Goals Of Green Computing

Think green

Go green

INTRODUCTION:

Green computing aims to 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

Green computing, Green ICT as per IFG International Federation of Green ICT and IFG Standard, green IT, or ICT sustainability, is the study and practice of environmentally sustainable computing or IT. Murugesan notes that Green IT —is 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 Murugesan lays out the following four paths along which he believes the environmental effects of computing should be addressed:

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 recycling unwanted computers and other electronic equipment.

Green computing is the environmentally responsible and eco-friendly use of computers and their resources. In broader terms, it is also defined as the study of designing, engineering, manufacturing, using and disposing of computing devices in a way that reduces their environmental impact.

Goals :

They are similar to green chemistry:

- Reduce the use of hazardous materials
- Maximize energy efficiency during the product's lifetime
- Promote the recyclacility or biodegradability of defunct products and factory waste.

Goals of Green Computing

The **goal of green computing** is to attain economic viability and improve the way computing devices are used. Green computing practices include the development of environmentally sustainable production practices, energy efficient computers and improved disposal and recycling procedures. There are other goals of green information technology, most notably at the design and manufacturing stages. In all cases, four main aims are:

- to cut down to as little as possible the amount of energy used.
- to minimize the inclusion of harmful materials.
- to use as many biodegradable materials as possible.
- to extend as far as possible the life of the equipment.

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.

To **ensure that the goals of green information technology are achieved**, the continuing efforts of developers, researchers, manufacturing companies and end users everywhere are necessary. A part is played in all this by education. A workforce and general public who have been made aware of the ecological issues of their computing choices are in the best position to help make IT greener

WHY GREEN COMPUTING:

The first thing that hits our mind is because it is the need of the hour. Global warming which has been the major disease since it came into light, poses threats for the future. We are in an era where needs and demands are growing by second of the clock. Resources are limited and they should be managed in such a way that our future has some silver linings to it.

1)Environmental Considerations which focuses on need of green computing in general with respect to electronic devices in use and when they are being disposed of giving birth to e-waste and pollution.

2) Focuses on areas where green computing is highly demanded with respect to cost and energy savings and

(3) Initiatives by governments and corporate sectors in this direction.

Now a day's computer is the basic need of every human. A computer made our life easier and saves a lot of time and human efforts, but the use of computer also increase power consumption and also generate a greater amount of heat. Greater power consumption and greater heat generation means greater emission of greenhouse gases like carbon dioxide(CO_2) that has various harmful impacts on our environment and natural resources. This is because we are not aware about the harmful impacts of the use of computer on environment. Personal computers and data centres consume a lot of energy which use various old techniques and they don't have

sufficient cooling systems. Resultant is the polluted environment. According to figure 1 all computer related terms like Data Centres, Pc & its peripherals and Network & networking devices all produce a large amount of Co2emission. But the huge part of Co2 emission is produced from only Pc's are bad for environment because they are not biodegradable and the parts and pieces will be around forever and them rarely recyclable. Environment pollution could be because of the defects in manufacturing techniques, packaging, disposal of computers and components. There are toxic chemicals used in the manufacturing of computers and when we use informal disposing they put harmful impacts on our environment. So to save our environment and to reduce the harmful impacts of computers we have to aware about it.

To decrease these impacts the term green computing comes into existence. There are various reasons for the use of green computing are:

A. Computers and electronic devices consume a lot of electricity that have some harmful impact on our environment. It produces air pollution, Land pollution and water pollution. Electricity generated through fossil fuel power plants release air pollution and requires a lot of water that effect our environment like climate change, acid rain(pH<5)

B. Most of electronic devices generate a lot of heat which cause the emission of CO2.Co2 is the greenhouse gases, warming the earth surface to higher temperature by reducing outward radiation .with the rapidly increasing of carbon dioxide the rate of global warming became increase causing and through anthropogenic climate change.

C. While disposing of computers and it resources produces a lot of hazardous waste that really damage our environment. It also releases heavy metal like lead (Pave), mercury (Hg), cadmium (cod) into air.

D. The manufacturing of computers products release heavily on the use of toxic comical for electrical insulation, soldering, and fire production .Expose the comical fumes over the long term can cause cancer, cause miscarriages.

One of the first manifestations of the green computing movement was the launch of the Energy Star program way back in 1992. Energy Star served as a kind of voluntary label awarded to computing products that succeeded in minimizing use of energy while maximizing efficiency. Energy Star applied to products like computer monitors, television sets and temperature control devices like refrigerators, air conditioners, and similar items. One of the first results of green computing was the Sleep mode function of computer monitors which places a consumer's electronic equipment on standby mode when a pre-set period of time passes when user activity is not detected. As the concept developed, green computing began to encompass thin client solutions, energy cost accounting, virtualization practices, waste, etc.

