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Current Trends in Green ICT

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ABSTRACT

In the wake of global warming and concerns over its impact due to environmental degradation, there is an urgent need for IT industries/companies to integrate a green agenda. Green IT is not a product that you can install and forget about, nor is it an application, which you can implement overnight. Green IT is a transition, which takes time and investment. It requires careful planning, which first involves doing a reality check of how green you really then deciding where you want to reach. Green IT is actually a way to move forward with your entire IT infrastructure. The end objective of green IT is to lower operational costs and increase the efficiency of IT infrastructure. This paper deals with the possible reasons of environment degradation due to the IT industry; the challenges and steps towards going green; and the various initiatives taken by countries, practitioners and industry towards greenness.

Key Words: information and communication technology, green house gases, restriction of hazardous substances

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Introduction

The entire world today is talking green. It's not green with envy, but green as in becoming more eco-friendly, environment friendly, energy conservation, efficient usage of computing resources, adherence to global standards (like Energy Star, ROHS (Restriction of Hazardous Substances etc.) so that the IT products could be managed efficiently throughout its life and even at the time of disposal. A 2008 survey by IDC (International Data Corporation) revealed that energy costs were the most pressing reason for the adoption of green IT. The goals of green computing are similar to green chemistry; 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. Research continues into key areas such as making the use of computers as energy-efficient as possible, and designing algorithms and systems for efficiency-related computer technologies.

According to Greenpeace Legislative Director Mr. Rick Hind, "Worldwide 20 to 50 million tons of computer gear and cell phones are dumped into landfills each year, and it's the fastest growing segment of waste. At most, 12% of PCs and cell phones are recycled putting chemicals such as mercury and PVC into the environment" (McGee, 2007, p.1). Last year, Gartner estimated that ICT accounts for 2% of global CO2 emissions, which is same as the aviation industry (Gartner. 2007).

It has been worked out that a typical computer consumes about 0.65 KWh in use, 0.35 KWh in hibernate mode. Assuming that a computer works 220 working days with 12 hours in operation, 12 hours in standby mode and spends 24 hours in hibernate mode for the remaining 145 days, it will consume 1716, 924 and 104KWh of electricity respectively in these three modes. It has also been worked out that one KWh produces 0.51 Kg of CO2 and 1960 KWhs would produce one ton of CO2. It thus suggests that a single PC on an average generates 1.4 ton of CO2 per annum. Thus in a distributed desktop environment of 2000 PCs, the annual carbon footprint is to the tune of 2800 tons per annum (McBrayne, & Lanyon-Hogg, 2007).

Green IT is not a product that you can install and forget about, nor is it an application, which you can implement overnight. Green IT is actually a way to move forward with your entire IT infrastructure. The end objective of green IT is to lower your operational costs and increase the efficiency of your IT infrastructure. Today, the concern is how to choose the right IT product and the steps to roll out the green IT strategies? Through this study, we shall try to decipher and jot down the various possible reasons for the degradation of environment with respect to the IT Industry. Alongside, an effort shall be made to study the various initiatives taken up by the countries, their industries, practitioners and law makers in this regard.

Factors Contributing to Non-Greenness

IT is a must for every business, and as business grows, an organization needs to invest more in the IT infrastructure. With the rising cost of energy, more IT equipment translates to higher costs of power consumption. So if products continue consuming the power they have been consuming, it could have serious implications.

Data Centers Servers

Data centers are well known for energy consumption. Industry experts say the power consumption of data centers is doubling every five years or so, making them one of the fastest-growing drags on energy in the U.S. "The IT industry is where the automotive industry was 20 years ago" says Rakesh Kumar, research vice-president at consulting firm Gartner (King, 2007). For every kilowatt of energy consumed by a server, roughly another kilowatt is chewed up to cool it today (McGee, 2007). "Data centers use 50 times the energy per square foot as an office" says Mark Bramfitt, principal program manager at PG&E. (King, 2007). According to Jonathan Koomey, a consulting professor at Stanford University and staff scientist at Lawrence Berkeley National Lab, "Energy consumed by data centers in the United States and worldwide has doubled from 2000 to 2005. Data center servers, air conditioning, and networking equipment sucked up 1.2% of U.S. power in 2005". (McGee, 2007, p.2) The Green IT project of Japan is promoting the technology like ultra-high density HDD and high efficiency cooling systems (Kounatze, 2009, p. 14).

