Environmental Benefits of 2008 EPEAT Purchasing

Green IT Procurement System's Success Drives Major Environmental Benefits

GREEN ELECTRONICS COUNCIL

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EXECUTIVE SUMMARY

Information technology has enabled significant improvements in the standard of living of much of the developed world, and through its contributions to greater transport efficiency, improved design, reduced materials consumption and other shifts in current practices, may offer a key to long term sustainability. However, the production, purchase, use and disposal of electronic products such as personal computers and monitors also can have significant negative environmental impacts.

The EPEAT (Electronic Product Environmental Assessment Tool) system for greener electronics purchasing addresses many of these issues with a lifecycle environmental standard that spurs improvements in product design and enables purchasers to directly reduce the lifecycle impacts of their product choices. This is the third annual report on the environmental benefits resulting from the purchase of electronic products registered and evaluated under the EPEAT program

The EPEAT System

The EPEAT program was launched in July 2006 to help purchasers identify environmentally preferable electronic products — starting with personal computers (desktops, laptops) and monitors.

The EPEAT environmental performance criteria and registry system were developed through a multi-year, multi-stakeholder process supported by U.S. EPA that included participants from the public and private purchasing sectors, manufacturers, environmental advocates, recyclers, technology researchers and other interested parties. The system and its environmental performance criteria are embodied in an international standard of the Institute of Electrical and Electronic Engineers (the IEEE 1680 Family of Standards for Environmental Assessment of Electronic Products)

The development of EPEAT was prompted by demand for an easy-to-use evaluation tool to support the comparison and selection of electronic products based on environmental performance attributes. IT purchasers needed a simple way to assess products' environmental impacts, and electronics manufacturers in turn wanted consistent guidance to ensure their green design efforts met with success in the marketplace.

The EPEAT system — 51 environmental performance criteria, a registry where products meeting those criteria are listed, and a verification system for vetting product declarations — established a user-friendly system designed and guided by all stakeholders and accessible to purchasers and manufacturers of any size. As a result, EPEAT has revolutionized the electronic product sector, with significant manufacturer and purchaser participation and an extensive registry of products that meet the system's demanding criteria. (See Appendix A for more details on EPEAT, and Appendix B for Participating Manufacturers.)

Growth and influence of EPEAT

Over the past three years, purchasers' adoption of EPEAT contract specifications has grown steadily. (See www.epeat.net/RFP.aspx for a sampling of purchasers using EPEAT.) International usage has spread rapidly, with purchasers in Asia, Latin America and European markets increasingly using EPEAT to identify green IT products. In August 2009, the EPEAT system rolled out to 38 countries in addition to the US and Canada, to meet international purchasers' demand for EPEAT registrations under local product numbers and with program support in geographies outside the US market. In addition, IEEE work group processes are underway to expand the universe of EPEAT products with new 1680 standards for imaging devices and televisions.

Increasing sales of EPEAT registered products reward participating manufacturers directly for their environmental design and service efforts. Because EPEAT establishes competition among manufacturers to meet higher rating levels, it also pushes innovation and environmental performance improvements forward. Some EPEAT criteria that were met by no products early in the program are now met by significant majorities of registered products (See Appendix D for details). And with more than 1200 base model products currently registered by more than 33 manufacturers, EPEAT has grown to be the most comprehensive and effective environmental purchasing tool available for IT hardware.

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Environmental Benefits of 2008 EPEAT Purchases

The rapid expansion of the EPEAT system is a clear indication of its value in the world of environmentally preferable purchasing. However, EPEAT's real value is measured by its benefits to the environment through energy savings, toxics elimination, materials reduction and other beneficial impacts. Following the creation of EPEAT, U.S. EPA supported the development of an EPEAT-related lifecycle environmental benefits calculator by the University of Tennessee Center for Clean Products. The calculator assesses environmental benefits from electronic product purchases based on specific EPEAT criteria and tiers. By entering information on unit sales of registered products provided by EPEAT subscribing manufacturers, it is possible to estimate the environmental benefits of overall EPEAT purchasing year by year.[i] Because the EPEAT system is in the process of shifting to an explicitly international registry, reporting on worldwide sales was somewhat complicated this year. Perhaps because of this new focus and transition process, voluntary reporting on sales outside the US, which had been robust in preceding years, fell to very low levels of participation in 2008.

With only 20-30% of EPEAT's manufacturer subscribers reporting on sales outside the US, the aggregate sales data reported this year cannot be viewed as representative. For this reason, this year's Environmental Benefits Report focuses primarily on US sales, since full reporting on US sales is obligatory under EPEAT's 2008 subscriber agreement. We anticipate being able to reliably report non-US sales and environmental benefits in future reports.

i For a detailed explanation of how the benefits reported here are assessed, please see the Methodology section and Appendix E..

