

TOWARDS GREEN ICT DRIVEN ECONOMIES: ASSESSING THE GOVERNMENTS ROLE IN GREEN ICT ADOPTION

¹Njeru Mwiti Kevin, ²Zipporah Munene, ³Mwangi Robert Kimani, ⁴Kevin Murithi Njagi, ⁵Bildad Mbagara, ⁶Kaaria Karwitha Joy

¹Department of Information Technology, Mount Kenya University

²KCA University, Department of Information Technology

³Department of Information Technology, Mount Kenya University

⁴Department of Information Technology, Mount Kenya University

⁵Mount Kenya University, Department of Information Technology

⁶Mount Kenya University, Department of Information Technology

ABSTRACT

This paper analyzes the role of the government in establishing green ICT within organizations. Looking at the practices currently adopted by governments, this paper identifies some of the most important areas through which the low carbon value added by new technologies could be increased. Drawing on evidence from other countries around the world, practitioners and from the academic community we can see that there are similarities between the approaches taken by a number of governments, but we can also see that this area of activity will need to be context-specific as well. As we move forward, areas of focus will become more obvious for particular countries and regions, where they have a unique role to play and can add more value. We achieve this by adopting two approaches. One is by investigating what other countries have done as regards to entrenching green ICT in their countries, second was by an analysis of the Kenyan context which took a case of the Kenyan government's ministry of Information Communication Technology (ICT) and the national environmental management Authority (NEMA) to find out the extent of government support for businesses and the implementation of Green ICT within the core functions and departments of the organization. Data collection was then carried out within two major ICT consumer companies to find out the level of green ICT adoption within them and the way forward, as well as gauge the level of user awareness on green ICT concepts. The paper concludes by making recommendations which could help the government to invest more on green ICT, develop a green ICT policy to guide in green ICT adoption and support for organizations implementation of green ICT.

Keywords: Green ICT, Regulations, Greenhouse gases (GHG)

1.INTRODUCTION

The potential to make our factories, office buildings, transport systems and energy use much more efficient by the utilization of information and communications technologies (ICTs), has been increasingly acknowledged and quantified during the past five years [1]. An increasing number of governments are seeing ICTs as a critical component of their strategies for tackling environmental problems. Governments have widely acknowledged the important contribution of ICTs in reducing CO₂ emission and energy consumption in households [2]. ICT is the critical enabler that will allow governments to take advantage of the opportunities in today's hyper-connected, integrated and information-rich world to create responsive 21st century State Services. The future for government ICT is envisaged as information-centric rather than the technology-centric model of today, transcending agency boundaries to deliver smarter customer-centered services [3].

From simple data input and processing tasks in an organization, to communication via mobile devices through manufacturing, product design and engineering, transport control and management systems through accounting and finance functions, the enabling role of ICT cannot be underestimated. ICT permeates every level of an organization and government. Its integrating and enabling capability of individual, business and government functions makes it one of the most essential technologies of our times. Unfortunately, progress in Information communication Technology (ICT)

comes at a price as ICT is a major user of energy and natural resources. It is also estimated that ICT contributes about 2-3% of the global greenhouse gas (GHG) emissions [4]. Reducing this ICT environmental footprint is the major aim of green IT/ICT. And hence, every effort should be made to reduce the environmental footprint of ICT in our economies.

The integrating and enabling role of ICT also provides an avenue where ICT can be applied as a solution to reduce the environmental footprint of other economic and social factors. This is estimated to about 97/98%. This concept is referred to as green Information systems (green IS), or greening by IT. Hence green IS aims to apply the innovative power of IT as a solution to the global environmental pollution and GHG emissions [5]. Consider this, major economic drivers such as transport, energy, manufacturing, and construction contribute heavily to the environmental pollution. How therefore can we apply ICT in these areas for a better cleaner environment? Various terms from green construction, green manufacturing, green energy and green transport have been coined.

Consider the case for green construction for example. In 2009 When the United Nations outgrew the office accommodation at its 140-acre Gigiri compound in Nairobi, it was clear that they needed a building and any new building had to meet several challenges head-on. It needed to be energy and water efficient, to reduce and recycle, and to maximize sustainability without compromising the quality of the working environment [6]. The chief head of facilities describes the building as a “showcase for sustainability and a huge enhancement of the working environment”. The new building he notes:

“But the new building takes environmental sustainability to a new level. Solar panels cover the roof space, automated low energy lighting illuminates workspaces, and energy efficient computers sit on desks. Rainwater is collected from the roofs to feed the fountains and ponds at the four entrances and sewage is treated in a state-of-the-art aeration system and recycled to irrigate the beautifully landscaped compound. Water saving lavatories, a central atrium and light wells in every office zone, together with an inventive design that maximizes cooling natural airflow through the building, all contribute further to sustainability. And far from compromising the working environment, the new building and its environmentally responsible features are acknowledged to be a huge enhancement of the surroundings and comfort in which its new occupants work.” [6]

What this demonstrates is that there is always a more environmental friendly way of doing things. Truth is that investing in environmental friendly systems comes at an initial cost, but in the long run the cost is lower for both the business and for the environment [7]. The use of ICT to build a low carbon future for our governments and societies offers a unique opportunity. Keeping up to date with technological developments and its ability to support innovation will deliver environmental, societal and economic benefits for both present and future generations [1].

Government agencies therefore should lead by example by setting a target in reducing use of materials and establishing necessary procedures, such as introducing travel substitution and more videoconferencing; create right financial incentives to encourage the development of private sector specialized in green products and services; encourage green ICT procurement by the public and private sectors and Raise awareness on market potentials for green ICT among the private sector companies [8]

Research questions

The study comprised of 3 research questions

- 1.What global trends as regards green computing public policy exists
- 2.What areas does the current ICT policy in Kenya cover as regards green ICT
- 3.What is the current status of green computing implementation in Kenya

2.METHODOLOGY

To be able to answer the research questions appropriately, this research employed the following methodology

Questionnaire administered to employees of two heavy ICT consumer companies in Kenya.

Interviews a group of 4 respondents participated in 20-minute in-depth interview. These individuals included a manager of a leading supermarket in the country, a bank manager, a ministry of Information communication Technology (ICT) in Kenya official and a National environmental management Authority (NEMA) official.