Currently, one of the popular green computing groups is tactical instrumentalists. This group applies and uses green computing philosophies mainly to save up on costs rather than save the environment. This green computing concept emerged naturally as businesses find

themselves under pressure to maximize resources in order to compete effectively in the market. This movement arose mainly from economic sentiments rather than political pressure.

Strategic Leaders take into account the social and environmental impacts of new and emerging technologies. Aside from minimizing costs, this particular movement also takes into account other factors such as marketing and branding. Unlike the position held by tactical instrumentalists, strategic leaders recognize the need to overhaul some existing policies or structural makeup of the organization. This can be seen in recent efforts to make IT personnel directly responsible for managing, minimizing and ensuring efficient energy expenditures.

Origins: In 1992, the launched Energy stay a voluntary labelling program that is designed to promote and recognize the 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.

Approaches:

Modern IT systems rely upon a complicated mix of people, networks, and hardware; as such, a green computing initiative must cover all of these areas as well. A solution may also need to address end user satisfaction, management restructuring, regulatory compliance, and return on investment (ROI). There are also considerable fiscal motivations for companies to take control of their own power consumption; "of the power management tools available, one of the most powerful may still be simple, plain, common sense."

1) Product longevity:

Gartner maintains that the PC manufacturing process accounts for 70% of the natural resources used in the life cycle of a PC. More recently, Fujitsu released a Life Cycle Assessment (LCA) of a desktop that show that manufacturing and end of life accounts for the majority of this desktop's ecological footprint. Therefore, the biggest contribution to green computing usually is to prolong the equipment's lifetime. Another report from Gartner recommends to "Look for product longevity, including upgradability and modularity." For instance, manufacturing a new PC makes a far bigger ecological footprint than manufacturing a new RAM module to upgrade an existing one

Data centre design:

Data centre facilities are heavy consumers of energy, accounting for between 1.1% and 1.5% of the world's total energy use in 2010 [1]. The U.S. Department of Energy estimates that data centre facilities consume up to 100 to 200 times more energy than standard office buildings.
Energy efficient data centre design should address all of the energy use aspects included in a data centre: from the IT equipment to the HVAC (Heating, ventilation and air conditioning) equipment to the actual location, configuration and construction of the building. The U.S. Department of Energy specifies five primary areas on which to focus energy efficient data centre design best practices:

- Information technology (IT) systems
- Environmental conditions
- Air management
- Cooling systems
- Electrical systems

Additional energy efficient design opportunities specified by the U.S. Department of Energy include on-site electrical generation and recycling of waste heat.
Energy efficient data centre design should help to better utilize a data centre's space, and increase performance and efficiency.

In 2018, three new US Patents make use of facilities design to simultaneously cool and produce electrical power by use of internal and external waste heat. The three patents use silo design for stimulating use internal waste heat, while the recirculation of the air cooling the silo's computing racks. US Patent 9,510,486, uses the recirculating air for power generation, while sister patent, US Patent 9,907,213, forces the recirculation of the same air, and sister patent,

US Patent 10,020,436, uses thermal differences in temperature resulting in negative power usage effectiveness. Negative power usage effectiveness, makes use of extreme differences between temperatures at times running the computing facilities, that they would run only from external sources other than the power use for computing.

Software and deployment optimization

Algorithmic efficiency

Further information. Analysis of algorithm

The efficiency of algorithms affects the amount of computer resources required for any given computing function and there are many efficiency trade-offs in writing programs. Algorithm changes, such as switching from a slow (e.g. linear) search algorithm to a fast (e.g. hashed or indexed) search algorithm can reduce resource usage for a given task from substantial too close to zero. In 2009, a study by a physicist at Hayward estimated that the average Google search released 7 grams of carbon dioxide (CO_2). However, Google disputed this figure, arguing instead that a typical search produced only 0.2 grams of CO_2

Resource allocation

Main article. Resource allocation

Algorithms can also be used to route data to data centres where electricity is less expensive. Researchers from MIT, Carnegie Mellon University, and Akamai have tested an energy allocation algorithm that successfully routes traffic to the location with the cheapest energy costs. The researchers project up to a 40 percent savings on energy costs if their proposed algorithm were to be deployed. However, this approach does not actually reduce the amount of energy being used; it reduces only the cost to the company using it. Nonetheless, a similar strategy could be used to direct traffic to rely on energy that is produced in a more

environmentally friendly or efficient way. A similar approach has also been used to cut energy usage by routing traffic away from data centres experiencing warm weather; this allows computers to be shut down to avoid using air conditioning.

