Green Computing

- Tushar Sambare
- Sonali Sambare

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Green Computing

(As per the Syllabus 2016-17 of Mumbai University for B.Sc. IT, Semester II)

Mr. Tushar Sambare

(M.Sc. [IT], B.Ed.)

Coordinator – M.Sc. (IT) Department
S.M. Shetty College of Science Commerce & Management Studies,
Bunts Sangha's S.M. Shetty Educational Institutions,
Next to Hiranandani Gardens, Opposite Jalvayu Vihar,
Mumbai – 400076.

Mrs. Sonali Sambare

(M.Sc. [IT])

Coordinator – B.Sc. (IT) and B.Sc. (CS) Department
Tilak Education Society's J.K. College of Science and Commerce,
Plot 22, Sector-5, (Opp. Ghansoli Station),
Ghansoli, Navi Mumbai – 400 701.

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New Delhi : "Pooja Apartments", 4-B, Murari Lal Street, Ansari Road, Darya Ganj,
New Delhi - 110 002. Phone: 011-23270392, 23278631; Fax: 011-23256286

Nagpur : Kundanlal Chandak Industrial Estate, Ghat Road, Nagpur - 440 018.
Phone: 0712-2738731, 3296733; Telefax: 0712-2721216

Bengaluru : Plot No. 91-33, 2nd Main Road Seshadripuram, Behind Nataraja Theatre,
Bengaluru - 560 020. Phone: 080-41138821; Mobile: 09379847017, 09379847005

Hyderabad : No. 3-4-184, Lingampally, Beside Raghavendra Swamy Matham, Kachiguda,
Hyderabad - 500 027. Phone: 040-27560041, 27550139

Chennai : New No. 48/2, Old No. 28/2, Ground Floor, Sarangapani Street,
T. Nagar, Chennai - 600 012. Mobile: 09380460419

Pune : First Floor, "Laksha" Apartments, No. 527, Mehunpura, Shaniwarpeth
(Near Prabhat Theatre), Pune - 411 030. Phone: 020-24496323, 24496333;
Mobile: 09370579333

Lucknow : House No. 731, Shekhupura Colony, Near B.D. Convent School, Aliganj,
Lucknow - 226 022. Phone: 0522-4012353; Mobile: 09307501549

Ahmedabad : 114, "SHAIL", 1st Floor, Opp. Madhu Sudan House, C.G. Road, Navrang Pura,
Ahmedabad - 380 009. Phone: 079-26560126; Mobile: 09377088847

Ernakulam : 39/176 (New No. 60/251), 1st Floor, Karikkamuri Road, Ernakulam,
Kochi - 682 011. Phone: 0484-2378012, 2378016; Mobile: 09387122121

Bhubaneswar : 5, Station Square, Bhubaneswar - 751 001 (Odisha).
Phone: 0674-2532129; Mobile: 09338746007

Kolkata : 108/4, Beliaghata Main Road, Near ID Hospital, Opp. SBI Bank,
Kolkata - 700 010. Phone: 033-32449649; Mobile: 07439040301

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Dedication

This book is dedicated to the fond memory of my late brother **"Amol Sambare",** in whose company I trod the morning dew in Flanders fields,

"Say not good night, but bid me good morning in some brighter clime."

– Mr. Tushar Sambare

Dedicated to my both lovely princesses **"Yashashree"** and **"Vedshree",** who are my inspiration always.

– Mrs. Sonali Sambare

Preface

Such a great move by University of Mumbai to introduce Green Computing as a Subject for F.Y. B.Sc. IT – Semester II! It is a really needed and innovative move.

The current world is the world of electronic equipment, such as computers and handheld devices and many more. As the technology is evolving day by day, number of users of technology is also drastically increased. Hardly 10 per cent population of rural India or less than that might not be using the mobiles and computers. Rest of the country is full of users of these devices, we can say addict of using these devices. Many industries are also growing along with technology in India. Some of the initiatives are also taken by the government such as "Make in India" which is a good move towards production in India. The industrialisation is taking place in the country very fast.

All businesses are increasingly dependent on technology, and small business is no exception. We work on our PCs, notebooks and smart phones all day, connected to servers running 24/7. Because the technology refresh cycle is fast, these devices quickly become obsolete, and at some point, more often sooner than later, we dispose of old devices and replace them with new ones. We use massive quantities of paper and ink to print documents, many of which we promptly send to the circular file.

In the process, most businesses waste resources, in the form of energy, paper, money and time, resources we could invest to develop new products or services, or to hire and train employees. Even if we aren't a tree hugger, it makes good business sense to green our IT environment and culture.