Document Review: this included previous research especially documents relating to green computing from other countries to identify what they have done and highlight issues that Kenya as a country can adopt. A review of Kenyan government policy documents to find out the extent of government involvement in green computing was also done.

In both questionnaires and interviews, respondents were asked to outline the Green ICT adoption states within their companies, and to describe the role and support the government was playing in facilitating the adoption of Green IT, as well as their organizations' outlook, attitudes, and reasons. They were also questioned about the state of environmental issues and action in their business practices and within the government, organizational culture as regards best environmental practices, the state of ICT in the country and the way forward. Data analysis was done based on the collected data. It comprised of the current state of green computing in Kenya, global trends in green computing and the organization view of green computing

3.LITERATURE REVIEW

Government and sustainability

Many governments are introducing aggressive environmental policy, encompassing everything from greenhouse gas reduction and natural resource protection to clean power initiatives and incentives for energy efficiency [9]. The threat posed by uncontrolled environmental usage has amplified the role of the government in facilitating proper usage of the environment and management of the limited natural resources. According to research, a more resource efficient and Green Economy provides the framework for a stronger and more sustainable business approach, at the heart of which lies the necessity to ensure sustained financial growth over the long-term. A Green Economy requires step changes in resource efficiency, investment in clean technologies, the development of alternative products, services and materials, and the ability to obtain value from unavoidable waste [10]. This means that enhancement of environmental friendly business practices goes behold the question of governments trying to legislate to a drive by organization trying to find better ways of doing business, cutting on their operation costs, offering more environmental friendly products and services to their customers which in the long learn gives these businesses a competitive advantage [11].

A number of government and non governmental institutions are providing guidelines for implementation of green ICT [12]. This means that the government has a lead role in providing the necessary legislative frameworks that are essential to guide organizational implementation of green ICTs. It should be noted that the core drivers of green ICT implementation are factors external and internal to the organization. These include and are not limited to government legislation, customer demands, competitors, technological changes and a desire to lower costs [13] [14]. At the same time, the recognition by organizations that greening their operations (green IT) is not a cost [13] of doing business but rather it can be a means by which organizations can be able to lower the cost of production [10] [7] will push many firms to adopt green ICT.

It should be noted that this paper considers green IS and green IT to be two different concepts within the same context. We adopt the argument of [5] [15] [16] [13] that Green IT is a component of green IS. Green IT (greening IT) focuses on the energy efficiency and equipment utilization of computers and related systems. Green IT aims at reducing the carbon footprint of IT. Green IS in contrast tries to find the innovative ways in which computers and information systems can be used to reduce the environmental footprint caused by other factors outside IT. Energy efficiency means using less to provide the same service whereas carbon footprint is defined by [4] as “the measure of the environmental impact of an individual or organization’s lifestyle or operations measured in terms of units of carbon dioxide produced” The UK government was one of the first governments to seriously take steps to green its ICT in 2009. The Greening Government ICT strategy of the UK government sets out the first steps of the government to reduce its carbon footprint. “We are the first government in the world to look at our ICT in this way and we want to see changes taking place immediately. We want to see best green practice throughout government - computers switched off overnight, printers defaulting to duplex, data centers efficiently cooled. The good news is that we are not alone in aiming for these goals. There is already a great deal of activity in departments and within industry and we will be working with our suppliers to ensure that action is taken immediately. [17]” to show the impact of simple green ICT strategies, the report notes that “turning off just one computer overnight can save 235kg of CO₂ in a year. Over the whole estate the potential is enormous – turning off 500,000 computers at night would have the same effect as taking 40,000 cars off the road.” This therefore shows that there should be no excuse for not adopting green ICT measures and underpins the potential environmental savings within the ICT sector.

In 2011 March, the UK government launched the greening government commitment to ensure that by 2015 the government will have made substantial reductions in waste generation, water use and greenhouse gas emissions [18] with a vision to provide a cost effective and energy efficient ICT estate, which is fully exploited, with reduced environmental impacts to enable new and sustainable ways of working for the public sector. The Greening Government: ICT strategy“ describes how government ICT will contribute to those commitments and deliver financial savings in addition to efficient, green practices. It sets out the green ICT commitments and actions that central government departments, their agencies and arms length bodies, will take over the next four years. Aligning with the Government’s transparency and efficiency agenda, it recognizes the importance of clear reporting against them and sets out how government will measure progress by departments, and aggregating this to give a whole of government report on an annual basis.” The strategy sets out how ICT can be exploited to assist the government in achieving the Greening Government Commitments, in a set of Green ICT commitments and environment. It defines how these commitments can be met through the adoption of green ICT principles and practices across the Government ICT Strategy and in its design, delivery and implementation phases as shown in figure 1 below.

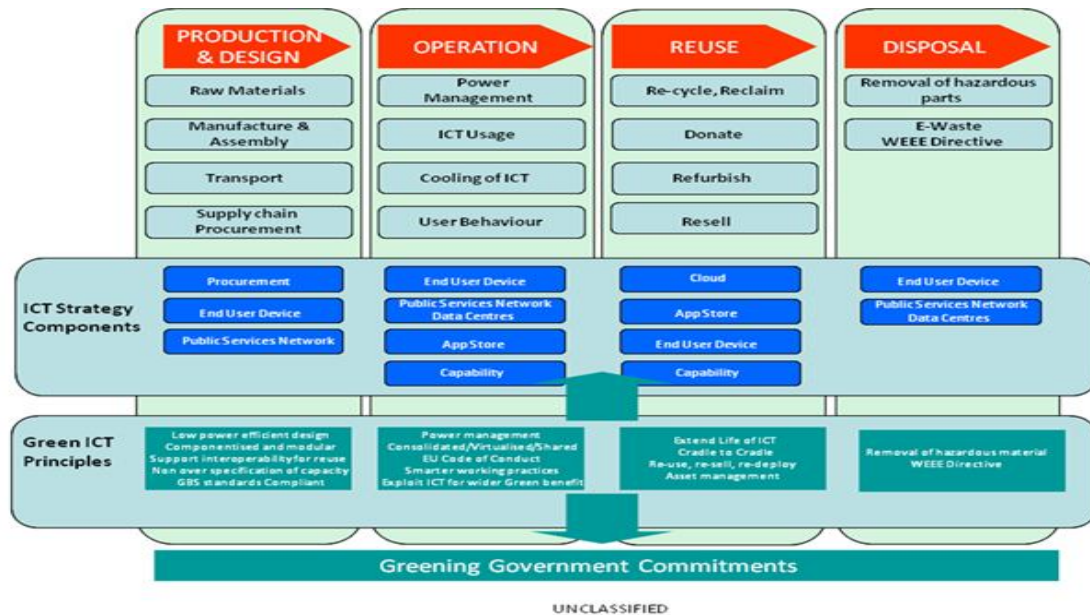


Figure 1: greening government strategy components: adopted from [18]