Larger server centres are sometimes located where energy and land are inexpensive and readily available. Local availability of renewable energy, climate that allows outside air to be used for cooling, or locating them where the heat they produce may be used for other purposes could be factors in green siting decisions.

Approaches to actually reduce the energy consumption of network devices by proper network/device management techniques are surveyed in. The authors grouped the approaches into 4 main strategies, namely (I) Adaptive Link Rate (ALR), (ii) Interface Praying, (iii) Energy Aware Infrastructure, and (IV) Max Energy Aware Applications.

Virtualizing

Main article. Platform virtualization

See also: comparison of platform virtualization software

Computer virtualization refers to the abstraction of computer resources, such as the process of running two or more logical computer systems on one set of physical hardware. The concept originated with the IBM mainframe operating systems of the 1960s, but was commercialized for x86-compatible computers only in the 1990s. With virtualization, a system administrator could combine several physical systems into virtual machines on one single, powerful system, thereby conserving resources by removing need for the original hardware and reducing power and cooling consumption. Virtualization can assist in distributing work so that servers are either busy or put in a low-power sleep state. Several commercial companies and open-source projects now offer software packages to enable a transition to virtual computing. Intel cooperation and AMD have also built proprietary virtual enhancement to the x86 instruction set into each of their CPU product lines, in order to facilitate virtual computing.

New virtual technologies, such as operation system virtualization also be used to reduce energy consumption. These technologies make a more efficient use of resources, thus reducing energy consumption by design. Also, the consolidation of virtualized technologies is more efficient than the one done in virtual machines, so more services can be deployed in the same physical machine, reducing the amount of hardware needed

Power supply:

Desktop computer power supplies are in general 70–75% efficient, dissipating the remaining energy as heat. A certification program 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.

In a recent case study, Fusion-ion, manufacturer of solid state storage devices, managed to reduce the energy use and operating costs of Myspace data centres by 80% while increasing performance speeds beyond that which had been attainable via multiple hard disk drives in Raid 0. In response, Myspace was able to retire several of their servers.

As hard drive prices have fallen, storage farms have tended to increase in capacity to make more data available online. This includes archival and backup data that would formerly have been saved on tape or other offline storage. The increase in online storage has increased power consumption. Reducing the power consumed by large storage arrays, while still providing the benefits of online storage, is a subject of on-going research.

Materials recycling

Main articles: Electronic waste, computer recycling, and Waste Electrical and Electronic Equipment Directive

Recycling computing equipment can keep harmful materials such as lead, mercury, and hexavalent chromium out of landfills, and can also replace equipment that otherwise would need to be manufactured, saving further energy and emissions. Computer systems that have outlived their particular function can be re-purposed, or donated to various charities and non-profit organizations. However, many charities have recently imposed minimum system requirements for donated equipment. Additionally, parts from out-dated systems may be salvaged and recycled through certain retail outlets and municipal or private recycling centres. Computing supplies, such as printer cartridges, paper, and batteries may be recycled as well.

A drawback too many of these schemes is that computers gathered through recycling drives are often 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 post-consumer e-waste collected for recycling is shipped abroad to countries such as China and Pakistan.

In 2011, the collection rate of e-waste is still very low, even in the most ecology-responsible countries like France. In this country, e-waste collection is still at a 14% annual rate between electronic equipment sold and e-waste collected for 2006 to 2009.
The recycling of old computers raises an important privacy issue. The old storage devices still hold private information, such as emails, passwords, and credit card numbers, which can be recovered simply by someone's using software available freely on the Internet. Deletion of a file does not actually remove the file from the hard drive. Before recycling a computer, users should remove the hard drive, or hard drives if there is more than one, and physically destroy it or store it somewhere safe. There are some authorized hardware recycling companies to whom the computer may be given for recycling, and they typically sign a non-disclosure agreement.

Cloud computing

Main article: Cloud computing
Cloud computing addresses two major ICT challenges related to Green computing – energy usage and resource
Consumption. Virtualization, Dynamic provisioning environment, multitenancy, green data centre approaches are enabling cloud computing to lower carbon emissions and energy usage up to a great extent. Large enterprises and small businesses can reduce their direct energy consumption and carbon emissions by up to 30% and 90% respectively by moving certain on-premises applications into the cloud. One common example includes Online shopping that helps people purchase products and services over the Internet without requiring them to drive and waste fuel to reach out to the physical shop, which, in turn, reduces greenhouse gas emission related to travel

Telecommuting

Teleconferencing and telepresence technologies are often implemented in green computing initiatives. The advantages are many; increased worker satisfaction, reduction of greenhouse gas emissions related to travel, and increased profit margins as a result of lower overhead costs for office space, heat, lighting, etc. The savings are significant; the average annual energy consumption for U.S. office buildings is over 23 kilowatt hours per square foot, with heat, air conditioning and lighting accounting for 70% of all energy consumed. Other related initiatives, such as Hoteling, reduce the square footage per employee as workers reserve space only when they need it. Many types of jobs, such as sales, consulting, and field service, integrate well with this technique.

