REDUCING GREENHOUSE GAS EMISSION STRATEGY: THE NEW DIMENSIONS IN GREENER COMPUTING

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ABSTRACT

Just as there are lingering economic crisis in the world today, so it is when it comes to global warming. Economic crisis and global warming has been seen as twin problems facing the planet today. The former results from greenhouse gas emissions. This paper has taken a bold step to address the issues of greenhouse gas emissions reduction strategies with the suggestions of newer dimensions to greener computing. It has also taken a further steps to review previous papers of interest to create understanding to the subject matter under discussion.

Keywords: Dimension, Emission, Greenhouse Gas, Greener Computing, Strategy.

I. INTRODUCTION

It is now a truism that all countries in the world today emits greenhouse gases either through natural or artificial activities. Since they have gone through the process of industralization over the past degades, and depend strongly on energy to drive vehicles, heat homes and operate industries. The developed countries tend to produce more greenhouse gas emissions than the developing countries of the world. Although current international regulations does not require developing countries to regularly report their greenhouse gas emission statistics. It has been found that some developing countries greenhouse gas emissions surpasses that of developed countries of the world.

For example, China is now believed to be the largest emitter of greenhouse gases. Other giant emitters inccludes:

- the United States
- the European Union
- Russia
- Japan and
- India

According to the United Nations Framework Conventions on Climate Change (UNFCCC), the greenhouse gases are as follows:

- Carbon (IV) Oxide – CO_2
- Methane – CH_4

- Nitrous Oxide - N2O

- Perfluorocarbons – PFCs

- Hydroflurocarbons – HFCs

- Sulphur Hexafluooride – HF6

- Sulphur (IV) Oxide – SO2

- Nitrogen (IV) Oxide – NO2

- Carbon Monoxide – CO

- Non-Methane Volatile Organic Compounds – NMVOCs

  Other findings has also reveal that:

- Water Vapour – H2O(g)

- Ozone – O3

are also regarded as greenhouse gases.

Greenhouse gases are gases (like the once mentioned above), according to Marc Lallanilla (2015), are/is any gaseous compound in the atmosphere that is capable of absorbing infrared radiation, thereby trapping and holding heat in the atmosphere. By propagating the heat in the atmosphere, greenhouse gases are resposible for the greenhouse effect, which eventually leads to global warming.

In other hand greener computing according to Enterprise Management Associates (EMA), is the practice of implementing policies and procedures that improve the efficiency of computing resources in such a way as to reduce the environmental impact of thier utilization. Greener computing is a philosophy which states that given that there are finite amount of available natural resources, it is in the interest of the business community as a whole to decrease their dependencies on those limited resources to ensure long-term economic viability. This is likened to logging industry in the distance past which learned that they have to plant a tree for each that they cut. Today's power consumption enterprises should optimize the ability of the planet to maintain a consistent level of resources to ensure the continuance of the existing level of society and commercial enterprises. This is proposed on the concept of sustainability which is a principle that defines an enterprise's successes based on its economic, environmental and social performace, what we may call the "triple bottom line" principle.

II. OBJECTIVES OF THESE STUDY

- To reduce greenhouse gas emission through greener computing

- To advice international and national legislators to continue to promogate laws that would reduce greenhouse gas emission

- To re-echo the danger of greenhouse gas emission with respect to global warming

- To suggest important steps towards greener computing

- To encourage smart computing

III. ADVANTAGES OF GREENER COMPUTING

- To reduce the cost of energy consumption and safe the environment from pollution

- To harmonize energy footprint with the required levels of computing performance

- To initiate and facitates e-waste recycling process

- To safe man and the environment from the danger of computing

- To help maintain a balance in the ecosystem

IV. PREVIOUS WORK

(Chaitali Patra and Asoke Nath 2014), [1], the paper maintain that with the rising energy cost and growing environmental concerns, green computing is receiving more and more attention. Software and system architectures play a vital role in both computing and telecommunication systems, in terms of concurrency patterns and they have been analyzed for performance, reliability, maintainability, and security. Yet, littlework on analysis based on the amount of energy that the CPU will consume has been reported. Since mostcommunication systems have to run 24/7 , the energy consumption of a system based on a specific software architecture is of great importance. Since high energy consumption always leads to higher operational cost of the system, high energy consumption also implies more heat produced, thus, more power is required for cooling-down. As the number of computers is increasing day by day, so is the amount of electricity consumed by them which in turn is increasing the carbon content in the atmosphere. This problem has been realized by the researchers and several corrective measures are being taken which help in minimizing the power usage of computers and this process is called as Green Computing. These paper present several green initiatives currently taken in the computer industry, as well as issues that have been raised regarding these initiatives and presents a study about the green computing and e-waste recycling process.