4.ECONOMIC SUSTAINABILITY AND THE ENVIRONMENT

Environmental factors are acting as constraints in production, particularly in the agricultural and energy sectors, heavily dependent on these resources. This confirms that business as usual over the long-term is simply unviable. Companies acting ahead of the game will be able to tap into most of the opportunities available, sustain growth and adjust to changes to the regulatory environment which, in turn, is responding to the growing evidence of environmental degradation

According to [19] the reduction of subsidies for GHG-related activities in various sectors can achieve emission reductions, depending on the social and economic context. While subsidies can affect emissions in many sectors, most of the recent literature has focused on subsidies for fossil fuels. Since a small but growing literature based on economy-wide models has projected that complete removal of subsidies for fossil fuels in all countries could result in reductions in global aggregate emissions by mid-century. Although political economy barriers are substantial, some countries have reformed their tax and budget systems to reduce fuel subsidies. To help reduce possible adverse effects on lower-income groups who often spend a large fraction of their income on energy services, many governments have utilized lump-sum cash transfers or other mechanisms targeted on the poor [19].

Green ICT means a shift to encouraging close level community and economic integration as opposed to international trade as much as possible. By encouraging the sourcing of raw materials, products and services locally, we reduce on travel which in return cuts on the CO2 emissions in the environment as a result of burning of fossil fuels. The introduction of green ICT within firms would end up transforming the traditional firm into a digital organization or even government which in return would improve the delivery of products and services to consumers and citizens efficiently and at the same time cut on costs at each of these levels. The integration of business functions into simple coherent systems such as Enterprise resource planning systems will be the greatest win for the environment: the result will be reduced consumption of paper based documentation as more and more documents can be transmitted and stored online; eliminating the need for travel as discussed above: it also means video based conferences will be preferred as opposed to having to travel to attend business meetings and such. This in turn results in lower product costs, a better and cleaner environment and increased revenue for organizations. The major drive for organizations adoption of information systems and ICT is because of the benefits in terms of increased revenue, better customer service, lower production cost and better decision making support [20]; however, green IS goes behold the quest for higher quest by firms to improve their revenue [21] to viewing green initiatives as a tool of corporate social responsibility.

While organizations implement green ICT as a means to cut on cost, government's implementation is driven by a desire for a cleaner environment for its citizens and to establish standards for other organizations to follow. In some cases and especially in developing countries, implementation of green ICT by governments could provide a low cost operating environment for the delivery of public services to the citizens in addition to some other major benefits. What this means is that benefits that come with green IT should not be the major drive for green ICT implementation by both organizations and governments.

The question therefore is, if green ICT offers all these benefits to firms and governments, and the environment, why are firms as well as governments not implementing it? We seek to discuss this in our findings.

The transition to a Green Economy is not an easy path however. It is characterized by step changes in resource efficiency and a shift in emphasis from shareholder value to stakeholder value. Some companies, and perhaps whole industries, will not survive the transition. Success over the long term will require new skills, diverse collaborations, continuous innovation, investments with uncertain returns, and a change in what the market values. Companies, like governments, will need to choose wisely if they are to capitalize on the opportunities it brings [10]. What this means is that these benefits are not a clear – cut thing and hence organizations should evaluate their readiness for green ICT before adoption. Models to access green ICT readiness already exist as proposed by [22] [23].

5. BUSINESS CASE FOR GREEN ICT

Today, companies around the world are looking at ways to implement ICT solutions to both improve their own productivity and provide new sustainable offerings to their clients, and are realizing significant benefits in the process [1]. Global bodies, government agencies and non-governmental organizations have set themselves the goal of identifying and accelerating scalable ICT-enabled energy solutions and helping policymakers to shape the strategies and policies to support businesses in implementing more energy efficient systems.

Green Information systems (ICT applications) can reduce the environmental impact of organizations. This includes ICTs for new way of production and collaboration like teleworking and teleconference applications, cloud computing, supply chain integration or moving businesses and governments to the Internet (e-government, e-business, and e-commerce) [2] [11]. Yet not many businesses seem to fully adopt and integrate ICT solutions such as teleworking and teleconferencing in their operations. [6] for example in their report noted that much of the organization's (UNEP) carbon emissions amounting to over 70% is caused by travel, and hence they adopted teleconferencing as opposed to travelling and reduced travel to the most essential cases in order to cut on this amount. Adopting such technologies should not be viewed as a cost for businesses [24] but rather, it offers many benefits to organizations including lower costs of production [11], increasing revenue and better environmental practices which are essential in enhancing the corporate social responsibility position of a company. However, the potential cost savings of green IS applications, such as videoconferencing resulting from local and trans-border travel reductions cannot be realized without having adequate infrastructure to make a conversation effective enough to make it a viable substitute hence global governments have the responsibility of laying down the necessary infrastructure to support business initiatives.

“Sustainability has worked on corporate social responsibility, we have witnessed time and again the multiple ways that sustainability delivers business value to companies that adopt it as a strategic principle” [19]. There is therefore no doubt that there is a clear business case for an economy that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. The long-term prosperity of businesses is tied directly to our ability as a society to make the transition. Critical choices need to be made now, to decouple economic growth from environmental impact and resource use, to prepare for the economic reality of tomorrow, and to enable business to seize the scale of the opportunity.

In the findings of UNEP on a report titled ‘business case for green economy’, [10] notes that as we switch to a more resource efficient and green economy, one where economic growth, social equity and human development go hand in hand with environmental security, business and industry will be a key driving force. This statement is two-fold; it highlights the key role that businesses have on sustainable development and also enhances the regulatory role of governments in ensuring that businesses and industry are just in the use of natural resources. That the drive to make profits does not overshadow their critical role in ensuring the protection of citizens as regards provision of a clean environment.