2008 US Sales Benefits

Despite the economic downturn and generally flat computer sales in 2008, more than 44 million EPEAT-registered products were sold in the United States in 2008 — an increase of more than a million units over 2007, with a very significant — 57 percent — increase in sales in the notebook category paired with declines in both desktops and displays. The lifecycle environmental benefit of 2008 US sales of EPEAT products, compared to the purchase of conventional products, is huge.[ii] 2008 US purchases of EPEAT registered laptops, desktops, and monitors over conventional products will:

- Reduce use of toxic materials, including mercury, by 1021 metric tons, equivalent to the weight of 510,949 bricks
- Eliminate use of enough mercury to fill 149,685 household fever thermometers
- Avoid the disposal of 43 thousand metric tons of hazardous waste, equivalent to the weight of almost 22 million bricks.
- Eliminate 14,353 Metric Tons of solid waste, equivalent to what 7202 U.S. households generate in a year

In addition, due to EPEAT's requirement that registered products meet ENERGY STAR's energy efficiency specifications, these products will consume less energy throughout their useful life, resulting in:

- Savings of over 8.39 billion kWh of electricity — enough to power over 700,000 US homes for a year
- Reduction in use of 14.8 million metric tons of primary materials, equivalent to the weight of more than 114 million refrigerators
- Avoidance of 34.2 million metric tons of air emissions (including greenhouse gas emissions) and over 71,000 metric tons of water pollutant emissions
- Reduction of over 1.57 million metric tons of greenhouse gas emissions — equivalent to taking over one million US passenger cars off the road for a year

ii For a detailed explanation of how the benefits reported here are assessed, please see the Methodology section and Appendix E.

Remarkably, these benefits will not come at a cost premium — in fact, manufacturers and purchasers will actually save almost $794 million US dollars over the life of the EPEAT products sold in 2008, primarily from reductions in energy use throughout the product lifecycle.

In addition to these benefits, reported global sales demonstrate EPEAT's potential for reducing the environmental costs of computing worldwide. Despite only 27% of participating manufacturers reporting on their Canadian EPEAT sales and only 20% reporting on their Rest of World sales, the estimated benefit of EPEAT sales to these regions is still significant:

- Reduction of 2.8 million metric tons of primary materials
- Elimination of over a million kilograms of toxic materials, including enough mercury to fill 157,311 household fever thermometers
- 16,297 Metric Tons of solid waste eliminated
- Greenhouse gas emissions equivalent to removing 2.3 million US cars from the road for a year

Conclusion

The immense volume of EPEAT registered products sold in 2008, and the very significant environmental and financial benefits resulting, confirm the EPEAT system's success as a driver for environmental change in the electronic products market. Credit for these benefits goes to the many purchasers who are demanding EPEAT products, and to the manufacturers who are developing products and services to meet EPEAT's requirements and reduce environmental impact.

The year 2008 has seen robust continued growth in EPEAT product registrations. As more products are designed to meet the current EPEAT standard, as the current computer standard is updated, and as standards covering additional electronic products come on line these tangible benefits will continue to grow. Finally, EPEAT's expansion from a single registry to one that encompasses 40 countries will enable purchasers worldwide to buy more EPEAT registered products more easily, increasing the EPEAT system's impact over the coming years.

INTRODUCTION

The EPEAT program — 51 environmental performance criteria, a registry where products meeting those criteria are listed, and a verification system for vetting product declarations — identifies environmentally preferable electronic products — currently computer desktops, notebooks, workstations and monitors. The EPEAT system and criteria were developed through an extensive stakeholder consensus process supported by United States Environmental Protection Agency (EPA). The on-line product registry was launched in July 2006. The Green Electronics Council, a nonprofit group established in 2005 to partner with stakeholders to improve the environmental and social performance of electronic products, manages the EPEAT product registry and verification programs, and reports on the benefits of EPEAT product sales annually as a measure of the program's impact. This document, covering EPEAT sales during calendar year 2008, is the third annual EPEAT Environmental Benefits report.

Background

Information technology has enabled significant improvements in the standard of living of much of the developed world, and through its contributions to greater transport and energy efficiency, improved design, reduced materials consumption and other shifts in current practices, may offer a key to long term sustainability. However, the production, purchase, use and disposal of electronic products also have significant negative environmental impacts.

As with all products, these impacts occur at multiple stages of a product's life: extraction and refining of raw materials, manufacturing to turn raw materials into finished product, product use, including energy consumption and emissions, and end-of-life collection, transportation, and recycling/disposal. Since computers and other electronic products have supply chains and customer bases that span the globe, these environmental impacts are widely distributed in time and distance.

The EPEAT (Electronic Product Environmental Assessment Tool) program was launched in 2006 to help purchasers identify environmentally preferable electronic products. EPEAT's environmental performance criteria were developed through an open, consensus-based, multi-stakeholder process supported by U.S. EPA that included participants from the public and private purchasing sectors, manufacturers, environmental advocates, recyclers, technology researchers and other interested parties. Bringing these varied constituencies' needs and perspectives to bear on standard development enabled the resulting system not only to address significant environmental issues, but also to fit within the existing structures and practices of the marketplace — making it easy to use and thus widely adopted.