(Shalabh Agarwal et al 2014), [2], puts it that the tremendous explorations in Information Technologies and the range of new equipment being developed every passing day, the 21st century can aptly be labelled as the Century of Gadgets and Gizmos. The paper refers to the term "Green Computing" to mean the practice of using energy wisely and efficiently, causing negligible degradation to environmental resources and parameters also maintaining feasibility on the other hand. It is basically a balanced and sustainable approach towards the achievement of a healthy and clean environment without compromising the needs and necessities of technology for the present generation. Thus taking up a more holistic and careful approach to making our IT-industry greener definitely falls in our list of responsibilities in creating a more healthier, safer and clean environment. This revolves on spreading awareness and ensuring people to take their necessary individual steps towards achieving the goals of Green Computing. The paper has made a systematic study of several strategies, approaches and practices of green and energy efficient computing.The paper concludes that the plans towards a greener IT-industry should include new electronic products and services with optimum efficiency and all possible options solutions towards energy savings.

(Tariq Rahim Soomoro and Muhammad Sarwar 2012), [3], explains that during recent years, attention in "Green Computing" has moved research into energy-saving techniques for home computers to enterprise systems. Saving energy or reduction of carbon footprints is one of the aspects of Green Computing. Since the research in the direction of Green Computing is more than just saving energy and reducing carbon foot prints. This paper provides a brief account of Green Computing with emphasis on current trends and challenges in the field of Green Computing and it future trends as well. It concludes that technology is not a passive observer, but an active contributor in achieving the goals of Green Computing. The paper maintain that IT industry was putting efforts in all its sectors to achieve Greener Computing through equipment recycling, reduction of paper usage, virtualization, cloud computing, power management, and Green manufacturing. The paper proves that current

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challenges to achieve Greener Computing are enormous and that the impact was on computing performance. Efforts of Governments and Non-Government Organizations (NGOs) were also appreciated. Government regulations are pushing Vendors to act green; behave green; do green; go green; think green; use green and in no doubt to reduce energy consumptions as well. The paper summarise that all these efforts in the acadamic sector are still in limited research since efforts are mainly to reduce energy consumption and facilities e-Waste but the future of Green Computing will be depending on efficiency and greener products.

(Vibhuti Vashishtha et at 2014), [4], observed that, almost all streams weather its IT, medicine, transportation, agriculture uses machines which indirectly requires large amount of power and money for its effective functioning. Since great machines and equipments used to accomplish our task are, great gadgets with royal looks and features that make our lives more impressive and smooth. Green computing goals was to reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote the recyclability or biodegradability of defunct products and factory waste. The paper proposed that; Virtualization, Green Data Center, Cloud computing, grid computing and Power optimization were the technologies of green computing. Virtualization is the use of software to simulate hardware. The paper maintained that in the data center if stand alone server system were replaced with virtual server that run as software on a small number of larger computer via a virtualized server we can efficiently use computer resources. These N-Computing's virtualization software and hardware taps this unused capacity so that it can be simultaneously shared by multiple users. The paper concludes that the greenest computer will not miraculously fall from the sky one day but would arise from the product of years of improvements. Thefeatures of a greener computer of tomorrow would be like efficiency, manufacturing & materials, recyclability, service model, self powering, and other trends. This paper is a brief study about green computing in a cloud environment.

(Swati Aggarwal et al 2012), [5], the paper defines the field of "Green Technology" to encompasses a broad range of subjects from new energy generation techniques to the study of advanced materials to be used in our daily life. Green technology focuses on reducing the environmental impact of industrial processes and innovative technologies caused by the Earth's growing population. It has taken upon itself the goal to provide society's needs in ways that do not damage or deplete natural resources. Mainly this means creating fullyrecyclable products, reducing pollution, proposing alternative technologies in various fields, and creating acentre of economic activity around technologies that benefit the environment. Green computing is the environmentally responsible use of computers and related resources. Such practices include the implementation of energy-efficient central processing units (CPUs), Servers and Peripherals as well as reduced resource consumption and proper disposal of electronic waste (e-waste). Green computing is the study and practice of efficient and eco-friendly computing. Green computing is an emerging topic these days, not only because of rising energy costs and potential savings, but also due to the impact on the environment. Energy to manufacture, store, operate, and cool computing systems has grown significantly in the recent years, primarily due to the volume of systems and computing that companies now heavily rely upon. Greentechnology plays a very important role in terms of computing. However, the scope of this paper is limited to"Smart Computing" that is, using green computing. Here the main focus on these paper was "Smart Computing". The principle behind energy efficient coding is to save power by getting software to make less use of the hardware, rather than continuing to run the same code on hardware that uses less power.Hence Green computing, the study and practice of efficient and Eco-friendly computing resources, is now under the attention of not only environmental

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organizations, but also businesses from other industries. Despite the huge surge in computing power demands, there are many existing technologies and methods by which significant savings can be made. This paper is dedicated to the ways a typical organization can reduce their energy footprint while maintaining required levels of computing performance.

