“Energy and carbon reduction practices in South Africa’s mobile telecommunication companies”

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Abstract

The major purpose of this paper involves examining the energy and carbon reduction practices of South Africa's mobile telecom enterprises. These activities were obtained from respective sustainability documents of the companies in the sector. Therefore, in order to precisely assess their effectiveness, they were evaluated by contrasting them with international regulations that manage energy, along with carbon reduction practices in the mobile telecom industry. Whiles surveyed firms demonstrate reputable practices being implemented, various areas that need improvements were also noted. Thus, the results disclosed that there is an extended need to promote mobile technology employment in vehicle usage, upgrading and modernizing mobile telecom devices and frameworks, along with improving the performance of mobile phone features, battery usability and status by integrating green applications. Moreover, increasing engagement of financial institutions, complete environmental disclosure as well as high support for multidisciplinary research on energy and carbon minimisation matters are essential for the sector as they foster development of a green society. Consequently, energy saving and zero-carbon offset exercises in the industry produce green networks, green services and green offices that ultimately generate a low carbon society.

Keywords: energy efficiency, carbon reduction practices, South Africa's mobile telecom enterprises, sustainability, corporate social responsibility, green society.
JEL Classification: M11, M14.

Introduction

As a result of extended global pressures towards integrating methods which preserve the environment, many organizations have been compelled to foster systems that maintain and sustain the environment. Consequently, green societies are constructed once sustainable development actions have been implemented. Necessarily, mobile telecom companies, besides promoting the free flow of information, are expected to incorporate sustainable energy and carbon reduction initiatives that ultimately create a green economy. Highlighting the significance of mobile telecom firm's green policy towards environmental accountability; an average built mobile network consume energy that is equivalent to 170000 households and also, the energy expense required to run the base stations constitute 50% of operator's total expenditure (Amanna, 2009). Clearly, performance of mobile telecom enterprises in South Africa and at international capacity in pursuit to fulfilling low carbon society demands cannot be underestimated in light of the expanding customer base as well as increasing mobile data utilization. In such a manner, strong and augmentative energy efficient policies in the sector are increasingly important. Thus, the objective of developing green and sustainable frameworks must form top of the agenda in mobile telecom business activities. And also, it is quite evident that the expanding global mobile telecom utilization process has also created extended energy expenses which calls for immediate intervention practices that will generate a low carbon telecom framework, and ultimately a green society. For instance, as of 2015, downlink conveying from mobile phones has been forecasted to increase from 56MB to 455MB on a monthly basis (Amanna, 2009). Thus much energy will be expended by such a procedure. This situation has been created as a result of the presence of complex mobile technology such as the Apple's App Store iPhone developments, which possesses vast mobile applications that consume a lot of energy. Moreover, mobile telecom infrastructure which uses large amounts of energy is being built so as to meet growing numbers of users and mobile broadband data needs. For example, on an annual basis, 120000 base stations are constructed to provide mobile services to approximately 400 million new customers (Sistek, 2008) and 75000 are erected in rural areas of emerging economies (Milosevic, 2011). In the same vein, global off-grid base stations were estimated to be 640000 by 2012 (GSMA, 2010) and these also rely on diesel generators (Martin and Murach, 2013). On that note, such practices increase environmental costs and challenges that increase carbon emission (Rowley and Haig-Thomas, 2008). More surveys illustrates that in Democratic Republic of Congo, 90% of base locations get energy deliveries through diesel powered generators and 90% of these facilities in Africa are fitted with a reserved diesel generator (Gerbier, 2010). Other reports also adds that mobile phones waste 11% of energy through the recharging exercise and 13.6 to 21.8 million tonnes of carbon emissions will be discharged through replacing old and malfunctioning mobile phone charging systems (Rowley and Haig-Thomas, 2008). Plainly, Information and Communi-

cation Technology (ICT) services have also been implicated to constituting 2% of the entire global carbon emissions (Gross, 2012) and in Africa alone 27.5 million metric tonnes of carbon emissions are given out yearly (Singhai, 2005) with 60-80% of this proportion being emitted from base stations (Vodafone, 2010). Important evidence also discloses that 13 kg of carbon emissions are being released from mobile and base station production process on an annual basis whilst 55 kg is emitted by a customer annually from operational outputs (Trai, 2011). Concerns have also been raised on first-generation networks that generate six times carbon emissions when they are compared to third-generation networks (Singhai, 2005). Hence, the increasing energy consumption totals are capable of causing serious negative environmental effects if no proper methods have been adopted to manage energy use in mobile telecom enterprises.

Thus, the key questions involving this study entails: Do South African telecom companies take part in sustainable development practices? What are the energy and carbon reduction practices of South Africa's mobile telecom firm's? Therefore, the paper aims to find out if South African mobile telecom companies are involved in sustainable development. The research also seeks to investigate energy and carbon reduction practices of South Africa's mobile telecom organizations sustainable development.

