A

TECHNICAL SEMINAR REPORT

ON

GREEN COMPUTING

Technical Seminar Report Submitted to

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD, HYDERABAD, TELANGANA.

Submitted in partial fulfilment of the requirements for the award of degree in

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE AND ENGINEERING

Submitted by

TELU ARAVINDA SWAMY

21UC1A0568

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

TALLA PADMAVATHI COLLEGE OF ENGINEERING

Approved by AICTE New Delhi, Affiliated to JNTUH

Somidi, Kazipet, Hanumakonda-506003

2024-2025

TALLA PADMAVATHI COLLEGE OF ENGINEERING

Approved by AICTE New Delhi, Affiliated to JNTUH

An ISO 9001:2015, NAAC Accredited

Somidi, Kazipet, Hanumakonda-506003

BONAFIDE CERTIFICATE

This is to certify that the Technical Seminar Report entitled "**GREEN COMPUTING"** is being submitted by **TELU ARAVINDA SWAMY (21UC1A0568)** in the partial fulfilment of the requirements for the award of the degree of BACHELOR OF TECHNOLOGY IN COMPUTER SCIENCE AND ENGINEERING from Talla Padmavathi College of Engineering, Hanumakonda, affiliated to Jawaharlal Nehru Technological University Hyderabad, Hyderabad, Telangana during academic year 2024-2025.

CO-ORDINATOR **HOD/CSE** **PRINCIPAL**

ACKNOWLEDGEMENT

I am grateful to our Chairman, **Mr. Talla Mallesham**, for providing me ambient learning experience at our institution.

I am greatly thankful to our Managing Director, **Dr. Talla Vamshi**, and Directress **Mrs. Chaitanya**, for their encouragement and valuable academic support in all aspects.

I am thankful to our Principal, **Dr. R. Velu**, for his support and inspiration to carry out this Technical Seminar Report in the institute.

I extend my heartfelt thanks to **Mrs. J. Shilpa**, Head of the Department of Computer Science and Engineering, Talla Padmavathi College of Engineering for providing me necessary infrastructure and thereby giving us freedom to carry out the Technical Seminar Report.

I express heartfelt thanks to the Technical Seminar Coordinator **Mrs. K. Madhurima,** Assistant Professor, Department of Computer Science and Engineering, for her constant support and giving necessary guidance for completion of this Technical Seminar Report.

ABSTRACT

Green computing, green IT or ICT Sustainability, refers to environmentally sustainable computing or IT. In the article Harnessing Green IT Principles and Practices, San Murugesan defines the field of green computing as "the study and practice of designing, manufacturing, using, and disposing of computers, servers and associated subsystems such as monitors, printers, storage devices, and networking and communications systems efficiently and effectively with minimal or no impact on the environment. 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 there cyclability 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. 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). One of the earliest initiatives towards green computing in the United States was the voluntary labelling program known as Energy Star. The Energy Star label became a common sight, especially in notebook computers and displays.

INDEX

1. INTRODUCTION

Green computing is the practice of using computing resources efficiently. The goals are to reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote recyclability or biodegradability of defunct products and factory waste. 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). In 1992, the U.S. Environmental Protection Agency launched Energy Star, a voluntary labelling program which is designed to promote and recognize energy-efficiency in monitors, climate control equipment, and other technologies. This resulted in the widespread adoption of sleep mode among consumer electronics. The term "green computing" was probably coined shortly after the Energy Star program began; there are several USENET posts dating back to 1992 which use the term in this manner.

Our so called technically successful world almost sounds fake We have great machines and equipments to accomplish our tasks, great gadgets with royal looks and features make our lives more impressive and smooth. Today almost all streams weather its IT, medicine, transportation, agriculture uses machines which indirectly requires large amount of power and money for its effective functioning. Newton ‘s Third Law of Motion states that—For every action, there is an equal and opposite reaction. ‖ therefore, consumption of energy sources has a negative reaction on the environment. Data centers use a large amount of power and consequently cooling energy is needed to counteract the power usage. It can be an endless circle of energy waste Hence the Three main reasons that made us realize the need for growing green are

Release of harmful gases from electronics.

More utilization of power and money.

Increase of E-waste and improper disposal.

