

UBC Social, Ecological Economic Development Studies (SEEDS) Student Reports

An Investigation into Sustainable Computer Hardware

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**AN INVESTIGATION INTO SUSTAINABLE
COMPUTER HARDWARE**

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ABSTRACT

The AMS is part of the planning committee responsible for the construction of a new SUB scheduled to be completed and open to students by 2014. The AMS wishes to replace and dispose of the old computers currently in the SUB. This report explores computer and monitor replacement options as well as methods to dispose of the old computers. This report is conducted based on the triple-bottom-line assessment model. Thus, the environmental impacts, economic and social sustainability are considered for all replacement options as well as computer disposal methods.

Two computer desktop models from Lenovo and Hewlett Packard, as well as the environmental trends of each company, are investigated. A constraint is that the actual usage time of each computer in the new SUB will be different. Therefore, an estimate usage time was used to calculate the total energy consumed per computer. It was found that the total operating costs of both computer systems, desktop and monitor, had a difference of less than a dollar. This result displays how similar each company's technology is to another in the same field. However, background research on both companies suggests that Lenovo is the greener of the two due to their transparent environmental efforts, and thus, the report recommends that the AMS purchase Lenovo systems for the new SUB.

The issue of sustainable computer disposal is mainly a social problem stimulated by economic benefits. The social problem lies in the fact that wealthier countries like Canada and the United States are illegally exporting their electronic waste (E-Waste) to third world countries where untrained labourers are exposed to high health risks while processing the waste. There is a financial incentive for both parties in this socially irresponsible trade: it costs Canada and the US 10 times less to export the E-waste and it provides jobs to poor people in third world countries that pay better than most other jobs available. The solution to this problem for the AMS is UBC's E-waste program. UBC's E-waste Program is headed by the UBC Waste Management Department and ensures that the old computers currently in the SUB will either be reused or recycled properly in a safe and certified facility.

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LIST OF ABBREVIATIONS

- 1) Electronic waste (E-Waste)
- 2) Social Ecological Economic Development Studies (SEEDS)
- 3) Alma Mater Society (AMS)
- 4) Student Union Building (SUB)
- 5) Hewlett Packard (HP)
- 6) Liquid Crystal Display (LCD)
- 7) Mean Time Between Failures (MTBF)
- 8) Electronic Product Environmental Assessment Tool (EPEAT)
- 9) Brominated Flame-Retardants (BFRs)
- 10) Polyvinyl chloride (PVC)
- 11) Environmental Protection Agency (EPA)
- 12) Recycling Council of British Columbia (RCBC)
- 13) Basel Action Network (BAN)
- 14) Computers for Schools BC (CFS)
- 15) Environment Handling Fee (EHF)
- 16) Environment Recycling Standard (ERS)
- 17) Electronic Product Stewardship Canada (EPSC).

1.0 INTRODUCTION

Computers have grown in popularity and functionality ever since they were made available to the public through mass production. They have become a daily necessity for certain individuals and businesses because they can be utilized tools which increase productivity and efficiency as well as help communicate ideas. It is predicted that there are approximately one billion computers as of 2008 and possibly two billion by 2015. This increase in the consumption and usage of electronics like a computer has resulted in a new by product called electronic waste (E-waste). This E-waste possesses new problems for communities because it contains toxic chemicals that can cause health-related consequences if not handled properly. UBC is a major consumer of this electronic good, so it has setup the Social Ecological Economic Development Studies (SEEDS) program which addresses campus sustainability issues such as the disposal of E-waste.

The Alma Mater Society (AMS) is leading the planning process exploring the possibilities of building a new Student Union Building (SUB). This report will investigate the life-cycle of a computer and why they can be so dangerous to the environment if not disposed of properly. A comparison of two different desktops from Hewlett Packard (HP) and Lenovo will be conducted as well to see which one is a more sustainable option for the new SUB. The two computer models will be evaluated based the economical, environmental and social impacts of the hardware. Finally, this report will also recommend a route by which the AMS can properly dispose of the existing computer hardware in the old SUB in a sustainable manner.

2.0 ECONOMIC ASSESSMENT

This report will conduct a comparison on two models of desktop computers and liquid crystal display (LCD) monitors from Lenovo and HP respectively. Figure 1 below shows pictures of each product.