According to Gartner, traditional data centers typically waste more than 60 percent of the energy that they use to cool equipment. To keep servers at the right temperature, companies mainly rely on air-conditioning. The more powerful the machine, the more cool air needed to keep it from overheating. Gartner reckons that in future, about half of the Forbes Global 2000 companies will spend more on energy than on hardware such as servers. Energy costs, which are now about 10% of the average IT budget, could rise to 50% in a matter of years (King, 2007).

PC Selection

PC standard has become largely irrelevant for businesses, as the last update came five years ago. PC energy saving can make a difference to companies. Union Bank of California expects to reduce its energy costs 10% to 12% annually just by buying more energy-efficient PC's says Julie LeDuc, the bank's VP of IT product procurement (McGee, 2007).

Table: 1. Carbon Footprint Analysis

Carbon Footprint of ICT Sector (2007-2010)				
	Emissions 2007 (Mt CO2e)	Percentage 2007	Emissions 2020 (Mt CO2e)	Percentage 2010
World	830	100%	1430	100%
Server farms/ Data Centers	116	14%	257	18%
Telecoms Infrastructure &Devices	307	37%	358	25%
PCs and Peripherals	407	49%	815	57%

Mt CO2e = Metric Tonne Carbon Dioxide Equivalent

***Source**: PC Quest, 2010*

Carbon Foot Print

The ICT industry is responsible for 2-3% of the global carbon footprint (Kounatze, 2009, p. 7).

Disposal of Obsolete Hardware

The other problem with ICT is that products like PCs, laptops, etc have short life cycles, becoming obsolete in only a few years. For instance, greenhouse gas (GHG) emissions of California's residential and commercial PCs in 2005 were estimated to be 4.18 Mt CO2 a year in the manufacturing phase, 1.72 Mt CO2 a year in the use phase, and 0.004 Mt CO2 a year in the disposal phase (California Energy Commission, 2005). Manufacturers have to comply with directives like ROHS (Restriction of Hazardous Substances) to minimize risks from e-waste, and the organizations should ensure systematic disposal of these products (Kothari, 2011).

Challenges in Going Green

There are many challenges involved in going green. Green computing is the practice of optimal usage of computing resources which requires a knowledge mix of both technology and policies. The policies may be both IT and non-IT related. The following are the possible challenges in going green:

- Determining the return on investment(ROI) from using green IT products
- Adopting and implementing a green IT Strategy
- Convincing top management about rolling out the strategy
- Choosing the right partner to assist you in effective implementation of the green strategy
- Dearth of equipment & skills to go green

Steps Towards Greenness

The various measures towards greenness may be the following:

- reality check of IT infrastructure
- management restructuring according to latest trends
- policies & its compliance
- monitor & PC management
- server virtualization
- be energy smart
- systematic disposal of e-waste
- telecommuting as per end user satisfaction
- thin client solutions (Photonic ICs)

Do a Reality Check of Your IT Infrastructure

The first step towards going green would be to assess the greenness of your existing IT infrastructure. For this, you need to divide your IT infrastructure into multiple parts, e.g. data center, desktops and laptops fleet, networking equipment, etc. For each, you could get an audit done to determine the power consumption by each part, and check the

compliance of the green standards like ROHS, etc. The data center is of course, the most crucial part of the entire IT infrastructure, and therefore requires a lot of planning. It may be further broken into multiple parts like power conditioning equipment used, air conditioning, servers, racks and enclosures and other equipment like storage etc. It is desired to be vigilant regarding future IT growth plans in terms of hardware.

Management Restructuring According to the Latest Trends

It is important to keep pace with the latest trends and developments in the Green World. From desktop mother boards to hard drives, network switches to a laser printer's toner cartridge, everything is going green. A motherboard from Gigabyte and a hard drive from Western Digital, claim to consume less power. [24] On the networking front, a network switch from D-Link consumes less energy. In fact 'Extreme Networks', which is into enterprise class network switches, has won awards for its green products (Network Computing. 2009).

More efficient processors are critical energy-saving elements. Sun's multi-core chip has the efficiency to fuel interest in new high end servers. According to Sun's chief architect Rick Hetherington "Sun's 32-thread Niagara 1 chip, Ultrasparc1, consumes 60 to 62 watts" (Information Week, 2008). Intel's quad-core Xeon chips delivers 1.8 teraflop peak performance using less than 10000 watts, compared to 800000 watts ten years ago when Pentium chips were used (Information Week, 2008). Hewlett Packard, offers cooling systems that rely on sensors to directly cool the needed spot. (Information Week, 2008)

A new trend has started for bigger impact by putting Energy Star Ratings on servers. Among the strictest regulations on the computer industry are the European Union's 'Restriction of Hazardous Substances' directive introduced last year, which restricts the use of six toxic substances, including lead and mercury (Kothari, 2011).