This book is an essence of ideas towards going green. Unit one of this book gives us the knowledge about the problems concerning with disposal of e-waste and its consequences on the environment. The unit also covers the information about globally available and most followed standards for going green.

Unit two addresses the issues related to power consuming as well as the energy cost associated with the cooling of computing devices. This unit gives a brief idea about the components involved and how effectively we can achieve cost saving without harming the environment.

Unit three of the book addresses the procedural aspects towards going green. It also gives the advantages and cost saving measures of going paperless.

Unit four addresses the recycling issues. It briefs about the standard procedures that are followed by the well-known countries for recycling of waste in proper way. This unit also addresses the hardware related part and mentions some of the effective selection and utilisation strategies that we can adopt in case of hardware.

Unit five gives an idea about how we can change the entire organization green. It discusses about the metrics we can adopt for the entire organization. The unit gives a brief idea about how to go green and how to maintain it.

At the end of this book, sample question paper is given for the student practice. Also, the 20 ideas for the projects that students have to undertake as a practical of this subject are also provided.

One of the truths is nobody is perfect in this world. We have tried our level best to give everything in this book in proper manner. Still, a few points from the book may be explained in better way than presently are there in the book. So if there are any suggestions for modification of the contents of this book, they are always welcome. Kindly feel free to contact us on….

hphbhandup@gmail.com

Hope the Teaching fraternity and Students will like this book.

Authors

Acknowledgement

While writing this book, many people inspired us. We express our gratitude to Prof. Mr. Hiren Dand Sir, Prof. Mr. Rajendra Patil Sir, Shri Arun Janardhan Kurup (Secretary and Director, Tilak Education Society), Principal Dr. Mr. Shridhara Shetty and Vice Principal Dr. Liji Santosh of S.M. Shetty College of Science, Commerce and Management Studies, Powai and Principal Dr. Mrs. Gurmeet Kaur Monga, J.K. College of Science and Commerce, Ghansoli for their immense support.

Special thanks to Anuj Pandey, Niraj Pandey, K.N. Pandey, Directors and Mr. S.K. Srivastava, Regional Manager, from **Himalaya Publishing House Pvt. Ltd.** for their co-operation.

Authors

Syllabus

B.Sc. (Information Technology)		**Semester – II**	
Course Name: Green Computing		Course Code: USIT205	
Periods per week (1 Period is of 50 minutes)		5	
Credits		2	
		Hours	**Marks**
Evaluation System	Theory Examination	2½	75
	Internal	–	25

Unit	Details	Lectures
I	**Overview and Issues:**	12
	Problems: Toxins, Power Consumption, Equipment Disposal, Company's Carbon Footprint: Measuring, Details, Reasons to Bother, Plan for the Future, Cost Savings: Hardware, Power.	
	Initiatives and Standards:	
	Global Initiatives: United Nations, Basel Action Network, Basel Convention, North America: The United States, Canada, Australia, Europe, WEEE Directive, RoHS, National Adoption, Asia: Japan, China, Korea.	
II	**Minimizing Power Usage:**	12
	Power Problems, Monitoring Power Usage, Servers, Low Cost Options, Reducing Power Use, Data De-duplication, Virtualization, Management, Bigger Drives, Involving the Utility Company, Low Power Computers, PCs, Linux, Components, Servers, Computer Settings, Storage, Monitors, Power Supplies, Wireless Devices, Software.	
	Cooling:	
	Cooling Costs, Power Cost, Causes of Cost, Calculating Cooling Needs, Reducing Cooling Costs, Economizers, On-demand Cooling, HP's Solution, Optimizing Airflow, Hot Aisle/Cold Aisle, Raised Floors, Cable Management, Vapour Seal, Prevent Recirculation of Equipment Exhaust, Supply Air Directly to Heat Sources, Fans, Humidity, Adding Cooling, Fluid Considerations, System Design, Datacentre Design, Centralized Control, Design for Your Needs, Put Everything Together.	
III	**Changing the Way of Work:**	12
	Old Behaviours, Starting at the Top, Process Reengineering with Green in Mind, Analysing the Global Impact of Local Actions, Steps: Water, Recycling, Energy, Pollutants, Teleworkers and Outsourcing, Telecommuting, Outsourcing, How to Outsource.	