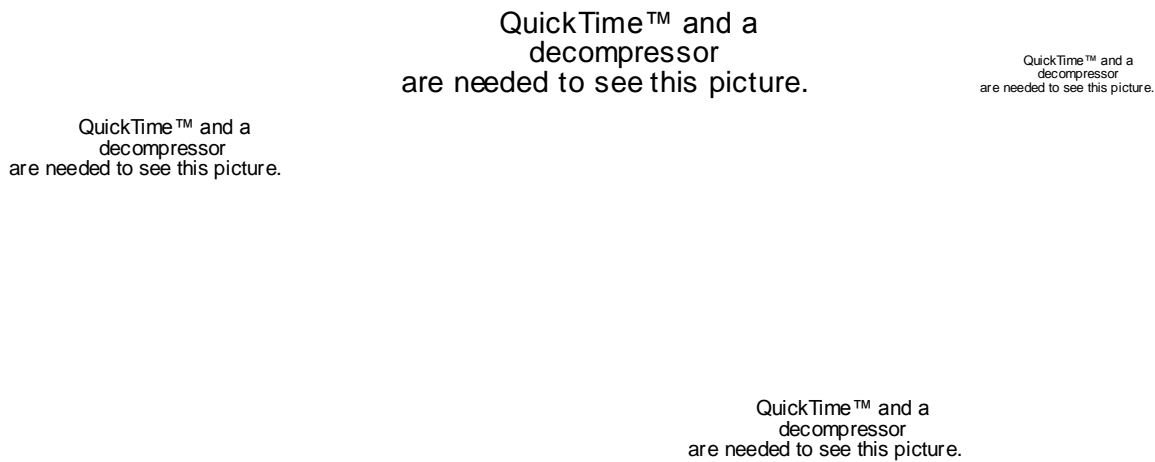


Figure 1. Lenovo and Hp System Pictures
(Left: Lenovo ThinkCentre M58p, Bottom Right: HP Compaq dc5800
Top Middle: Lenovo L2060 W LCD Monitor, Top Right: HP Compaq LA1905wg W LCD Monitor)
Sources: www.lenovo.ca and www.hp.ca

This section will focus on the economic portion of this comparison as well as some performance issues. The main topics which will be discussed are the performance and purchasing cost, operating cost, maintenance cost and overall lifespan of each system. Refer to Appendix A for the technical specifications of each product.

2.1 PERFORMANCE AND PURCHASING COST

The Lenovo model has a faster processor and a better video card chip than the HP model, however since the usage will be limited to office use and possibly light media work, the difference in performance is negligible. The reason we choose to compare desktop computers is because thin client

desktops generally do not have DVD writers which could be needed in an office setting. The Lenovo system would be purchased directly from the Lenovo website. On the other hand, the HP system can be purchased from DirectDial which is a HP distributor located in Richmond, BC. Since the distribution center for the HP is located relatively close to UBC, the shipping and handling fees could be avoided provided that the AMS decides to pick up the computers themselves. which would make the HP the cheaper solution. Also note that Lenovo has free shipping for a limited time, which means delaying any purchases could increase the total cost. The price breakdown of the Lenovo and HP systems is listed in Table 1 below.

Item	Lenovo	Hp
Desktop Computer	1199.00	1170.00
Monitor	189.00	200
Environmental Fee for monitor	12*	9
Environmental Fee for Desktop	10*	5.5
GST(5%)	69.45	70.48
PST(7%)	97.23	98.67
Shipping & handling	0	25
Total	1576.68	1578.64

Table 1. Price Comparison: Lenovo ThinkCentre M58p vs HP Compaq dc5800

(* not taxed, prices as of Nov. 14, 2009)

Source: www.lenovo.ca and www.hp.ca

2.2 OPERATING COST

The operating cost is the cost of using the computers and it depends on how often the computer is used. To calculate the electrical consumption the assumption was made that a typical computer is going to be powered on and used eight hours a day, asleep for six hours and powered off for ten hours. The current rate for electricity from BC Hydro is 5.91 (cents/kWh) as of November 2009, however UBC may have a different rate so the regular residential rate was assumed. Table 2 is the list of power consumption of the products and the resulting yearly cost associated with each item. The operating expense of the Lenovo package is cheaper by seventy-six cents when looking at the total yearly cost of the computer and LCD monitor.

	Energy consumption (Watts)			Cost per year (Yearly operating hours * cost of Electricity, units in dollars)
	Standby	Sleep	Regular	
HP Monitor	< 1	< 1	26	4.832016
HP Desktop	1.6005	3.2813	55.5	10.34769324
Lenovo Monitor	< 1	< 1	22	4.141728
Lenovo Desktop	1.82	2.90	55.1	10.2766626
Hours per day (estimate)	10	6	8	
Cost of Electricity	.0591 \$/kWh			

Table 2. Energy Consumption: Lenovo ThinkCentre M58p vs HP Compaq dc5800

Source: <http://oe.nrcan.gc.ca/residential/business/manufacturers/office.cfm?attr=12>
(computer and monitor energy consumption spreadsheets)

2.3 LIFESPAN AND MAINTENIENCE COSTS

In general a LCD monitor has a manufactured lifetime of 45,000 hours in general according to manufacturers and technical experts (Socolof, Overly, Kincaid, & Geibig, 2001). A typical LCD monitor can last up to eight to ten years depending on how rigorous the usage is. However, figuring out the useful lifetime is difficult because monitors are usually replaced much earlier for aesthetic and performance reasons. The current computers made available for students found at the SUB are five years old so it is a good assumption that the monitors will be used for at least that amount of time before they get donated or recycled.