It deals with Green Computing detailing. Green computing can lead to a lot of energy savings, reduction in emission of co2 & CFC's which leads to environment protection. It also leads to serious cost savings overtime. Devices use less and less power while renewable energy gets more and more portable and effective. New green materials are developed every year, and many toxic ones are already being replaced by them.. The features of a green computer of tomorrow would be like: efficiency, manufacturing &materials, recyclability, service model, self-powering, and

other trends. Green computer will be one of the major contributions which will break down the 'digital divide', the electronic gulf that separates the information rich from the information poor.

The introduction part of the report. It provides the background information necessary for understanding GREEN COMPUTING. Provides a brief introduction of importance Green Computing & its objectives. Basically, the goals of green computing are similar to green chemistry, reduce the use of harzardous materials, maximize energy efficiency during the product's lifetime, and promote recyclability or biodegradability of defunct products and factory waste. Green computing researchers look at key issues and topics related to energy efficiency in computing and promoting environmentally friendly computer technologies and systems include energy efficient use of computers, design of algorithms and systems for environmentally-friendly computer technologies, and wide range of related.

Figure Green Computing

2. LITERATURE SURVEY

In 1992, the U.S. Environmental Protection Agency launched Energy Star, a voluntary labelling program which is designed to promote and recognize energy-efficiency in monitors, climate control equipment, and other technologies. This resulted in the widespread adoption of sleep mode among consumer electronics. The term "green computing" was probably coined shortly after the Energy Star program began; there are several USENET posts dating back to 1992 which use the term in this manner. Concurrently, the Swedish organization TCO Development launched the Certification program to promote low magnetic and electrical emissions from CRT-based computer displays; this program was later expanded to include criteria on energy consumption, ergonomics, and the use of hazardous materials in construction. When it comes to PC disposal, it is necessary to know everything there is to know in order to be involved in green computing. Basically, the whole green aspect came about quite a few years back when the news that the environment was not a renewable resource really hit home and people started realizing that they had to do their part to protect the environment. Basically, the efficient use of computers and computing is what green computing is all about. The triple bottom line is what is important when it comes to anything green and the same goes for green computing. This considers social responsibility, economic viability and the impact on the environment. Many businesses simply focus on a bottom line, rather than a green Triple bottom line, of economic viability when it comes to computers. The idea is to make the whole process surrounding computers friendlier to the environment, economy, and society. This means manufacturers create computers in a way that reflects the triple bottom line positively. Once computers are sold businesses or people use them in a green way by reducing power usage and disposing of them properly or recycling them. The idea is to make computers from beginning trend a green product.

3. ABOUT GREEN COMPUTING

3.1 What is green computing?

Green computing is the study and practice of using computing resources efficiently. The primary objective of such a program is to account an expanded spectrum of values and criteria for measuring organizational (and societal) success. The goals are similar to green chemistry; reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote recyclability or biodegradability of defunct products and factory waste. Modern IT systems rely upon a complicated mix of people, networks and hardware; as such, a green computing initiative must be systemic in nature, and address increasingly sophisticated problems. Elements of such a solution may comprise items such as end user satisfaction, management restructuring, regulatory compliance, disposal of electronic waste, telecommuting.

3.2 Origin

In 1992, the U.S. Environmental Protection Agency launched Energy Star, a voluntary labelling program that is designed to promote and recognize energy-efficiency in monitors, climate control equipment, and other technologies. This resulted in the widespread adoption of sleep mode among consumer electronics. Concurrently, the Swedish organization TCO Development launched the TCO Certification program to promote low magnetic and electrical emissions from CRT-based computer displays; this program was later expanded to include criteria on energy consumption, ergonomics, and the use of hazardous materials in construction.

3.3 At Present

Currently the ICT industry is responsible for 3% of the world's energy consumption. With the rate of consumption increasing by 20% a year, 2030 will be the year when the world's energy consumption will double because of the ICT industry. Organizations use the Green Computing Lifecycle when designing and implementing green computing technologies. The stages in the Lifecycle include Strategy, Design, Implementation, Operations and Continual Improvements. Many governmental agencies have continued to implement standards and regulations that encourage green computing. The Energy Star program was revised in October 2006 to include stricter efficiency requirements for computer equipment, along with a tiered ranking system for approved products.

3.4 Roads to Green Computing

Green use

Reducing the energy consumption of computers and other information systems as well as using them in an environmentally sound manner.

Green disposal

Refurbishing and reusing old computers and properly recycling unwanted computers and other electronic equipment.