The paper is structured as follows. The following section examines the role of mobile telecom firms in sustainable development. The section which succeeds it analyze energy and carbon reduction practices of mobile telecom enterprises. A comprehensive account of South Africa's mobile telecom energy and carbon reduction practices is also displayed. Important international regulations that South African telecom mobile sector need to integrate are also outlined. A brief discussion on South Africa's energy and carbon reduction practices in contrast to recommended international regulations is clearly explained. Finally, a detailed conclusion is completely summed up.

1. Role of mobile telecommunication companies in sustainable development

The fast growth and advancement in mobile communications is redefining ways on how people should live as well as how business operations should conduct their everyday activities. Thus, continued innovation and emancipation has brought new technologies, state of the art models, along with identifying new locations that will enhance further market demand and improve sustainability of mobile services in diversified disciplines. On that account, swift growth in mobile technology lessens the burden on economically disadvantaged groups in reaching out to important services that include among others financial services, healthcare and agricultural knowledge.

For instance, RapidSMS in Nigeria monitor movement of supplies, Reuters Marketlite mobile systems from India offer agricultural advice, schemes such as Masiluleke in South Africa use SMS packages to communicate to their HIV infected patients and MXit also in South Africa offer platform for social communication with over 19 million users by 2010 (Karippacheril et al., 2013). Furthermore, as surveyed in Ghana's small and medium companies, mobile telecommunication provision boost intercommunication with their suppliers, customers and investors without experiencing large financial expenses on transport use. Greater possibility that improve mobile telephony access to financial services also exist (Essegbey and Frempong, 2011). So, Mobile Financial Services (MFS) are important since they save time, reduce money spending's on transport use, improve individual innovativeness and support direct user connection scenarios (Lee et al., 2012). Vigorous development in mobile technology has created sustainable environments that promote innovativeness in the sector and other disciplines, convenience to users and better standard of living to employees and customers.

Not surprisingly, mobile facility novelty in the US designed the iPhone through Apple and Japan has created most of the mobile data utility inventions which results in better income occupations, minimized prices for data provisions as well as improved management of technical details which promotes compatibility and efficiency of resources, networks and mobile phone's functions (Weber et al., 2011). Essentially, Mobile Data Services and Applications (MDSA) such as Apple's App Store are constituted with wi-fi, 4G configurations, iPhone, iPad, iMovie, social networking structures, mobile games and other diversified functions. In this manner, MDSA have been associated with enhancing users to enjoy money savings, encouraged them to access information anytime and at any place plus, they possess varied service operations (Kim, 2012).

Adding to Japan's mobile evolution, the introduction of Internet on mobile phones enhance viability of using mobile handsets, along with promoting further development of complex mobile applications on a continual basis that are favorable in quality (Chen et al., 2007). Thus, available mobile applications include cameras, music players, game functions and Internet browsers. In that manner, the ability to incorporate these functions on a single mobile

handset achieves independence, flexibility, affordability and convenience on part of the user primarily by reducing wastage of time and resources. On part of mobile operators, significant sustainable returns have also been noticed. For example, technological competence in terms of growth pertaining to China's mobile telecom sector has great potential to advantageously position a firm strategically on the market, supports continual research on mobile technologies innovative capacity, puts a barrier on inefficient enterprises from gaining entrance into the sector and assists in diffusing mobile knowhow to all parts of the economy (Jina and Zedtwitz, 2008). On industry-particular matters, remaining firms are also capable of conducting businesses jointly so that sustainable optimization of resources and sustainable economic efficiency is achieved.

Hence, as a result of development in fast and intricate technology, demanding regulatory expectations and very high capital requirements, some circles have advocated for mobile network providers in developing economies to share telecom frameworks which results in considerably minimized network charges, allow information sharing and improves control of service provision (Meddour et al., 2011). In another study, expertise movement from the industry leader can be utilized by smaller firm's in order to gain improved market and innovative base, thereby improving competition in the industry. For example, research approves that Motorola exploited advantages which included new consumers, advanced technology, superior marketing as well as favorable branding practices owing to its complex research as well as development framework. Thus, smaller firms such as Samsung, Ericsson, together with Nokia employed the expertise spill overs from Motorola and hence continuously grew and established their market and innovative bases (He et al., 2006). Such courses of action sustainably strengthen the industry's competitiveness.

Reliably, increased competition in the sector also promotes other companies to develop distinct, unique and superior technologies that result in low production costs ultimately lowering prices of mobile products. For instance, growth in mobile telecom such as the introduction of 3G systems expands the employment of mobile data operations and it affords the introduction of flat rates which is a sustainable enterprise activity since pricing could be kept moderate irregardless of time period. In addition, mobile users benefit from reduced tariffs and extended service delivery that can reach people in remote areas (Harno, 2010). Other companies in various countries are also guaranteed to learn from experiences of other enterprises situated in other regions by making them test sites, which support growth of sustainable business practices.

