it also assisted to develop plans for solar manufacturing plant aimed at selling solar modules both in Mozambique and other neighboring countries. The plant was budgeted to spend USD 13 Million and its construction started in 2012 at Beleluance, Maputo province and was expected to be completed within one year (IRENA, 2012).

Sub-Saharan Africa

The leading opportunities for Sub-Saharan African SMEs are in wastewater (about $90 billion), small hydro (about $43 billion), and water (about $40 billion). Solar PV and geothermal are also large potential markets worth between $20 billion and $30 billion to SMEs(infodev,2013).The largest opportunities in wastewater are in West and Central Africa (about $41 billion), followed by Southern Africa (about $32 billion). Demand for small hydro projects in East Africa would address rural electrification needs and this sector is well suited to SMEs. East Africa is leading the way in small hydro opportunities with about $38 billion of the $43 billion regional SME opportunity, in part because of the numerous small rivers that run through the region. Small hydro provides large opportunities for SMEs in the balance of systems and operation and maintenance segments of the value chain (Infodev, 2013).

Middle East & North Africa

The leading opportunities for North African and Middle Eastern SMEs are in wastewater (about $90 billion), water (about $40 billion), and CSP about ($20 billion). Solar technology represents a significant opportunity in the region. This region is one of several global hotspots for solar resource. The UAE was the first Arab country to launch the green economy initiative. The initiative falls under the UAE Vision 2021 and under the Arab Green Economy Initiative. The launch was a natural continuation of green economy initiatives in the UAE, such as the building of the Masdar City, the first green city in the world; the investment in the creation of renewable energy sources, including nuclear energy; and the development of greenhouse and organic agriculture. In the recent past UAE has also become the center of green building in the Arab world. As a global nation, the UAE is committed in developing and implementing innovative solutions to protect and sustain the environment with a view of playing its part in mitigating against global warming among other environmental challenges. New, energy-efficient technologies will harness the UAE's pioneering role in the green revolution and reduce its carbon footprint (Terdiman, 2012).

Russia and Middle-Income Europe

The leading opportunities particularly for SMEs in Russia and middle-income Europe region are in wastewater (about $30 billion), small hydro (about $29 billion), and waste (about $34 billion) Small hydro is a particularly prominent opportunity in Romania and Bulgaria, which have hundreds of megawatts of untapped hydrological resources(Infodev,2013).

Germany

In May 2011, Germany determined to become the first industrialized country to completely shift to clean energy by increasing investment and research and development for renewable energy. To attain its vision the country planned to close all its nuclear plants by 2022 despite the fact that nuclear power provides 22 percent of the Germany power. To fill the gap for its energy supply after doing away with nuclear, Germany has proposed strong development of wind, solar, and biomass; new standards for the thermal efficiency of buildings; and the creation of a continent-wide super smart grid which would include the import of power from sun-rich North Africa.In light of the above determination to use sustainable source of energy, Germany has in the recent past increased its use of wind, biogas and solar to produce electricity as opposed to brown coal.TheNet-generation of energy from renewable energy sources in the German electricity sector has increased from 6.3% in 2000 to about 30% in 2014. Further Germany has an average of 900 kWh/kWp of solar energy (McKinsey, 2008, 2013b). According to European Environmental Agency In 2013 12 percent of final energy consumption came from renewable energy. Renewable energy also accounted for 9.1 percent of heat and 5.5 percent of fuel consumption in Germany.

Asia (Excluding China and India)

According to World BankInfodev report (2013) the leading opportunities for Asian SMEs are in wastewater (about $85 billion), small hydro (about $50 billion), and geothermal (about $48 billion) The region's strong geothermal investment potential largely reflects the Indonesian government's ambitious plans. Indonesia enjoys about 40 percent of the world's total potential geothermal resources because of its location on some of the most volcanically active sections of the Pacific Ring of Fire (McKinsey Global Institute, 2012)