The economic benefits of green economies is highlighted by [10] in its argument that “businesses cannot afford to ignore the benefits that a green economy will bring”. The report gives examples from case studies of organizations like PUMA, Equity bank Kenya, Unilever and Colombian coffee growers corporation, firms they argue that by investing in green strategies, have been able to reap big in terms of savings and revenue some amounting to hundreds of millions of dollars. Organizations therefore need to step up and show the role they can play in generating decent jobs, in developing energy efficient technologies and industrial processes, in greening their supply chains and in integrating environmental, social and governance principles throughout their lending, investment and insurance decision-making.

Some of the benefits highlighted include: more resilient supply chains, New investment opportunities, Increased consumer demand for sustainable goods and services, Sales growth and duration of sales, Training and job creation, Reduced dependency on natural resources and Mitigation against the negative financial risk from environmental impact [10].

6. DISCUSSION OF FINDINGS

State of Green Economy in Kenya

The Kenyan Government has implemented electronic systems in various State Departments and other state-owned institutions. These include national tax systems, immigration information system, legal information system, the integrated financial management system and education system. Most of these systems are to be found in the National

Treasury, Kenya Revenue Authority, Home Affairs State Department and Immigration Office. In addition, information is manually exchanged by and between departments and institutions using fax, e-mail and electronic media [25]. The Kenya ICT master plan identifies ICT as a critical tool in Kenya's vision of a knowledge based economy, which aims at shifting the current industrial development path towards innovation where creation, adoption, adaptation and use of knowledge as the key source of economic growth.

In a green assessment report of the Kenyan economy, United Nations Environmental programmes (UNEP) notes that "Kenya has one of the most dynamic economies in Africa, yet it is facing a number of pressing economic, environmental and social challenges. From climate change and natural resource depletion to high poverty rates and rising unemployment, the country is addressing these concerns through its commitment to a low-carbon and resource-efficient development pathway." The report continues to argue that Kenya has adopted several green economy-related approaches and policies, which include implementing renewable energy feed-in tariffs in 2008, embedding sustainable natural resource utilization into its 2010 Constitution and mainstreaming green economy in its Second Medium Term Plan [26]. However, the report continues to note that there is still untapped potential to pursue a development pathway that will create green jobs, accelerate poverty reduction, support sustainable growth and restore environmental health and quality. This point to the fact that we cannot be able to separate the social well being of a people, businesses and economy without considering the well being of our environment.

Efforts by Kenya have been driven by a number of pressing economic, environmental and social concerns such as the increasing rural to urban migration need for job creation for youth, and degradation of valuable ecosystems. In response to this, the government has established key policies and programmes for a green economy including:

Developing a national climate change response strategy and action plan, and seeks to embrace a low-carbon development pathway that is inclusive and equitable, and contributes to its global competitiveness.

Through the Greening Kenya Initiative (GKI), the government has developed a database on green economy activities, which highlights efforts on the manufacturing of eco-friendly materials, tree planting, organic farming, fish farming, renewable energy, eco-labeling, solid waste management and environmental management, among others.

The country's long-term development blueprint, Vision 2030, launched in 2008, aims to transform the country into an industrialized, middle-income country, providing a high quality of life to all its citizens in a clean and secure environment [27].

The Constitution of Kenya 2010, in Article 42, recognizes a healthy and clean environment as a right and calls for sustainable exploitation, utilization, management and conservation of the environment and natural resources [28] [26].

The government of Kenya Medium-Term Plan (2013-2017) which has endorsed the development of a comprehensive national green economy strategy [25]. It is important to note that lack of a government green ICT strategy has been identified as one of the major reasons for the slow adoption of green ICT within the country by this research.

The UNEP report [26] concludes that country's Green economy-related investments in the agriculture, energy, manufacturing and transport sectors could help lower energy consumption and carbon emissions. "While CO₂ emissions are projected to increase from 12 million tonnes per year in 2012 to 24.35 million tonnes per year in 2030 in the agriculture and energy sector alone, under a green economy scenario, emissions would be approximately nine per cent lower than BAU investment scenario (26.7 million tonnes)."

7. Business View of Government adoption of Technology

In 2006, a UK study investigated companies' perception of government procurement and technology adoption. Four areas were identified where the government was regarded as a problem. First, companies do not believe that the government fosters innovation; it does not engage to define solutions and is not an early adopter. Smaller companies in particular identified lack of innovation, lack of engagement to define the problem, late adoption and lack of skills as some of the major problems in relation to the government [29]. The report concludes that as long as public procurement does not support greening with ICT it will be very difficult to deliver concrete results, regardless of general policy statements. In order to speed up the adoption of green ICT the report suggests that an increase in public transfers for developing and implementing green ICT products and solutions. It recommends the following policy measures:

-Conditioning public procurements and businesses, entrepreneurship benefits and high risk investments on their greenness and use of green ICT solutions.

- Budget funding of exemplary, pioneering, visionary and inspiring green ICT products, services, solutions

What this demonstrates is the issues that arise in relation to government functions. An introduction of ICT would greatly booster a public confidence in governments from how procurement is performed is performed to manufacturing, human resource and supply chain integration within the government.

Great strides have been made by the Kenyan government in relation to ICT deployment and usage within the government and in the private sector. In 2009, as a means of entrenching financial accountability within government by automating and integrating public financial management systems which facilitate efficient and effective execution of the financial management process, eliminate risk and enhance security and financial controls in all service areas. According to officials from the ministry of finance, the implementation of the IFMIS facilitated a faster transaction processing cycle after the inclusion of six modules that reengineered the system.

8.ENVIRONMENTAL POLICIES AND FRAMEWORKS IN KENYA

Kenya Vision 2030 is the new long-term development blueprint for the country. It is motivated by a collective aspiration for a better society by the year 2030. The aim of Vision 2030 blueprint is to create “a globally competitive and prosperous country with a high quality of life by year 2030” [27]. The Vision is anchored on three key pillars: economic; social; and political governance. Of importance to this research are the economic and social pillars. On the social pillar, environmental protection is identified as key to the achievement of the major aspiration of vision 2030. The blueprint notes that Kenya aims to be a nation that has a clean, secure and sustainable environment by 2030. “This will be achieved through: promoting environmental conservation to better support the economic pillar’s aspirations; improving pollution and waste management through the application of the right economic incentives; and improving the capacity for adaptation to global climatic change.