Voice over IP (VoIP) reduces the telephony wiring infrastructure by sharing the existing Ethernet copper. VoIP and phone extension mobility also made hot disking more practical.

Telecommunication network devices energy indices

The information and communication technologies (ICTs) energy consumption, in the US and worldwide, has been estimated respectively at 9.4% and 5.3% of the total

electricity produced. The energy consumption of ICTs is today significant even when compared with other industries. Some study tried to identify the key energy indices that allow a relevant comparison between different devices (network elements). This analysis was focused on how to optimise device and network consumption for carrier telecommunication by itself. The target was to allow an immediate perception of the relationship between the network technology and the environmental effect. These studies are at the start and the gap to fill in this sector is still huge and further research will be necessary.

EFFORTS FOR GREEN COMPUTING:

We need not to stop using computers and even need not to stop using electricity but we have to do some efforts to make environment healthy. The following actions should be taken by us: **Abused energy star labelled products**: - All the energy star labelled products are manufactured with keep in mind the term green computing and its features. These products are manufactured on the idea of less power consumption. These devices are devices are programmed to power-down to a low power state or when they are not in use. So we have to Use EnergyStar"labledesktops, monitors, laptops, printers and other computing promote the recyclability or biodegradability of defunct products and factory waste

B. **<u>Turn off your computer</u>**:-As the previously used figures stated that PC's and its peripherals consume more power and resultant is the high amount of CO2 emission. So we have to keep it our mind and never hesitate to turn off our personal computers when they are not in use.

C.)**Sleep mode**:-Sleep mode save our session and put our computer in a low power state so that we can quickly resume windows always put our Pc on sleep mode when not in use. It use in electricity


Run...
Windows Virtual PC
MediaMonkey
Text Tally
Google Chrome
Getting Started
All Programs
Search programs and files
Shut down
Switch user
Log off
Lock
Restart
Sleep
Hibernate
Keeps your
a low-powe
working.

Advantages of green computing Barriers and benefits

By using virtualization technology we can run multiple virtual machines on a single physical server

Use energy star labelled products

As energy labelled products are manufactured by keeping in mind green computing features like less power consumption and recyclable products. Then product automatically shut down when not in use specific time

Turn off computer

Use led than CRT

E waste

E-waste is growing at a compound annual rate (CAGR) of about 30 per cent in the country. ASSOCHAM, one of apex trade associations of India, estimated that E-waste generation was 1.8mt per annum in 2016 and would reach 5.2 MT per annum by 2020

E-waste in India

India now has 178 registered e-waste recyclers, accredited by the state of governments to process e-waste. But many of them India's e-waste. But many of India's e-waste recyclers aren't recycling waste at all

While some are storing it in hazardous conditions, others don't even have the capacity to handle such waste, as per by the report of union

The ministry of electronics and information technology (Meaty) has initiated an e-waste awareness among the public about the hazardous the e-waste recycling by the unorganised sector. And to educate them about alternate methods of disposing their e-waste.

83%

I don't know where to recycle e-waste

Check out *techcollect.com.au* or *recyclingnearyou.com.au* for your nearest site