Green design

Designing energy-efficient and environmentally sound components, computers, servers, cooling equipment, and data centres.

Green manufacturing

Manufacturing electronic components, computers, another associated sub-system with minimal impact on the environment.

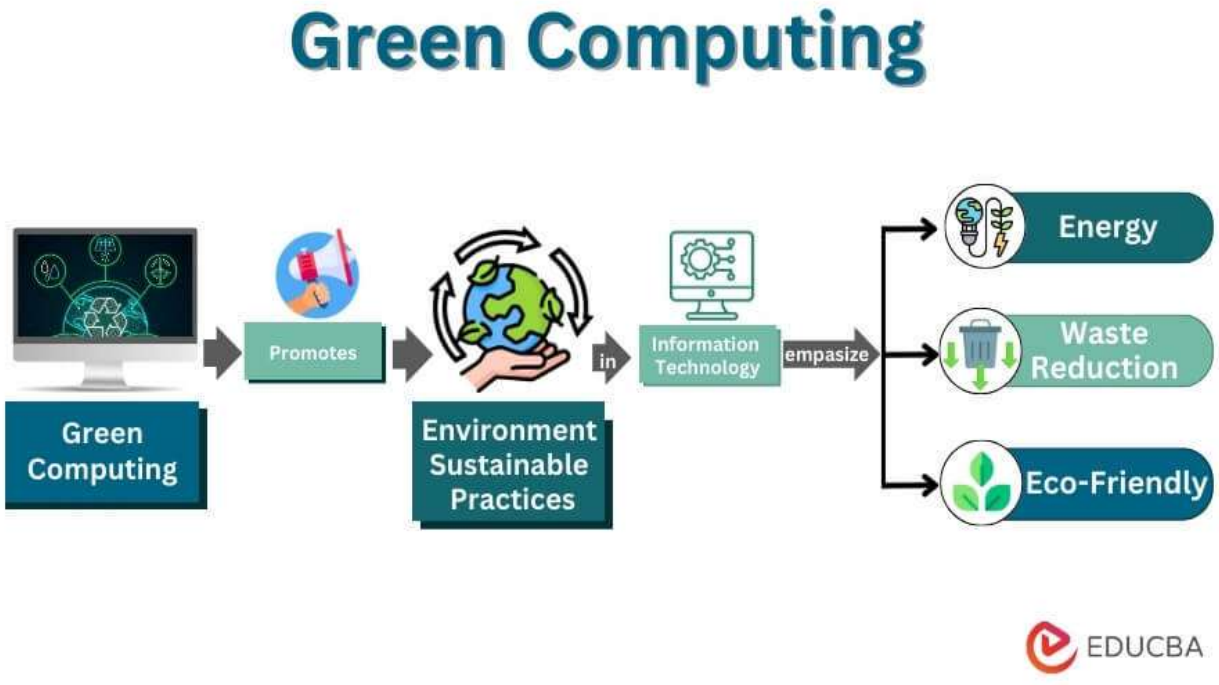

Fig 3.4

4. REGULATIONS AND INDUSTRY INITIATIVES

4.1 From the government

Many governmental agencies have continued to implement standards and regulations that encourage green computing. The Energy Star program was revised in October 2006 toinclude stricter efficiency requirements for computer equipment The European Union‘s directives 2002/95/EC (RoHS), on the reduction of hazardous substances, and 2002/96/EC(WEEE) on waste electrical and electronic equipment required the substitution of heavy metals and flame retardants like PBBs and PBDEs in all electronic equipment put on the market starting on July 1,2006. The directives placed responsibility on manufacturers for the gathering and recycling of old equipment (the Producer Responsibility model).

4.2 From the Industry

Climate Savers Computing Initiative

CSCI is an effort to reduce the electric power consumption of PCs in active andinactive states. The CSCI provides a catalogue of green products from its member organizations, and information for reducing PC power consumption.

Green Computing Impact Organisation Inc

GCIO is a non-profit organization dedicated to assisting the end-users of computing products in being environmentally responsible. This mission isaccomplished through educational events, cooperative programs and subsidized auditing services. The heart of the group is based on the GCIO Cooperative, a community of environmentally concerned IT leaders who pool their time, resources, and buying power to educate, broaden the use, and improve the efficiency of, green computing products and services.