(Scott Canonico et al 2009), [6], confirmed that Many commercial print applications such as book publishing, newspaper and magazine production, paper-based marketing material and numerous others were characterized by high levels of over-production and waste. Printed matter is manufactured and distributed to end users, retailers and warehouses, where a proportion is unwanted or loses its value before being sold. Subsequently, obsolete printed material is recycled or discarded as waste. This occurs in large part as theresult of business models built around traditional large scale offset litho, web-offset and gravure printing presses which have evolved to deliver very low cost per page on large print runs. Since digital press technology has the potential to re-engineer print business models and eliminate much of this waste. Paper was an exquisite technology that offers a durable, high contrast, high resolution and low power color display surface at very low cost. Despite this low cost and low environmental impact during use, paper has significant embedded Greenhouse Gas (GHG) emissions resulting from other phases of paper's life cycle. In fact, in most print applications, including those mentioned above, paper is the dominant contributor to GHG emissions. Although alternatives to paper such as e-books, e-paper and erasable ink have been proposed, it is not clear that these will succeed or that they will reduce emissions. These paper suggest that it would be certainly unwise to rely on them as the sole route to abatements. This paper attribute the GHG emissiions to the inefficiencies in current commercial and office print applications and describes improved business models built on digital print and distribution technologies to conserve paper and enable GHG emission reduction.

(Manisha Ganpati Patil and R. D. Kumbhar 2013), [7], the paper maintained that the study of energy consumption through the use of computing resources is now a very vast topic which causes a drought. The paper defines "green computing" as the study and practice of using computing resources efficienctly. It took into consideration the popular use of green computing in information technology industryas turning green into a manner no industry has ever done before. The paper saw that it was worth emphasizing that this green technology should not just be about sound bytes to impress activist but a concrete action and organizational policy. The paper said since green computing was seen as a term used to denote efficient use of resources in computing. It was generally acceptable to relate it to the use of computing resources in conjunction with minimizing environmental impact, maximizing economic viability and ensuring social duties. The paper after it study concluded that consumers do not care about ecological impact when buying computers and that they only care about speed and price. Hence green computing would be one of the major contributors which helps to minimize drought if every organization wishes to adopt it.

(Susan A. Shaheen and Timothy E. Lipman 2007), [8], proposed that climate change should be known as a tangible issue that must be addressed to avoid major environmental consequencies in the future. It saw that recent change in public opinion has been caused by the physical signs of climate change such as melting glacier, rising sea levels, more severe storms and drought events and hotter average global temperatures annually. Since temperature was a major contributor to carbon dioxide and other green house gas emissions from human activities, accounting for approximately 14% of total anthropogenic emissions globally and about 27% in the United States. The paper saw that transportation technologies and strategies are emerging that could help meet

the climate challenges. These includes automotive and fuel technologies, intelligent transport system and mobility management strategies that would reduce the demand for private vehicles. Since these was well understood, fewer studies were available on the energy and emission impacts of intelligent transport system and mobility management strategies. It follows that, in the future, intelligent transportation system and mobility management strategies would play a greater role in reducing fuel consumption. The paper observed that studies were based on simulation models, scenario analysis, and limited deployment experience which requires more research to be able to quantify their impacts. Its summary, was that, both incremental and evolutionary options are possible for reducing the greenhouse gas emissions impacts from motor vehicles.

(Siddharth Ghansela 2013), [9], saw that since energy was important and its cost was increasing day by day, many electronic companies were interested on how to produce minimum energy consuming electronic equipment so that they can save power and minimize carbon dioxide emissions. The paper has suggested some techniques for saving energy by applying some power saving techniques which involves green computing. It maintained that the quantity of electrical and electronic waste generated each year by computers and televisions was alarming, although there was no definite official data that exist on how much waste was generated or disposed in India. Its estimations were based on independent studies conducted by non-governmental organizations or government agencies. The paper concludes that since e-waste contains a number of hazardous substances, it was proper to suggest some techniques for proper recycling of e-waste.