Under these circumstances, China's problems in the telecom sector have been attributed to market reconstitution exercise on resource allocation involving 3G industry's framework and existing technological gaps. And also, uneven construction concerning 3G standards as well as greater need to modulate communication networks as a result of their high technical make-up are other challenges (Xia, 2011). This presents a peculiar Chinese set up that calls for evaluation, testing and assessment from both academic and scientific inquiries. The findings can provide information to other countries and associated stakeholders on how to develop sustainable telecom strategies, regulations, positioning and progression. Though China has been experiencing these difficulties, notable sustainable economic, technological and social benefits have been identified owing to growth of the sector. To support this view, studies conducted in Chinese telecom enterprises indicates that associated growth of these firms' results in overall development of product, enterprise, investment and manufacturing strengths that strikingly improve corporate governance, innovation and technological advancements (Cai and Tylecote, 2008). Similarly, as evidenced in Organization for Economic Cooperation and Development (OECD) companies, improved regulation of the telecom industry, champion high investment in the country which results in an overally stronger economic base (Paleologos and Polemis, 2013). This takes place as a result of privatising telecommunication projects and extension of competitor prevalence on the market. Isolated and remote locations have also gained significant advantages due to presence of mobile telecom service provisions.

In this sense, the US has extended telecom services to its remote and rural settlements. Thus, people in such localities can optimise essential services at low cost which further champion developmental schemes in these areas (Nazem et al., 1996). As such, digitalized rural advancement allow sharing of important information on a wider scope, supports growth of small and medium enterprises, along with improving performance of rural tourism (Maleci, 2003). Inevitably, growth of telecom networks in rural areas result in sustainable economic advancement in totality of a nation. Mobile networks also help to link people together when they are confronted with difficult situations.

On that note, mobile phones and other communication modes assist people to connect with each other when sudden disasters take place (Moss et al., 2006). These disasters can include earthquakes,

various forms of accidents, avalanches and tsunamis. Thus, severity of such challenges can be significantly minimized owing to quick reaction time afforded to helpers. All things considered, mobile telecom services constitute the future of this world, though some participants may seem to doubt and question its complete adoption. Therefore, parties who shall holistically determine the significance of mobile networks shall be empowered to achieve the greatest possible benefits (Peppard and Rylander, 2006).

2. Sustainable energy and carbon reduction practices in mobile telecommunication companies

Energy and carbon reduction practices have become of significance in modernized business frameworks. As such, they present a considerable challenge as well as a chance for enterprises to generate a semi-permanent stakeholder worth. In the mobile industry, achieving energy efficiency indicates the most cost-effective method which minimize carbon emissions. Accordingly, Lubritto et al. (2011) informs that it takes place through minimizing energy usage in transmission appliances, increased use of non-exhaustible sources of energy and improvedenergy auditing of associated base stations. In addition, reducing energy consumption in air conditioning appliances and control networks is also important. Thus, ventilation cooling technology (VCT) applications in telecom base locations helps in the attainment of energy efficiency by monitoring indoor heat concentrations which significantly optimize energy savings (Chen et al., 2012). And in these base stations, evidence in Guangzhou situated in China demonstrates that buildings can be constructed in ways that propel them to support energy saving priorities on their own. Thus, an energy efficient designed framework with passive cooling attributes was proposed, capable of attaining 20% target in energy savings (Zhang et al., 2008).

Moreover, passive cooling models can be improved through integrating phase change material (PCM) as well as two-phase closed thermosyphon (TPCT) that manage telecom base station high temperatures by consuming extra heat produced by machines during the day, then sets it free during the night (Sundaram et al., 2010). Such practices create indoor environments that enable equipment to function effectively as well as ensure them longevity which generates energy efficiency. In addition, telecom structures could also be made more sustainable through the introduction of photovoltaic engines as well as diesel powered systems which forms a hybrid framework that enhances consumption of small amounts of diesel plus deployed solar technologies are renewable, clean and minimize carbon emissions which creates energy balances that support dependability along with minimized maintenance costs (Kaldellis and Ninou, 2011). Ideally, fuel cells also possess great potential for mobile telecoms in realising energy savings as well as ensuring a better network up-time and dependability since they can substitute diesel generators in isolated locations that have long reinforcement needs. Information and Communication Technology (ICT) frameworks of mobile telecom organizations need to be designed in ways that achieves energy efficiency.

More fundamentally, ICT systems in India's telecom industry, achieved energy use reductions when energy efficient appliances that include energy-aware design spaces and energy profiling were employed at device level as well as at network capacity which realised a 60% minimization in energy consumption (Bolla et al., 2012). Moreover, these entities must develop green IT models by employing virtualization electronic systems as well as apply green metrics (Power Usage Effectiveness (PUE), power shift competence, efficiency of applied hardware components, Data Center Density (DCD) so as to attain energy savings in data stations which capably minimize emission of greenhouse gases that result in climate change (Uddin and Rahman, 2012). Strengthening ideas that embrace energy efficiency of telecom devices, Ericsson (2008) expresses that the company assist mobile providers by supplying them with commodities such as the Base Transceiver Station Power Savings (BTSPS), a facility that minimize energy use for mobile phone frameworks through resting radio devices of the system in low traffic situations. Thus, in low traffic periods, channel monitoring reduces energy movement from the base station (Rulnick and Bambos, 1997). Other important energy regulation practices that must be supported include erecting Energy Tower Tubes (Ericsson, 2008). These are energy saving and green cell pillars which utilize wind power from incorporated perpendicularly aligned wind turbines. Openly, diversified power management technologies have also been designed for implementation by mobile telecom companies.