The EPEAT system offers purchasers a common measuring stick to assess products' lifecycle environmental impacts. The system also provides manufacturers with guidance for development of environmentally preferable products that will meet market demand. And it establishes competition among manufacturers to meet higher numbers of criteria and qualify products at higher levels, which pushes innovation and environmental excellence forward. (For a detailed overview of the EPEAT system, see Appendix A)

Environmentally Preferable Electronics Purchasing

While the environmental impacts of products are complex and often are distributed in space and time, from a user's perspective there are only a few high-leverage "decision points" that drive these impacts. Users can decide:

- What to buy
- How to use the product during its life
- How and when to dispose of the product when they are done with it.

The design of a product determines the materials used, and how they are assembled. These choices impact the supply chain, including extraction and processing, production and transportation. In addition, design affects, energy consumption during use, and the efficiency of end-of-life recovery.

But design does not occur in a vacuum — manufacturers design products to meet market demand. By specifying environmentally preferable products, purchasers can send a strong signal to manufacturers to design and manufacture greener products. When many purchasers use a centralized tool like EPEAT in lieu of individualized specifications, the aggregated demand for environmentally preferable attributes sets a clear direction and drives change effectively.

The EPEAT system encourages manufacturers to design their products to last longer, contain less hazardous material, to be more energy efficient, and easier to upgrade and recycle. These benefits are real improvements realized in offices and communities around the world over the life of these products. By buying EPEAT registered products, purchasers are keeping significant quantities of pollutants out of the world's air, water, and landfills, conserving resources, reducing greenhouse gas emissions and protecting public health from the impact of hazardous materials.

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Overall, EPEAT:

- Provides a credible assessment of electronic products based on agreed-upon criteria
- Evaluates products based on environmental performance throughout the life cycle
- Maintains a robust verification system to maintain the credibility of product declarations
- Helps to harmonize numerous international environmental requirements
- Promotes continuous improvement in the design of electronic products; and
- Leads to reduced impact on human and environmental health.

Growth of the EPEAT program

In the short time since its inception, EPEAT is transforming the marketplace for greener computer products. The program has seen a rapid growth in the number of registered products, a rising public awareness of pressing environmental issues with electronics and of the need for greener alternatives, and a burgeoning roster of private and public purchasers using EPEAT to green their IT purchases. Increasing interest among consumers has motivated EPEAT's gradual entry into the consumer market, as international demand has expanded the system's geographic reach. Such trends clearly show EPEAT's value in the world of green purchasing.

In its first three years, the EPEAT program has evolved from three participating manufacturers and 60 registered products to 33 manufacturers and more than 1200 registered products sold worldwide. The more than 44 million EPEAT-registered units sold in the US in 2008 surpass the entire worldwide sales volume of EPEAT registered products in 2006.

Demand from international users for an EPEAT registry that will make it easier to use the system outside the North American market has resulted in the implementation and imminent launch of a country-specific registry that will provide product declarations for 40 countries worldwide using local model names and numbers. This expanded registry will enable ever-easier product selection by purchasers worldwide.

Additional standards — for Imaging Devices (printers, fax machines, copiers) and Televisions — are in development through the Institute of Electrical and Electronic Engineers (IEEE) stakeholder Standards Development Working Group process, and should come on line in late 2010 or early 2011 — further expanding EPEAT's impact. (For information on the standards workgroups, including how to participate, see www.epeat.net/StandardsDevelopment.aspx)

EPEAT Use

In addition to these standards and country expansion processes, large numbers of public and private purchasers, as well as individual consumers, continue to turn to EPEAT to help meet their environmental goals:

- **US Federal government agencies** — As of January 2008 EPEAT is a required US federal government purchasing criterion embedded in Section 23.705 of the Federal Acquisition Regulation. This year's reporting showed 13 of 22 Federal agencies already meeting the 95% or higher EPEAT purchase requirement, with others close behind.
- **Other National Governments**: Canada, New Zealand, Thailand and Singapore
- **States and Provinces**, including California, Maine, Massachusetts, Minas Gerais (Brazil), Minnesota, New York, Nova Scotia, Ontario, Oregon, Pennsylvania, Quebec and Wisconsin, as well as the Western States Contracting Association (WSCA)
- **Cities** such as San Francisco, Portland, OR, San Jose, Phoenix, Seattle, Keene, NH, Culver City, CA, Vancouver BC and Los Angeles County
- **Enterprise Purchasers** such as the HDR architecture firm, health care nonprofit Kaiser Permanente, hospitality giant Marriott International, international consulting firm Deloitte, Fortune 500 health services company McKesson, and healthcare Group Purchasing Organization Premier Health Alliance.
- **Educational Institutions** such as Cornell, Penn State University, Yale, and the University of California system, as well as growing numbers of K-12 school districts in the US and Canada

Leading Resellers and Distributors have also joined with EPEAT to integrate EPEAT ratings information and educational outreach into the IT Channel to help their customers access EPEAT information they need to meet organizational requirements for EPEAT or simply to 'green' their purchasing. (See Appendix C for participants in EPEAT's growing Partner programs.)

2008 Sales reporting and Benefits Analysis

Manufacturers who participate in EPEAT must annually report on their sales of all EPEAT qualified products. In the current system, reporting on US sales is mandatory, while reporting on sales in Canada and Rest of World is voluntary.