Green Electronics Council

The Green Electronics Council offers the Electronic ProductsEnvironmental Assessment Tool (EPEAT) to assist in the purchase of "green" computing systems. The Council evaluates computing equipment on 28 criteria thatmeasure a product’s efficiency and sustainability attributes. On 2007-01-24, President George W. Bush issued Executive Order 13423, which requires all United States Federal agencies to use EPEAT when purchasing computer systems.

The Green Grid

It is a global consortium dedicated to advancing energy efficiency in data centers and business computing ecosystems. It was founded in February 2007 by several keycompanies in the industry – AMD, APC, Dell, HP, IBM, Intel, Microsoft, RackableSystems, Spray Cool, Sun Microsystems and VMware. The Green Grid has since grown to hundreds of members, including end users and government organizations, all focused on improving data center efficiency.

4.3 Facts About Green Computing

1. Computer technology use accounts for 2% of anthropogenic CO2
2. Roughly equivalent to aviation industry.
3. IT energy usage will double next 4years.
4. A typical desktop PC with a 17-inch LCD monitor requires about 145 watts—110watts for the computer and 35 watts for the monitor.
5. For every 12 consumers who keep power settings enabled for their on their monitors and PCs, CO2 emissions equivalent to removing one average automobile from the road will be avoided.
6. If left on 24x7 for one year, this same computer will consume 1,270 kilowatt hours of electricity—that's enough to release 1,715 pounds of carbon dioxide into the atmosphere and the equivalent of driving 1,886 miles in the average car.

Fig 4.3

5. IMPLEMENTATIONS OF GREEN COMPUTING

Blackle

Blackle is a search-engine site powered by Google Search. Blackle came into being based on the concept that when a computer screen is white, presenting an empty word or the Google home, your computer consumes 74W. When the screen is black it consumes only59W. Based on this theory if everyone switched from Google to Blackle, mother earth would save750MW each year. This was a really good implementation of Green Computing. The principle behind Blackle is based on the fact that the display of different colours consumes different amounts of energy on computer monitors. 6.2 Fit-PC: a tiny PC that draws only5w: Fit-PC is the size of a paperback and absolutely silent, yet fit enough to run Windows XP or Linux. fit-PC is designed to fit where a standard PC is too bulky, noisy and power hungry. If you ever wished for a PC to be compact, quiet and green then fit- PC is the perfect fit for you. Fit-PC draws only 5 Watts, consuming in a day less power than a traditional PC consumes in 1 hour. You can leave fit-PC to work 24/7 without making a dent in your electric bill.

Zonbu Computer

The Zonbu is a new, very energy efficient PC. The Zonbu consumes just one third of the power of a typical light bulb. The device runs the Linux operating system using a 1.2gigahertz processor and 512 meg of RAM. It also contains no moving parts, and does even contain a fan. You can get one for as little as US $99, but it does require you to sign up for a two-year subscription.

Sunray thin client

Sun Microsystems is reporting increased customer interest in its Sun Ray, a thin desktop client, as electricity prices climb, according to Subodh Bapat, vice president and chief engineer in the Eco Responsibility office at Sun. Thin clients like the Sun Ray consume far less electricity than conventional desktops, he said. A Sun Ray on a desktop consumes 4 to 8 watts of power, because most of the heavy computation is performed by a server. Sun says Sunrays are particularly well suited for cost-sensitive environments such as call centers, education, healthcare, service providers, and finance. PCs have more powerful processors as well as hard drives, something thin clients don't have. Thus, traditional PCs invariably consume a substantially larger amount of power. In the United States, desktops need to consume 50 watts or less in idle mode to qualify for new stringent Energy Star certification.

The Asus Eee PC and other ultra-portables

The "ultra-portable" class of personal computers is characterized by a small size, fairly low power CPU, compact screen, low cost and innovations such as using flash memory for storage rather than hard drives with spinning platters. These factors combine to enable them to run more efficiently and use less power than a standard form factor laptop. The Asus Eee PC is one example of an ultraportable. It is the size of a paperback, weight less than a kilogram, has built-in Wi-Fi and uses flash memory instead of a hard drive. It runs Linux too.