Notably, for mobile telecom sector's base stations, a huge amount of energy is lost for cooling priorities owing to weak and incompetent technologies hence complex power amplifiers can reduce power requirements (Koutitas, 2010). Moreover, multi carrier appliances champion power efficiency by lessening power per user. Also as expected, widely dispersed base location models can be organised to acquire portions of the baseband components through utilising various isolated radio equipment-thereby reducing cooling technologies usage as well as transfer losses via the network (Koutitas, 2010).

It also follows that, reasonable and acceptable site location realize energy efficiency as the location and quantity of base transceiver stations show a positive association with energy use of the framework (Ericsson, 2007). And also, minimizing the number of site locations help in realization of energy efficiency. Firstly, Huawei (2009) reports that it is important to widen the scope involving efficiency as well as reduce the framework consumption by incorporating efficient network structures which enhances a wider service provision to customers using few sites. Secondly, improving the strength of the base station by employing among others, key advanced technologies which include High Receiver Sensitivity (HRS), Adaptive Multi Rate (AMR) and Transmitting Diversity (TD) which expands the area of service coverage is also crucial. Some telecom enterprises have improved efficiency of mobile phones so as to facilitate green communications.

For that reason, Collaborative Downloading System (CDS) is an important instrument that saves up to 76% of energy in cellphone batteries during information downloads when it is held in comparison with present mobile downloading exercise (Bojic et al., 2012). Thus, it advisable for mobile telecom entities to embrace such green technological downloading models. Reports also disclose that, mobile phone production expends 80% of energy and in its life time, it disposes off 20% (Williams et al., 2010). Therefore, in-order to accomplish energy savings, mobile phones should be manufactured in ways which increase their life span. In addition, a facility for old phone recycling should also be established so as to reduce carbon quantities and also save energy instead of using virgin resources that consume large quantities of energy (Williams et al., 2010).

Necessarily, research in Korea asserts that an estimated 5 million old mobile phones have been collected by telecommunication and linked manufacturers for the period 2004 to 2007, though appropriate frameworks and systems that utilize collection and recycling processes need to be fully expanded and properly instituted so as to manage mobile electronic waste and carbon emissions effectively (Jang and Kim, 2010). Thus harmful chemicals found in mobile phones are arsenic, lead, cadmium as well as beryllium, which are potentially harmful to human beings and the environment (soil, water, air, plants and animal life) as they also release carbon from batteries and other mobile components. In a related survey, investigations in Nigeria's mobile telecom sector informs that long lived mobile phones that can be readily disposed, are capable of giving out dangerous materials and halocarbons from batteries, liquid crystal display, integrated wiring settings and plastic made components. Thus, reprocessing and recycling old phones, colleting second hand phones, increasing awareness and educating people on energy, waste and carbon management of mobile phones could help to improve sustainability objectives (Osibanjo and Nnorom, 2008). Greater need also exist for mobile phone users to be provided with comprehensive information on matters that involve battery status and battery use, so that energy savings are realized.

Heikkinen et al. (2012) explain that the issues of concern involving current battery supplies include lack of knowledge on electrical saving settings, insufficient power framework attributes, battery energy indicators are not precise and users are exposed to new applications that consume much energy, especially via the Internet. And also, telecom firms must provide specifications and complete guidelines on how to recharge the phone's battery. This is very important if energy efficiency is to be realized. As such, Banerjee et al. (2007) confirm that mobile phone batteries must be recharged when they still contain considerable amounts of energy, rather than at low energy amounts so that users are assured of a contended experience even when savings in energy have not been maximized. And also, users must recharge their mobile phones out of necessity instead of being driven by particular situations. Incorporation of practices in the company policy that guarantee realization of a low carbon economy must also be instituted by mobile telecom organizations.

Therefore, important strategies telecom industries should employ in reducing carbon footprint include integration of a green culture (in policies, goals and strategy), establishing green retail outlets, network sharing, network co-siting as well as erecting green building infrastructure (Little, 2009). Supporting this view (Kearney, 2009) also states that mobile telecom companies must design extensive climate protection policies, establish energy management boards, along with adopting energy saving tools and networks. In China, telecom organizations adopted an Eco-design project which accomplishes their product environmental objectives. Thus, the design supported minimization and removal of toxic substances, achieving energy efficiency in product manufacturing process, promoted greening of sales as well as training staff members on environmental issues (energy, carbon and waste matters) (Zhu and Liu, 2010). Analysis also establishes that, if smart teleworking and smart teleconferencing are adopted by China's telecom sector, then it can considerably reduce carbon emission by 340 million tonnes by 2020 and 123 million tonnes by 2020 respectively (Tianjian et al., 2009). And also, smart appliances

which include remote controlled frameworks designed for street lights and grid metering frameworks have shown potential to minimize carbon emissions (GSMA, 2012; Tianjian et al., 2009). Lastly, telecom firms must also incorporate green practices which include, improving environmental disclosure on energy and carbon issues and supporting green product lines (Booz & Company, 2008).