As the EPEAT system is shifting to a broader country-specific registry, reporting on worldwide sales was somewhat complicated this year. Subscribing manufacturers were actively registering products in the 38 new countries added to the EPEAT registry, and establishing the services and verification systems needed to provide support for their declarations in every country where EPEAT will be active. However, perhaps because of this new focus and transition process, voluntary reporting on 2008 sales outside the US, which had been robust the preceding year, fell to very low levels of participation.

With only 20-30% percent of EPEAT's manufacturer subscribers reporting on sales outside the US, the aggregate sales data reported cannot be viewed as representative. For this reason, this year's Environmental Benefits Report focuses primarily on US sales alone, since full reporting on US sales is obligatory under EPEAT's subscriber agreement, which ensures robust data. We have provided a review of the benefits of the reported worldwide non-US purchasing below, but it must be understood to reflect only a fraction of total sales and thus to significantly underestimate the environmental benefits of worldwide EPEAT sales.

Overall Environmental Benefits

The annual EPEAT Environmental Benefits Report is intended to answer the basic question whether growth in EPEAT product registration and increases in purchasers specifying and buying greener electronic products through use of EPEAT have moved the market towards environmentally preferable alternatives and had a beneficial environmental impact. The answer this year, as last, is a resounding "Yes!"

When purchasers specify and buy EPEAT registered laptops, desktops, and monitors rather than "conventional products," a host of environmental benefits accrue over the lifetime of those products. Using the Electronics Environmental Benefits Calculator, developed as a means to assess the benefits of purchasing EPEAT-registered products, we can estimate the total environmental benefits that can be directly attributed to the lifetime use of the EPEAT registered products purchased in the US in 2008.[iii]

These benefits accrue from all phases of the life of the products themselves. For instance, when a purchaser selects a computer containing less toxic materials, these substances will not be extracted through mining with potentially serious impacts, will not be used in manufacturing, potentially exposing workers to health hazards, and will not be released into the environment at the end of the product's life. Similarly, by buying a computer that, like all EPEAT registered products, is ENERGY STAR compliant, the user (and the environment) benefits from reduced power consumption over the life of the product, and that reduced energy consumption also lowers the upstream material inputs and emissions associated with power generation, as well as reducing costs. So, the reported benefits are the result of an informed purchase decision but are realized over time and in multiple places

The results reported in the first table below are based on evaluation of the environmental impacts resulting from sale of **44,047,352 EPEAT**-registered products in the United States in 2008 — including just under 10 million desktops and integrated systems, more than 18 million monitors and more than 16 million notebook computers.

We have also provided two tables showing the benefits from reported 2008 sales in Canada and the Rest of World — since these sales are significantly underreported with only 20% and 27% of participating manufacturers providing sales data for these geographies, we have not combined the benefits totals into a single figure this year.

iii For a detailed explanation of how the benefits reported here are assessed, please see the Methodology section and Appendix E

Estimated Environmental Benefits from 2008 US EPEAT Purchasing

	Reductions	Equivalents
Electricity	8.39 Billion kWh	Annual consumption of 701,329 US households
Primary Materials	14,8 million Metric Tons	Weight of 114,959,611 refrigerators
Greenhouse Gas Emissions	1.57 million Metric Tons Carbon Equivalent	Removing 1,059,363 US cars from the road for a year
Air Emissions	34,224,122 metric tons	
Water Emissions	71,683 Metric Tons	
Toxic Materials	1021 Metric Tons	The weight of 510,949 bricks and the amount of mercury in 149,685 household fever thermometers
Solid Waste	14353 Metric Tons	Equivalent to the waste generated annually by 7202 U.S. households.
Hazardous Waste	43,337 Metric Tons	Weight of 61,831,455 bricks
Cost Savings to manufacturers and end users		**$793,826,980.52**

Estimated Environmental Benefits from Reported 2008 Canada Sales

27% of EPEAT Subscribers Reporting

	Reductions	Equivalents
Electricity	555,135,711 kWh	46403 US Households for a year
Primary Materials	982,198 Metric Tons	The weight of 7614743 refrigerators
Greenhouse Gas Emissions	104,470 Metric Tons	Removing 70165 US passenger cars for a year
Air Emissions	2,266,986 Metric Tons	
Water Emissions	4,747 Metric Tons	
Toxic Materials	63, Metric Tons	The weight of 31,902 bricks, including enough mercury to fill 8624 fever thermometers
Solid Waste	854 Metric Tons	Equivalent to the waste generated by 431 households in a year
Hazardous Waste	2580 Metric Tons	The weight of 1,294,545 bricks
Cost Savings to manufacturers and end users		**$793,826,980.52**

