GREEN COMPUTING
CONTENTS

• INTRODUCTION
• PURPOSE OF GREEN COMPUTING
• CHEMICALS USED
• AREAS OF FOCUS
• FUTURE SCOPE
• CONCLUSION
• REFERENCES
INTRODUCTION

- Green computing is the environmentally responsible use of computers and related resources.
- 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).
WHY??

– computer energy is often wasteful
  • leaving the computer on when not in use (CPU and fan consume power, screen savers consume power)

– printing is often wasteful
  • how many of you print out your emails or meeting agendas
  • printing out partial drafts
  • for a “paperless” society, we tend to use more paper today than before computer-prevalence
– pollution
  • manufacturing techniques
  • packaging
  • disposal of computers and components
– toxicity
  • as we will see, there are toxic chemicals used in the manufacturing of computers and components which can enter the food chain and water!
Chemical Elements Used: Lead

- used in soldering of printed circuit boards and other components
  - also used in glass for CRTs
  - It is estimated that between 1997 and 2004, 1.2 billion tons of lead was used in computer components

- The problem:
  - lead can cause damage to the central and peripheral nervous systems, blood system, kidneys, endocrine system and cause negative effects on child brain development
  - lead accumulates in the environment and has toxic effects on plants, animals and microorganisms
  - electronics contribute 40% of the total amount of lead found in landfills and can make its way from landfills into the water supplies
Chemical Elements Used: Mercury

- Mercury is used in
  - batteries, switches, housing, printed circuit boards
  - mercury is found in medical equipment, data transmission equipment, telecommunications equipment and cell phones as well
  - if is estimated that 22% of the yearly use of mercury is in electrical and electronic equipment
    - although a small amount of mercury is used, it is used in nearly all computer construction amounting to 400,000 pounds of mercury used between 1997 and 2004

- The problem
  - mercury spreads out in water transforming into methylated mercury which easily accumulates in living organisms
  - it enters the food chain through fish that swim in polluted waters
  - methylated mercury can cause chronic brain damage
Cadmium & Chromium

- Cadmium is used in resistors for chips, infrared detectors and in semiconductors
  - estimated that between 1997 and 2004, 2 million pounds of cadmium was used in computer components
  - cadmium is classified as toxic, these compounds accumulate in the human body, particularly the kidneys
  - cadmium is absorbed through respiration and also food intake
  - cadmium has a half life of 30 years so that cadmium can poison a human body slowly through the human’s life

- Hexavalent Chromium (Chromium VI) is used to treat steel plates (an anti-corrosive)
  it is estimated that between 1997 and 2004, 1.2 million pounds were used in computer components
  --that this can lead to cancer and a number of other medical problems
Plastics

- Plastics are found throughout the computer, largely from casings but also internally to hold components together
  - 4 billion pounds of plastic were used to build computers and components between 1997 and 2004
- One specific form of plastics used is polyvinyl chloride (PVC) which is used in cabling and housings
  - PVC is difficult to recycle and the production and burning of PVC generates dioxins and furans
- The plastics in computers are often treated with flame retardant chemicals, particularly brominated flame retardant
  - these chemicals can act as endocrine disrupters and increase risk of several forms of cancer
  - they have been found entering the food chain
Other Chemical Elements

- Elements in bulk: lead, tin, copper, silicon, carbon, iron and aluminum
- Elements in small amounts: cadmium and mercury
- Elements in trace amounts:
  - germanium, gallium, barium, nickel, tantalum, indium, vanadium, terbium, beryllium, gold, europium, titanium, ruthenium, cobalt, palladium, manganese, silver, antimony, bismuth, selenium, niobium, yttrium, rhodium, platinum, arsenic, lithium, boron, americium
- List of examples of devices containing these elements
  - almost all electronics contain lead & tin (as solder) and copper (as wire & PCB tracks), though the use of lead-free solder is now spreading rapidly
  - lead: solder, CRT monitors (Lead in glass), Lead-acid battery
THREE AREAS OF FOCUS

- Purchase/Disposal
  Responsible computer purchase and disposal considerations
- Energy use
  Energy use and efficient approaches to computing
- Reducing waste
  Using computers to reduce the use of natural resources
PURCHASE/DISPOSAL

- Consider that the average computer lifespan is about 2 years (cell phones < 2 years)
  - 10 years ago, the lifespan of a computer was 5 years
  - between 1997 and 2004, it is estimated that 315 million computers became obsolete (and were discarded, donated, or recycled)
- 183 million computers were sold in 2004 (674 million cell phones!!)
- New users in China (178 million by 2010) and India (80 million by 2010) will require the creation of new computers
- Disposal of these devices constituted 20-50 million tons per year (about 5% of the total waste of the planet)
  - this waste is called e-waste
Land Fills

- Europe has outlawed using landfills for computer components
  - the US and Europe export a lot of e-waste to Asian landfills (especially China even though China has outlawed the importing of e-waste)
  - in addition, incineration of computer components leads to air pollution and airborne toxins
PURCHASE/DISPOSAL METHODS

- Minimal toxic content: The Center for Clean Products and Clean Technologies
- Energy saving features: Energy Star
- Check out your vendor: EPEAT (Electronic Product Environmental Assessment Tool)
- Vendor programs
- Independent recycling programs
- Responsible donations
Energy Use of PCs