3. Theoretical framework of the study

Freeman (1984) outlines five different stakeholder classifications that include: the narrow stakeholder theory; utilitarian theory; stockholder theory; social-harmony theory as well as rawlsian theory. These strategies emphasize on giving particular attention to stakeholders who have been given the first preference. This study utilize the social-harmony theory. Thus, this theory demonstrates that enterprises sustain their lawfulness, standing and image by undertaking environmental, social and governance disclosures through communication methods (Selznick, 1994). So, the theory entails optimizing benefits to the society (Menzar, Chrisman & Carroll, 1991). In line with this argument, enterprises seek to show the society that their business activities conform to social responsibility expectations and, as such, the integrated practices benefit the firm as well as the society as a whole. Consequently, it also informs that all stakeholder expectations must be satisfied; hence it supports ethical practices in business operations (Freeman, 2002). Thus, for social-harmony to exist, a sound relationship shown by its practices between the organization CSR policy and society views must be evident (The Worden Report, 2013). Backing this idea, Drucker (1954) demonstrates that enterprises must completely be accountable to the public as a result of their everyday business operations. Therefore, yearly reports can be utilized to strengthen the society's expectations concerning the company's behavior towards particular environmental matters (Patten, 1992). A significant number of researches have been carried out so as to prove the significance of the social-harmony theory.

On that account, with regard to Thailand enterprises, the motivation behind the organizations CSR activity include top management support and high society expectations with crucial matters linked to implementing suitable CSR exercises and improved participation of the society engaged with the company's CSR practices (Virakul, Koonmee & MacLean, 2009). Essentially, with regard to fulfilling social harmony with the society, the Ricoh Group (2013) has adopted CSR practices that develop value in the community with particular emphasis on supporting environmental sustainability activities, high involvement towards actions that reduce social and environmental challenges as well as improve society engagement and development. In consideration of these views, this study follows the social-harmony assertion through setting out to understand South Africa's mobile telecom company's energy and carbon reduction practices as well as identify the type of activities they are engaged in and report on. The following section examines the methodology.

4. Methodology

The study included an identified sample of two South African mobile telecom companies. These companies are, namely, Vodacom and MTN. This sample was selected since they are the mobile telecom companies that are listed on the Johannesburg Stock Exchange (JSE) in South Africa. On that account, the companies meet specific essential sustainability conforming standards and have qualified to be added to the JSE Socially Responsible Investment (SRI) Index (JSE, 2013). For this reason, they are the only mobile telecom companies that have been reporting on corporate responsibility issues in their company's annual reports and websites. Thus, an Internet study was conducted so as to gather data of each company's energy and carbon reduction practices using the respective company's online sustainability reports.

5. South Africa's mobile telecommunication companies energy and carbon management practices

Table 1 presents, a summary of common energy and carbon management practices of the above telecommunication companies.

Table 1. Energy and carbon management practices of South Africa's mobile telecommunication companies

South African mobile telecommunication companies carbon/energy management practices
♦ Use of advanced Software Defined Radio (SDR) technologies that enhance the network framework to adopt long-term evolution (LTE) services that minimize electricity use and also reduce carbon levels in each base station.
♦ Contracts professionals who plan and builds Site Solution Innovation Centers (green building), where the firm's specialists are employed to manage energy efficiency standards of the company's business activities.
♦ Increased use of solar energy that has also been responsible to recharging batteries in various base locations.
♦ Establishing mobile phone shops which utilize solar power in recharging cell phones.
♦ Measuring energy consumption and carbon foot print on a yearly basis.
♦ Off grid generators are being transformed into hybrid powered systems that minimize diesel use and optimise renewable energy consumption.
♦ Upgrading the speed of GSM 2G technology and 3G frameworks using dual carrier appliances which significantly improve mobile data transmission and inevitably use less power.