	Going Paperless:	
	Paper Problems, The Environment, Costs: Paper and Office, Practicality, Storage, Destruction, Going Paperless, Organizational Realities, Changing Over, Paperless Billing, Handheld Computers vs. the Clipboard, Unified Communications, Intranets, What to Include? Building an Intranet, Microsoft Office SharePoint Server 2007, Electronic Data Interchange (EDI), Nuts and Bolts, Value Added Networks, Advantages, Obstacles.	
IV	**Recycling:**	12
	Problems, China, Africa, Materials, Means of Disposal, Recycling, Refurbishing, Make the Decision, Life Cycle, from Beginning to End, Life, Cost, Green Design, Recycling Companies, Finding the Best One, Checklist, Certifications, Hard Drive Recycling, Consequences, Cleaning a Hard Drive, Pros and Cons of Each Method, CDs and DVDs, Good and Bad about CD and DVDs Disposal, Change the Mindset, David vs. America Online.	
	Hardware Considerations:	
	Certification Programs, EPEAT, RoHS, Energy Star, Computers, Monitors, Printers, Scanners, All-in-Ones, Thin Clients, Servers, Blade Servers, Consolidation, Products, Hardware Considerations, Planned Obsolescence, Packaging, Toxins, Other Factors, Remote Desktop, Using Remote Desktop, Establishing a Connection, In Practice.	
V	**Greening Your Information Systems:**	12
	Initial Improvement Calculations, Selecting Metrics, Tracking Progress, Change Business Processes, Customer Interaction, Paper Reduction, Green Supply Chain, Improve Technology Infrastructure, Reduce PCs and Servers, Shared Services, Hardware Costs, Cooling.	
	Staying Green:	
	Organizational Check-ups, Chief Green Officer, Evolution, Sell the CEO, SMART Goals, Equipment Check-ups, Gather Data, Tracking the Data, Baseline Data, Benchmarking, Analyse Data, Conduct Audits, Certifications, Benefits, Realities, Helpful Organizations.	

B.Sc. (Information Technology)		Semester – II	
Course Name: Green Computing Practical		Course Code: USIT2P5	
Periods per week (1 Period is of 50 minutes)		3	
Credits		2	
		Hours	**Marks**
Evaluation System	Practical Examination	2½	50
	Internal	–	–

Project and Viva Voce	
1	A project should be done based on the objectives of Green Computing. A report of minimum 50 pages should be prepared. The report should have a font size of 12, Times New Roman and 1.5 line spacing. The headings should have font size 14. The report should be hard bound.
2	The project can be done individually or a group of two students.
3	The students will have to present the project during the examination.
4	A certified copy of the project report is essential to appear for the examination.

Paper Pattern

1. Internal Evaluation: **(25 Marks)**

I. Test: Class test of 20 marks. (Can be taken online)

Q	Attempt any four of the following:	20
(a)		
(b)		
(c)		
(d)		
(e)		
(f)		

II. 5 marks: Active participation in the class, overall conduct and attendance.

2. External Examination: **(75 Marks)**

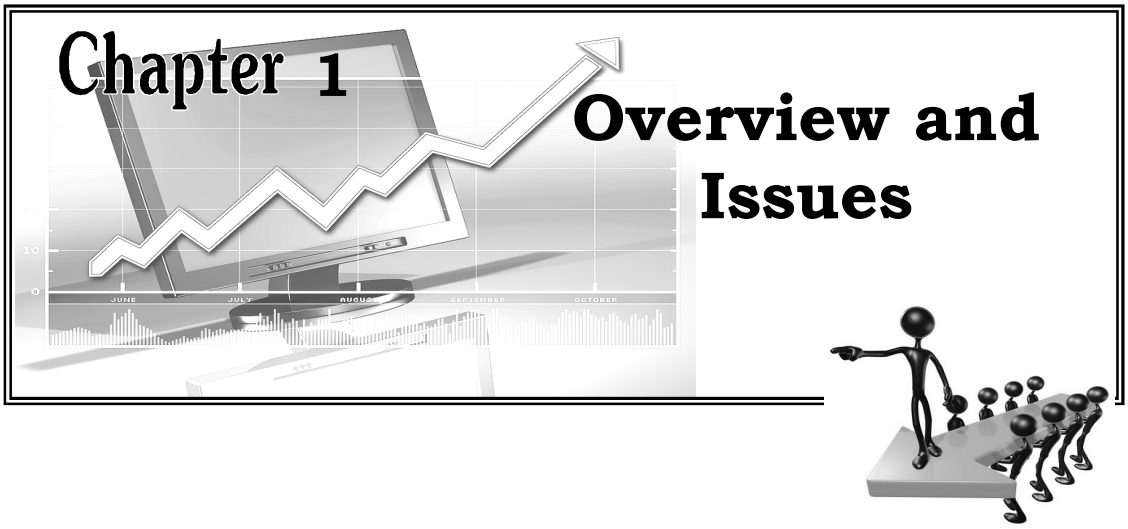
All questions are compulsory.