On the economic pillar, the role of ICT is identified with the aim of making the country a top off shoring destination in Africa. On this, the country aims to attract at least five major leading information technology (IT) suppliers, and at least ten large multinational companies and global BPO players to the country. Target areas of ICT adoption and usage within the policy document include also the Installation of effective ICT infrastructure in all security agencies to aid in crime detection, prevention and investigation and the establishment of ICT parks in the country with the flagship project being KONZA techno city [27].

It is evident from this that investment in ICT and related infrastructure is expected to grow rapidly as the country moves towards implementing vision 2030 projects. With these heavy investments, the environmental footprint of ICT in Kenya is expected to increase rapidly as more ICT investments are made by 2030. With this, it is our argument that an analysis on the overall impact on the environment, for a country that aims to provide a better cleaner environment for its citizens, should have been made and mechanisms adopted even through proposed legislations to minimize the ICT environmental footprint. These legislations would provide guidelines for purchase, use and disposal of obsolete computing devices hence minimizing its impact to the environment as possible.

While developing its green ICT policy, the government of Estonia found that as much as the companies within the country were innovative, there were various obstacles that constrain wider and more pervasive development and adoption of green ICT in Estonia: low awareness, uncertainty concerning advantages, constrained cooperation, scarcity of financial resources [29]. Policy recommendations to ease and overcome these constraints were made including: Raising awareness about green ICT by compiling green ICT products and solutions databases, consulting businesses on green ICT, and acknowledging and inspiring companies with green ICT award; Clarifying the advantage of green ICT by reviewing and developing green ICT auditing and evaluation methodology, doing follow-up study of greenness of green ICT solutions, and disseminating the best practice of evaluation of greenness of green ICT; Advancing cooperation by initiating public-private partnership in developing and implementing exemplary green ICT solutions, greening ICT and other technology clusters, and clarifying the limits of cooperation and Increasing funding by conditioning public procurements, grants, investments on greenness and use of green technology, including green ICT, and allocating resources for public-private partnership projects for developing green ICT solutions. Several governments, Kenya included can learn a lot from this regarding measures they can take to facilitate adoption of green ICT in their economies.

9.GREEN ICT IN KENYA

The study found that the green ICT attitude level of organizations was very low in Kenya as compared to other countries such as the Germany, EU, OECD countries and Australia. This is in contrast to the fact that Kenya has been on the forefront when it comes to research in the area of adopting green strategies and environmental sustainability, but has been slow in moving towards green ICT. Prior research shows that the awareness and adoption of green ICT in the country is very low [30]. While there seems to be heavy investments in ICT within firms and the government, very few controls exist on how these computers are used within both private and public organization. Most of the Kenyan government programmes cover the areas of reuse and disposal, ICT diffusion, and skills and awareness, with many having multiple objectives ignoring other critical areas of ICT lifecycle. For example, a study on green ICT in OECD countries found that most governments focus on development and promotion of Green ICT standards and labels indicating the resource efficiency of ICTs, and increasing energy cost transparency (e.g. the multi-stakeholder task force of the Global e-Sustainability Initiative). These governments efforts also include increasing energy efficiency of data centers through virtualization for server consolidation and improved power and cooling systems (e.g. The Green Grid). Furthermore, they include green procurement of recyclable, reusable, and energy efficient ICT components. Green purchasing also applies to end-users (e.g. myGreenElectronics.org of the Consumer Electronics Association). A few initiatives promote ICT applications such as energy saving tools or tele-working [2]. In Kenya, few initiatives seem to focus on optimizing the ICT value chain and even the adoption and use of energy efficient computers, and mainly cover reducing energy consumption and resource use in ICT supply chains, production and distribution. A majority of Kenyans however seem to agree that the government plays a great role in the adoption of ICT within their organization as shown in figure 1 below

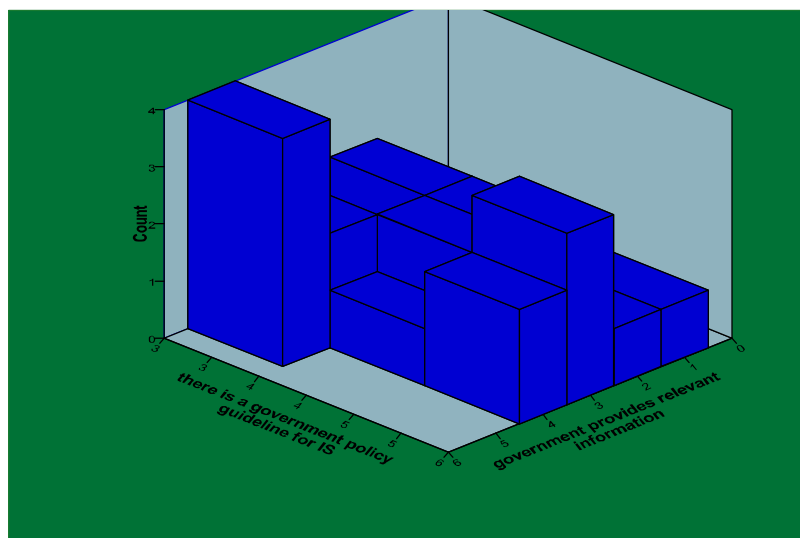


Figure 2: perception of government role in green ICT adoption

Kenya is not alone in this, while most policy makers, major studies and business groups clearly state that the greening with ICT is significantly more important, the actual programs and policies in countries, NGOs’ work, research at universities, business initiatives etc still focus on the direct effects. In fact, prior research has shown that most organizations and governments globally seems to focus more on greening ICT (green ICT) rather than greening with ICT/IT (green IS) [29] [11]. It should be noted that as argued above, greening ICT just solves a small portion of the global carbon footprint because the ICT carbon footprint is only 2-3%. The Kenyan Government has adopted a range of ICT and the environment policies, covering innovation, ICT adoption, ICT application, usage, education on ICT and the environment and the disposal of obsolete computing devices.

Areas of waste that can be directly addressed to bring in immediate benefits not just in reducing CO2 emissions but also direct savings were identified. These areas involve direct application of ICT as opposed to the current way of doing things; eliminating travel and reducing it to the most basic especially within the government, encouraging organizations to develop internal green ICT policies and strategies and the environmental authorities developing inherent policies for acquisition of computers and the disposal of obsolete computers.