Table 1 (cont.). Energy and carbon management practices of South Africa's mobile telecommunication companies

South African mobile telecommunication companies carbon/energy management practices
♦ Work jointly with South Africa's Department of Environmental Affairs and Environmental Management Framework (EMF) partners when conducting Environmental Impact Assessments (E.I.As) and also, when establishing mobile telecommunication base locations respectively.
♦ Designing products that make use of video conferencing technologies which minimize carbon emissions that are highly connected with transport use.
♦ Participates in Carbon Disclosure project exercises.
♦ Virtual Data centres have been built in small sizes which lessen carbon emission level and reduce energy requirements.
♦ Have adopted "cloud computing" systems that minimize energy use of final user computing equipment.
♦ Belong to the World Business Council on Sustainable Development (WBSCD) and Green Building Council of South Africa (GBCSA) where they serve as members.
♦ Are building climate change tools and policies which simultaneously manage environmental risks as well as enterprise operations.
♦ Undertake load shedding practices so as to monitor electricity consumption.
♦ Minimize air conditioning needs by using sunlight deflection methods which retain the cool environment in various company branches.
♦ Improved employment of deep cycle batteries that use less power.
♦ Have embraced Green Grid benchmarks that regularly control Power Usage Effectiveness (PUE) metrics so as to attain considerable energy savings.
♦ Have approved European Union Code of Conduct for Data Center in order to better infrastructure and power consumption.
♦ Sharing network facilities and company structures with other companies which minimize energy consumption.
♦ Undertaking public awareness and training campaigns on carbon reduction and energy efficiency matters.
♦ Integrating smart metering methods in lights and buildings.
♦ Strengthened their carbon management practices by engaging with GSMA Mobile Energy schemes which establish the entity's energy intensity level when compared with other adversaries.
♦ Continual investment in innovation and technologies that realize carbon reduction and energy efficiency.
♦ Incorporating window covering screens that absorbs heat in offices during winter but also reduces heat intake during summer.
♦ Protected roofs with reflective painting which scatter sun's radiation thereby regulating room temperature from cool roofing properties attained.
♦ Increased switching on and off of air conditioning systems in order to save electricity.
♦ Centralizing use of office equipment so as to achieve energy efficiency.
♦ Educating and training staff members on green energy and carbon reduction matters.
♦ Introducing lighting sensors that monitor the provision of illumination services in all office buildings which realize energy savings.
♦ Greening catering systems to as to manage energy use.
♦ Recycling mobile phones so as to reduce carbon and release of other harmful toxic waste.
♦ Better management of time in using electronic equipment in offices as well as base stations so as to lower power consumption.
♦ Base stations as well as masts are strategically positioned so as to foster site sharing practices thereby improving energy consumption of the telecommunication radio network.
♦ Works hand in hand with Eskom, South Africa's electricity provider on fundamental ways that realize energy efficiency in business operations.
♦ Built energy consumption ratings with reference to transceivers per cubic meter and energy consumption per cubic meter so as to standardize future radio appliances.
♦ Electricity that is being received is audited whilst power that is within the organization is well distributed by a compatible network.
♦ Geyser function is controlled using moderate temperature levels and is solar powered.
♦ Tracking technology that measure waste produced from all equipments such as carbon is being investigated.
♦ Installed HVAC (heating, ventilation, and air conditioning) frameworks help in minimizing night energy needs.
♦ Have established green management boards that deal with climate change and environmental issues.
♦ Pioneer meetings such as GSMA Green Power for Mobile Projects (Cape Town, 2012) and South African Corporate Leader' Group (CLG) which support use of non-exhaustible fuel appliances and advocates for effective climate change strategies respectively.
♦ Use mobile technology to assist agriculturalists with advice on efficient agricultural technologies and sustainable farming practices which cuts carbon emission levels.
♦ Sets up free cooling components which substitutes deployment of air conditioning appliances at base stations which saves energy consumption.
♦ Increased use of energy saving light bulbs in all buildings.
♦ Employ hydrogen and methanol-water fuel cells as important sources of energy at various base stations which minimize carbon emissions.
♦ Complete adherence to energy efficiency projects which eventually lower carbon tax and energy tax.
♦ Apply Lithium Bromide in HVAC systems as the refrigerant does not emit green house gases.
♦ Introducing Metrix, which are technologies that independently measure energy usage in data centres and office buildings by controlling power movement through minimising high energy requirements when these infrastructures share networks.
♦ Integrating dematerialization schemes which reduce carbon emissions e.g. using virtual technology in place of physical answering machine, undertaking online rather than paper billing activities.

5.1. Towards improving energy and carbon management practices in South Africa's telecommunication companies. Considering all carbon and energy management practices in South African mobile telecommunication companies highlighted in the preceding section, it is evident that there are still some international regulations not yet observed by South Africa's mobile telecom enterprises, therefore this section highlights some of these international practices which can further strengthen South African mobile telecom firm's energy and carbon management practices. These suggested international regulations are presented in Table 2 below.

Table 2. International mobile telecommunication regulations South African telecommunication corporations need to adopt

Body	Regulation
Global Reporting Initiative's G3 Sustainability Reporting Guidelines, 2006	♦ Measuring all direct and indirect carbon gas emissions indicated by their composition. ♦ Accounting and quantifying secondary green house gas emissions according to their load. ♦ Determining related energy consumption through principal source.