60%

I didn't know e-waste could be recycled

Electronics including TVs, laptops, computers, and accessories can be recycled

58%

I don't want to pay to have my e-waste recycled

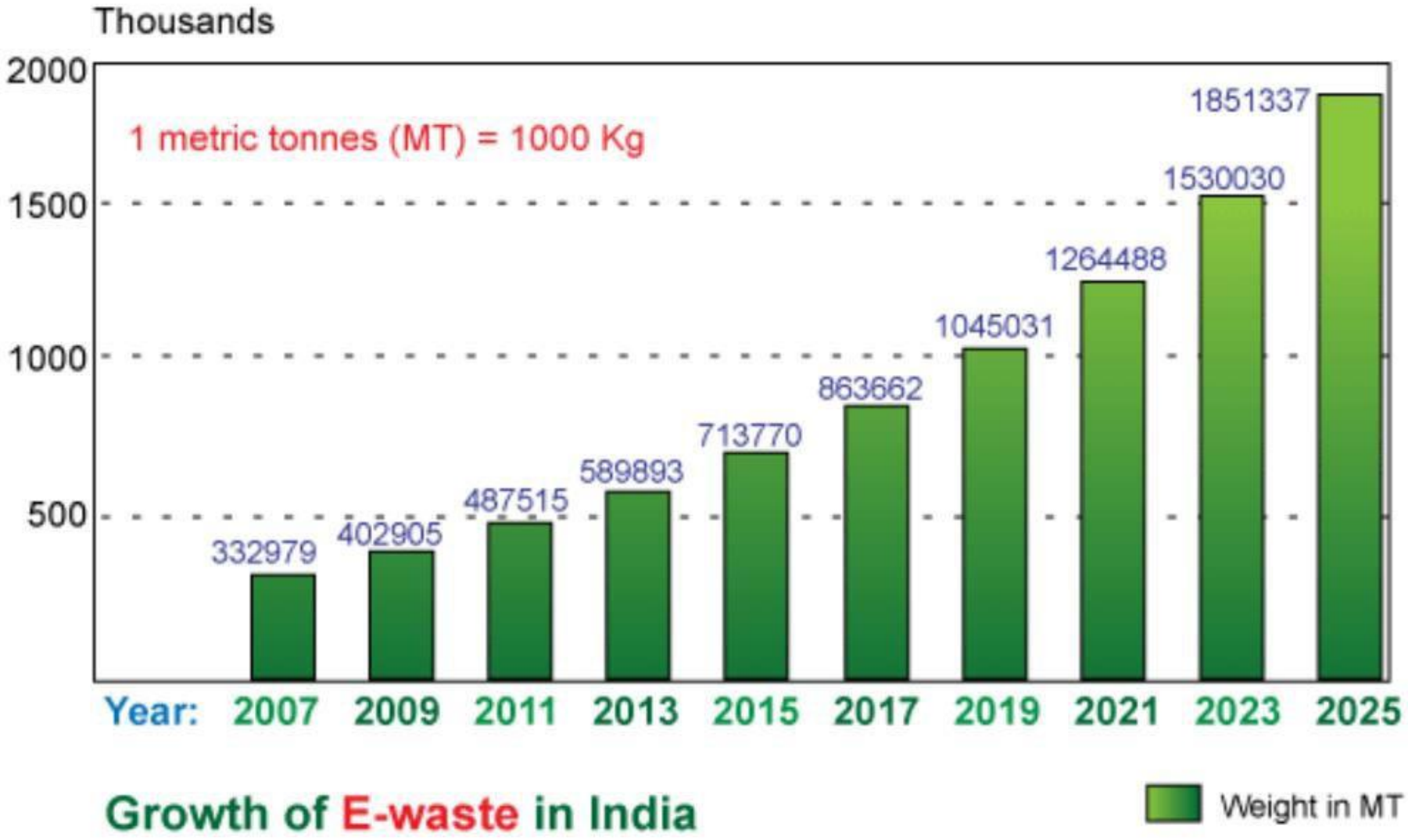
You can recycle your e-waste at over 900 free drop-off locations around Australia

52%

I'm worried I'll lose my personal data

It's easy to securely delete your data

E-waste in India



E waste management Policy

E waste management policy

The lifestyle of all the IT assets spanning from acquisition to disposal shall be managed in a manner which confirms to sound environmental norms as detailed in the IT e-waste guidelines. This includes: preferential dealing with IT vendors having sound e-waste management process