Policies and ITs Compliance

Green IT is a transition, which takes both time and investment. It requires careful planning, which first involves doing a reality check of how green you really are today, and then deciding where you want to reach. You could also incorporate a green clause in all your RFPs (Request For Proposals). This would automatically ensure that your vendor offers you the most power and eco-friendly equipment. Keep the disposal cost of your IT equipment in mind at the time of purchasing it, just as you account for its initial purchase, running, and maintenance costs. For this, you need to tie-up with a vendor who specializes in e-waste management.

Monitor and PC Management

Flat panel monitors use less energy than traditional CRT monitors. It is said that a LCD monitor will pay for itself in two years time, just out of the savings it brings in your electricity bills (Chopra, 2008). Since the life of a LCD monitor itself is much longer than two years, this benefit is definitely worth it. Moreover, since the prices of LCD monitors have dropped significantly, it can be considered as a replacement to CRTs much more easily now.

A CRT monitor when switched off still consumes around 5W of power. A standard power extension board eats up around 2 to 5 watts depending on its wattage and the number of plug points it has. Just imagine how much power would be wasted if a person leaves high workstation on for the whole night? You can find the power options settings in your PC's Control Panel. When you're going to be away from your PC for more than a few minutes,

set it to stand-by mode and turn off the monitor. Set the Power Options on your computer to switch to sleep mode when it's not active (Roy, 2008)

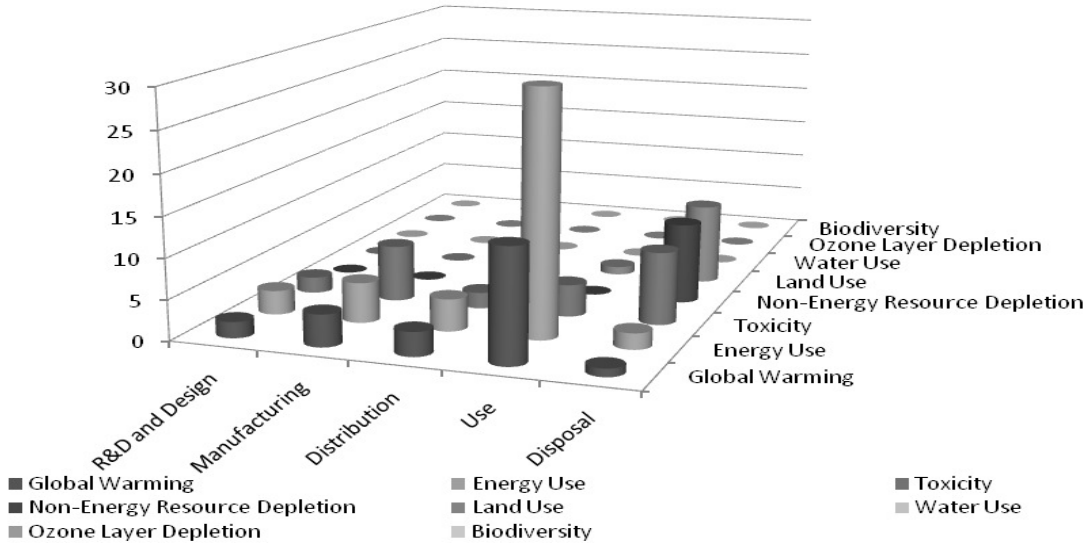
Now flat panel monitors that meets EPS's stricter Energy Star 4.0 guidelines is easily available in the market. Organic Light Emitting Diodes (OCED) is the technology in pipeline.

Server Virtualization

Virtualization is one of the most effective tools for more cost-effective, greener computing. By dividing each server into multiple virtual machines that run different applications, companies can increase their server utilization rates and shrink their sprawling farms (Lamb, 2009). Virtualization is making the most efficient use of available system resources so that both cooling costs and energy utilization can go down. It is also estimated that "Cloud Computing" can reduce hardware usage by a ratio of 4:1 and administration by a ratio of 7:1.

Cloud computing is a trend that has really picked up momentum across the IT industry, and is a key technique being touted for going green. There is a server for just about every application-mail, web proxy, business apps, security, content management, file serving, and so on. The sad part is that their average utilization hovers around 30-40%, if not less and yet they continue to run 24X7 and consume energy cost of servers, which are idle almost 70% of the time. Virtualization technology allows you to abstract the hardware from the software. So a server, which traditionally runs a single OS and application in the data center, is able to run multiple OS and applications simultaneously (Oracle 2010).