Q.1	(Based on Unit 1) Attempt **any three** of the following:	15
(a)		
(b)		
(c)		
(d)		
(e)		
(f)		
Q.2	(Based on Unit 2) Attempt **any three** of the following:	15
Q.3	(Based on Unit 3) Attempt **any three** of the following:	15
Q.4	(Based on Unit 4) Attempt **any three** of the following:	15
Q.5	(Based on Unit 5) Attempt **any three** of the following:	15

3. Practical Exam **(50 Marks)**

Contents

Unit I



INTRODUTION

Nowadays computers are used on huge scales worldwide. Use these devices may be in the form of Desktop, Laptop and Mobile phones. As these all are electronic devices and runs on electric power and batteries, it causes harm to an environment directly as well as indirectly.

As the technology enhances, interest of people again moves towards using new devices and dumping the old ones. Disposal of these electronic devices is also a big problem. We can't directly dispose these devices because they are made of several metals and some harmful chemicals are also used in it. Energy consumption is also on large scale, sometimes energy consumed for cooling the computer server is more than used for running of the servers. Along with mentioned issues above there are many other issues related with these electronic equipment's. The Green Computing addresses these issues with words "Reduce, Reuse, Recycle."

- **Reduce:** We should limit the number of purchases that we make in the first place. So, for example, we might limit our household to a single computer.
- **Reuse:** We should reuse items as much as possible before replacing them. For example, it generally makes more environmental sense to update our computer rather than get rid of it and buy a new one. However, if we replace our computer, we should ensure that it, or its components, are reused. Many charitable organizations welcome donations of second-hand computers.
- **Recycle:** We should ensure that items or their components are put to some new purpose as much as possible. If our computer is not fit for reuse as is, we can donate it to one of several organizations which will refurbish it or recycle its components.