India

The clean technology market opportunity analysis in India indicates that $103 billion will be invested across 13 clean technology sectors in India over the next decade. The opportunities are ranked as follows; onshore wind (about $23 billion), solar PV (about $21 billion), and wastewater (about $18 billion). India is in an advantaged position to exploit this opportunity because it enjoys among the world's highest isolation rates as well as clear, sunny skies, which makes it ideal for both solar PV and CSP. India has responded well to its rapidly growing energy demand as it is concerned about energy security, and desire to reduce greenhouse gas emissions and therefore has directed investment towards domestic renewable energy sources India's installed wind capacity is forecasted to reach 60 GW by 2020, up from about 18 GW in 2012 (GWEC, 2012, 2013). The country also plans to deploy up to 22 GW of solar power by 2022 as part of its National Solar Mission (Ministry of New and Renewable Energy-India, 2012a). As with most other regions, water, wastewater treatment, and solid waste management are all significant opportunities since hundreds of millions of Indians lack access to basic water and sanitation services. Government programs are aiming to accelerate the deployment of these important public services (Infodev, 2013).

China

Since 1978, China has been developing at an average annual growth rate of nearly 10% per year. Over just three decades, it has developed in one giant leap from a poor country into the world's second largest economy after the United States. Great changes have taken place in the quality of people's lives. If this trend continues, then by 2030 China will have attained high income status in an unprecedented short period of time. China's global market share of solar PV production grew from less than 2 percent in 2002 to 45 percent in 2010 (Sahoo and Shrimaliy, 2013). The government of china institutionally coordinated industrial PV strategy has helped develop a strong domestic manufacturing base, and domestic innovation, targeted subsidies, and lower-cost government loans have enabled manufacturers to thrive while cutting costs through process innovations. This is evidence that government intervention can drive sustainable development and also decouple growth from resources depletion. According to Bloomberg News (2012), solar PV costs have fallen by 80 percent since 2008, which has given the government confidence to boost its deployment targets to 50 GW installed capacity by 2020, and to further support its domestic industry. As a result, solar PV continues to present a large opportunity in China(Infodev, 2014).

The Republic of Korea:

Korea imports 96 percent of its energy which account for 2/3 of all imports. The financial crisis exposed Korea's reliance on imported energy as a major weakness in its growth model to rebalance this situation by 2030.

Korea aims to decrease its energy intensity by 46 percent and increase the share of renewable energy in total primary energy from 2.4 percent in 2007 to 11 percent. Furthermore, the latest Five-Year Plan allocates 2 percent of GDP to 10 green growth strategies, each containing quantitative objectives and well-defined projects. Korea aims to increase its global market share of green technology exports from 2 percent in 2009 to 10 percent by 2020.

Japan

Japan's energy intensity decreased 26% between 1980 and 2009, and it is one of the most energy-efficient countries in the world. Nevertheless, Japan pledged to go further with its 2006 "Energy Conservation Law" by improving energy efficiency by another 30 percent by 2030 relative to 2006. The plan's implementation strategy fosters energy conservation technologies and develops a benchmarking approach to monitor energy conservation. In addition to promoting the most advanced technologies across the energy sector, the plan also introduces integrated energy consumption standards for all buildings and targets net zero- energy houses by 2020 (and the norm nationwide by 2030). Japan's Top Runner Program, tests 21 types of appliances ranging from vending machines and air conditioners to television sets to determine the most efficient model, and make that model's level of efficiency the new baseline. Then, manufacturers have the obligation to achieve the new baseline within four to eight years. Japan's newest innovation is the concept of "smart community", a model city that maximizes the use of renewable energy and relies on smart grids to deal with its intermittent nature.