Figure 1. Number of government programmes focusing on direct effects of ICTs by life cycle phase and environmental impact category



1. Direct effects of ICTs: Initiatives focusing on environmental impacts produced by ICTs themselves.
2. Based on 50 policies and programmes of governments in a survey of 92 programmes and initiatives across 22 OECD countries plus the European Union (42 initiatives of industry associations).

Source: OECD, Towards Green ICT Strategies, 2009

Be Energy Smart

Why depend upon the standard energy source to power your IT equipment when you can use alternate energy sources like wind, solar power etc. Though it might be too expensive to power an entire data center on wind power today, and solar power may not be able to produce sufficient energy for the job. However, you can use solar power for remote areas. In fact, one well known company, Mahindra and Mahindra Financial Services Ltd, has started using solar power to power its computers in remote villages (Chopra, 2008). Renewable energy sources are gradually gaining importance amongst enterprises. The DOE Data Center Energy Efficiency Program of the United States, for instance, aims at increasing energy efficiency of at least 1500 "mid-tier and enterprise-class data centers" by 25% (on average) and of at least 200 "enterprise-class data centres" by 50% (on average) by 2011 (Kounatze, 2009, p. 22). In Denmark's Action Plan for green IT, the Danish Ministry of Science, Technology and Innovation has committed itself to save 10% of its annual electricity consumption each year (Kounatze, 2009, p. 17). The DOE Data Center Energy Efficiency Program of the United States, for example, aims at reducing energy consumption of data centers. As another example, the Equipment Energy Efficiency (E3) Program of Australia and New Zealand sets mandatory energy performance standards for the use of ICT equipment (Kounatze, 2009, p. 25).

Systematic Disposal of E-Waste

While you might purchase equipment that is green, what would you do with the old or obsolete equipment? Countries like the US are trying to cope with the problems of e-waste. They are finding it difficult to dispose off the waste IT products. According to a recent report by MAIT, 3.3 lakh tones of e-waste was generated in India last year alone, and an additional 50,000 tonnes came in through illegal imports from developed countries (Singh, 2009). This figure is large by any account, and will only grow. Currently, most of this e-waste ends up in landfills. It produces toxins that are hazardous for human health and the environment. Some of these are barium, cadmium, lead, lithium, mercury, brominates flame retardants, etc; which can cause serious health problems like birth defects, damage to vital organs like heart, liver, lungs, kidneys, etc. The sad part is that most of this recycling is being done by the informal sector, which is not all equipped to handle it properly. So these toxins are freely let into the air and seep into ground water and drainage systems (Jain, 2008).

Japan's New Action Plan towards a Global Zero Waste Society is tackling e-waste. The EC has adopted two directives targeting the disposal of ICTs: The Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment (ROHS) (EC, 2002a) and the Directive on waste electrical and electronic equipment (WEEE) (Kounatze, 2009, p. 25). The United Kingdom has one of the largest Government Disposal Services Authorities (DSA), which is an integral part of MOD's Defense Equipment & Support (DE&S, 2007). The DSA is responsible for the reuse, resale and recycling of ICT equipment as well as other goods such as buildings, vehicles, furniture and textiles across 61 government bodies (Kounatze, 2009, p. 25).

Telecommuting to Reduce the Greenhouse Effect

At Sun Microsystems, 14,219 employees work from home two days a week, and 2,800 work from home three to five days a week. Some use "drop-in centers" closer to home that save an average of 90 minutes in commute time. About 40% of employees use the telecommuting program to some extent that saved 6,660 office seats, cutting Sun's real

estate costs by $63 million in the last fiscal year, Reduced commuting by Sun workers avoided an estimated 29,000 tons of CO2 emissions (Lamb, 2009; McGee, 2007).

Gartner estimates that 12.6 million U.S. workers tele-worked last year more than eight hours a week. But Gartner thinks that number will grow just 3% this year. That's the reality of corporate green initiatives (Lamb, 2009). ICT Norway, uses tele-working applications for all its members in order to reduce traveling (Lamb, 2009).

Thin Client Solutions

The "Photonic Integrated Circuit" could make the internet nearly 100 times faster and give users unlimited error-free access anywhere in the world. This newly developed technology, which has terabit per second capacity, may find application as a guide of switching path for information. This switch will turn on and off about one million times in one second, thus enabling the networks 100 times faster without any additional cost. The researchers have now developed "the grid" which is about 10000 times faster than a typical broadband connection which will enable us to download entire feature film within seconds, resulting in huge power saving (Hub pages, 2008).