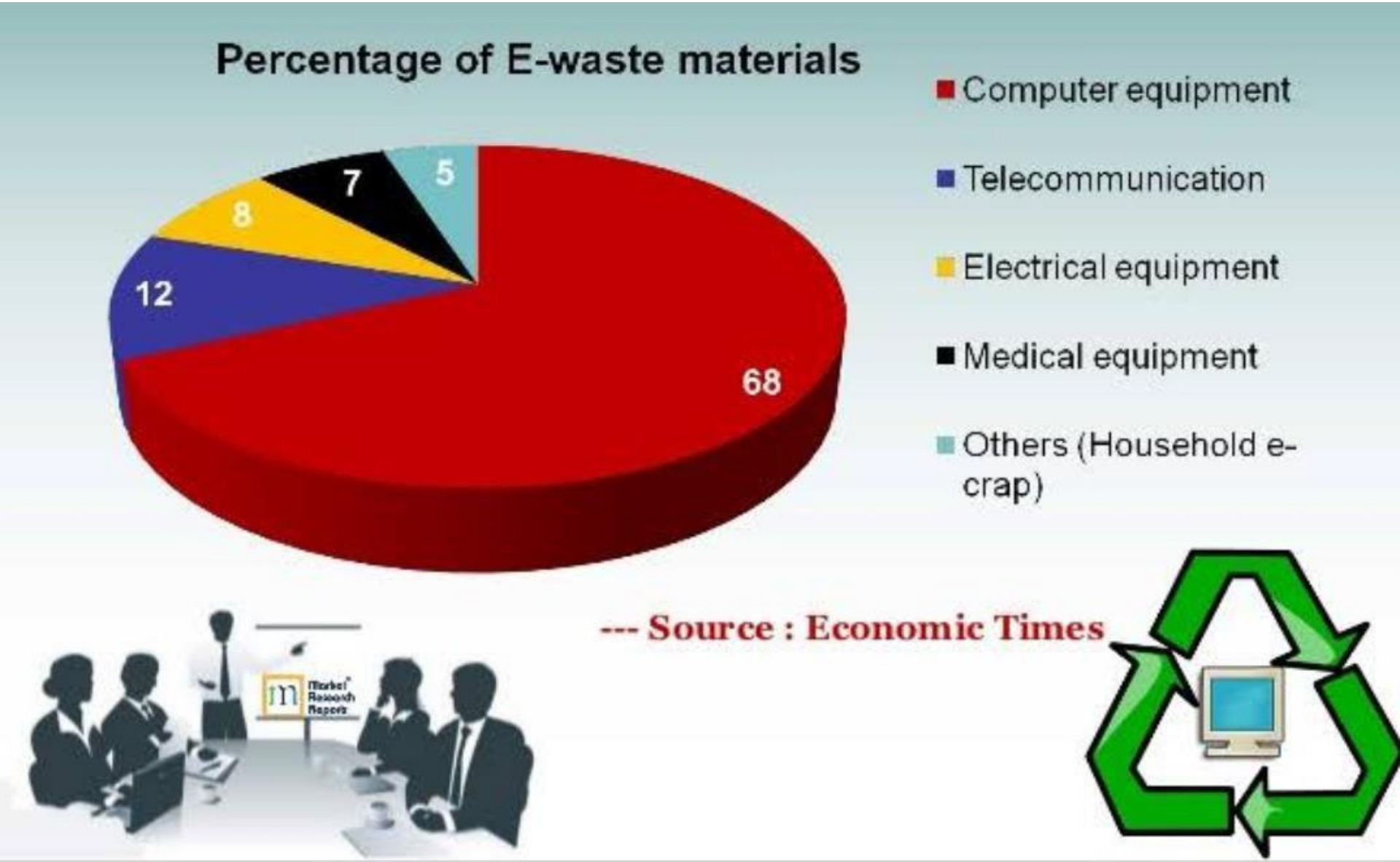
Extending the useful life of IT assets to postpone/minimise generation of e-waste

Responsible disposal processes conforming to regulatory

IT E-waste MINIMISATION PROCESS

- It shall endeavour of every user to maximize utilisation of all IT assets to their full productive life.
- Apart from internal re-use, option to extend use outside ITC through donation to Bonfire philanthropic institutions will also extend the useful life of IT assets
- Only such IT assets which are non-operational and cannot be used for any other alternate purpose should be considered as IT waste for disposal. The DMM will certify this position

E waste management in India pie chart



E-waste management challenges and opportunities

• Growth in the IT and its communication sectors has enhanced the usage of the electronic equipment exponentially.

- Faster upgradation of electronic product is forcing consumers to discard old electronic products very quickly, which in turn, adds to e-waste to the solid waste stream.
- The growing problem of e-waste to the solid waste stream. The growing problem of e-waste to the solid waste stream. • The growing problem of e-waste calls for greater emphasis and better e-waste management.

Impact of recycling waste in developing world

- Almost all e-waste contain some form of recyclable material , including plastic, glass and metals;

- However, due to improper disposal techniques these materials cannot be retrieved for other purposes
- If e-waste is dismantled and processed in a crude manner, it's toxic constituents can break havoc on the human body
- Processes such as dismantling components wet chemical processing and incineration are used to dispose the waste and result in direct exposure and inhalation of harmful chemicals

Opportunities of e-waste management in India

- The management of environment forest and climate change Rolled out the e-waste (management) rules in 2016 to reduce e-waste production and increase recycling. Under these rules, the government introduced era which makes producers liable to collect 30 per cent (over seven years) of green the e-waste they produce, said the study
- The integration of the informal sector in to a transparent recycling system crucial for a better control on environmental and human impacts

Way to waste free economy for electronics

The global consumption of green smartphones and other electronic devices increasing, and bringing benefits to many people in areas as wide ranging as health, education , finance and the commerce but there is no a down side

the world is now seeing growing tsunami of E-waste. According to UN e-waste coalition indicates that the global economy generates approximately 50 million of waste every year

Better legislations new partnership

ITU has been raising awareness and guiding efforts to reduce and rethink e-waste for several years now. Today, approximately 4.8 billion people or 66% of the world's population are now