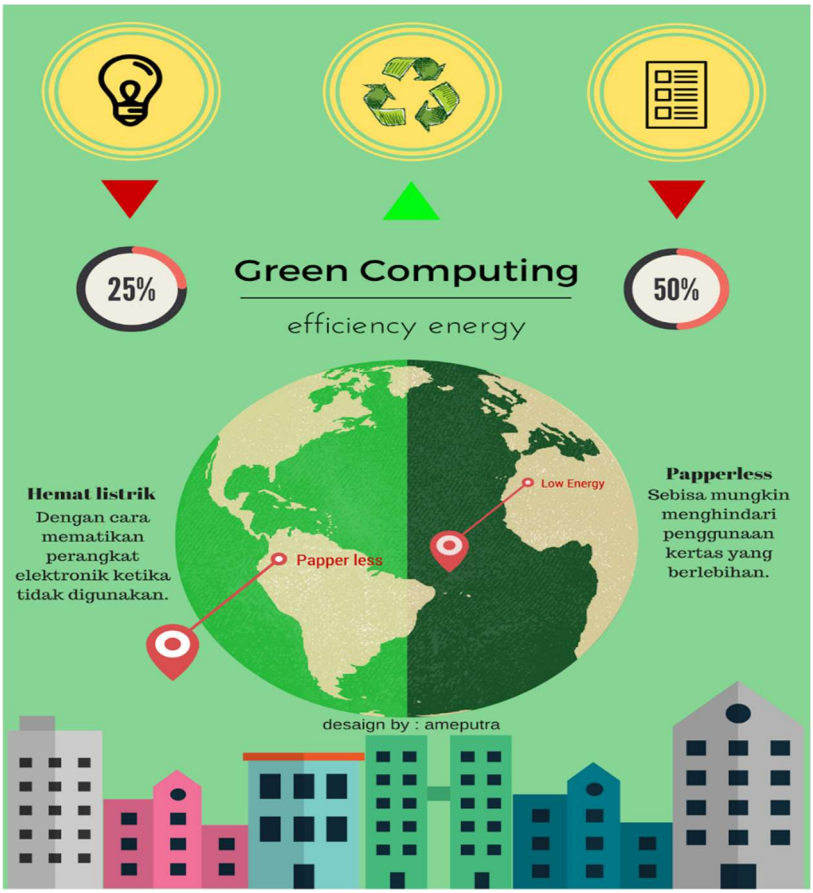

Fig 5

6. APPROACHES TO GREEN COMPUTING

Virtualization

Computer Virtualization means abstraction of computer resources, such as the process of running two or more logical computer systems on one set of physical hardware. Through Virtualization, a system administrator can combine several physical systems into virtual machines on one single, powerful system, thereby reducing power and cooling consumption. In the longer run, more profits and less expenses.

Reducing the number of hardware components and replacing them with Green Computing systems reduces energy costs for running hardware and cooling as well as reducing carbon dioxide emissions and conserving energy.

The phrase ―green computing‖ may conjure up some humorous images if you're not familiar with the term. Normally, we think of gas guzzling cars, factories, pesticides, and such when considering environmental concerns. So, what does the term ―green signify in the context of everyday computing?

In a world where computers are everywhere, and environmental concerns are growing by the day, we need to consider how we can build, use and dispose of computers in a manner that's conducive to the health of the environment. That includes reducing the use of lead and other hazardous materials in manufacturing, being careful about energy consumption and paper waste by computer users, and concern for salvage or recycling of old computers. Millions of computers are dumped into landfills each year. That equates to a lot of lead, cadmium, mercury and

brominates flame retardants, which will contaminate both water and air.

Power management

The Advanced Configuration and Power Interface (ACPI), an open industry standard, allow operating system to directly control the power saving aspects of its underlying hardware. This allows a system to automatically turn off components such as monitors and hard drives after set periods of inactivity. In addition, a system may hibernate, where most components (including the CPU and the system RAM) are turned off. ACPI is a successor to an earlier Intel-Microsoft standard called Advanced Power Management, which allows a computer's BIOS to control power management functions.

Power Supply

Desktop computer power supplies (PSUs) are generally 70–75% efficient, dissipating the remaining energy as heat. An industry initiative called 80 PLUS certifies PSUs that are at least 80% efficient; typically, these models are drop-in replacements for older, less efficient PSUs of the same form factor. As of July 20, 2007, all new Energy Star 4.0-certified desktop PSUs must be at least 80% efficient.