Estimated Environmental Benefits from Reported 2008 Rest of World Sales

20% of EPEAT Subscribers Reporting

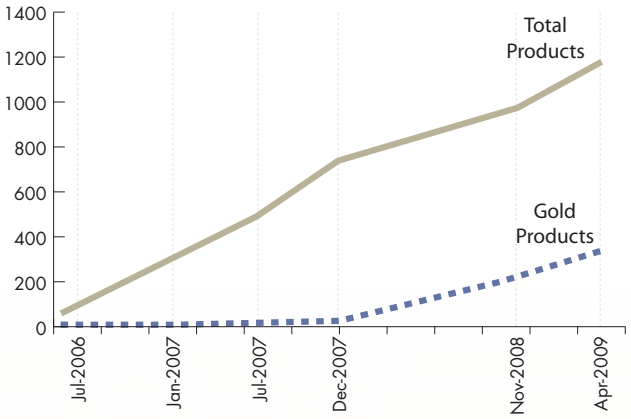
	Reductions	Equivalents
Electricity	10,043,166,761 kWh	83,9379 US households
Primary Materials	17,769,588 Metric tons	137,748,746 refrigerators
Greenhouse Gas Emissions	1,890,040 Metric Tons	Removing 1269258 US cars form the road for a year
Air Emissions	41,013,573 Metric Tons	
Water Emissions	85,892 Metric Tons	
Toxic Materials	1,143 Metric Tons	571773 bricks worth , including enough mercury to fill 148687 household fever thermometers
Solid Waste	15,442 Metric Tons	Equivalent to the waste generated by 7748 U.S. households in a year
Hazardous Waste	46,314 Metric Tons	Equivalent to the weight of 23,157,311 bricks
Cost Savings to manufacturers and end users		**$950,083,576**

Growth in EPEAT registration and participation

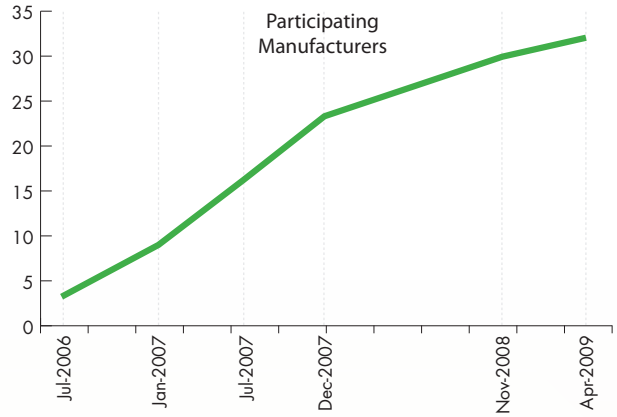
2008 witnessed significant growth in manufacturer participation and EPEAT product registrations, with very rapid growth in Gold product registrations.

In December 2007 EPEAT contained 735 total product registrations from 23 manufacturers, with 29 Gold rated products. By the close of 2008, there were 975 registered products in total, with 30 manufacturers participating, and 217 products registered at the Gold level. In April 2009 those numbers climbed to 1168 products, 32 manufacturers and 338 Gold products.

EPEAT Growth since Inception



Participating Manufacturers



Growth in EPEAT-registered Product Sales — United States

Total unit sales of EPEAT registered products continue to grow in 2008 despite the general economic and purchasing slowdown, with an increase of 1,187,636 in unit sales for the US alone.

Interestingly, EPEAT mirrored the overall trend in the PC market away from desktops in the direction of notebooks — with a 34% reduction in EPEAT registered desktop sales and a slight (2%) decrease in monitor sales counterbalanced by a remarkable 57% increase in sale of notebook products.

2007 to 2008 US Unit Sales of EPEAT Registered Products

Region	Desktops	Notebooks	Monitors	Integrated Systems	TOTAL
2007	12,403,405	10,375,874	18,883,816	1,196,621	42,859,716
2008	8,106,204	16,351,938	18,455,653	1,133,557	44,047,352

EPEAT Cumulative Benefits — United States

The 2008 US EPEAT Environmental Benefits figures show a slight decrease over those noted in our 2007 Environmental Benefits Report despite an overall increase in unit sales of EPEAT registered products. This decrease is largely due to the comparative enery efficiency of notebook computer — an inefficient notebook typically uses less power than an efficient desktop, so the energy and energy-related benefits — including cost savings — on a per product basis are somewhat reduced. Similarly, all notebooks contain less materials than desktop products, so material savings are proportionally smaller as well

Cumulatively, 101 million EPEAT registered products have been sold in the US since the system's debut in July 2006, and the benefits of US EPEAT purchasing have burgeoned over time — and will continue to be realized throughout the life of the products. The table below shows the benefits of these sales, year to year and cumulatively.

2006 to 2008 EPEAT US Sales Environmental Benefits

Benefit	2006	2007	2008	Cumulative Total
Electricity *(from ENERGY STAR)*	5.5 billion kWh	16.5 billion kWh	8.4 billion kWh	30.4 billion kWh
Primary materials	9.8 million MT	29.4 million MT	14.8 million MT	54.0 million MT
Air emissions *(from ENERGY STAR – includes GHG)*	22.0 million MT	68.0 million MT	34.2 million MT	124.2 million MT
Greenhouse gas emissions *(from ENERGY STAR)*	0.43 thousand MTCE	1.29 million MTCE	1.57 million MTCE	3.29 million MTCE
Water emissions (from ENERGY STAR)	47 thousand MT	142 thousand MT	71 thousand MT	260 thousand MT
Toxic materials used	404 MT	1,190 MT	1,020 MT	2,613 MT
Mercury eliminated	63,407 fever thermometers	198,613 fever thermometers	149,685. fever thermometers	411,705 mercury fever thermometers worth
Hazardous waste	15.6 thousand MT	46.7 thousand MT	43.3 thousand MT	105.6 thousand MT
Cost Savings	$477 million	$1.43 billion	$793 million	$2.67 billion