To test on power saving, the respondents were asked on how frequently they use power saving options on their computers, the results are shown in figure 2 below

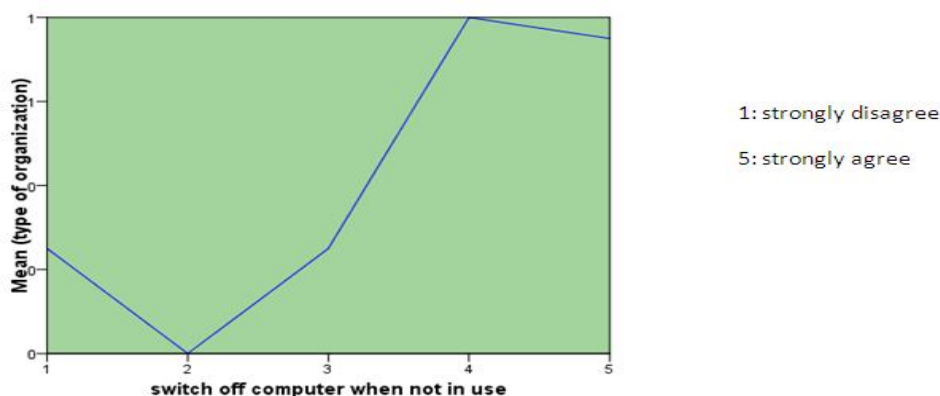


Figure 3: Green IT in organizations. 0 for public, 1 for private organizations

It should be noted that simple green computing good practices such as switching off the computer can go a long way in enhancing energy savings [11]. From the results, very few individuals in both private and public organizations performed simple basic green ICT tasks. This collaborates prior research by [31] which identified the level of green ICT awareness in Kenya as being very low.

Regulations

Regulatory approaches and information measures are widely used, and are often environmental. Examples of such regulatory approaches include energy efficiency standards; examples of information programmes include labeling programmes that can help consumers make better-informed decisions. While such approaches have often been found to have a net social benefit, scientific literature is divided on the extent to which such policies can be implemented with negative private costs to firms and individuals [19].

In Kenya for example, various regulatory frameworks have been put in place by the government to help in the protection of the environment. Industrial leaders contend that the government has been supportful as far as legislative measures are concerned. As noted above, a majority of the respondents seemed to agree that the government plays a key role in the implementation of green ICT. Some of these key legislations include article 42 of the Kenyan constitution which states that “every person has the right to a clean and healthy environment which includes the right to have the environment protected for the benefit of present and future generations and article 70 which guarantees a clean environment as a claimable right by any member who feels that his rights to a clean environment have been infringed. This article states that “if a person alleges that a right to a clean and healthy environment recognized and protected under article 42 has been, is being or is likely to be denied, violated, infringed or threatened, the person may apply to a court for redress [28]. Other policies in Kenya include the controlled substances regulations, EIA regulations and the environmental management and coordination act of 1999 which established a number of environmental regulatory institutions such as NEMA, provincial and district environmental committees and the public complaints committee. It is also important to note that the ICT authority in Kenya proposes the development of a green ICT implementation strategy in Kenya [25]

In some countries, tax-based policies specifically aimed at reducing greenhouse gases (GHG) emissions alongside technology and other policies have helped to weaken the link between GHG emissions and GDP (high confidence). In a large group of countries, fuel taxes (although not necessarily designed for the purpose of mitigation) have effects that are akin to sectoral carbon taxes [2]. Some mitigation policies raise the prices for some energy services and could hamper the ability of societies to expand access to modern energy services to underserved populations (low confidence). These potential adverse side-effects can be avoided with the adoption of complementary policies (medium confidence). Most notably, about 1.3 billion people worldwide do not have access to electricity and about 3 billion are dependent on traditional solid fuels for cooking and heating with severe adverse effects on health, ecosystems and development. Providing access to modern energy services is an important sustainable development objective.

10. CONCLUSION

It is our inherent that the government has an important role in promoting green IS. „In the case of Kenya, it is our clear that the government needs to raise awareness about green ICT by compiling green ICT products and solutions database, consulting businesses and international organizations such as UNEP on green ICT, and acknowledging and inspiring companies with green ICT award. From our findings and even with support from other academic literature, the level of ICT awareness in Kenya and a majority of African countries is fairly low [30] [32].

It is clear that Kenya has made some great strides in greening its economy: from the adoption of geothermal, solar and wind energy to afforestation through to the provision of proper legislations to govern environmental management. However, in terms of green ICT, very little seems to have been done. And even where policies are in place, only a few of all government programmes and industry association initiatives have measurable targets and indicators to measure whether these targets are being achieved. For example, within the ICT master plan for 2014-2017, the only statement that touches on green ICT is found on page 39 “Environmental protection and conservation - All institutions involved in ICT Master Plan implementation to adhere to the green ICT concept by environmentally friendly equipments that are cheaper and easy to implement and ensuring there is no e-waste dumping.” This statement is to a large extent vague as very little in terms of policy exist to provide guidelines on green ICT within the Kenyan government. This puts the government on the spot in terms of providing guidelines for green ICT eight years since green ICT was identified as a major strategic technology in 2008. These findings reinforce an earlier research in the UK where private businesses accused the government of being a late adopter. Overall, much more needs doing to develop and apply clear and measurable policies and initiatives to improve environmental performance of ICTs, and to apply ICTs across the economy to tackle the challenges of global warming and environmental degradation. In particular, policies and initiatives can encourage improvement of environmental performance along the entire ICT life cycle and promote

On a global scale, the west seems to have made great strides with a number of countries having already developed their green ICT strategies/policies. These include Germany, UK, Uruguay, Newzealand, Denmark and Estonia among others.

11. RECOMMENDATIONS

Clarifying the advantage of green ICT by reviewing and developing green ICT auditing and evaluation methodology, doing follow-up study of greenness of green ICT solutions, and disseminating the best practice of evaluation of greenness of green ICT is an essential undertaking of every government. This may include developing a country policy for green ICT that can be implemented at government level and adopted within the private enterprises.