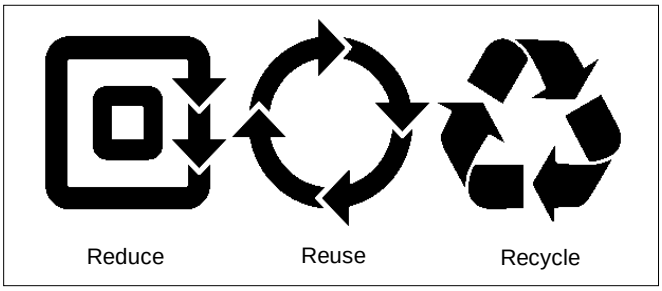


Fig. 1.1

E-Waste Eecycling

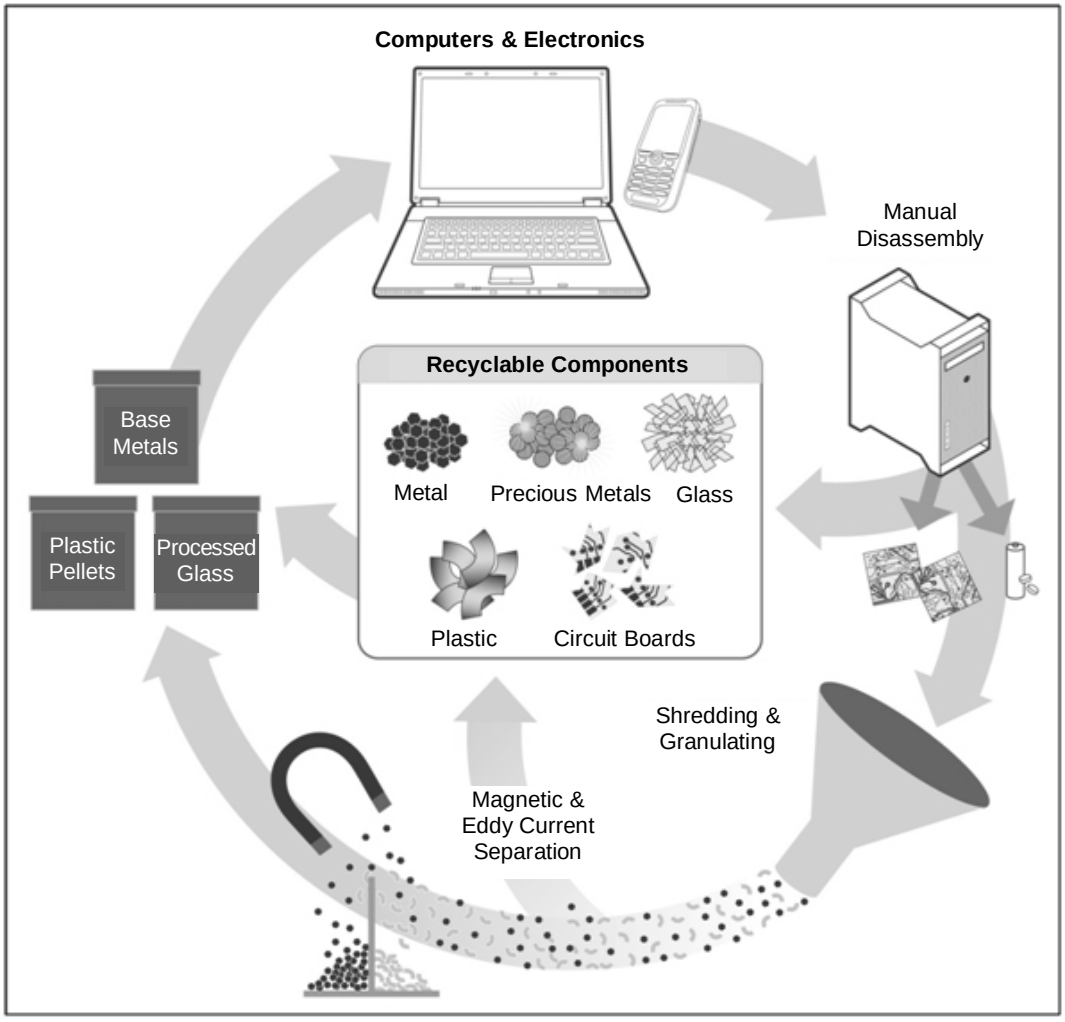


Fig. 1.2

GREEN COMPUTING

The Green computing is a scientific study of efficient and effective designing, manufacturing, using, disposing, and recycling of computers and computer related products like servers, network systems, communication systems, monitors, USBs, printers, etc. The study uses science to create technologies that help to preserve natural resources and reduce the harmful impact on the environment.

The goal of green computing very clear and simple: reduction in the use of harmful materials, maximizes energy efficiency, and promotes recyclability. Green computing is commonly referred to as Green IT. The idea is to ensure the least human impact on the environment. Apart from this, it aims to achieve environmental sustainability.

These are pathways of green IT that focus on various activities such as:

1. **Power Management:** This feature means conservation of power used by all electrical appliances with power saving/management features.
2. **Energy Efficient Computing:** Computers have a fan/heater-like component inside them. Unfortunately, not many people are aware of this. Energy waste is leading to a climatic change from burning coal and oil.
3. **Remediation of Environmental Pollutants:** This deals with reducing and removing pollution or contaminants from groundwater, soil, surface water, or sediments.
4. **Server Virtualization:** Here the idea is to use one server which connects with many individual computers.
5. **Sewage Treatment:** This waste water treatment involves removing of contaminants from waste water and sewage.
6. **Efficient Disposal/Waste Management:** This is the collection, processing, recycling, and disposal of waste materials.
7. **Efficient Recycling:** Reusing products is much better than letting them stay in landfills.
8. **Regulatory Compliance:** A strategy must be designed by governments, which would offer rules for curbing waste management, reducing pollution, and stringent penalties for noncompliance.
9. **Recycling and Water Purification:** This is the process of removing all unneeded materials and contaminants from water.
10. **Green Metrics and Methodology:** It is important to quantify sustainability and environmental performance to help reach our goals.
11. **Renewable Resources:** Use of renewable sources of energy such as solar power and wind to serve purposes like heating, cooking, etc.
12. **Eco-Labeling of IT Products:** More companies should design their products so they receive the eco-label.
13. **Thin Client Solutions:** Thin client is also known as a lean client solution, and requires computers to depend on another computer or server to function.

PROBLEMS

Data centers are physical or virtual infrastructure used by enterprises to house computer, server and networking systems and components for the company's Information Technology (IT) needs, which typically involve storing, processing and serving large amounts of mission-critical data to clients in a client/server architecture. Here the problems related to energy consumption and environment are more.

The Datacenter managers concern about saving the environment as well as they also want to save money. So they are in favor of green computing as it may cost more initially but at the end results are going to observed for longer duration. This automatically will save money by making only few changes.

Toxins

As mentioned earlier, an Electronic waste is one of the fastest growing components. When these electronics break down, they release mercury and other toxins. The improper disposal of E-waste may cause harm to environment, because it has toxic and radiation substances within it. Toxic substances can include:

- Lead
- Mercury
- Cadmium
- Polychlorinated Biphenyls (PCBs)

The lead is a part of computer monitors Cathode Ray Tube (CRT), up to 6 percent. Also the components such as capacitors, transformers, and PVC insulated wires of old production type contain PCBs which is very harmful for environment. These above mentioned toxins are also not disposable or difficult or costly to dispose. The bad effects of these toxins can be observed on soil, plants, micro-organisms and animals.