The average mean time between failures (MTBF) for hard drives is usually half a million. It is hard to get exact MTBF data on hard drives because manufacturers generally do not specify which model they use and can switch at anytime. Based on the MTBF, there is a 0.73% chance per year that a hard drive in a cluster of computers will fail (Nguyen, 2007). Therefore, if the AMS decides to purchase one hundred computers, there is a good chance at most one hard drive per year would need to be replaced. However MTBF information is unavailable for most other computer parts and it makes it hard to quantify an estimate on the potential total maintenance costs. A study published by Carnegie Hall University indicating that MTBF is not an accurate reliability measurement (Nguyen, 2007). However

based on a reliability survey done by Rescuecom, a computer repair franchise, they have been able to rank computer brands in terms of reliability based on support calls made by their customers. Lenovo placed third with 314 points and HP placed fifth with 142 points respectively on this ranking system. Based on this reliability survey it is probable that Lenovo will have fewer problems than HP in terms of maintenance (Kaplan, 2009). This would result in less labour hours needed for maintenance and less cost on hardware replacement. The AMS also has a computer and IT department that could administer any repairs needed. This will greatly decrease any external costs of maintenance.

3.0 ENVIRONMENTAL ISSUES

The environmental impact of a computer is often hard to pinpoint for the average consumer. Computers can appear to have no big apparent influence on environment, but the accumulation of energy use and materials passing through the entire life-cycle of a computers is significant.

As more is discovered on the environmental impacts of computers, computer companies are beginning to pay more attention to the environmental sustainability of their products. Organizations such as EPEAT, derived from Electronic Product Environmental Assessment Tool, and ENERGY STAR make sure companies are reducing the impact of their products on the environment and also to provide consumers with good references when they are choosing eco-friendly computers.

This section of the report will cover the life-cycle of computers, environmental impacts of computers, some background information on the EPEAT and ENERGY STAR organizations and finally an environmental impact comparison between Lenovo, HP and their products.

3.1 LIFE-CYCLE OF COMPUTERS

The life cycle of a computer can be generalized into the following stages: pre-manufacturing, manufacturing, transportation or distribution, use and reuse, disposal and recycle, de-manufacturing and reusing raw material. Figure 2 shows how these different stages are connected.

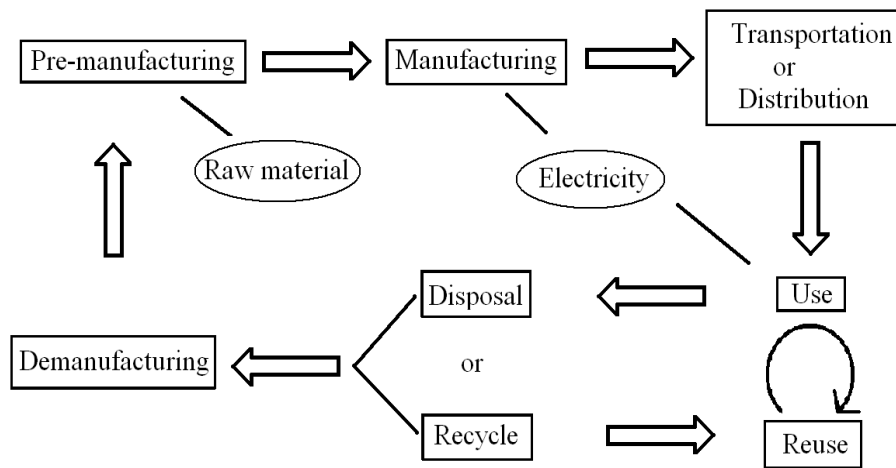
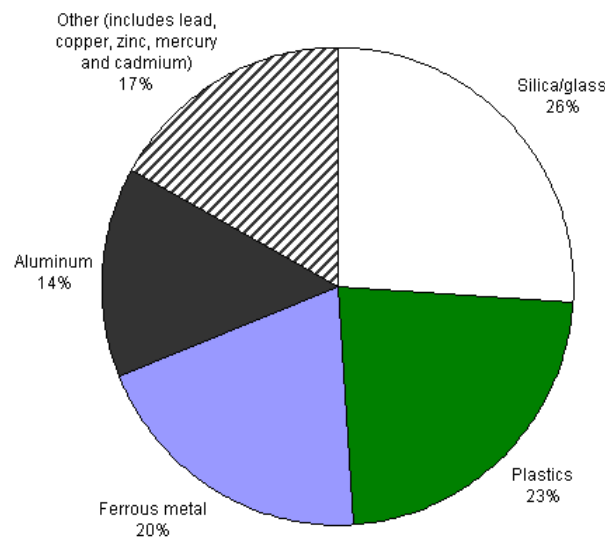


Figure 2. The Life cycle of a Computer (self-adapted)

Throughout the life-cycle of a computer, a lot of raw materials and energy resources are consumed. Many of these raw materials consumed in the pre-manufacturing stage are non-renewable resources such as metals and oil to manufacture the plastic casings. Manufacturing requires a large amount of electricity which may or may not be from a renewable source. Usage of a computer has a relatively smaller impact on environment. A typical computer user will consume approximately 60-500 watts of electricity per day depending on how long they use the computer for (ENERGY STAR). A LCD monitor will use additional 35-150 watts per day (ENERGY STAR).