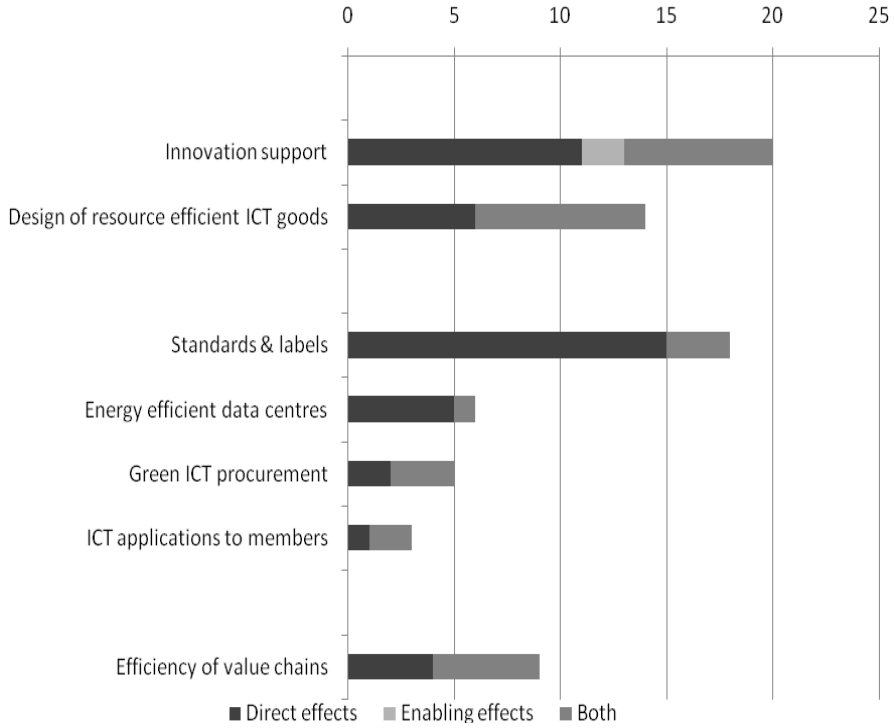
Role of the IT Industry

IT industry is also applying green standards to their own operations. Salesforce.com in January announced an initiative to "offset its carbon footprint", that is, compensate for the 19,700 tons of carbon emissions created by everything from its data centers to employee travel. This effort includes a partnership with Native Energy, a Native American owned company involved in renewable energy projects, and invested $126,000 in five projects to develop alternative energy sources, including windmill and methane farm. Sun created a Sun Eco office a year ago to oversee all of the company's green programs, including telecommuting but also core products such as low-power servers. It is touting its Project Blackbox, a data center in a shipping container, not just portable but also 20% more energy efficient than today's data centers (Information Week. 2008). Google has built a data center on Oregon's Columbia River to tap hydroelectric power while Microsoft did the same in Washington for the same reason. Financial services company HSBC is building a data center near Niagara Falls. Wyoming's trying to lure data centers with the promise of cheap power from coal-fired plants (Information Week. 2008).

Started by Google and Intel in 2007, the Climate Savers Computing Initiative is a nonprofit group of eco-conscious consumers, businesses and conservation organizations. Their goal is to promote development, deployment and adoption of smart technologies that can both improve the efficiency of a computer's power delivery, reduce the energy consumed when the computer is in an inactive state and cut carbon dioxide emissions. (Climate savers computing, 2007)

Cisco also put most of its green initiatives under one umbrella, the Eco Board. Its efforts include using its own high-end videoconferencing and other IP tools to cut company travel by 20% a year. Cisco is also working with San Francisco, Seoul, and Amsterdam, to find ways to reduce CO2 through broadband and other networking technologies that support tele-work (Information Week. 2008).

Figure 2. Number of initiatives of industry associations by business activity area and type of effect



Based on 42 initiatives of industry associations in a survey of 92 policies and initiatives across 22 OECD countries plus the European Union (50 policies of governments).

Note: Direct effects of ICTs: Initiatives focusing on environmental impacts produced by ICTs themselves.

Enabling effects of ICTs: Initiatives focusing on reducing environmental impacts by using ICT applications
Note: Direct effects of ICTs: Initiatives focusing on environmental impacts produced by ICTs themselves.

Enabling effects of ICTs: Initiatives focusing on reducing environmental impacts by using ICT applications

Source: OECD, Towards Green ICT Strategies, 2009

Innovation support is one of the most frequent activities of industry associations. Twenty of 42 industry associations are stimulating innovation among their members, strengthening co-operation and exchange of information and knowledge between their members. For instance, Intellect through its Consumer Electronics Energy Efficiency Group is identifying best low carbon technologies among its members and promoting their development. As another example, the Energy Efficiency Inter-Operator Collaboration Group (EE IOCG) is sharing information on "energy critical issues" of ICT equipment and networks (Kounatze, 2009, p. 32).