Table 2 (cont.). International mobile telecommunication regulations South African telecommunication corporations need to adopt

Body	Regulation
Booz & Company: Global Management Consulting Firm, 2008	♦ Availability of low energy vehicles, together with training the driver. ♦ Introducing benchmarked carbon footprint and energy efficiency frameworks. ♦ Engage image rating structures on energy consumption and carbon reduction matters, issued to relevant stakeholders for their own assessment.
United States Environmental Protection Agency (USEPA), 2007	♦ Removing malfunctioning and old servers. ♦ Embrace low cost minimization in energy consumption involved with organization storage appliances. ♦ Acquire better transformers as well as provide continuous, undisturbed electricity provisions. ♦ Technologically advanced pumps, chillers as well as fans must be instituted as they achieve energy savings.
Ericsson, 2007	♦ Perfected network designs with complex radio system arrangements that houses modular high-gain antenna (MHGA), transmitter coherent combining (TCC) and fourway receiver diversity (4WRD) that reduce power consumption. ♦ An external jointly built radio base station and battery back-up unit creates a modernized housing which lessen hardware as well as energy use, such that the battery can be used for long hours.
Hans-Otto Scheck, Nokia Siemens Networks, Kyoto, 2008	♦ Address climate change issues as the major guiding principle that is vital in determining the business success.
GSM Association, 2009	♦ Improve working relationships with the banking sector so as to acquire adequate financial bases that propel increased investment in green energy for mobile communication systems. ♦ Green power generation using wind and solar equipment should be constructed in ways that consider maximum harvests scenarios. Thus, base station location specialists' should take into account weather conditions and seasonality. ♦ Expand renewable technologies base (solar, wind) by using Pico-hydro, which are appliances that utilize water resources of stream and rivers to generate energy hence realizing energy savings in remote areas
International Telecommunication Union (ITU), 2008	♦ Considerable minimization with regard to quantity of switching points which attains favorable energy savings. ♦ Comprehensively make use of next-generation network (NGN) with advanced models such as Very High Speed Digital Subscriber Line VDSL2 that contains particular classifications (full, less energy as well as sleep functions) instead of VSDL technologies with only one electricity instructor (full power). ♦ Promote parking instructing frameworks which directs drivers to choose the most suitable parking zone, in that manner minimizing engine running period.
Commission of European Communities, 2008	♦ Motivate growth of an extended dominant-edge market in relation to Information and Communication Technology (ICT) enhanced green appliances, which propel competitiveness of the sector as well as develop vital business ventures. ♦ Engage complete green procurement exercise within the sector so as to realise a zero carbon trade pattern. ♦ Encourage multidisciplinary research on energy networks and ICT development on issues that concern energy efficiency.
UNEP (Basel Convention), 2008	♦ Institute well organized, integrated and clear frameworks that realize better collection and recycling processes of mobile phones on a regular basis.
GSMA and Climate Group, 2009	♦ Devise universal mobile phone recharging devices that are three times energy saving when compared to ordinary chargers. ♦ Develop solar powered mobile phones which have green attributes. ♦ Incorporate controlled vehicle tracking frameworks that keep in touch with dispatched vehicles so as to direct them on suitable routes, provide speed and identifies vehicle position which minimize delays and unnecessary waste of fuel. ♦ Employ instituted telematics models in fleets, which provide data on fuel use, level of temperature as well as condition of engines which manages energy efficiency, status and security of vehicles. It also identifies areas on the vehicles where maintenance is required. ♦ Utilizing mobile networks that champion road pricing frameworks by charging standardised prices which cuts unwarranted travelling. ♦ Designing green digital mobile downloads that minimize carbon emissions when users are getting music through compact discs. ♦ Embrace green e-health mobile models that enable x-ray pictures to be delivered in fifteen seconds, capably reducing energy, costs and time. ♦ Acquire mobGAS mobile phone structures which allow consumers to monitor how their decisions have effect on climate change. For instance, information on energy consumption can be disclosed.

6. Discussion

Having identified important international mobile telecom regulations South African mobile telecom firms need to adopt in the previous section, it appears that by embracing these practices, South Africa's mobile telecom enterprises can extensively realize large energy savings and zero carbon yardsticks. Firstly, there is an extended need to promote mobile technology which can improve efficient performance of vehicles. Vehicle emissions add a lot of carbon in the atmosphere and that has adverse effects on people's lives and climate change respectively (Lloyd and Cackette, 2001; CEC, 2006). Thus, there must be improved use of mobile technology in controlling

vehicle travelling and engine status. This can be seen by incorporating mobile managed and road pricing frameworks, supporting on-board telematics models in vehicles, instituting parking instructing models as well as installing vehicle tracking systems designed and pioneered by telecom firms.

And also, mobile networks and devices need to be upgraded and modernized by removing old equipment and network infrastructure that consume a lot of energy as well as increase carbon emissions. For instance, the network structure must substitute 2G/3G appliances with Long Term Evolution (LTE) frameworks or adopting single radio access network (RAN) technologies that show LTE plus 2G plus 3G characteristics employing similar equipment (GSMA, 2012). In addition, old servers, outdated transformers, out moded pumps, old fashioned chillers and fans must be replaced with more advanced equipment as this improve performance of machines which eventually saves energy. Furthermore, policies that deal with matters on comprehensive Information and Communication Technology (ICT) emission course of developmental transformation must be embraced, instead of focusing on issues that concern the consumption level pertaining to ICT facility life cycle. One of the vital methods towards achieving energy efficiency implies complete adoption of renewable sources of energy on a much broadened scope.