Covered by e-waste legislation. That's a large increase from just 44%

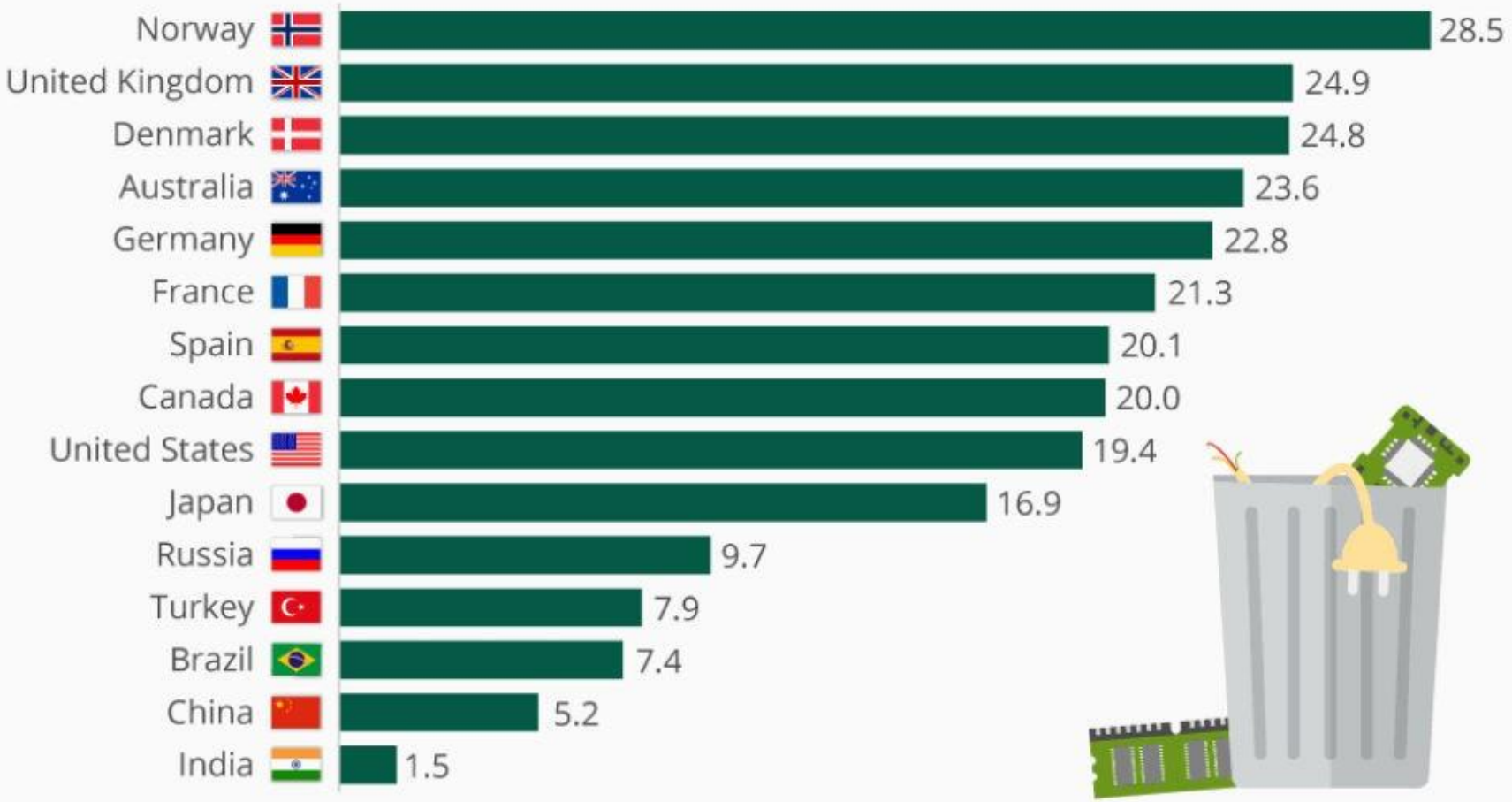
In 2014

More and more actors have recently joined the fold to fight

E-waste. The United Nation e-waste coalition, launched last year includes a long and growing list of UN organization