3.2 ENVIRONMENTAL IMPACTS

The production of computers uses a lot of raw materials, including metals, glass and oil as well as energy. Figure 3 below shows the percentages of the materials and metals used in a computer.



Source: Environment Canada.

Figure 3. Material Composition of a Computer

Source: <http://www.sustainableit.com.au/images/resources/ewaste.gif>

The largest environmental impact of computers occurs when they are not disposed of properly. Dumping or burning a computer can cause the many combined materials such as Brominated Flame-

Retardants (BFRs) and Polyvinyl chloride (PVC) in the plastic computer casing to released toxic dioxin gases. Toxic materials such as lead can also leech underground and poison the water supply.

3.3 EPEAT AND ENERGY STAR

EPEAT and ENERGY STAR are two green organizations which evaluate computer products based on their environmental friendliness and energy efficiency. These two companies also provide rankings and categorize products based on sets of environmental criteria.

The EPEAT process is a system which is used to evaluate computers according to their environmental performance, and give them a rank of either Bronze, Silver or Gold. The evaluation and ranking is based on a set of 23 required criteria and 28 optional criteria. Gold level computers meet all the required criteria and 75 percent of the optional criteria. The criteria are mostly about the pollution produced by the computers, computer performance, life cycle extension, packaging, energy reservation and end of life management. For a complete list of EPEAT criteria, see Appendix B.

ENERGY STAR is a voluntary certification assessment program for energy efficiency. The program was founded by United States Environmental Protection Agency (EPA) in 1992. Originally ENERGY STAR certification was only available for computers and displays, but gradually the organization expanded to other electronic products such as home appliances as well. ENERGY STAR shares its partnerships with more than 15,000 organizations, and also provides these organizations with the technical content to help them find out energy-efficiency solutions. Energy Star 5.0 is the most recent version for energy-efficiency assessment.

3.4 LENOVO AND HEWLETT PACKARD

Lenovo and HP are two major computer manufacturing companies who design computers that are green and environmentally friendly. The products we are considering in this report, the Lenovo ThinkCentre M58p and HP Compaq dc5800 desktop computers and monitors are designed with environmental goals in mind and have all achieved EPEAT Gold status.

The ThinkCentre M58p by Lenovo is an Eco BFR and PVC free Ultra Small desktop that is ENERGY STAR 5.0 certified. The desktop casing is manufactured from 10 percent post-consumer recycled plastic. Similar to the Think Centre M58p, many of Lenovo products contain post-consumer recycled content, such as post-consumer recycled plastics. Lenovo is a company that thinks about the environmental impacts of their products. On their website, it is possible to locate environmental datasheets for almost all their recent products. Lenovo also releases environmental sustainability reports every year as well. Lenovo is a company that is showing their dedication in protecting the environment by being transparent with their products and operations.

The HP Compaq dc5800 also qualifies for the ENERGY STAR 5.0 certification and is Gold ranked in terms of the EPEAT. HP produces all kind of computer related hardware, but also takes care of the end-of-life management. The company provides four options that are donation, recycling, trade-in and returning for cash. Additionally, the company has the HP Planet Partners program that teams up with other companies such as Staples to collect HP products for disposal. Uniquely, HP is known for collecting malfunctioning hardware and computers for refurbishment to resell. Consumers can also sell old products to the local HP branches, or exchange products for updates.

4.0 SOCIAL IMPACTS

When looking at electronics such as a desktop computer or monitor, it can be difficult to spot the social impacts in its life-cycle assessment. Almost all social impacts are not experienced by the user of the computer or electronic device. Some minor social impacts of using a computer affecting the user's well being our report has considered include the quality of the display and the small size of the computer itself to help organize and save workspace. Aside from these minor points, the user of the computer is seldom exposed to the most important social impact: the problem of how to deal with old and used electronics. The disposal of old electronics such as a computer in a landfill is environmentally hazardous because of all the toxins discussed in Section 2.2. However, proper disposal of electronics is expensive and some wealthy countries such as Canada and the United States have found it easier to just dump their electronic trash onto poorer countries and let them deal with it. This section of the report will discuss this globally expanded problem, provide some common solutions and ultimately recommend a plausible route the AMS SUB renewal team can take to dispose of the old computers currently in the old SUB in an ethical and socially sustainable manner.