Latin America

In Latin American the largest opportunity for SMEs in clean technologies are in wastewater (about $160 billion), bio energy (about $40 billion), and water (about $40 billion). In this region some countries are seeing fast growth according to Inter-American Development Bank (2013) with triple digit growth they are; Mexico (450 percent), the Dominican Republic (431 percent), Uruguay (327 percent), Peru (325 percent), and Chile (314 percent). Bioenergy presents a large opportunity for SMEs across the value chain in Latin America. The region has great bioenergy potential, with a land area of around 250 million hectares available for feedstock production, led by Brazil (Inter-American Network of Academies of Science, 2012). Ethanol production is poised to grow enormously over the next ten years, and heat and electricity from biomass, especially from sugarcane bagasse, is also ready for significant growth (Carbon Trust, 2012a: infodev,2013)

Case Studies in Kenya for green and clean technologies opportunities

This section focuses on Kenya green and clean technology opportunities stating with bioenergy, Crop based biofuels, Industrial biomass and Climate-Smart Agriculture in that order. Bioenergy is a renewable energy made from biomass, which is organic material derived from plant or animal matter. In Kenya there are three sources of bio energy namely Naturally occurring biomass (from trees or mature), Industrial biomass (Agro-industries waste), and Crops grown commercially with sole purpose of biofuel production to Supply heat, power, gas, and transport fuel. In Kenya biogas production exists particularly for industrial waste, areas where industrial scale Biogas can be exploited in Kenya according to GTZ are; Solid waste from Nairobi City Council, Sisal waste, Coffee waste and Certain food processing (German Biomass Research Centre, 2010). Crop based biofuels in Kenya is generated from Jatropha crop seeds which produce biodiesel oil. According to Khatum, (2013) though Jatropha was introduced in Kenya several years ago in arid lands the results have being similarly poor (Infoldev, 2014).Farmers in several parts of Kenya reported that Jatropha grew more slowly and produced fewer seeds than they were led to believe (GTZ, 2009; Husberge 2009, Wadhams, 2009).

Industrial biomass (Agro-industries waste)mainly produced by sugar companies are used to generate two types of bioenergy namely; Bioethanol from molasses and Cogeneration using Bagasse. Kenya sugar board requires all sugar millers to produce Bio ethanol and electricity within 24 months (Business daily, 2013). Only Mumias sugar met these requirements then, however, currently Mumias Sugar Company is in financial crisis and in mid-2014 received Ksh 1 billion ($100 million) to save the company from closure.

Climate-Smart Agriculture is an approach that aims to increase agricultural yields, boost profits, reduce local pollution, address poverty, enhance climate resilience and reduce greenhouse gas emissions (FAO, 2013). Kenya leads the African continent in tea production and is a large exporter of coffee. It is also well known for floral exports, as well as other horticultural products including; green beans, onions, cabbages, snow peas, avocados, mangoes, and passion fruit (Horticultural Crops Development Authority, 2013).

Market opportunity analysis for clean technology shows that approximately $290 billion will be invested across 11 clean technologies in the next decade in East Africa. Of this market opportunity a significant portion is expected to be focused in Kenya.Wastewater, small hydro, solar PV geothermal and water are top five clean technologies to be adopted in East Africa. In Kenya a survey of 50 clean technology firms suggest that majority are in renewable energy as shown below: 87% renewable energy, 46% energy efficiency, 28% - sustainable agriculture, 26% - waste management & Purification.

Drivers and challenges of Green global economy

The global economy is almost five times the size it was half a century ago. This economic growth resulted to unprecedented environmental damage over the years with an estimated 60 per cent of the world's ecosystems having been degraded. The reality is that significant scarcity of key resources such as oil could be less than a decade away (Science and Environment. Policy,2011). This reality is causing governments, communities, private investors, entrepreneurs to explore green initiatives especially in clean technologies.

The realization that it is much smarter to anticipate and address climate change impacts and build resilience up front than to simply respond to the human and economic costs after impacts occur is also a driving force to green actions. This implies that that the cost of taking action today is much less than the costs of inaction. According to an analysis by the US Geological Survey and the World Bank, an investment of $40 billion to reduce disaster risk could prevent disaster losses of $280 billion (Caring for Climate Report, 2011).

The ability of clean technology to foster job growth and stimulate innovation makes it particularly relevant to developing countries and more so in small and medium enterprises. Clean technology is a growing employment sector globally and green jobs compare favorably to jobs in other sectors further they tend to be more skilled, safer, and better paid (Infodev, 2013).