Product design is an essential stage of production for improving energy and material efficiency of ICTs. For instance, members of the Climate Savers Computing Initiatives have to commit to "develop products that meet or exceed the Initiative's Program Criteria". For desktops, laptops and workstation computers, the Program Criteria equal the ENERGY STAR 4.0 specifications. The European Information and Communication Technology Industry

Association (EICTA), another example, is promoting the "integration of environmental considerations at the stage of product design with the aim of reducing all relevant potential environmental impacts over its entire life cycle" (Kounatze, 2009, p. 33).

Increasing Diffusion of Green ICTs and ICT Applications

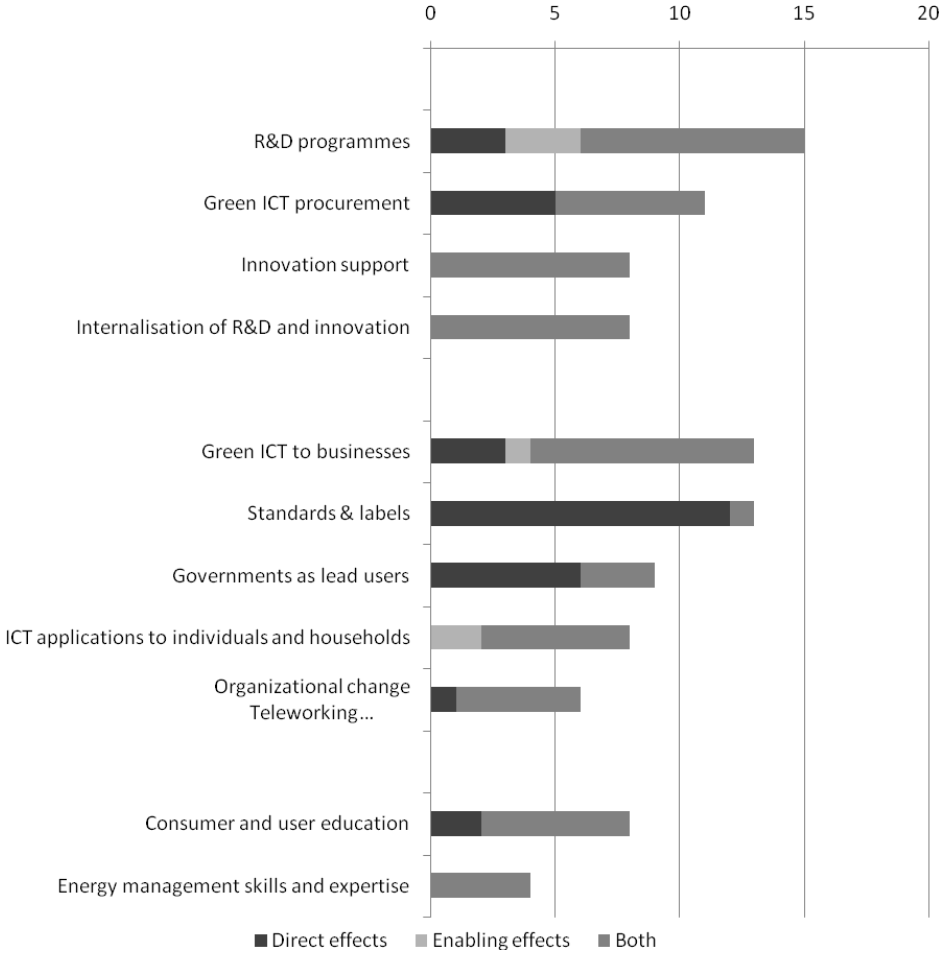
Industry associations have acknowledged the potential of saving energy costs throughout their sector, and are increasing the diffusion and usage of both green ICTs and ICT applications for reducing environmental impacts. This includes green ICT standards and labels, green procurement, and ICT applications such as energy saving tools as well as tele-working applications for reducing traveling (Kounatze, 2009, p. 33).