Advancing cooperation by initiating public-private partnership in developing and implementing exemplary green ICT solutions, greening ICT and other technology clusters, and clarifying the limits of cooperation. Increasing funding by conditioning public procurements, grants, investments on greenness and use of green technology, including green ICT,

and allocating resources for public-private partnership projects for developing green ICT solutions will go a long way in stamping the effectiveness and benefits of green ICT in the economy.

Raising awareness of green ICT in the country especially among organizations will be essential. Providing essential policy guidelines specifically targeting the broader green ICT practices is critical to the operations of the organization. Organizations too need to realize the economic potential of green IT.

ICT needs to be separated from other sustainability mechanisms and addressed by governments individually if efforts without bundling it together with other environmental protection areas. This is because green ICT is a multifaceted tool that tries to reduce the environmental footprint of ICT as well as provide solutions to other environmental pollution agents.

BIBLIOGRAPHY

- [1] KAREN, ANDERTON; SUBASKAR, SITSABESHAN. ICTs for Sustainable Energy Partnership. GREENING GOVERNMENT THROUGH ICT: INSIGHTS FROM EUROPE. THE CLIMATE GROUP DESSC, LONDON, 2013.
- [2] OECD. TOWARDS GREEN ICT STRATEGIES: ASSESSING POLICIES AND PROGRAMMES ON ICT AND THE ENVIRONMENT. ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD), Denmark, 2009.
- [3] GOVERNMENT OF NEWZEALAND. Government ICT Strategy and Action Plan to 2017. GOVERNMENT OF NEWZEALAND, NEWZEALAND, 2013.
- [4] ASSOCIATION FOR COMPUTING MACHINERY (ACM). Green Computing. Communication of the association for computing machinery, united states, 2008.
- [5] Boudreau, Marie-Claude, Chen, Adela, and Huber, Mark. Green IS: Building Sustainable Business Practices. University of Georgia: A Global text Project (2007), 1-17.
- [6] UNEP. Building for the future. Nairobi, 2011.
- [7] Orsato, Renato J. Sustainability Strategies-when does it pay to be green. Palgrave Macmillan, Hampshire, 2009.
- [8] PREMINDA FERNANDO,ATSUKO OKUDA. Green ICT: A “Cool” Factor in the Wake of Multiple meltdowns. UNITED NATIONS ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC (ESCAP), 2009.
- [9] INFO-TECH RESEARCH GROUP. Green IT: Why mid size companies are investing now. IBM & Info-Tech Research group, Toronto. Ontario, 2009.
- [10] UNITED NATIONS ENVIRONMENTAL PROGRAMME (UNEP). The Business Case For The Green Economy. Sustainable Return On Investments. United Nations Environmental Programme (UNEP), Nairobi, 2012.
- [11] Kevin, Njeru Mwit, Kamau, John Wachira, Wanyembi, Gregory Wabuke, Dinda, Wilkister Atieno, and Njagi, Kevin Murithi. ENTERPRISE LEVEL GREEN IS STRATEGY FOR DEVELOPING ECONOMIES: CASE OF KENYA. International journal of Application or Innovation in Engineering and Management (IJAIEM), Volume 4, Issue 1 (January 2015), 132-139.
- [12] Molla, Alemayehu. GITAM: A Model for the Adoption of Green IT. In 19th Australasian Conference on Information Systems (Melbourne Australia 2008), Australasian Conference on Information Systems (ACIS), 658-668.
- [13] Njeru, Kevin Mwit, Wachira, John Kamau, Geoffrey, Muchiri, Wanyembi, Gregory, and Waiithaka, Stephen. an investigation on the applicability of Green IT concepts into Green IS. international Journal of Application or Innovation in Engineering and Management (IJAIEM), 3, 12 (DECEMBER 2014), 198-204.
- [14] Orsato, Renato J. Competitive Environmental Strategies: When Does it Pay to be Green? California, 2006.
- [15] Brooks, Stoney, Wang, Xuequn, and Sarker, Saonee. Unpacking Green IS: A review of existing Literature and directions for the future. Springer (2012), 15-37.
- [16] Chen, Adela, Boudreau, Marie-Claude, and Watson, Richard T. Information systems and ecological sustainability. Emerald Insight (2008), 186-201.
- [17] MINISTRY OF TRANSFORMATIONAL GOVERNMENT, UK. Greening Government ICT: Efficient, Sustainable, Responsible. Ministry of Transformational Government, UK, London, 2008.
- [18] HM GOVERNMENT. Greening Government: ICT Strategy. UK Government, London, 2011.
- [19] Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B.Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.). Summary for Policy Makers in climate change 2014. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Intergovernmental policy on climate change (IPCC), Cambridge, United Kingdom and New York, NY, USA., 2014.
- [20] Collon, J.D. Competitive Advantage through Information Technology. McGraw Hill, New York, 1996.
- [21] Loeser, Fabian, Ere, Koray, Schmidt, Nils-Holger, Zarnekow, Ruediger, and Kolbe, Lutz K. Aligning Green IT with Environmental Strategies: Development of a Conceptual Framework that Leverages Sustainability and Firm