MT = Metric Tons

MTCE = Metric Tons Carbon Equivalent

METHODOLOGY

How EPEAT sales data is gathered and reported

As part of their annual agreement with EPEAT, manu¬facturers that register products in the system are required to report the US unit sales of their EPEAT registered products (notebook computers, desktop computers, integrated desktop systems, and computer monitors) to EPEAT through the Information Technology Industry Council (ITI), an industry trade association that acts as a data consolidator for this process. Subscribers are also encouraged to voluntarily report their Canadian and Rest of World sales; however this is not currently a legally binding part of their Subscriber commitments. The ITI preserves the confidentiality of each manufacturer's individual data, and forwards the aggregated sales data to the Green Electronics Council.

Manufacturers report total sales of their EPEAT-registered products – not only the sales to purchasers that required EPEAT, or the sales because of EPEAT. Though contract specifications and policies requiring EPEAT are increasingly common, and consumers have begun to use EPEAT registration as a criterion in their purchasing, many sales still occur without such intentional use of EPEAT. However the redesign of registered products and related services have environmental benefit, whether or not purchasers understood at the point of purchase that they were selecting environmentally preferable products.

As discussed above, reporting this year on Canada and Rest of World sales was not robust, so we have chosen to focus the 2008 benefits calculation primarily on US sales, with the understanding that the exclusion of sales outside the US means an underestimation of the environmental benefits by at least 50% and probably more. (Reported Canada/ROW sales totaled 46,895,321 units – with only 20 and 27% of manufacturers reporting for these geographic regions, respectively.) Next year, worldwide reporting will be required and we will once again be able to measure the full benefits of EPEAT global sales.

Electronics Environmental Benefits Calculator

The Electronics Environmental Benefits Calculator (EEBC) is a tool developed to support and evaluate pur¬chase of EPEAT and other environmentally preferable electronics, and to provide information on the benefits of different practices in the use and end-of-life phases of electronics products' lifecycle.. The tool was developed by the University of Tennessee Center for Clean Products with funding from the U.S. EPA, and was revised significantly in 2008-2009. The EEBC measures quantifiable benefits (such as green house gas reductions, waste avoided, pounds of mercury eliminated) of specific EPEAT (and other electronics) purchases over purchase of comparable conventional products.

The EEBC tool estimates environmental benefits for eight metrics:

- Energy savings
- Greenhouse gas reduction
- Solid waste reduction
- Primary material savings
- Hazardous waste reduction
- Toxic material reduction
- Air emissions
- Water emissions

The EEBC can be viewed and downloaded at http://isse.utk.edu/ccp/projects/benefitscalculator/elecbenecalc.html.

The EEBC's primary data input is the number and type of EPEAT registered products reported bought/sold. The tool calculates the environmental benefits resulting from the purchase of a specific number of EPEAT registered products, based on a comparison of EPEAT product attributes, such as material composition and energy consumption, to the average attributes of a composite conventional product.[iv]

iv For an explanation of how the "conventional product" model was developed, see the Calculator itself at Sheet #8a Assumptions — Baseline

The calculations variably include impacts from raw material extraction and processing, product manufacture, and product use and disposition, depending on the specific metric involved.[v] Data for greenhouse gas reduction, primary material savings, and air and water emissions may be proportionally greater than other metrics because they include inputs and outputs from all phases of product life, including those from upstream processes.

The EEBC explicitly outlines all the assumptions for EPEAT and "conventional" products so that users can review all data inputs. (See Appendix E for details.)

Report Assumptions

The environmental benefits detailed in this report were obtained by entering the total number of EPEAT registered products sold in the United States in 2008, as reported by subscribing manufacturers, into the EEBC by product category, with some specific choices:

- We assumed EPEAT Silver registration for all product types. Given the increasing percentage of Gold rated products, this assumption will be inadequate going forward; however we think that it offers a reasonable average for 2008, given the past year's product mix and the fact that most purchasers were specifying EPEAT Silver, or "Silver or higher" in current IT purchase contracts.
- Since we do not have sufficiently detailed information about the exact composition of the individual products purchased to apportion individual attributes accurately, we used the generic assumptions for the EPEAT Silver product tier.[vi]
- For the purposes of calculation, each Integrated System (e.g. a product where the CPU and Monitor are part of a single unit) was counted as one laptop. Given the small market share of integrated systems and the close similarity of these products to laptops we do not expect this to skew results significantly.
- Finally, although EPEAT includes a mandatory requirement for manufacturers to provide end-of-life takeback and recycling of all registered products, we do not have sufficient information about the actual end-of-life disposition of EPEAT-registered products to assess those benefits, or to evaluate how much the EPEAT requirement contributed to their end-of-life handling. Therefore we included no environmental benefits specifically related to the method of end of life management in the figures reported here.