(Y. S. Mohammad et al 2012), [10], observed that despite looming energy crises in the world, global change in environmental dignity resulting from power generation and energy consumption scenario is rapidly becoming a globally disturbing phenomenon. Since stakeholders and environmental activist have been clamouring for the adoption of reduction procedures using sustainable means in ignominious environmental practices that has disastrous consequencies. It proposed that increasing essential strategies were needed to fortify the pursuit for the reduction in the emissions from power generation and energy consumption. These paper presents an overview of the effects of anthropogenic energy generation and consumption practices that were capable of ejecting emissions of greenhouse gases into the atmosphere. It went further to identify some greenhouse gases emission reduction and control measures.

V. THE GREENHOUSE GAS EFFECT

The atmosphere is comprised of the following gases:

- Nitrogen which does not absorb infrared
- Oxygen which does not absorb infrared
- Methane which is a good absorber of infrared
- Carbon dioxide which is a good absorber of infrared
- Water vapour which is a good absorber of infrared
- Nitrous Oxide which is a good absorber of infrared and
- others

Transmittance (%)

Vibration spectra

Bond streching

Bond

4   30   ᴐ   1   ᴐ

Wavenumber (1/cm)
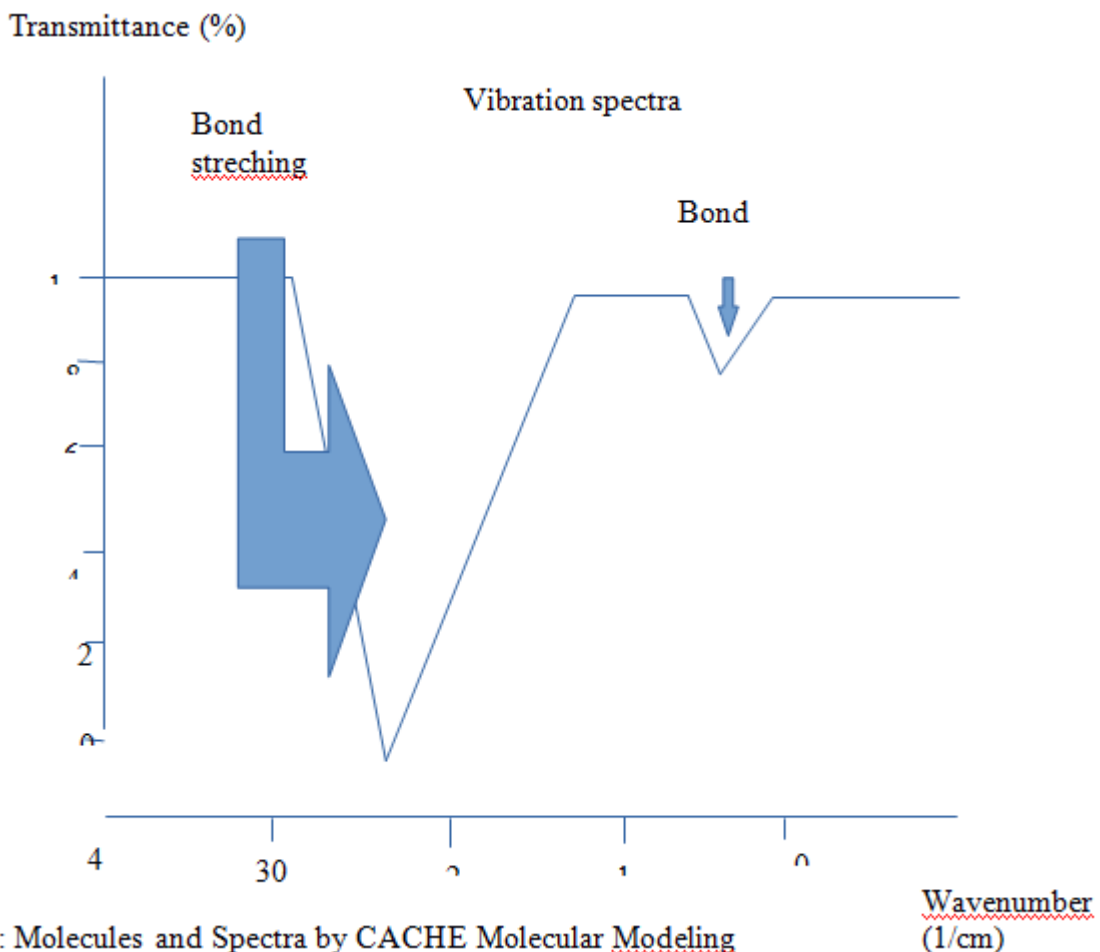
Source: Molecules and Spectra by CACHE Molecular Modeling

- An infrared photon is absorbed by molecules causing the bond to bend and vibrate.
- This rotational and vibrational energy is eventually translated into Kinetic energy of the gases through intermolecular collisions.
- This extra Kinetic energy is transmitted to other non-infrared absorbers like Nitrogen and Oxygen.
- The result is generally heating of the atmosphere which eventually leads to global warming.
- Mathematically:

$$A = \log_{10}(1/T)$$

Where A is the band intensities expressed as absorbance and

T is the transmittance.