The World's Worst Electronic Waste Offenders

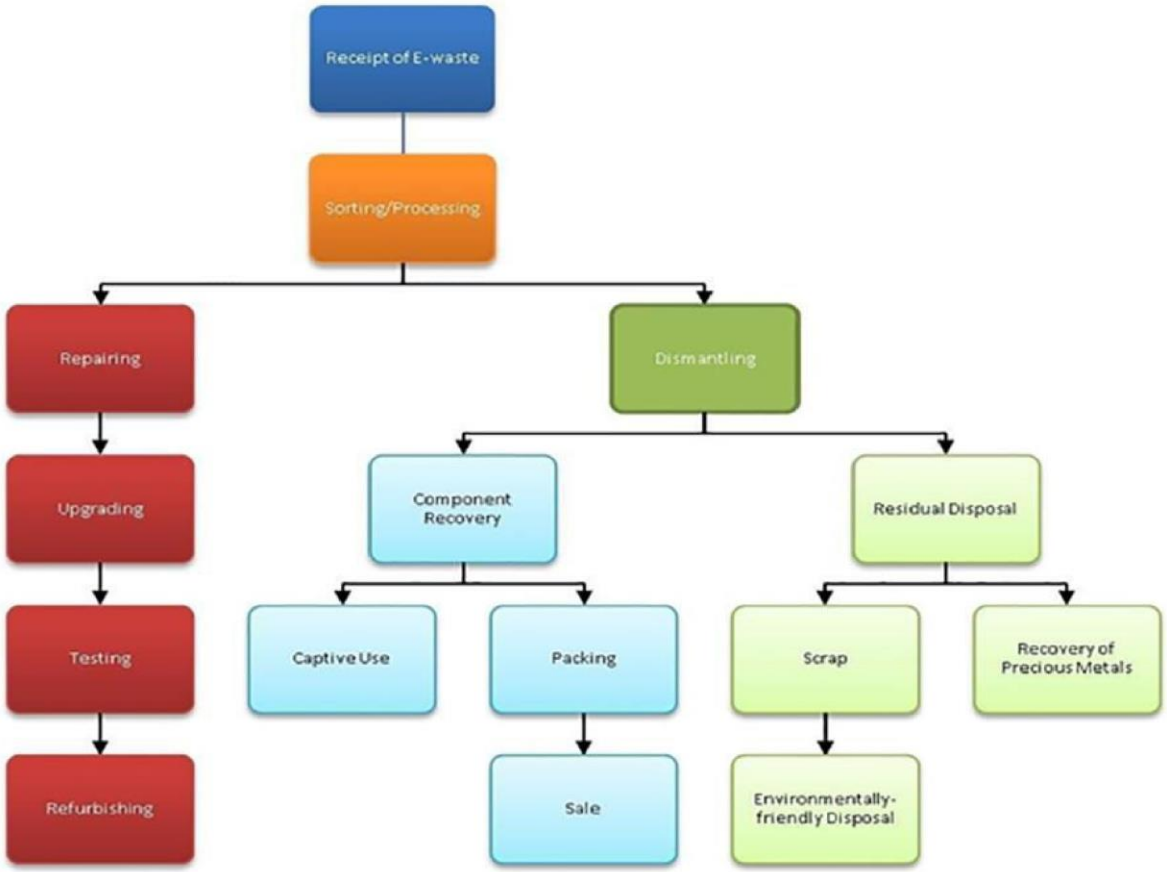
E-waste generated per inhabitant in selected countries in 2016 (kg)



The countries which produced most e-waste

- In total, it's estimated that almost 50 million tons of E-waste will be generated in 2018.
- China lead the way, while the USA(6.3), Japan (2.1), India (2.0)
- and Germany (1.9) trial behind
- However, since china and India have the two biggest populations worldwide by some distance, their e-waste generations not quite troublesome when viewed in the terms of per-capita population

E-waste processing steps



Description of goals

- The goal of green computing reduce the use of this hazardous materials , maximize energy efficiency during the products life time, and promote the recyclability or biodegradable of defunct 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
- Reduce the use of hazardous materials
- Maximize energy efficiency during the products lifetime • The waste act creates a general duty for waste products holders to avoid generating waste and failing that, to minimise the amount and toxicity of the waste generated

Review

The information and communication technology (ICT) has changed the way we live, work, learn, and I play but at the same year time it is is affecting our environment in several ways. It has created many opportunities for employment round the globe as the computer literacy becomes a prerequisite condition for sustenance in almost every public/private sectors. The computer's ability to store. Use in managing many clerical, accounting and services documentation functions in organization. But, at each stage of computer life, from its production, throughout its use and into its disposal.

Conclusion

Whilst the performance and the breadth of the application of computers increasing, so too is our awareness of the cost and scarcity of the energy required to power them, as well as the materials needed to make them in the first place. However, because

Computing developments can enable individuals and businesses to

Adopt Greener lifestyle and work styles, in terms of the environmental debate computing is definitely both part of the problem and part of the solution

Through more environmentally aware usage and by adopting current lower power technologies, computers can be already be made significant more energy efficient

Thank you