

## Reference List

Agarwal, S. and Nath, A. , “Green Computing --- a new Horizon of Energy Efficiency and Electronic waste minimization”: a Global Perspective in *CSNT 2011 --- International Conference on Communication Systems and Network Technologies*, (Katra, Jammu / India, 3---5 June 2011), 688 – 693

<http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5966538>

**Keywords:** *climate change, carbon emission, Green IT, Green Computing, Green, recycle, electronic waste, energy efficiency, air pollution.*

This academic paper focuses on the effects of IT usage on the environment. The authors depict a complete picture of the matter at hand. Starting from what the effects of global warming are, how much computer usage has increased over the years, the tangible and intangible costs to keep up with the demand as well as to the effects our earth is suffering.

Green IT upholds the beliefs that it is not necessary to upgrade all components in order to upgrade a system. The report discusses how users can upgrade computers by altering specific components and not by replacing all of the components. This in turn contributes to less waste. The authors discuss other methods of cutting down on energy and power waste, from a normal user point of view.

With the ever---changing growth of companies and the influence of IT in the running of the companies, the authors discuss ideas on how to minimize the usage of IT in order for the businesses to still achieve their objectives with minimal effects on the environment. At the same time such “cut---backs” in the use of IT leads to exploitation of newer technology such as video---conferencing instead of physical travel.

After having discussed the effects of global warming and land pollution due to the habitual unnecessary usage and improper disposal of the IT parts, the authors ended the article with methodologies and approaches towards Green IT. They elaborated on methods leading towards a more Green IT path.

Mr. Agarwal and Mr. Nath do justice to the article as they have discussed the matter at hand fully and included problems as well as suitable solutions to them. This makes us believe that we can use IT more sensibly in order to have a much healthier and greener future.

Blume, O. ; Zeller, D. ; Barth, U. ; Approaches to Energy Efficient Wireless Access Networks in *4th International Symposium on Communications, Control and Signal Processing*, (Limassol, Cyprus , 3---5 March 2010), ISCCSP 2010, 1---5

<http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5463328>

**Keywords:** *EARTH, Green Touch, consumption, carbon emission, IT, computing, wireless signals, WAN, conserve energy, organizations, advanced radio transmission technology, data traffic, base stations*

Nowadays, most of our devices have access to wireless signals. These signals contribute to the emissions of carbon dioxide which is harming our environment. The main focus of this report is to discuss and analyze two approaches to minimize the carbon dioxide emissions. The approaches being: EARTH and Green touch Initiative. The difference between them being that EARTH aims to reduce the carbon dioxide emissions by 50% with development of strategies as soon as 30 months. Whereas, the Green Touch Initiative aims to reduce at a much higher magnitude than the prior. However, it will require at least 5 years to develop and implement the approach.

The report begins by discussing how much the IT industry contributes to the carbon emissions made by humans. According to reports and studies, it is found that that it contributes to 2% of the global human carbon dioxide emission and it is expected to triple from 2002 to 2020. Later, more approaches to conserve energy on wireless techniques were mentioned, such as *PANAMA, ELB, CLASS--S, Cool Silicon and Mobile VCE Green radio*. However, the report's main focus was on the in depth analysis of the approaches with leading involvement of Alcatel---Lucent, being EARTH and GREEN TOUCH INITIATIVE. The hardware changes were discussed and analyzed on both types of approaches. Where EARTH being more of a much simpler fix in a short period of time whereas, GREEN TOUCH INITIATIVE requiring a lot of major investments by Alcatel---Lucent Bill on equipment manufacturing, network operations and leading academia.

In conclusion, this report gives an in depth analysis on the two approaches which in turn gives us a clear understanding of the matter at hand and how it can be dealt with best.

Unhelkar, B. Green IT: The Next Five Years. *IT Professional*, 13 (2), 56---59

<http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5735595>

**Keywords:** *green IT, organizations, goals, green computing, energy consumption, environment, environment factors, greenhouse emissions*

The publication by Unhelkar B., discusses the future of Green IT and the strategies companies can adopt over different time frames in order to decrease their carbon footprint. Three different time frames emerge in the discussion of this report.

The first of the timeframes discussed is the short---term effects. Though most of the report identifies businesses as major power consumers and therefore larger contributors to the carbon footprint, the normal consumer also can control the immediate effects. Advice such as usage of recycled paper and ink for printing, double sided printing, virtualization of desktops and adaptation of newer monitor technology that consumes less energy are some of the suggestions consumers can adopt from the discussion of the initial section of the article.

Mid---term goals discussed in this article mostly applied to companies that are currently in operation. Unhelkar discusses the awareness of green computing for companies should fall high in the priority list as profits and company roles. This is further helped along with the status received by the companies with awards and standards of the ISO. The implementation of social media, development of software and resources in the companies allows the companies to function more efficiently thus less power consumption. Lastly, he suggests the use of renewable energy resources such as wind, solar and nuclear.

As the title suggests, Unhelkar discusses the future of green computing. Unhelker ends the article by stating that it is hard to predict the consumption but he goes on to mention that the utmost care can be taken by following basic strategies of power consumption, which are implemented by other companies. One of the major strategies the writer believed in was adopting the cloud for less demanding tools. So if all the companies adopted it, it will make a large contribution to the decrease of carbon emissions.

In conclusion, the report by Unhelkar discusses with sufficient depth the 3 time frames that the IT consumer can keep in mind and take precautions appropriately.

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Thought leadership white paper. 2011. Crossing the sustainability chasm: strategies and tactics to achieve sustainability goals. IBM Software. Available from <http://public.dhe.ibm.com/common/ssi/ecm/en/til14006usen/TIL14006USEN.PDF> ; accessed 27 November 2011.