Green ICT Standards and Labels

One continuing barrier to green ICT is the lack of standardized instruments for monitoring and evaluating energy cost of ICTs (IDC 2008; Wikberg, 2008). Instruments can consist of eco-labels, which indicate energy and material efficiency of ICTs. Researchers expect that the global market for such green IT services will grow by 60% a year over the coming years, peaking at $4.8 billion in user spending in 2013. The green IT project of the Norwegian ICT industry association, for instance, is promoting joint transportation of goods in order to reduce transport costs. As another example, the Voluntary Action Plan on Global Warming Prevention of the Liaison Group of Japanese Electrical and Electronic Industries for Global Warning Prevention encourages improving production capacity in order to reduce CO2 emissions per basic unit of production (Kounatze, 2009, p. 35).

The Korean Telecommunications Technology Association (TTA) and the Silicon Valley Leadership Group are focusing on direct effects of ICTs. EICTA, through its Environment Policy Group (EPG) is identifying and promoting best practice low-carbon ICTs and accelerating their development and implementation between its members. TTA is promoting standards for mobile telephone chargers including end-of-life management. The Silicon Valley Leadership Group through its Clean & Green Energy Action Plan is encouraging the increase of energy efficient data centres (Kounatze, 2009). In contrast, the Global e-Sustainability Initiative (GeSI, 2008) and the UK Centre for Economic and Environmental Development (UK CEED) are industry associations considering reducing direct and enabling impacts of ICTs. GeSI is promoting sustainable development in the ICT sector. This includes, for example, the promotion of programmes to reuse and recycle ICT equipment, as well as the promotion of ICT applications such as "smart" buildings and "smart" transportation systems. UK CEED through its Sustain IT initiative is also promoting the development and usage of ICT applications for sustainable development including green ICTs. ICT Norway is promoting joint transportation of goods in order to reduce energy costs of its members, as well as encouraging the usage of tele-working applications (Kounatze, 2009, p. 36).

Figure 3. Number of government programmes by policy area and type of effect



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Enabling effects of ICTs: Initiatives focusing on reducing environmental impacts by using ICT applications

Source: OECD, Towards Green ICT Strategies, 2009

Policies and Programmes

Denmark, Japan and the United States are countries where policies and programmes are administered centrally, yet, with some differences. Denmark's Action Plan for green IT has been established by the Ministry of Science, Technology and Innovation (2008). Japan's green IT initiative has been created by the Ministry of Economy, Trade and Industry (METI, 2008). However, the Ministry of Internal Affairs and Communications (MIC, 2008) is also contributing to Japan's efforts on improving the environmental impact of ICTs and by using ICT applications. In the United States, two national agencies have each initiated green ICT-related measures. The US Department of Energy (DOE) has established the DOE Data Center Energy Efficiency Program (DOE, 2008), and the US Environmental Protection Agency (EPA) the ENERGY STAR label. DOE and EPA are also co-operating on energy

efficiency (U.S. Department of Energy and U.S. Environmental Protection Agency, 2008) (Kounatze, 2009, p. 10).

The European Commission (EC) and the Asia-Pacific Economic Cooperation (APEC) are examples of intergovernmental institutions with programmes on ICT and the environment. The EC has formulated one of these in its Communication "Addressing the challenge of energy efficiency through ICTs" (EC, 2008c) and its Communication "on mobilizing Information and Communication Technologies to facilitate the transition to an energy-efficient, low-carbon economy" (EC, 2009).

Another example is APEC's Energy Standards Information System (APEC-ESIS), which provides information about energy efficiency standards in member countries (APEC, 2008) (Kounatze, 2009, p. 11). Government can focus on a single policy such as Australia's Minimum Energy Performance Scheme, which includes mandatory eco standards enforced by Australian government legislation (Kounatze, 2009, p. 12).

Also the industry associations are promoting the optimization of power supply and cooling systems within data centre facilities. For instance, the Telecommunications Infrastructure Standard for Data Centers of the Telecommunications Industry Association (TIA) specifies standards for data centre facilities, including "site space and layout, cabling, tiered reliability and environmental considerations". Its new project, Addendum 2, will also include wider ranges of temperature and humidity, "permitting lower power consumption and reducing of Heating, Ventilating and Air Conditioning (HVAC)" (Kounatze, 2009, p. 34).

Eco Labels Established by Non-Government Organizations

More eco labels have been established by industry associations or by single companies and non-profit organizations than by governments alone. The following describes some eco labels established by the private sector:

80-Plus is an initiative established in 2004 by Ecos, a US consulting company. 80-Plus certifies energy efficient Power Supply Units (PSUs). It requires PSUs to have a minimum efficiency rate of 80% at 20%, 50% and 100% load rate. This means, at a load rate of 20%, 50% and 100%, 20% at maximum of the power consumed by PSUs is wasted. In 2008, Bronze, Silver, and Gold 80-Plus were introduced to distinguish between various levels of efficiency. Thirty-eight companies used 80-Plus for labeling their PSUs in 2007" (Kounatze, 2009, p. 33).