2008 Calculator Revisions Impact

A full discussion of all revisions and corrections made to the EEBC in the revision process are documented in Appendix F of this document, and in the calculator tool itself. Because of the way that we use the EEBC — the Silver assumption, and the fact that we do not assume a specific end of life handling method in our calculations, most of the changes made to the calculator in this past year's revisions process do not significantly affect the comparability of the results from previous years and the 2008 figures. However there are a few changes in the newer version of the EEBC that impact this year's benefits reporting.

First: The calculator now measures the benefits of ENERGY STAR as a comparison between a product registered at the current ENERGY STAR 4.0 standard for computers and a product registered at the previous ENERGY STAR 3.0 standard, which became obsolete in 2007. All products registered in EPEAT at any time during 2008 were required to meet ES 4.0. Previously the comparison was between an ENERGY STAR 3.0 product vs. a non-ENERGY STAR product.

This change will tend to reduce the benefits calculated for the ENERGY STAR compliance requirement in EPEAT. These reductions may appear in the number of kilowatt hours saved, the air and water emissions and the greenhouse gas reductions calculated, as well as cost sav-

v The use of life cycle data in benefits calculations varies depending on the metric and EPEAT criterion. For a complete summary of benefits calculations, see Appendix E, and the EEBC tool itself at http://isse.utk.edu/ccp/projects/benefitscalculator/elecbenecalc.html

vi For the specific criteria assumptions for EPEAT Silver, see Appendix E and the EEBC tool itself at, http://isse.utk.edu/ccp/projects/benefitscalculator/elecbenecalc.html

ings figures. While this may give the appearance of lesser benefit from EPEAT, it is more accurate in relation to the market at large.

Second: The conversion factor for power to GHG emissions was increased to reflect an update of the underlying EPA data source. Calculations will as a rule reflect a higher rate of benefit in that category than with the previous version of the EEBC.

Finally, the revisions adjusted the assumptions about which specific criteria the different tiers of products could be expected to meet, based on an analysis of the current products in the registry. This resulted in a slightly higher level of benefit calculated for Silver products, based on the actual attributes of registered products.

Important Notes

The EEBC is an excellent tool and has been carefully reviewed by EPA and other independent scientists. However, like any lifecycle impact calculator, the EEBC tool employs methodological and data assumptions that are open to argument and to improvement. In addition, data culled from the EEBC can be interpreted in a wide variety of ways. We encourage readers to carefully review the methodology described here and in the EEBC itself in order to correctly interpret the results.

In addition, some of the significant environmental benefits resulting from individual EPEAT criteria (such as ease of product disassembly, corporate performance criteria, and providing a product take back option which may or may not be used by the purchaser) are not easily quantified and therefore are not addressed by the EEBC. Given these omissions, the real environmental benefits of the EPEAT system may actually be underestimated in our calculations. (See Appendix E for detailed explanation of which benefits (or metrics) are calculated for each criterion within the EEBC tool.)

Finally, three main points provide general context for the environmental benefits reported here:

As noted earlier, manufacturers report their total sales of EPEAT-registered products – not only the sales to purchasers that required EPEAT. In addition, because stakeholders wanted to reduce duplicative effort and streamline environmental reporting, many of EPEAT's environmental criteria are also requirements of other programs or regulatory schemes, including ENERGY STAR and the EU's RoHS and WEEE regulations. Therefore the environmental benefits reported here cannot be characterized as resulting solely from EPEAT – though without EPEAT many of the benefits might not have been realized in geographies not covered by specific regulatory or labeling schemes.

EPEAT's role is as a channel to aggregate purchaser demand for environmentally preferable products, not as a creator of those products in itself. Credit for the development of products that meet EPEAT's environmental performance criteria lies with researchers who have developed enabling technologies, with environmental advocates and purchasers who have demanded more environmentally responsible products, and with manufacturers who have designed and manufactured greener products.

The environmental benefits reported here come from the purchase of EPEAT registered products. That said, the benefits accrue from all phases of the life of the products themselves. So, the reported benefits are the result of an informed purchase decision, yet may be realized over time and in multiple places. Many other benefits may accrue if purchasers take advantage of management options such as unified power management software, virtualization, refurbishment and resale or donation programs, and responsible recycling. Such activities, however, are not assessed in this report. EPEAT brings many strands of innovation and environmental improvement together into a single tool that is easily used and that clearly lays out an overall scheme for product and service design — that is the system's value in the marketplace and its role in motivating the environmental benefits enumerated in this report.

CONCLUSION

Numerous factors have contributed, and will continue to contribute, to EPEAT's rapid expansion and uptake as a preeminent environmental purchasing standard.

The EPEAT system's standards development model — open, life-cycle focused, based on stakeholder knowledge, consensus and global best practice, and subject to continual updates — offers electronics purchasers the opportunity to use a single standard worldwide to address all lifecycle phases, and the assurance that that standard will address crucial impacts and grow increasingly stringent over time.

The transparency of the registry itself — with a full searchable database of all registrations, including optional attributes met and date of registration — and open reporting of any deviations from or failures to conform with the criteria claimed for a product through regular verification processes — allows users to both find the products they need and be confident that the registry and participating companies are policed for accuracy and honesty.