The main drivers for this clean technology growth particularly of Waste to Energy (WtE) could be summarized as increasing waste generation, high energy costs, growing concerns of environmental issues, and restricted land filling capacities. The Rapid growth in the clean technology industry is partially also attributed to the reduced cost of wind and solar power combined with more generous subsidy programs from various governments. Further clean energy technologies have experienced remarkable cost reductions, due to among others adoption by many countries of clean energy policies and frameworks over the past decade, growth in emerging markets, beneficial economic stimulus packages favoring clean energy investment and rising costs of fossil fuels.

Greening the world requires extraordinary levels of cooperation, collaboration and resource mobilization among governments, businesses, civil society groups and communities themselves. Due to the reality that climate change affects all globally though the effect is more serious in developing countries has resulted in more cooperation, collaboration and resources mobilization globally. The private sector has much also to contribute to the development and implementation of climate change adaptation solutions, for instance through sector specific expertise, technology, significant levels of financing, efficiency and entrepreneurial spirit. Companies that carefully assess climate change risks and opportunities and implement creative solutions to climate change will create business value while making important contributions to green growth and eventually green global economy (caring for climate report, 2011).

Despite the opportunities in clean technologies, the unique character of investing in clean technology is high upfront capital requirements and longer payback periods for investors. This means it has greater difficulty attracting venture capital and requires more public investment than traditional sectors. This investment obstacle is even more pronounced in developing countries where payback scenarios are more uncertain and SMEs and new ventures are riskier.GDP has been an 'unreliable compass' that has guided the world into the current economic and environmental crisis, this because there are many aspects of wellbeing it does not measure, including; environmental conditions (both current and future), individual income, health and education. GDP measures the flow of goods and services produced within a national market. Further it is regularly used by Economists, politicians and the media as a representation of overall progress, however, it is a measure of economic activity not economic well-being. To use the analogy of an electric meter in a building, the assumption that increased GDP means increased well-being is comparable to saying that the more electricity used by the building, the better the quality of life for people living in that building (science and environment policy, 2012). However, previous research indicates that, beyond a certain threshold, increase in GDP may have a negative effect on well-being.

This argument brings to right the fact that continued use of GDP as a measure overall progress of global economy will be a stumbling block to adoption and exploitation of clean technologies opportunities. Despite multitudes of global environmental agencies and programs, environmental deterioration Continues Unabated, this can be attributed to weak global governance mechanisms towards green economy. Indeed, many contemporary global environmental policies have a built-in failure as they simply shift the problem, rather than address it head-on. For example, the UN's Clean Development Mechanism (CDM) allows parties to meet their emission reduction targets by funding environmental projects in other countries more so in developing countries. This results to locking developing countries into the same environmentally problematic, western paths of development. To promote a global green economy, policy will have to begin by recognizing how much resource extraction and waste production can be accommodated by natural systems, and then restructure economic activities accordingly. This requires analyzing the scale of emissions and waste streams that natural systems can cope with, and constrain economic activities according to these limits(Science for Environment Policy, 2011).

Conclusion

The Green investments in clean technologies are happening everywhere both in developed and developing world. These investments are being made all over the world to shift from finite and costly fossil fuels to renewable sources with the aim of avoiding the disastrous consequences of climate change moving forward. China is leading in terms of the rate at which it has grown particularly in solar production. The European market share is projected to fall as North America and other Asian markets continue to grow. Africa's renewable energy power potential is substantially larger than the current and projected power consumption of the continent. The moment is right for a rapid scale-up of renewable energy in Africa. If developing countries rely more on renewable energy, they will spend less on importing petroleum and reduce poverty greatly.

References

Aparisi, T.D. and Ekins, (2015). Science for Environment Policy: Exploring the Links Between Energy Efficiency and Resource Efficiency http://ec.europa.eu/environment/integration/research/newsalert/pdf/energy_efficiency_and_resource_efficiency_links_49si_en.pdf. Date accessed 19 August 2015.