To avoid effects of these toxins, E-waste is handled separately from conventional garbage and recycling processes. Maximum of E-waste material is reused, renovated and redeployed. So very less amount of toxins are going into soil.

The computers contain toxins in various parts such as Lead in the cathode ray tube and solder, Arsenic in older cathode ray tubes, Antimony trioxide used as flame retardant, Polybrominated flame retardants in plastic casings, cables, and circuit boards, Selenium used as a power supply rectifier in circuit boards, Cadmium in circuit boards and semiconductors, Chromium used as corrosion protection in steel, Cobalt in steel for structure and magnetism, Mercury in switches and the housing etc.

As we can observe computer is almost house of toxic components. These toxins are one the reason behind global warming, so we have to take the disposal of these elements in serious manner to secure our future.

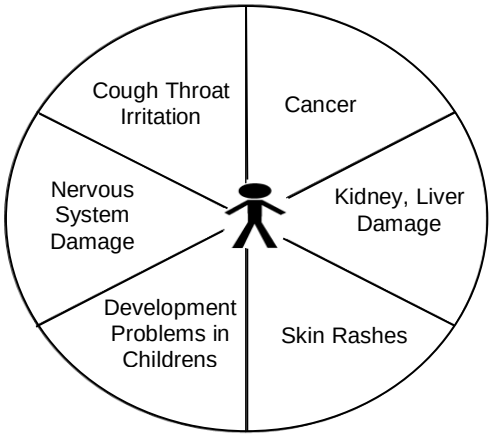


Fig. 1.3

Tons of Electronic Waste

Majorly pronounced E-Waste, this is a major threat that has an impact on our environment since the machinery came in. Tons and millions of dump get collected daily around the globe in junkyards.

Limited Resources

The Resources for producing electronic goods are limited and should be utilized efficiently in order to save environment. Green ideas that lead to minimize the usage of these scare resources should be used as much as possible. Cloud technology is one great example of that.

Energy/Power Consumption

Producing electrical energy these days is getting costlier and limited. All our desktop PCs, servers, switches, and so forth use electricity to run. This electricity not only costs money, but the utility has to generate the electricity, quite often by using fossil fuels, which generate more greenhouse gas emissions.

Solutions:

There are solutions to avoid fossil fuel based sources of electricity and to save:

1. **Virtualization:** The Virtualization works on single machine instead of several servers. A special kinds of Software's are used in virtualization to run multiple servers on one physical machine, which causes less consumption of power consumed.
2. **Generate your own power:** The problem can only be solved by moving to other clean and green options. Solar energy, bio gas and wind energy are great motivators towards that. By using these options we can save money on electrical bill as well as make a move toward carbon neutrality. Also, in case of more power generated, we can sell it to other, so on other hand we can also earn the money.

Heat

Because of Heat emitting devices, the energy we consume to cool that equipment is also an issue. The more equipment we have (and the less efficient it is), the more heat it generates and the more electricity we use to cool that equipment.

Equipment Disposal

If the waste electronic materials dismantled properly then many of the parts of that can be reused and if not then may cause problem to environment.

The Business of Recycling

The process of recycling e-waste material is very complicated. First, the metals and plastics must be separated, and then the circuit boards are shredded to separate the aluminum, iron, and copper from the valuable precious metals, such as silver. If not handled properly, uncontrolled burning, disassembly, and disposal are causing environmental and health problems, including health effects among those who extract precious materials.

The Recycling Process

E-waste processing generally involves first dismantling the equipment into these different components:

- Metal frames
- Power supplies
- Circuit boards
- Plastics

Doing It Right

There is not exact procedure is followed for handling e-waste, but many countries doing it far better way. It is needed to have some standard procedure for it, but due to variations in material used in components and also because difference in laws about environment, it difficult to opt for standard procedure. There is always scope for improvement in using the methods to handle E-waste.

The European Union: Europe is doing fantastic job in case of e-waste handling. In the 1990s, some European countries banned the disposal of e-waste to landfills. As a result a new industry is formed for E-waste processing.

The United States: The United States is one the top country for consumption of many things such as energy. However, not so fast in case of handling e-waste.

YOUR COMPANY'S CARBON FOOTPRINT

A carbon footprint is defined as: The total amount of greenhouse gases produced to directly and indirectly support human activities, usually expressed in equivalent tons of carbon dioxide (CO_2). In few organizations, *carbon footprint* might mean that everything is tallied—sourcing materials, manufacturing, distribution, use, disposal, and so forth.