4.1 SOCIAL RESPONSIBILITY OF E-WASTE

E-waste is a term used to describe electronic equipment that is old, used, obsolete or has reached the end of a useful life. In Canada alone, more than 140 000 tones, equivalent to 5.6 million computers, of E-waste are generated annually (RCBC). Disposal of E-waste into landfills is problematic because of its toxic and harmful nature to both the environment and human health. An issue of greater social concern is the amount of Canadian E-waste leaving from our very own Port of Vancouver to third world countries such as India or China. It is estimated that 80% of all E-Waste generated in Canada is shipped illegally overseas and Vancouver is the perfect location to do it. In December 2006, Environmental Canada and the Canada Border Services Agency seized 50 containers holding approximately 500 000 kilograms of E-Waste at the Port of Vancouver destined for Hong Kong and China is even more alarming that the 27 companies involved, whose names have not been released by the federal government, settled for fines of only \$2000 each in court (Leader-Post).

The E-waste of consumer-based wealthy countries like Canada which makes it onto the large ships often ends up in small towns located on the South China Sea coast like Guiyu. Guiyu, often

dubbed as the E-waste capital of the world, has a population of approximately 130 000 and is about the size of North Vancouver. According to the local government website, Guiyu employs approximately 5 500 family workshops totaling to 60 000 laborers in its E-waste processing industry. Although the importing of E-waste into China was banned in 1996, Guiyu still processes approximately 1.5 million tons of E-waste each year, 80% of this E-waste is imported from overseas (BAN). The illegal exporting of E-waste from countries like Canada and the United States is so prevalent because it is 10 times cheaper to export the E-waste to an overseas town like Guiyu than to have it properly processed by a certified recycling company. It should also be noted that the laborers in Guiyu have no safety training in the expertise of properly disposing of E-waste. Guiyu also lacks the state-of-the-art facilities required for proper disposal of E-waste in a safe and environmentally sound manner. Instead, laborers scavenge through the E-waste: shredding plastic casings into particles, prying chips off circuit boards and then passing the circuit boards through open acid baths to extract tiny amounts of metals such as gold and silver. Anything left over that the laborers cannot break down or scavenge is left to burn in open fires. It is also unsettling that this work pays \$24 US - \$36 US a month and is better than many of the jobs Guiyu citizens can find elsewhere (Greenpeace). Refer to Figure 4 to see how some of the circuit boards are processed in Guiyu.

QuickTime™ and a
decompressor
are needed to see this picture.

Figure 4. Guiyu laborers extracting metals from circuit boards,
a process that releases toxic fumes and it can be seen that
the laborers do not have any form of respiratory protection

Source: <http://www.greenpeace.org/international/news/e-waste-china-toxic-pollution-230707>

The main social implication of countries like Canada and the United States imposing substantial amounts of E-waste on a small town like Guiyu is the fact that the health and safety of a relatively small population of people is compromised by a massive population of consumers. In fact, only the shop bosses and government officials of Guiyu can even afford to own their own television set or mobile phone. There is a social imbalance because the consumers in wealthy countries get to actually use and enjoy all the benefits of electronics while the poor people in third world countries must pay with their health in the process of taking care of E-waste they did not produce. One can see that this issue of E-waste is a global problem with social implications that result in environmental and health related tragedies.

4.2 REUSING COMPUTERS

One of the ways people can help reduce the amount of E-waste generated by wealthy countries is by reusing old electronics. Reusing electronics is the most environmentally friendly option because it requires no extra resources and energy to manufacture a new product and dispose of the old one. There are also positive social impacts that can arise from reusing old electronics. A Lower Mainland organization stationed in Burnaby invoking positive social impacts through facilitating the reusing of old computers is Computers for Schools BC (CFS). CFS, a non-profit organization, has received and refurbished 102 000 computers to date and distributed them to schools, libraries and non-profit organizations across the Lower Mainland. Since interception in 1993, CFS has diverted approximately 52 million pounds of E-waste from landfills and promoted the equality of access to the benefits of technology and information (CFSBC).

Some of the disadvantages of reusing electronics, especially computers, are the security of information and possible incompatibility of old electronics with new technologies. One would assume that you would clear your computer of any important information before donating it to be reused. However, companies like CFS have security policies set in place which ensure that all hard drives are cleared during the computer refurbishment process. The software they use to achieve this is the same software utilized by the Royal Canadian Mounted Police (RCMP).

4.3 RECYCLING COMPUTERS

Instead of imposing E-waste on poorer countries, another socially responsible method of E-waste disposal is to recycle it in safe and environmentally certified facilities. Electronic recycling processes extract raw materials such as metals, glass and plastics which can be refined and used in future manufacturing processes. Refer to Appendix C for additional information on types of materials that can be recovered and what they are used for.

This socially responsible solution can sometimes be counter-balanced by the fact that proper recycling of E-waste is expensive. The recycling process is so expensive because of the complex processes required to separate the many components of electronics that are manufactured out of a multitude of toxic materials. In BC, with the environment handling fee (EHF) averaging from \$5 - \$10 per desktop computer imposed by recycling companies is often enough to deter the average consumer from recycling (Encorp). Refer to Appendix D for additional information on the EHF's of common old electronics.