• CPU uses 120 Watts

• CRT uses 150 Watts
  – 8 hours of usage, 5 days a week = 562 KWatts
    • if the computer is left on all the time without proper power saver modes, this can lead to 1,600 KWatts
  – for a large institution, say a university of 40,000 students and faculty, the power bill for just computers can come to $2 million / year

• Energy use comes from
  – electrical current to run the CPU, motherboard, memory
  – running the fan and spinning the disk(s)
  – monitor (CRTs consume more power than any other computer component)
  – printers
REDUCING ENERGY

- Turn off the computer when not in use, even if just for an hour
- Turn off the monitor when not in use (as opposed to running a screen saver)
- Use power saver mode
- Use hardware/software with the Energy Star label
  - Energy Star is a “seal of approval” by the Energy Star organization of the government (the EPA)
- Don’t print unless necessary and you are ready
- Use LCDs instead of CRTs as they are more power efficient
Methods for Energy Reduce

• Virtualization
  Computer virtualization is the process of running two or more logical computer systems on one set of physical hardware.

• Power Management and Power Supply
  Prolong battery life for portable and embedded systems.
  Reduce cooling requirements.
  Reduce noise.
  Reduce operating costs for energy and cooling
• Storage
  3.5" desktop hard drive
  2.5" laptop hard drive
  Solid state hard drive

• Displays
  LCD monitors

• Video-card
  No video card - use a shared terminal, shared thin client, or desktop sharing software if display required.
REDUCING WASTE

• **Reuse:** donate your computer components to people who may not have or have lesser quality computers
  -inner city schools, churches, libraries, third world countries
  -this however leads to the older computers being dumped but there is probably no way around this as eventually the older computers would be discarded anyway

• **Refurbish:** rather than discarding your computer when the next generation is released, just get a new CPU and memory chips – upgrade rather than replace
  – while you will still be discarded some components, you will retain most of the computer system (e.g., monitor, the system unit housing, cables)
Recycling

• If companies can recycle the plastics and other components, this can greatly reduce waste and toxins
  – however, the hazardous materials in e-waste can harm the recycle workers if they are not properly protected

• Developed countries now have facilities for recycling e-waste
  – however, in Europe, the plastics are discarded instead of recycled because the flame retardant chemicals are too toxic to work with

• To resolve these problems, the computer manufacturers must start using recyclable chemicals
<table>
<thead>
<tr>
<th>RANK</th>
<th>JUNE '07</th>
<th>MARCH '07</th>
<th>DECEMBER '06</th>
<th>AUGUST '06</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nokia ↑</td>
<td>Lenovo ↑</td>
<td>Nokia ↔</td>
<td>Nokia</td>
</tr>
<tr>
<td>2</td>
<td>Dell ↑</td>
<td>Nokia ↓</td>
<td>Dell ↔</td>
<td>Dell</td>
</tr>
<tr>
<td>2</td>
<td>Lenovo ↓</td>
<td>Sony Ericsson ↑</td>
<td>Fujitsu-Siemens ↑</td>
<td>HP</td>
</tr>
<tr>
<td>4</td>
<td>Sony Ericsson ↓</td>
<td>Dell ↓</td>
<td>Motorola ↑</td>
<td>Sony Ericsson</td>
</tr>
<tr>
<td>5</td>
<td>Samsung ↔</td>
<td>Samsung ↑</td>
<td>Sony Ericsson ↓</td>
<td>Samsung</td>
</tr>
<tr>
<td>6</td>
<td>Motorola ↔</td>
<td>Motorola ↓</td>
<td>HP ↓</td>
<td>Sony</td>
</tr>
<tr>
<td>7</td>
<td>Toshiba ↑</td>
<td>Fujitsu-Siemens ↓</td>
<td>Acer ↑</td>
<td>LGE</td>
</tr>
<tr>
<td>8</td>
<td>Fujitsu-Siemens ↓</td>
<td>HP ↓</td>
<td>Lenovo ↑</td>
<td>Panasonic</td>
</tr>
<tr>
<td>9</td>
<td>Acer ↔</td>
<td>Acer ↓</td>
<td>Sony ↓</td>
<td>Toshiba</td>
</tr>
<tr>
<td>10</td>
<td>Apple ↑</td>
<td>Toshiba ↑</td>
<td>Panasonic ↓</td>
<td>Fujitsu-Siemens</td>
</tr>
<tr>
<td>11</td>
<td>HP ↓</td>
<td>Sony ↓</td>
<td>LGE ↓</td>
<td>Apple</td>
</tr>
<tr>
<td>12</td>
<td>Panasonic ↑</td>
<td>LGE ↓</td>
<td>Samsung ↓</td>
<td>Acer</td>
</tr>
<tr>
<td>13</td>
<td>LGE ↓</td>
<td>Panasonic ↓</td>
<td>Toshiba ↓</td>
<td>Motorola</td>
</tr>
<tr>
<td>14</td>
<td>Sony ↓</td>
<td>Apple ↔</td>
<td>Apple ↓</td>
<td>Lenovo</td>
</tr>
</tbody>
</table>
FUTURE SCOPE

• Energy saved on computer hardware and computing will equate tonnes of carbon emissions saved per year.

• The plan towards green IT should include new electronic products and services with optimum efficiency and all possible options towards energy savings.
CONCLUSION

• 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.
REFERENCES

- http://searchdatacenter.techtarget.com/sDefinition/0,,sid80_gci1246959,00.html
THANK YOU!!!