In other words: When we drive a car, the engine burns fuel which creates a certain amount of CO_2, depending on its fuel consumption and the driving distance. (CO_2 is the chemical symbol for carbon dioxide). When we heat our house with oil, gas or coal, then we also generate CO_2. Even if we heat our house with electricity, the generation of the electrical power may also have emitted a certain amount of CO_2. When we buy food and goods, the production of the food and goods also emitted some quantities of CO_2.

For measuring carbon footprint we require to track lot of information such as:

- Facilities
- Operations
- Transportation
- Travel
- Purchases

The carbon foot printing is done by many organizations/ companies to achieve environmental friendliness.

Measuring

Measuring of carbon footprint is time consuming job. Following steps can be used for it:

Step 1: Define the boundary for your carbon footprint: We need to monitor the carbon footprint process year by year, so it is very important to have some rules to follow about scope of work to be done. Our primary objective is to reduce the emission of carbon, if we fail to define the carbon footprint boundary can inhibit comparisons against benchmarks and could also undermine meaningful monitoring of performance.

There are three types of boundaries:

- **Type 1:** Operational control: Using this approach every operation of our organization/company is captured in the carbon footprint. This also includes supply chain if an organization has sufficient operational control over suppliers.
- **Type 2:** Financial control: In this approach all financial elements are included. Often this excludes elements which our company may operate but not financially control and therefore using this approach can result in a smaller carbon footprint.
- **Type 3:** Equity control: This approach includes all elements that our company owns. If our company has part ownership then the proportion ownership is used to calculate the relevant carbon footprint attributable to that company.

Step 2: Decide which emissions will be included under scope: Scope refers to the emission types captured in a carbon footprint. The scope of an organization's carbon footprint also breaks down into three components.

- **Scope 1 emissions:** These are direct emissions from assets that are either owned by our company (i.e. fleet vehicle emissions from the consumption of fuel) or emissions produced through an on-site activity (i.e., emissions from the burning of natural gas in a company's boiler).
- **Scope 2 emissions:** Scope 2 covers all indirect emissions or more specifically emissions derived from the production of purchased electricity. Here company hasn't actually produced the emissions associated with electricity generation but due to the consumption of electricity to power lights, equipment etc. we can say that our organization is indirectly responsible for these emissions.
- **Scope 3 emissions:** Scope 3 covers all other indirect emissions which are not as a result of the consumption of purchased electricity. This includes a wide array of emission sources including waste, consumables, staff commute, supply chain emissions, water use etc.

Step 3: Define your carbon footprint period: A carbon footprint is typically measured across an annual period. When choosing our period for measurement it is best to think of other reporting cycles which can be used as the set time-frame.

Step 4: Use a practical approach to collect annual data: Once we have defined our boundary and the type of emissions we are going to capture, we'll then need to collect data on all elements that we are going to measure carbon emissions for (i.e. electricity and gas usage, vehicle mileage, waste volume etc.)

Here are some top tips that can be used:

- **Tip 1:** Annualize partial data: Data should be for an annual period. If we can't get complete annual data we will have to use what we know about a sample of data to annualize our information.

  For example, if we know that we used 1,000 liters of petrol for our company vehicles for the first six months of our carbon footprint period then we could extrapolate that we will use 2,000 liters over the year.
- **Tip 2:** Use proxies where you don't have primary data: If we don't have primary data (i.e., liters consumed, kWh used etc.) we will have to convert our secondary data (miles driven, electricity spend etc.) into a primary data.
- **Tip 3:** Use intelligent estimation: If we cannot get real data is to use estimation. Here the best approach is to look at benchmarks or basic knowledge of our operations. Estimation should be used as a last resort and always stated in any published result.

Step 5: Calculate footprint: After we have collected all our relevant annual data the task is then relatively simple.

You need to use a carbon footprint calculator or carbon conversion factors to calculate our organizational carbon footprint.

There are many carbon footprint calculators on the internet that can be used for free.

Why Bother? (Need of Carbon Footprint)

Measuring carbon footprint is nothing but it another way to measure overall progress toward becoming green. It can help with numerous business goals such as:

- Helping company to improve its efficiencies
- Reducing costs
- Getting public recognition
- Maintain link in the supply chain
- Good impact on customer

Plan for the Future

If company's infrastructure is always expanding, even if we virtualize, our virtualized solution will expand as well—just not as covetously as a "conventional" system. Try to anticipate our future needs when computing our carbon footprint, and take the time now to think about how we can minimize that growth's impact.

COST SAVINGS

If properly followed Green Computing practices can save millions of rupees of an organization. Ecologically responsible practices must be adopted. For green computing, initial investment will be more, but eventually not only we will save money but also help to sustain the environment.