4.4 UBC E-WASTE PROGRAM

Come 2014 when the new SUB opens, the AMS will be faced with the decision of what to do with their old computers, monitors and accessories such as keyboards and speakers. It is in the best interests of the AMS to uphold UBC's vision of "[advancing] a civil and sustainable society" by ensuring that these old electronics do not end up overseas in a town such as Guiyu (UBC, 2009). In fact, UBC has already taken the steps to prevent such irresponsible social behaviour by implementing its very own E-Waste Program under the UBC Waste Management Department. UBC's E-waste Program provides free E-waste collection of Stewardship Program Approved items and Non-Stewardship Program Approved items with a recycling fee. Please refer to Appendix F to see the recycling fees for different Non-Stewardship Program electronics. Please also refer to Table 3 on the next page to see which items are included or not included in the Stewardship Program.

Category	Items
Stewardship Approved	Desktop and Laptop computers, monitors (LCD and CRT), televisions, computer peripherals (mice, keyboards, cables), printers, fax machines
Non-Stewardship Approved	Microwaves, stereo systems, video cameras, DVD/CD players, large printers, scanners, handheld electronics, other electronic items

Table 3. Stewardship Program Electronic Classification

Source: <http://www.recycle.ubc.ca/ewaste.htm>

After collection, UBC Waste Management will sort the electronics to see if reusing any of the equipment is a viable option. Reusable electronics get sent to Free Geek Vancouver, a non-profit community organization whose motto is to “reduce the environmental impact of waste electronics by reusing and recycling donated technology” (Free Geek, 2009). Items need to be recycled are sent to Encorp Pacific Canada, a federally incorporated organization, through the Return-It Electronics Program. Encorp Pacific ensures that the E-waste is recycled properly by downstream companies such as E-Cycle Solutions, located in Chilliwack, B.C., through a rigorous environmental audit and assessment process. The assessment process of such recycling companies is according to the Environment Recycling Standard (ERS) set by Electronic Product Stewardship Canada (EPSC). The ERS not only considers the correct procedures to recycle E-waste properly to minimize any negative environmental impacts but also the health and safety of the workers in the recycling facilities.

5.0 CONCLUSION AND RECOMMENDATIONS

The objective of this report is to investigate and recommend a computer system that the AMS council could purchase for use in the new SUB. The triple-bottom-line comparison of the replacement option products takes into account the social, environmental, and economical positive and negative impacts. Organizations such as EPEAT and ENERGY STAR help provide guidelines that help companies reduce their impact on the environment, and provide product ratings for consumers wishing to buy eco-friendly electronic products. Using these references, two computer packages from HP and Lenovo were determined to be suitable replacement options. The two products are the Lenovo ThinkCentre M58p and the HP Compaq dc5800 desktop computers. Both are good candidates for the new SUB but the Lenovo system is the recommended replacement option chosen because it focused on the long-term health of the environment during usage, whereas the HP focused more on the recycling their own products. The Lenovo company is also very dedicated to reducing its environmental footprint of their products and are very transparent about their environmental policies and products.

The economic analysis of these two computer systems was based on the purchase, power consumption, and maintenance costs associated with each product. The purchase price was taken from online sources such as the company website or authorized distributors to determine which package was more cost effective. The power consumption was calculated using data from the manufacturer or ENERGY STAR spreadsheets. Determining the exact cost of maintenance was difficult but based on customer support surveys it was determined that a Lenovo product would be more reliable than a HP product. Overall, the Lenovo products bested the Hp products slightly in all three economic categories, and are the better economical choice.

The main social aspect of this report is taking the responsibility of properly disposing E-waste. Steps have to be taken in order to properly dispose of the existing computers so that they do not end up being exported to a third world country. It is in the best interests of the AMS to participate in UBC's existing E-waste Program. By doing so, the AMS can make sure the old computers get recycled properly or reused elsewhere and maintain the social sustainability UBC has developed and strongly believes in.

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APPENDIX A – LENOVO AND HP TECHNICAL PRODUCT SPECIFICATIONS

	Lenovo ThinkCentre M58p	HP Compaq dc5800
Processor	Intel Core 2 Duo E8400 Processor (3.00GHz 1333MHz 6MBL2)	Intel Core 2 Duo E7400 processor (2.80 GHz, 1066 MHz 4MBL2)
Operating System	Windows 7 Professional (32 bit)	Windows Vista Business (32 bit)
RAM (memory)	2GBx1 PC3-8500 DDR3 SoDIMM	4 GB (2 x 2 GB)
Video Adapter	Integrated Video GMA 4500	Integrated Intel GMA 3100
Hard Drive	160GB 7200RPM	160GB 720RPM
Audio Adapter	Integrated Audio ADI 1882HD	Integrated High Definition audio with ADI1884 codec
Monitors		
	Lenovo ThinkVision L2060 W LCD Monitor	HP Compaq LA1905wg 19-inch Widescreen LCD Monitor
Viewable Size	20-inch widescreen	19-inc widescreen
Aspect Ratio	16:9	N/A
Contrast Ratio	1000:1	1000:1
Maximum Resolution	1600 x 900	1440 x 900
Metric Weight	4.76 kg	6.2 kg

