Abstract: Green IT (Information Technology) is comprised of strategies and best practices for optimizing the usage of computing resources and reducing the environmental footprint of technology. It is a critical building block for corporate social responsibility. As concern for climate change and sustainability continues to grow, businesses around the world are realizing that Green IT initiatives offer cost savings benefits. The idea of Green IT has increasingly gained relevance as a strategy that can add value to business. This paper provides an introduction to green IT.

Key Words: green IT, green ICT, IT metrics, e-waste

I. INTRODUCTION

Sustainability has been a top priority to IT managers because sustainable practices can strengthen their reputation, improve employee morale, deliver cost savings, and benefit the environment. Sustainability is meeting the needs of present generations without compromising the ability of future generations. A good starting point toward sustainability is greening the IT, which has proven to be a potential enemy of the environment. IT equipment and infrastructure are known to be energy-inefficient.

Green IT (information technology) is a new emerging field that combines environmental sustainability and information technology (IT). It is the practice of environmentally sustainable computing. The objective of Green IT is to minimize the negative impact of IT operations on the environment and bring the field of sustainability closer to IT [1]. This is achieved by reducing greenhouse gas emissions, reducing the use of hazardous materials, disposing computer-related products in an environmentally-friendly manner, making data centers and computing devices more energy efficient, and using more renewable energy sources.

The concept of green IT emerged in 1992 when the U.S. Environmental Protection Agency launched Energy Star. This is a labeling standard for energy efficiency in electronic equipment. Energy Star was applied to different types of devices such as computer monitors, television sets, refrigerators, air conditioners, etc. [2]. Green IT can also be viewed from an Information Systems (IS) perspective termed Green IS. Green IS involves people and their use of IT [3]. While green is the use of informationsystems to achieve environmental objectives, Green IT emphasizes reducing the environmental impacts of IT production and use. With the recent developments in IT, business organizations are being made aware of their environmental effects and social responsibility.

II. GREEN IT STRATEGY

Green IT is comprised of the measures and strategies designed to reduce our environmental impact. It is the use of IT resources in an energy-efficient and cost-effective manner. It is green principles and practices applied to IT to achieve environmental sustainability. It relates to the ability of an organization to reduce CO2 emissions, decrease energy consumption, and minimize e-waste. IT may be regarded as both a problem and a solution for environmental sustainability or both barrier and enabler of environmental sustainability. Green IT involves both using IT to reduce our environmental impact and reducing the environmental impact of the IT sector. Numerous IT applications, such as e-commerce, smart grids, smart buildings, digital media, and intelligent transport systems, have a positive effect on reducing environmental pollution and carbon emissions [4].

The green IT principles show the concepts of reducing the environmental impact. They consist of four key green holistic principles [5], which are illustrated in Figure 1 and explained below.

- **Green use**: Reduce the energy consumption of data centers and computer-related devices. IT practitioners should deploy green usage initiatives to reduce energy utilization of computers and other IT infrastructure.
- **Green design**: Design energy efficient and environmentally sound components, computers, servers, and cooling equipment. Green design aims to decrease use of non-renewable resources, manage non-renewable resources, and reduce toxic emissions.
Green manufacturing: Manufacture electronic components, computer-related subsystems with minimal or no impact on the environment. Every process in manufacturing should have a low or no impact on the environment.

Green disposal: Green disposal aims to reduce e-waste by repairing, redeploying, or disposing, refurbishing, retaining, reusing of outdated IT hardware. In this practice the company should plan to refurbish and reuse unwanted computers or other electronics components.

III. IMPLEMENTING GREEN IT

Green IT is currently becoming an important topic for organizations. Although green IT is becoming popular, not every organization is ready to implement it. Therefore, it is necessary to consider ways to implement green IT practices in any organization [6].

1. Buy energy efficient hardware: Use hardware products including notebooks, workstations, power supplies, and servers that meet the EPA's Energy Star guidelines.
2. Use virtualization technology to consolidate servers: One can reduce the number of servers and the corresponding energy consumption by using virtualization technology.
3. Consolidate storage with SAN/NAS solutions: One can save energy through consolidation of storage using storage area networks (SAN) and network attached storage (NAS) solutions.
4. Optimize data center design: Data centers consume a lot of energy and should have cooling system.
5. Recycle systems and supplies: One can donate old computer-related products to schools and nonprofit organizations. Much electronic waste can be recycled, the parts used to make new items.
6. Reduce paper consumption: One can reduce the consumption of paper. Send documents as e-mail attachments rather than faxing.
7. Encourage telecommuting: By encouraging as many workers as possible to telecommute, one can reduce the amount of office space required. Telecommuting reduces costs for both employers and employees.
8. Foster a positive culture of Green IT: Create awareness for Green IT in the day-to-day activities and operation of the organization. Have Green IT policy which includes definition and vision of Green IT, strategic plans for Green IT, etc. Inform staff and practitioners on the ethics of sustainability.

Green IT can be implemented as software, hardware, or business process. Implementing green IT reduces the organization's impact on the environment. Virtualization may be the easiest way to implement Green IT in any organization, because it provides a better utilization of computer hardware. Virtualization allows the design of several virtual machines on one physical machine, thereby increasing capacity utilization of physical servers and reducing energy need. Besides virtualization, an energy-saving technique is cloud computing.

IV. BENEFITS AND CHALLENGES

The main benefits of Green IT can be categorized into three areas [7]: energy efficiency of IT, eco-compatible management of the lifecycle of IT, and IT as an enabler of green governance. By adopting Green IT solutions, companies save a lot of money and help minimize their environmental impact. Reducing hardware implies less energy usage because there are fewer devices. Today the most talented people in IT prefer to work with organizations that are considered environmentally progressive.

The capital cost of implementing green IT (replacing existing hardware and software with greener IT products) is often regarded as the main challenge. Reengineering of business processes and practices may be a major stumbling block. Redesigning an entire company to leverage green IT might be risky since it challenges some of the ongoing day-to-day operations. Resistance to change (cultural and behavioral) is another key barrier. Other barriers include inadequate funding, misalignment with physical facilities, and a lack of resources such as IT staff.

V. CONCLUSION

Green IT is the study and practice of designing, using, and disposing of computer-related products efficiently and effectively with minimal impact on the environment. The heart of green IT is the concept of “environmental sustainability.”

Green IT is a relatively young field. Its impact has already changed lots of commonly accepted human activities. Companies are willing to spend more today to implement green technology than in the past. Each organization can implement green IT according to its own criteria. Companies that implement green IT solutions save a lot of money and reduce their environmental impact. More information about green IT can be found in [8].
REFERENCES


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Figure 1. Holistic approach to green IT [5].