**Keywords:** Green ICT, IBM, sustainability chasm

This white paper presents the results of a recent study by Gartner, in collaboration with TRIRIGA, an IBM Company, of surveyed 130 professionals responsible for the planning

and implementation of sustainability initiatives across large corporations and public sector organizations.

It provides a new definition for a useful Green ICT performance measuring tool for organizations in terms of “crossing the sustainability chasm”:

“Sustainability chasm refers to the gap between two distinct groups of organizations seeking to achieve their sustainability goals—the first, who were quick to understand the environmental and economic benefits of sustainability and achieved their goals through the implementation of energy and environmental programs, and the second, that is attempting to move beyond the measurement of environmental performance and evaluation of opportunities to achieve their sustainability goals.”

It distinguishes the organizations in to three main categories:

Achievers: who implemented and successfully crossed the sustainability chasm

Planners: who are implementing but have yet to cross the sustainability chasm

Stragglers: who have no strategy in place to attempt to cross the sustainability chasm.

The paper describes the scope and gives a detailed breakdown of the survey in both the private and public sectors. It presents the results in user-friendly flowchart and pie-chart diagrams. It makes a valid point: that energy efficiency and not the greenhouse gases are the top priority. It also lists high level tactics to reduce energy in facilities as employed by the “achievers”. It emphasizes the importance of strong executive management involvement in strategic initiatives. This report identifies the critical strategies, tactics and technologies employed by the Achievers, and provide a roadmap to success for Planners and Stragglers. It suggests that while most large organizations measure energy and environmental performance, barely a third have “crossed the sustainability chasm” and actually achieved their sustainability objectives.

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Greenpeace International, Make IT Green: Cloud Computing and its Contribution to Climate Change. Available from

<http://www.greenpeace.org/international/en/publications/reports/make-it-green-cloud-computing/> (2010); accessed 27th November 2011

Keywords: carbon, cloud computing, greenpeace, internet, CO2 emissions

This article discusses how cloud computing will grow in the future and ultimately how much power it will need to consume. It shows several statistics showing power usage of different countries, where various internet giants get their energy from and projected CO2 emissions.

It starts with the discussion that the release of the iPad has brought about a revolution in cloud computing, then goes on to say that for a more green future, internet giants must make the effort into investing in cleaner methods of using energy. It then talks about how much energy it takes to “power the cloud” and how much it’s likely to rise by per year. It predicts usage of personal computers, mobile phones and tablets will increase substantially between now and the year 2020, which will put more demand on energy usage and therefore higher CO<sub>2</sub> emissions. The article later goes on to discuss how much the increase in technology overall will affect the environment and what targets should be set by the government to reduce emissions over time.

This article is good in that it considers everything needed to power cloud computing, right down to telecoms and that it discusses in depth both how the future of hardware and of software will affect CO<sub>2</sub> emissions. It does set clear targets for what Greenpeace want in the future, however I found the article quite heavy on statistics which may not be entirely true. It also doesn’t consider how much energy cloud computing can save in the long run.

Carbon Disclosure Project, Carbon Disclosure Project study 2011, Cloud computing- The IT solution for the 21st century. Available from

[http://www.businessgreen.com/digital\\_assets/3236/CDP\\_US\\_Cloud\\_Computing\\_-\\_FINAL\\_as\\_of\\_7\\_15\\_11.pdf](http://www.businessgreen.com/digital_assets/3236/CDP_US_Cloud_Computing_-_FINAL_as_of_7_15_11.pdf) (2011); accessed 27th November 2011

Keywords: Carbon Disclosure Project, cloud computing, CO<sub>2</sub> emissions, finance, business, environment

This article discusses how cloud computing helps to make ICT much more efficient, and thus how it can save vast amounts of energy in the long run. It argues that cloud computing is necessary to cut down CO<sub>2</sub> emissions and that it can also help to increase financial income.

The article starts with a summary of all the key points it visits. There is an explanation of what cloud computing is and how it helps businesses, before going on to explain why it’s worth investing in, and shows that overall it would cut down CO<sub>2</sub> emissions by taking into account how it can use virtualisation and run servers at higher utilisation rates. It later shows some statistical graphs showing their predicted carbon emissions in the future both with and without cloud computing.

This article is much more formally written than the Greenpeace one, and is concerned not only with reduction of carbon emissions, but of how much money cloud computing can save and how much it can help businesses. The article is quite long and not all of it is relevant to green ICT. Overall, it takes a very different viewpoint from the Greenpeace article, which raises a point saying that cloud computing is likely to increase energy usage substantially, whereas this one says that cloud computing is necessary in order to

lower carbon emissions.

explainingcomputers, Explaining Green Computing. Available from <http://www.youtube.com/watch?v=350Rb2sOc3U> (2008); accessed 28th November 2011

Keywords: green computing, efficiency, Intel, virtualisation, energy efficient coding

This video covers all the main points in green computing and is mainly a tutorial as to what it is and why it is so important. It tries to argue how computers are both “part of the problem and part of the solution”, but overall that they are more beneficial for the environment. It also briefly mentions that computing is economically favourable.

It starts by mentioning that computers are consuming increasingly more power over time and that they have overtaken aviation in this sense. It then mentions that most tools used in ICT could be a lot more efficient, and then starts to go over the details of how this could be done. An example of one of the methods covered is virtualisation. It shows how travel can be minimised by doing more online, such as having a meeting which will save far more than it uses. Another example is ‘efficient coding’. The idea behind it is to write code that executes as efficiently as possible and to minimise use of peripherals. It ends by concluding that computers are probably more beneficial for the environment than harmful.

This video is more of a guide that covers key points than anything else. Unlike the other two resources it does not mention cloud computing, however much like the second resource it tried to argue that computers save more power than they use. Like the other two links it relies fairly heavily on statistics, but the points made in this video are very clear.

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