Sources:

Lenovo ThinkCentre M58p

http://shop.lenovo.com/SEUILibrary/controller/e/webca/LenovoPortal/en_CA/config.workflow:java-configure?x=x&sb=%3A00000025%3A000026A2%3A

HP Compaq dc5800

<http://h10010.www1.hp.com/wwpc/ca/en/sm/WF06b/12454-12454-64287-3328896-3328896-3658082-3916052.html>

Lenovo ThinkVision LCD Monitor

http://shop.lenovo.com/SEUILibrary/controller/e/webca/LenovoPortal/en_CA/catalog.workflow:item.detail?GroupID=38&Code=2120HB1¤t-category-id=2FAF239B768947AD95895F826C34447E&&hide_menu_area=yes

Hp Compaq LCD Monitor

<http://h10010.www1.hp.com/wwpc/ca/en/sm/WF06a/382087-382087-64283-3884470-3884470-3955305.html>

APPENDIX B – EPEAT ELECTRONICS ENVIRONMENTAL CRITERIA LIST

(R = required, O = optional)

- 4.1 Reduction/elimination of environmentally sensitive materials
 - R 4.1.1.1 Compliance with provisions of European RoHS Directive upon its effective date
 - O 4.1.2.1 Elimination of intentionally added cadmium
 - R 4.1.3.1 Reporting on amount of mercury used in light sources (mg)
 - O 4.1.3.2 Low threshold for amount of mercury used in light sources
 - O 4.1.3.3 Elimination of added mercury used in light sources
 - O 4.1.4.1 Elimination of intentionally added lead in certain applications
 - O 4.1.5.1 Elimination of intentionally added hexavalent chromium
 - R 4.1.6.1 Elimination of intentionally added SCCP flame retardants and plasticizers in certain Applications
 - O 4.1.6.2 Large plastic parts free of certain flame retardants classified under European Council Directive 67/548/EEC
 - O 4.1.7.1 Batteries free of lead, cadmium and mercury
 - O 4.1.8.1 Large plastic parts free of PVC
- 4.2 Materials selection
 - R 4.2.1.1 Declaration of postconsumer recycled plastic content (%)
 - O 4.2.1.2 Minimum content of postconsumer recycled plastic
 - O 4.2.1.3 Higher content of postconsumer recycled plastic
 - R 4.2.2.1 Declaration of renewable/bio-based plastic materials content
 - O 4.2.2.2 Minimum content of renewable/bio-based plastic material
 - R 4.2.3.1 Declaration of product weight (lbs)
- 4.3 Design for end of life
 - R 4.3.1.1 Identification of materials with special handling needs
 - R 4.3.1.2 Elimination of paints or coatings that are not compatible with recycling or reuse
 - R 4.3.1.3 Easy disassembly of external enclosure
 - R 4.3.1.4 Marking of plastic components
 - R 4.3.1.5 Identification and removal of components containing hazardous materials
 - O 4.3.1.6 Reduced number of plastic material types
 - O 4.3.1.7 Molded/glued in metal eliminated or removable
 - R 4.3.1.8 Minimum 65 percent reusable/recyclable
 - O 4.3.1.9 Minimum 90 percent reusable/recyclable
 - O 4.3.2.1 Manual separation of plastics
 - O 4.3.2.2 Marking of plastics
- 4.4 Product longevity/life cycle extension
 - R 4.4.1.1 Availability of additional three year warranty or service agreement
 - R 4.4.2.1 Upgradeable with common tools
 - O 4.4.2.2 Modular design

APPENDIX C – CONTINUED

- O 4.4.3.1 Availability of replacement parts
- 4.5 Energy conservation
 - R 4.5.1.1 ENERGY STAR®
 - O 4.5.1.2 Early adoption of new ENERGY STAR® specification
 - O 4.5.2.1 Renewable energy accessory available
 - O 4.5.2.2 Renewable energy accessory standard
- 4.6 End of life management
 - R 4.6.1.1 Provision of product take-back service
 - O 4.6.1.2 Auditing of recycling vendors
 - R 4.6.2.1 Provision of rechargeable battery take-back service
- 4.7 Corporate performance
 - R 4.7.1.1 Demonstration of corporate environmental policy consistent with ISO 14001
 - R 4.7.2.1 Self-certified environmental management system for design and manufacturing organizations
 - O 4.7.2.2 Third-party certified environmental management system for and manufacturing organizations
 - R 4.7.3.1 Corporate report consistent with Performance Track or GRI
 - O 4.7.3.2 Corporate report based on GRI
- 4.8 Packaging
 - R 4.8.1.1 Reduction/elimination of intentionally added toxics in packaging
 - R 4.8.2.1 Separable packing materials
 - O 4.8.2.2 Packaging 90% recyclable and plastics labeled
 - R 4.8.3.1 Declaration of recycled content in packaging
 - O 4.8.3.2 Minimum postconsumer content guidelines
 - O 4.8.4.1 Provision of take-back program for packaging
 - O 4.8.5.1 Documentation of reusable packaging