Storage

Smaller form factor (e.g.; 2.5 inch) hard disk drives often consume less power per gigabyte than physically larger drives. Unlike hard disk drives, solid-state drives store data in flash memory or DRAM. With no moving parts, power consumption may be reduced somewhat for low-capacity flash-based devices. Even at modest sizes, DRAM-based SSDs may use more power than hard disks, (e.g., 4GB I-RAM uses more power and space than laptop drives). Flash based drives are generally slower for writing than hard disks.

Display

LCD monitors typically use a cold-cathode fluorescent bulb to provide light for the display. Some newer displays use an array of light-emitting diodes (LEDs) in place of the fluorescent bulb, which reduces the amount of electricity used by the display.

Materials Recycling

Computer systems that have outlived their particular function can be repurposed, or donated to various charities and non-profit organizations. However, many charities have recently imposed minimum system requirements for donated equipment. Additionally, parts from outdated systems may be salvaged and recycled through certain retail outlets and municipal or private recycling centres. Recycling computing equipment can keep harmful materials such as lead, mercury, andhex avalent chromium out of landfills, but often computers gathered through recycling drives are shipped to developing countries where environmental standards are less strict than in North America and Europe. The Silicon Valley Toxics Coalition estimates that 80% of the postconsumer e-waste collected for recycling is shipped abroad to countries such as China, India, and Pakistan. Computing supplies, such as printer cartridges, paper, and batteries may be recycled as well

7. APPLICATIONS IN GREEN COMPUTING

Energy-Efficient Computing

Energy-efficient computing focuses on reducing power consumption in hardware and software systems. Techniques like dynamic voltage scaling, energy-aware algorithms, and efficient cooling systems are used. Data centers adopt virtualization and consolidation to maximize resource utilization. Energy-efficient processors, such as ARM-based CPUs, help reduce power usage in devices. Companies also use renewable energy sources to power servers and devices.

Virtualization

Virtualization involves running multiple virtual machines on a single physical machine, reducing hardware requirements. It optimizes resource usage, minimizes energy consumption, and lowers operational costs. Virtualization allows better scalability and flexibility, enhancing server utilization. It reduces the environmental footprint by limiting the need for additional physical servers. Popular tools include VMware, Hyper-V, and VirtualBox.

Recycling of E-Waste

Proper recycling of e-waste prevents hazardous materials from polluting the environment. Companies design eco-friendly products that are easier to recycle and reuse. Programs like take-back schemes encourage responsible disposal of old electronics. Recycling rare-earth elements and precious metals reduces the need for mining.

Green Data Centers

Green data centers are designed to minimize environmental impact while maintaining efficiency. They use energy-efficient cooling systems, such as liquid cooling and free cooling. Renewable energy sources like solar and wind power are often integrated. Advanced monitoring systems ensure optimal resource usage and energy savings. Companies like Google and Facebook are pioneers in building sustainable data centers.

Thin Client Solutions

Thin clients are lightweight computers that rely on a central server for processing. They consume less power compared to traditional desktops. Thin clients reduce hardware waste and promote centralized energy-efficient computing. They are ideal for office environments, schools, and other institutions. Companies like Citrix and Dell specialize in thin client technology.

Energy-Aware Software Development

Developers create software optimized for energy efficiency, reducing computational overhead. Algorithms and coding practices are refined to minimize resource consumption. Mobile apps are developed with low power consumption in mind. Tools like Energy Profiler assist in monitoring and improving energy usage in software. This ensures devices last longer on a single charge, reducing energy costs.

Use of Renewable Energy Sources

Integrating renewable energy sources in IT operations significantly reduces carbon footprints. Solar panels, wind turbines, and hydropower are used to power data centers. Companies are investing in renewable energy projects to offset their energy needs. Hybrid energy systems combining renewables and traditional power ensure reliability.

Telecommuting

Telecommuting reduces the need for physical office spaces and associated energy costs. It minimizes the environmental impact caused by daily commuting. Employees use collaboration tools like Zoom, Teams, and Slack for effective remote work. Telecommuting supports flexible work environments while saving resources. Companies adopting this model benefit from reduced operational costs.

Sustainable Manufacturing

Green computing extends to the production phase, focusing on sustainable manufacturing. Eco-friendly materials are used in making computers and electronic devices. Energy-efficient manufacturing processes reduce emissions and waste. Companies follow green certification standards to ensure sustainability. This approach improves product lifecycle management and reduces environmental impact.