Therefore, besides wind and solar energy sources South African mobile telecom industry has adopted, the companies can also embrace Pico-hydro, which are devices that make use of water derived from rivulets and other small water courses in order to produce energy vital for mobile infrastructure usability in remote locations, ultimately saving energy. In addition, wind and solar renewable energy systems should be designed in ways that enhance the company to optimize harvests through considering weather conditions and seasonality aspects. If these issues are addressed, then substantial energy savings are promoted.

South Africa's mobile telecom firms must also work to improve performance of matters that concern mobile phone features, battery usability and status. Thus, there must be better services on energy saving settings, battery energy indicators as well as integration of green mobile downloading frameworks. In the same vein, these organizations must introduce universal mobile phone recharging appliances since these are capable of achieving three times more energy savings when compared with ordinary charging systems. Furthermore, it is also crucial to create solar powered mobile phones which also posses green attributes as such devices considerably realize energy efficiency and reduce carbon emissions.

Engaging financial institutions and other finance lending entities by improving working relationships so as to acquire financial strengths which can propel them to increase investment in green energy practices is vital for South Africa's mobile telecom industry. Thus, banks also have policies that support energy efficiency and carbon reduction priorities. For example, through carbon finance (Yeoh, 2008) and carbon insurance (Yang, 2010). If mobile telecom enterprises have a large financial base, then they are able to achieve their carbon emission and energy efficiency standards at reduced costs and are empowered to gain considerable advantages as a result of better investment in zero-carbon and energy efficient technology.

Complete environmental disclosure on metrics that include carbon emission minimization and energy efficiency issues is also outstanding for South Africa's mobile telecom firms. For instance, information pertaining to measure on secondary greenhouse gases (e.g nitrogen dioxide, ground level ozone and peroxyacetyl nitrate) is not being presented. In addition, indirect carbon gas emissions as shown by their compositions also need to be extensively reported. Moreover, it is also highly advisable for mobile telecom sector to design and integrate standardized and reliable carbon footprint, along with energy efficiency models since they assist the company to universally compare its environmental performance against previous yearly reports and also with other companies. Policies that enhance the firms to collect and recycle mobile phones on a regular basis must be integrated to support compatibility factors and comparison on accomplished objectives. Though expanded efforts are being made to the public so as to improve their knowledge levelson energy efficiency and carbon reduction principles through green campaigns; these practices must also create room for the consumers to rate the companies concerning their environmental performance. Thus, feedbacks will open new worlds and possibilities on how carbon minimization and energy efficiency can be optimized from a user's point of view.

Increased support for multidisciplinary research involving energy issues and ICT development is strongly suggested. This will help the mobile telecom companies to be updated on current practices, which are in agreement with existing scientific reports on climate change management as well as energy efficiency advancement. Moreover, using skills and ideas taken from other fields so as to attain energy efficiency and zero-carbon offsets can be very beneficial for the firms. These enterprises must therefore, be able to reward departments and individual staff members who excel on such matters

through yearly energy performance awards. This will serve to motivate other staff members who were reluctant to be involved in energy efficiency matters to assume leading roles.

Conclusion

Policy on energy efficiency and carbon emission minimization represents important methods by which undesirable world wide climate change issues can be averted. On that account, mobile telecom organizations have a significant role to exercise in sustainable development towards improving performances that eventually attain a low carbon society. Thus, though mobile phone devices have been singled out as the most transformative instrument for advancement, it also possesses great capability of being a change instrument that realize energy efficiency as well as minimizing carbon emissions. And also, besides enhancing the free movement of information, mobile telecom companies must establish smart frameworks that results in a sustainable future, together with a green economy. Therefore, leadership in mobile telecom sector should take principal roles in doing away with "business as usual" settings through high prioritization towards technologies that develop commodities and network infrastructure that is critical towards generation of low carbon societies. Such a process is necessary to propel future investment, along with promoting growth of energy efficient appliances. An assessment carried out on South Africa's mobile telecom firms that have integrated sustainability reporting in their company policy, demonstrates the firms doing very well with regard to energy efficiency and carbon emission reduction though expanded programmes are still outstanding and needs to be incorporated. These include an extended need to promote mobile technology implementation in vehicle usage, upgrading and modernizing mobile telecom devices and frameworks, expanded and strategic utilization of renewable energy, along with improving the performance of mobile phone features, battery usability and status by integrating green applications. Moreover, increasing engagement of financial institutions, complete environmental disclosure as well as high support for multidisciplinary research on energy and carbon minimiszation matters are essential for the sector as they foster development of a green society.

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