- Competitiveness. (Detroit Michigan 2011), Proceedings of the Seventeenth Americas Conference on Information Systems.
- [22] Molla, Alemayehu, Cooper, Molla, and Pittayachawan, Saddhi. The Green IT Readiness (G-Readiness) of Organizations: An Exploratory. Analysis of a Construct and Instrument. Communications of the Association for Information Systems (2011), 67-96.
- [23] Wabwoba, Franklin, Stanley, Omuterema, Wanyembi, Gregory W., and Omiero, K. Green ICT Readiness Model for Developing Economies: Case of Kenya. International Journal of Advanced Computer Science and Applications (IJACSA) (2013), 51-65.
- [24] Brooks, Stoney, Wang, Xuequn, and Sarker, Saonee. Unpacking Green IS: A Review of the Existing. Springer (2012), 15-36.
- [25] KENYA ICT AUTHORITY. THE KENYA NATIONAL ICT MASTER PLAN: TOWARDS A DIGITAL KENYA. MINISTRY OF INFORMATION COMMUNICATION TECHNOLOGY (ICT) KENYA, NAIROBI, 2014.
- [26] UNITED NATIONS ENVIRONMENTAL PROGRAMME (UNEP). GREEN ECONOMY ASSESSMENT REPORT: KENYA. United Nations Environmental Programme (UNEP), Nairobi, 2014.
- [27] GOVERNMENT OF KENYA. Sessional paper No. of 2012 on Kenya Vision 2030. Government of Kenya, Nairobi, 2012.
- [28] GOVERNMENT OF KENYA. Constitution of Kenya. Kenya Government, Nairobi, 2010.
- [29] ERNST & YOUNG. The role of green ICT in enabling smart growth in Estonia. Commissioned by Ministry of Economic Affairs and Communications: Estonia, Tallinn, 2012.
- [30] Wabwoba, Franklin, Wanyembi, Gregory W., Omuterema, Stanley, and Mutua, Stephen Makau. Pervasiveness of green ICT awareness amongst Kenyan ICT personnel. International Journal of Application or Innovation in Engineering and Management (IJAIEM) (2013), 93-104.
- [31] Wabwoba, Franklin, Wanyembi, Gregory W., and Omuterema, Stanley. Barriers to Implementation of Green ICT in Kenya. International Journal of Science and Technology (IJST) (2012), 823-836.
- [32] Curry, Edward and Donnellan, Brian. Sustainable Information Systems and Green Metrics. John Wiley and Sons limited (2012), 168-198.
- [33] ASSOCIATION FOR COMPUTING MACHINERY (ACM). Green Computing. Association for computing Machinery (ACM), United States, 2008.
- [34] ASSOCIATION FOR COMPUTER MACHINERY (ACM). Green Computing. Association for Computer Machinery, United States, 2011.
- [35] Marie-Claude Boudreau, Adela Chen, Mark Huber. Green IS: Building Sustainable Business Practices. Ceport Report: Global text (2008), 1-17.
- [36] Melville, Nigel P. INFORMATION SYSTEMS INNOVATION FOR ENVIRONMENTAL SUSTAINABILITY. MIS QUARTERLY (2010), 1-21.
- [37] Olson, Eric G. Creating an enterprise-level "green" strategy. Journal of Business Strategy (2008), 22-30.
- [38] IPCC. Fifth assessment Report of Climate Change by the Intergovernmental Panel on Climate Change. Copenhagen, 2014.
- [39] GOOGLE. Google's Green Computing: Efficiency at scale. California, 2012.
- [40] Johnson, Gerry and Scholes, Kevan. Exploring Corporate Strategy, 6th edition. Financial Times/Prentice Hall, 2002.
- [41] Jenkin, Tracy A., Webster, Jane, and McShane, Lindsay. An agenda for green Information Technology and Systems Research. Information and Organization (2011), 17-40.
- [42] Loeser, Fabian, Ereka, Koray, and Zarnekow, Ruediger. TOWARDS A TYPOLOGY OF GREEN IS STRATEGIES: INSIGHTS FROM CASE STUDIES. In Thirty Third International Conference on Information Systems, Orlando 2012 (ORLANDO 2012), International Conference on Information System, 1-19.
- [43] MICROSOFT. Green Computing. The Architecture Journal #18, 2013.
- [44] SUSTAINABLE BUSINESS OREGON. IT sector cuts CO2 emissions by 32M metric tons. Portland Business Journal, Oregon, 2010.
- [45] CDW. Implementing Green I.T. Eleven Ways I.T. Can Lower Power Consumption, Reduce Costs & Eliminate Waste. CDW-G, Illinois, 2007.
- [46] Mann, Hanuv, Grant, Gerald, and Mann, Inderjit Singh. Green IT: An Implementation Framework. In Americas Conference on Information Systems (ACIS) (San Francisco 2009), Association for Information Systems Electronic Library (AISel), 1-11.
- [47] Porter, Michael. competitive strategy. The academy of management journal (1980).
- [48] SAFARICOM LIMITED. Safaricom UNCOP Report. Safaricom Limited, Nairobi-Kenya, 2011/2012.
- [49] Mukunzi, Sichiri. Sustainable Green Energy - Safaricom's Experience. Safaricom Limited, Nairobi Kenya, 2011.

Authors



Kevin Mwiti Njeru is a lecturer at Mount Kenya University in the Department of Information Technology. He holds a Master of Science in Information Technology from Mount Kenya University and a Bsc. Computer Science from Gretsia University. He has published a number of papers in Green ICT/IS and His research interests include Green Computing, Information Systems, Computer Networks, Databases, and Artificial intelligence.



Zipporah Wangechi Munene is Lecturer at KCA University in the department of Information Technology. She holds a Master of business Administration - management Information System from The University of Nairobi (UON) and a Bsc. Information Technology from Jomo Kenyatta University of Agriculture and Technology (JKUAT). She has a wealth of knowledge and experience in teaching in the areas of Management Information Systems, Business Information Systems, Business Intelligence, software Engineering and data communications and networking areas which also form a major component of her research interests.



Kevin Murithi Njagi is Lecturer at Mount Kenya University in the department of Information Technology. He holds a Master of Science in software Engineering from Jomo Kenyatta University and a Bsc. Computer Science from Kabarak University. He has a wealth of knowledge and experience in teaching in the areas of programming, software Engineering, hardware and software maintenance and data communications and networking. He has research interests mainly in software security, Information Technology Systems and Computer Networks.



Robert Kimani Mwangi is a lecturer at Mount Kenya University in the Department of Information Technology. He holds a Master of Science in Information Technology from Mount Kenya University and a Bed (Science). Majoring in computer Studies and mathematics from Mount Kenya University. His research interests is in Integration of ICT in education, information Systems, Business Intelligence, Green ICT and Network security



Bildad Mbagara is a lecturer at Mount Kenya University in the Department of Information Technology. He has been a lecturer at Meru University of Science and Technology, Zetech University and Kenyatta University in The field of computing. He holds a Master of Science in Informatics from University West in Sweden and a Bachelor of Applied science in Information Technology from RMIT (Australia). His research interests is in Integration of ICT in artificial Intelligence, Smart networks and Network Security



Kaaria Karwitha Joy is an associate faculty at Mount Kenya University. She holds a Master of Science degree in Procurement from Jomo Kenyatta University of Agriculture and Technology (JKUAT) and B.Com. procurement from University of Nairobi. Her research interests includes Supply Chain Integration, Business Information Systems, E-procurement, and E-procurement