8. SOFTWARE AND HARDWARE REQUIREMENTS

8.1 Software Requirements

Virtualization Software: VMware, VirtualBox, or Microsoft Hyper-V to consolidate servers and optimize resources.

Cloud Platforms: AWS, Google Cloud Platform, Microsoft Azure to leverage scalable, shared infrastructure.

Monitoring and Management Tools: Tools like Nagios, SolarWinds, or Prometheus for monitoring energy consumption and system performance.

Data Center Management Software: Platforms like DCIM (Data Center Infrastructure Management) for optimizing power and cooling management.

8.2 Hardware Requirements

Energy-Efficient Processors: Processors with power-saving capabilities, like Intel Xeon or AMD EPYC, which support low-power modes.

Efficient Cooling Systems: Modern data centers use liquid cooling or advanced air-cooling systems to reduce power requirements.

Solid-State Drives (SSDs): SSDs consume less power than traditional hard disk drives (HDDs) and have faster data access speeds.

LED Monitors: LED monitors consume less power than LCDs or CRTs, contributing to energy savings in office environments.

9. ADVANTAGES AND DISADVANTAGES

9.1 Advantages

Reduced energy usage from green computing techniques translates into lower carbon dioxide emissions, stemming from a reduction in the fossil fuel used in power plants and transportation.

Conserving resources means less energy is required to produce, use, and dispose of products and Saving energy and resources saves money.

Green computing even includes changing government policy to encourage recycling and lowering energy use by individuals and businesses.

Reduce the risk existing in the laptops such as chemical known to cause cancer, nerve damage and immune reactions in humans.

System Wide Green Computing and Individual Green Computing is the best possible way to practice Green Computing. Companies implementing System Wide Green Computing and employees and individuals practicing individual green computing techniques help in a long way in creating an impact to save the planet.

9.2 Disadvantages

High Initial Costs

Implementing green computing infrastructure, such as renewable energy systems or efficient cooling, can require significant initial investment.

Complex Technology Adoption

Green technologies like virtualization, cloud infrastructure, and advanced cooling systems require specialized skills and training.

E-Waste Recycling Challenges

Recycling e-waste is challenging, as it involves the disposal of hazardous materials and complex dismantling processes.

10. CONCLUSION

Green computing represents a significant step forward in the pursuit of environmentally sustainable practices within the technology sector. By focusing on energy efficiency, responsible e-waste management, and the use of renewable energy sources, green computing helps reduce the carbon footprint of IT systems. It is not just an ethical imperative but also a practical approach to cutting operational costs and aligning with global sustainability goals.

Adopting green computing practices fosters innovation, enhances corporate responsibility, and helps organizations comply with environmental regulations. As technology continues to evolve, embracing green computing is essential for building a sustainable future that balances technological advancement with ecological stewardship.

10.1 FUTURE SCOPE

The future scope of green computing is vast and transformative, driven by the increasing global emphasis on sustainability and technological innovation. As industries shift toward greener practices, green computing will play a pivotal role in designing energy-efficient data centers, promoting cloud computing, and enhancing virtualization technologies to minimize resource consumption. Advances in artificial intelligence and machine learning will further optimize energy use in IT infrastructure. The integration of renewable energy sources like solar and wind power into computing systems and the development of biodegradable and recyclable hardware components will revolutionize the way technology impacts the environment. Moreover, green computing is poised to support smart cities, IoT applications, and sustainable development initiatives, fostering a balance between economic growth and ecological preservation. This transition not only meets regulatory demands but also addresses the increasing consumer preference for environmentally conscious practices, ensuring green computing's relevance and expansion in the future.

REFERENCES

[1] Harmon, R.R. and N. Auseklis, “Sustainable IT Services: Assessing the Impact of Green Computing Practices,” PICMET 2009 Proceedings, PICMET/IEEE.

[2] http://gcomputing2011.blogspot.in/p/green-computing.html

[3] http://www.blackle.com/about/

[4] https://www.energystar.gov

[5] Pushtikant Malviya, Shailendra Singh. “A Study about Green Computing”, International Journal of Advanced Research in Computer Science and Software Engineering.

[6] http://www.mbtmag.com/article/194428

[7] www.zonbu.com/download/EPEAT-June-07.pdf

[8]http://www.mbtmag.com/article/194428 Green_computing_Sun_helping_partners_of fer _eco_friendly_services_.php.

[9] www.asus.com/Notebooks_Ultrabooks/Eee_PC_S101