- Absorbance is therefore defined as the logarithmic, to the base 10, of the reciprocal of the transmittance.

VI. THE IMPACT OF COMPUTING

Studies has shown that information and communication technology (ICT) accounts for 2% of the Carbon dioxide emission which is approximately as that of aviation. Energy costs has already exceeds hardware costs over a computer life time. It takes about 1.8 tones of chemicals to produce one personal computer (PC). The recent guide to greener electronics does not give the manufacturers satisfactory explanation to greener computing. According to National Science Foundation 2006 & 7 report, the United States and United Kingdom has 20 billion kilowatt hour (kwh) of energy wasted annually due to leaving computers on throughout the night.

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Computing has already serve more resources than it can consume. According to Intel Sustainability Whitepaper 2007, Intel atom processors is the most energy efficient emission reducing device ever created.

Computers can be used to:

- Increase business efficiency through logistics coordination.

- Enable dematerialization through digital download and web based applications.

- Reduce the need for people to travel considering vedio communication and other online tools.

VII. THE DANGER OF GREENHOUSE GAS EMISSIONS AND IT REDUCTION STRATEGIES

The danger of greenhouse gas emissions is as follows:

- It poses health risk

- It leads to natural ecological depletion

- Global warming

- Polar glacier melting and sea water increase

- Flooding and drought

- Dispute between nations etc.

The suggested greenhouse gas emission reduction strategies are as follows:

- Better process and product management

- Technological developments

- Carbon capturing

- Consumption modification strategies

- Solar and wind energy generation and conservation

- Reforestation

- Roof gardening

- International, regional and national regulations and

- Greener computing

VIII. THE NEW DIMENSIONS IN GREENER COMPUTING AND THE SUCCESSES OF CURRENT GLOBAL CLIMATE TREATY

Studies has shown that the following strategies are new dimensions in greener computing:

- Cloud computing

- Virtualization

- Use of Electronic Product Enviroment Assessment Tool (EPEAT) developed by the Institute of Electrical and Electronic Egineers (IEEE)

- E-waste recycling and reuse

- Telecommuting

- Mobile computing

- Creating awareness on the green use of computers

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According to Maria Callucci, International Business Times September, 2015, says India has the world's third-biggest climate polluter has not offered any plan to reduce it greenhouse gas emissions ahead of the United States climate negotiations in Paris this year. This she said was following a statement on a New York Times report, stating that, Mr. Prakash Javadekar, India's new environment minister complained that developed nations – not emerging economies – should shoulder most of the burden for cutting pollution. His arguement was based on the moral principle of historic responsibility.

Although the United States and China has long been disagreeing over the role each nation should play in United Nations negotiations. Obama administration has been reluctant to adopt legally binding emissions targets without China's participation. Chinese leaders as well as India have argued that "historic" emitters should make the steepest cuts. The tensions between these two nations are easing as global pressure mounts to address the climate crisis. Scientiests have warned that the planet is on the track to be warmer by 4 degrees Celsius, that is. 7.2 degrees Fahrenheit above pre-industrial levels by the end of the century, a level that will yield catastrophic climate impacts like significant sea-level rise, more frequent and intense extreme weather events, long lasting droughts and poorer air quality. Thus, given the current cummulative Carbon dioxides emission revelations, China and India's cooperation would be crucial for any global climate treaty to succeed.

IX. CONCLUSION

Greener computing is a possible step for all to follow even if its results are not automatically archieved. It is a philosophy that guide the use of computers without causing damage to our environment. It involves the use of computer resources with eco-friendly intent. Apart from offering an opportunity to reduce greenhouse gas emissions, it also help to conserve energy and reduce cost. Academic research on greener computing should be encourage to reap it full benefits. Awareness about greener computing should be created mainly in the academic environment to help to expand and propagate its tenets and statutes as to computer usage without causing harm to man and its environment.

X. ACKNOWLEDGEMENT

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