Source: <http://www.epeat.net/Criteria.aspx>

APPENDIX C – RECYCLED COMPUTER MATERIALS

Material/Component	Process	Result	Process Location
Leaded Glass	Hand Dismantle / Crushed / Smelted	Metal Recovery	Canada
Glass	Grind	Material Recovery	Canada
Plastic	Regrind / Smelted	Plastic / Energy Recovery	Canada
Plastic	Bailed / Ground	Plastic Commodity	US
Metal (non-ferrous)	Ground / Smelted	Metal Recovery	Canada / US
Metal (ferrous)	Ground / Smelted	Metal Recovery	Canada / US
Other Metals (Brass, Bronze & Fine particles)	Smelter	Metal Recovery	Canada
Cables and Wires	Regrind	Metal Recovery	Canada
High Grade Printed Wire Boards (Circuit Boards)	Smelted	Metal Recovery	Canada / Belgium
Low Grade Printed Wire Boards (Circuit Boards)	Smelted	Metal Recovery	Canada / Belgium
Mercury Bulb	Distilled	Mercury	US
Mercury Bulb	Distilled	Phosphorus Recovery (Powder Reuse)	US
Batteries (non rechargeable)	Smelted	Metal Recovery	Canada
Batteries (rechargeable)	Smelted	Metal Recovery (Lithium, Nickel, Cadmium)	Canada / US

Source: <http://www.encorp.ca/cfm/index.cfm?It=939&Id=12&Se=40>

APPENDIX D – ENVIRONMENT HANDLING FEES OF ELECTRONICS

Product Definition	New EHF (Effective Aug 1, 2009)	Old EHF	Products Included	Products Not Included	
Desktop Computers	Includes Central Processing Units (CPUs), mouse, keyboards, cables and other components within the computer. This includes desktop computers, desktop computers acting as servers, and all associated keyboards, mice and cabling.	CPU: \$5.50	\$10	Standalone: <ul style="list-style-type: none"> • Computer terminals • Thin Client • Desktop computers used as Servers 	<ul style="list-style-type: none"> • Non-standalone computer terminals that are embedded into non-regulated products • Uninterruptible Power Supply
Portable Computers	Includes portable computers such as notebook, laptop and tablet PCs.	Portable computer: \$1.20	Notebook Computers: \$5	Standalone: <ul style="list-style-type: none"> • Laptop computer • Notebook computer • Tablet computer 	<ul style="list-style-type: none"> • PDAs • Other handheld computing devices
Display Devices 29" and Smaller	Display devices include flat panel and tube technologies (CRT, Plasma, LCD, flat panel, rear projection, etc.) used for televisions, computer monitors and professional displays.	Display Devices 29" and smaller: \$9	<ul style="list-style-type: none"> • TV < 18": \$15 • TV 19 - 29": \$25 • Monitors: \$12 	Standalone: <ul style="list-style-type: none"> • TVs • Combination PC/TV displays • Computer monitors • Video displays with or without TV tuner • Professional displays • Closed circuit monitor screens 	<ul style="list-style-type: none"> • Non-standalone displays that are embedded into non-regulated products • Refrigerator with built in TV

APPENDIX D – CONTINUED

Display Devices 30" and Larger

Display devices include flat panel and tube technologies (CRT, Plasma, LCD, flat panel, rear projection, etc.) used for televisions, computer monitors and professional displays.

Display Devices 30" and larger: \$31.75

- TV 30 - 45": \$30
- TV > 46": \$45

Standalone:

- TVs
- Combination PC/TV displays
- Computer monitors
- Video displays with or without TV tuner
- Professional displays
- Closed circuit monitor screens

- Non-standalone displays that are embedded into non-regulated products
- Refrigerator with built in TV

Desktop Printers

This includes printing devices that are designed to reside on a work surface, and includes various printing technologies, including Laser & LED (electrophotographic), ink jet, dot matrix, thermal, dye sublimation, etc. and "multi-function" or "all in one" devices that perform different tasks such as copy, scan, fax, print, etc.

Desktop Printer: \$6.50

\$8

Standalone:

- Desktop printers
- Portable or PC-free photo printer
- Camera dock printers
- Desktop label, barcode, card printers
- Desktop fax machines

- Floor standing printers
- Point of sale (POS) receipt printers
- Handheld printers such as calculators with printing capability or label-makers
- Non-standalone printers that are embedded into non-regulated products

Source: <http://www.encorp.ca/cfm/index.cfm?It=939&Id=7&Se=40>