Many organization hesitate for going green because of initial cost. Unless equipment is planned to be replaced or there's a datacenter design in the works, most businesses aren't likely to replace their equipment just for the sake of duty to society. But when the cost of power starts taking a bigger and bigger bite out of the IT budget, organizations start really looking at green computing nowadays.

Hardware

There are a number of ways that specific hardware and hardware deployments can affect the environment. We can reduce cost for hardware is to simply buy less equipment.

Taking the Steps, Gaining the Rewards: The Nashville's Vanderbilt University and the state of Oregon have begun datacenter virtualization projects and expect to save millions of dollars by the time the projects are finished.

Vanderbilt's Information Technology Services organization is using server virtualization to reduce its energy use to save money and less damage to the environment.

Use What You Have: Every time before purchasing new equipment, once again go through our old inventory and old dump electronic elements. If we found something that can be reused and renovated with energy efficiency, first do that.

We can take an older computer and turn it into a thin client for the processing and storage duties are conducted at the server, as the client just needs enough power to be able to display what is going on at the server. A thin client uses 15 watts of energy instead of the 150 watts that workstations use on an average. If we are doing so our energy bill will be ten times less than what it is now.

Power

Buying computers and then disposing of them is a one time work. But the issue of power consumption is ongoing as we continue to use new machines. The more power we use, the more money we spend as well as more fossil fuels the local electrical utility has to burn, thus causing more greenhouse gases to be generated. So saving the power is saving the money as well as saving the environment.

Desktops: The power can cab be effectively used in desktop computer by enabling power management settings. Normally desktop PC requires 85 watts power, even with the monitor off. If that computer is only in use or idling for 40 hours a week instead of a full 168, much more energy costs will be saved annually from that workstation alone.

Datacenters: The increase in servers and network infrastructure has caused a sharp hike in the electrical usage in the datacenter. Power consumption per rack has risen from 1 kW in 2000 to 8 kW in 2006 and is expected to top 20 kW in 2010. This increase in energy consumption is not only because of more servers but also use of additional network infrastructure.

A normal 24-port Ethernet switch uses 250 watts of power on an average. If the electricity generated to power this switch comes from a coal-fired plant, 1,780 pounds of coal are needed to produce the 2,190 kW as shown in next figure.

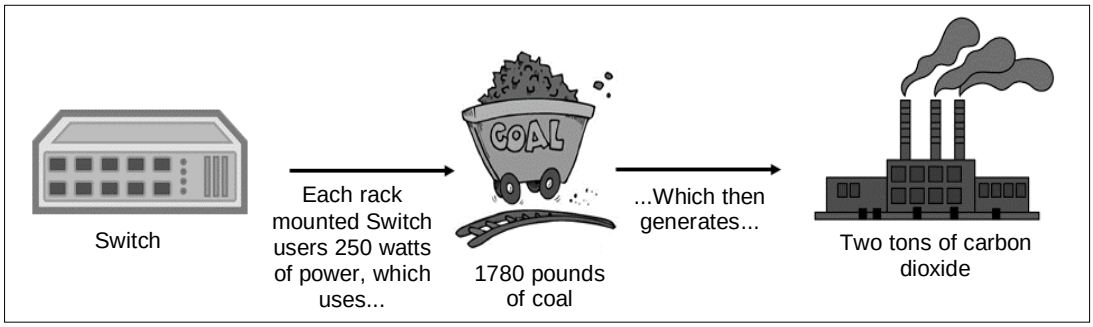


Fig. 1.4

Burning 1,780 pounds of coal releases over two tons of carbon dioxide into the atmosphere, along with other pollutants, such as sulfur dioxide and nitrogen oxide.

Consumption: It is estimated that datacenters consume 1.5 percent of the nation's electrical power and this number will triple again by 2020, as number users of computers are rapidly increasing. If we do not save power then we need more power plants to satisfy future needs. Which in turn will increase many million metric tons of carbon dioxide per year.

The EPA (US: Environmental Protection Agency) suggested few ways for being more energy efficient, ranging from properly organizing physical space to reduce cooling loads to using energy-efficient power supplies.

We have to increase the use of energy efficient certified power supply. It always better if all organizations follow Green IT methodology. We can also follow the guidelines of EPA.

QUESTIONS

1. What is green computing? What the pathways are of green IT?
2. Explain the term toxin.
3. Explain to avoid fossil fuel–based sources of electricity.
4. Write a note on Equipment Disposal.
5. How to define carbon footprint?
6. What are the steps involved for Measuring of carbon footprint.
7. What is Need of carbon footprint?
8. Give the tips for a practical approach to collect annual data.
9. How green computing effect on cost saving?
10. Explain the term power.
11. How hardware deployments can affect the environment?

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