Chandak. S. P. (2010). Trends in Solid Waste Management: Trends in Solid Waste Management: Issues, Challenges and Opportunities Issues, Challenges and Opportunities. International Consultative Meeting on Expanding Waste Management Services in Developing Countries, Tokyo, Japan. http://www.un.org/esa/dsd/susdevtopics/sdt_pdfs/meetings2010/icm0310/1a_Surya_Chandak.pdf . Date accessed 19 August 2015

Dutz. M. A. &Sharma.S. (2012). Green Growth, Technology and Innovation: The World Bank Poverty Reduction and Economic Management Network Economic Policy and Debt Department https://search.yahoo.com/yhs/search?hspart=mozilla&hsimp=yhs-006&ei=utf-8&fr=ytff1-ff24&p=Dutz%2C%20M.%20and%20Sharma%2C%20S.%20%20%282012%29.%20Green%20Growth%2C%20Technology%20and%20Innovation%20pdf&type= Date accessed 19 August 2015.

Eurostat (2013): http://epp.eurostat.ec.europa.eu/portal/page/portal/waste/introduction/Radermacher. The EU in the world 2013A statistical portrait.

http://www.effra.eu/attachments/article/137/The%20EU%20in%20the%20World%202013_A%20Statistical%20Portrait_Eurostat_2013.pdf. Date accessed 19 August 2015.

Frost & Sullivan (2011). Key opportunities in waste to energy plant market (technical insights). http://www.marketresearch.com/product/sample-6357606.pdf Date accessed 20 August 2015.

Hill, J. (2012). World Solar PV Market Grew Considerably in 2011, UNDP Articles and Excerpts that Illustrate Green Economy and Sustainable Development Efforts. http://cleantechnica.com/2012/03/19/worldwide-solar-pv-market-grew-in-2011/Accesses on 19 August 2015.

IISD, (2015) .Rwanda Identifies Green Opportunities. Retrieved from http://climate-l.iisd.org/news/world-bank-identifies-clean-tech-market-opportunities-for-smes/ Date accessed 7 August 2015.

IRENA.(2009). Africa's renewable future. The path to sustained growth. http://www.irena.org/DocumentDownloads/Publications/Africa_renewable_future.pdf Date accessed 19 August 2015.

IRENA. (2013). Africa's renewable future. The path to sustained growth

Mavropoulos,Alexandros (2012).International Scenario in Waste and e-Waste Management,D-waste. http://www.d-waste.com/presentations/international-scenario-in-waste-and-e-waste-management-detail.html#.VdS1BLU6AjE. Date accessed 19 August 2015.

N.a. (2011). A Caring for climate report Adapting for a Green Economy Companies, Communities and Climate Change

Sangeeta Haindl(2012). China Spending on Social Innovation to Become World First Green Superpower ,UNDP Articles and Excerpts that Illustrate Green Economy and Sustainable Development Efforts

Supporting report 3: seizing the opportunity of green development in china http://www.worldbank.org/content/dam/Worldbank/document/SR3--229-292.pd. downloaded on 17th august 2015

Terdiman. M. (2012). The Launch of the Green Economy Initiative in the UAE .

https://muslimenvironment.wordpress.com/category/articles/the-launch-of-the-green-economy-initiative-in-the-uae/. Date accessed 19 August 2015.

UNDP Report, (2012) Green Economy in Action: Articles and Excerpts that Illustrate Green Economy and Sustainable Development Efforts.

http://www.un.org/waterforlifedecade/pdf/ green_economy_in_action_eng.pdf. Date accessed 13 July 2015.

World Bank. (2012). What a waste: a global review of solid waste management. Urban development series knowledge papers. http://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/336387-1334852610766/What_a_Waste2012_Final.pdf. /. Date accessed 19 August 2015.

World Economic Forum Report. (2013). The Green Investment Report The ways and means to unlock private finance for green growth; A Report of the Green Growth Action Alliance.

http://www3.weforum.org/docs/WEF_GreenInvestment_Report_2013.pdf Date accessed 19 August 2015.

World energy council (2013) seven billion waste to energy http://www.worldenergy.org/wp-content/uploads/2013/10/WER_2013_7b_Waste_to_Energy.pdf. Date accessed 19 August 2015.