The Electronic Product Environmental Assessment Tool (EPEAT) is a system for supporting green procurement of desktop computers, notebooks and computer displays. It was developed in 2007 in compliance with the IEEE 1680- 2006 standard by the Zero Waste Alliance, a non-profit organization including universities, government and industry. EPEAT is based on environmental criteria including "reduction/elimination of environmentally sensitive materials", the usage of recyclable and biodegradable material, and "product longevity / life cycle extension". Like 80-Plus, EPEAT also differentiates between three quality tiers, EPEAT Bronze, Silver and Gold, depending on the fulfillment of optional criteria (Kounatze, 2009, p. 34).

The PC Green Label was developed in 2004 by Japan's PC3R Promotion Center. Its goal is to develop principles to reduce, reuse and recycle (3Rs) of computers and computer displays as in the Japanese "Law for Promotion of Effective Utilization of Resources". It considers all main life cycle phases: R&D and Design, Manufacturing, Use, and Disposal, and also focuses on the energy efficiency of computers and computer displays (Kounatze, 2009, p.34).

TCO Certification for ICT and office equipment has been established by TCO Development, a non-profit organization of the Swedish Confederation of Professional Employees. TCO Certification was first introduced in 1992 (TCO'92) for certifying low electromagnetic emissions of computer displays. Now it is available for a wide range of ICT and office equipment, for instance, headsets (TCO'07), media displays (TCO'06), desktop computers (TCO'05), notebooks (TCO'05), office furniture (TCO'04), and mobile phones (TCO'01). Besides energy efficiency and environmental criteria, TCO Certification also includes ergonomic criteria (Kounatze, 2009, p.34).

Indian Scenario

The per capita consumption of energy in India nearly doubled from 238 KWh in 1990 to 408 KWh in 2001. At the current annual generation capacity of 1,30,000 MW, India faces shortages of nearly nine percent with peak load deficits being higher at 10 to 11 percent according to the Central Electricity Authority (CEA), India. Electricity generation capacity needs to go up from the current installed capacity to between 800,000 to 950,000 MW as indicated by the Integrated Energy Policy document mentioned in the Hon. Prime Minister's speech at the Energy Conclave 2006 (Economic Times, 2006).

China and India are expected to adopt versions of ROHS within the next year. The EU has two other significant green-tech rules, the Waste Electrical and Electronic Equipment regulations, which require sellers to take back any product they sell for recycling; and Registration, Evaluation and Authorization of Chemicals, which aims to improve the management and risk assessment of dangerous chemicals. The United States has no federal computer recycling mandate, but California's Electronic Waste Recycling Act is a "cradle to grave" program aimed at reducing hazardous substances in electronic products sold in that state . It includes a recycling fee of $6 to $10 paid by the buyer of PCs and monitor. Other states are likely to follow. ROHS standards are slowly becoming de facto requirements, as the United States makes them part of the EPEAT standards and vendors look to standardize products worldwide (Lamb, 2009).

Several world renowned IT companies like AMD, APC, Dell, HP, IBM, Intel, Microsoft, Rackable Systems, Spray Cool, Sun Microsystems and VM ware, have formed the Green Grid Consortium which is dedicated to advancing energy efficiency in data centers and business computing eco-systems. India could study and adopt their best practices for ensuring green and clean IT In India (Lamb, 2009).

The Planning Commission of Government of India has already cleared the proposal to build 43 new IT cities in India by 2018, thus it is imperative to plan the green buildings housing IT infrastructure which follow the green global standards. In addition, compulsory implementation and compliance of Energy Conservation Building Code should be adhered to and emphasized to reduce the energy demand. There is a need for strict standards and regulations to encourage and ensure green and clean computing.

Conclusion

As per NASA, "*The danger point is closer than thought due to Global Warming. With 10 more years of business as usual, it will be impractical to avoid the disastrous effect of Global Warming*" (Hansen, 2007).

In the wake of global warming and concerns over its impact due to environmental degradation, there is an urgent need for the IT industries/practitioners to come forward and integrate a green agenda into their industrial/manufacturing and business models. The

concept of 'Green and Clean IT' is awakening India to IT's responsibilities towards environment conservation. IT professionals, have the onerous responsibility to develop new green and clean technologies which are energy efficient and eco-friendly. IT users can pick and choose the solution that they want to use to reduce costs and can dip a toe in the eco water with simple assessment tools to see where and how much money is spent on energy and cooling and how it can be controlled using the right solution.

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