Because EPEAT was developed by and is managed in consultation with stakeholders, it simply works well for them. Purchasers find it a simple and accessible system which they can use to adjust existing contracts or develop new ones. Manufacturers are able to register compliant products with no delay in time to market, and to know that the system will provide access to significant contracting opportunities to reward their environmental efforts. Resellers and retailers are able to access the product registry data to identify EPEAT registered products by tier on their web portals and other materials — making it easy for customers to access the information at point of purchase.

As EPEAT expands to new product categories and moves increasingly into the consumer market, all of these strengths will ensure its continued success, and an ongoing growth in the environmental benefits that result

APPENDIX A: EPEAT DETAILS

The Electronic Product Environmental Assessment Tool is a system for identifying environmentally preferable personal computers and monitors.

Development

EPEAT was developed over three years by a large group of stakeholders including environmental advocacy organizations, institutional purchasers, electronics manufacturers, the U.S. EPA and other government officials, electronics recyclers, researchers, and others, in a process supported by the US EPA and facilitated by an independent non-profit organization. The draft EPEAT criteria and system developed by this working group were balloted, revised and accepted by the Institute of Electrical and Electronic Engineers (IEEE) through an ANSI-accredited process, becoming IEEE Public Standard 1680 for the Environmental Assessment of Personal Computer Products.

Registered products

EPEAT registered products are high-performance business-class computers that cost no more on the whole than comparable products that do not meet EPEAT's criteria. Compared to traditional computer equipment, however, all EPEAT registered computers have reduced levels of cadmium, lead, and mercury to better protect human health and the environment. They are more energy efficient (meeting ENERGY STAR specifications), which reduces power consumption and related emissions of global warming gases, and they are also easier to upgrade and recycle.

Environmental Criteria

The EPEAT program compares computer desktops, laptops, and monitors based on 51 environmental criteria across eight performance categories:

- Reduction/elimination of environmentally sensitive materials;
- Materials selection;
- Design for end of life;
- Product longevity/life cycle extension;
- Energy conservation;
- End of life management;
- Corporate performance; and
- Packaging.

Based on the IEEE 1680 Standard, all EPEAT registered products must meet a minimum of 23 environmental performance criteria, placing them at the "Bronze" level. Required criteria include compliance with the current applicable ENERGY STAR standard, compliance with the EU's RoHS Directive (which requires reduction or elimination of 4 toxic heavy metals and two classes of brominated flame retardants) and provision of a takeback and recycling program for the product by the manufacturer.

Ratings Tiers

An additional 28 optional criteria across the environmental performance categories are used to determine whether products earn higher level EPEAT Silver or Gold recognition. Manufacturers select among the optional criteria to achieve higher EPEAT ratings, as follows:

- **Bronze** – product meets all 23 required criteria.
- **Silver** – product meets all required criteria plus at least 50% of the optional criteria.
- **Gold** – product meets all required criteria plus at least 75% of the optional criteria.

Financial Support

The Green Electronics Council's EPEAT management activities include maintenance of the website and registry, EPEAT promotion through direct assistance to purchasers and media outreach, verification program management, support of EPEAT's Board of Advisors (a stakeholder group that guides the system's operations and development), and responding to all inquiries by purchasers, manufacturers, government agencies and other interested parties. EPEAT received start-up funding from the US EPA but on an on-going basis is supported entirely by annual fees paid by participating manufacturers to register their qualified products in the EPEAT system. The fee is independent of the number of products registered, for two reasons: 1) to eliminate direct linkage between numbers of products registered and system income, avoiding the potential conflict of interest where program income depends on maintaining and increasing numbers of registered products; and 2) to promote the registration of as many conforming products as possible, since the direct cost per product to manufacturers is reduced with every additional registration.

Verification

Similar to ENERGY STAR, EPEAT is based on self-declaration by manufacturers that their products meet the criteria of the IEEE 1680 Standard, combined with regular audits of the registry to assure the accuracy of declarations. The EPEAT approach requires active and tough auditing of the registered product set both on a random and on a "for cause" basis, with public disclosure of the verification results, to assure that the Registry is accurate. There is no advance warning of verification — manufacturers must be able to provide verification information at any time it is requested. EPEAT's verification system is designed to include multiple levels of scrutiny of manufacturer declarations, including strategic investigation of especially difficult-to-meet criteria across the entire registered product set, individual verification of criteria declarations that appear questionable, and regular rounds of verification addressing selected subsets of the criteria. Verifications are of two types — those based on evidence provided by the manufacturer and/or their suppliers, and those based on examination of the product.

For much more detail on EPEAT including sample contract language, media coverage, manufacturer and purchaser lists, detailed criteria and more, visit **www.epeat.net**.

APPENDIX B: EPEAT PARTICIPATING MANUFACTURERS

Epeat Participating Manufacturers July 10, 2009	
ACE COMPUTERS	HYUNDAI IT AMERICA CORP.
ACER INC.	LENOVO
APPLE INC.	LG ELECTRONICS USA, INC.
ARQUIMEDES AUTOMACAO E INFORMATICA LTDA	MDG COMPUTERS CANADA INC.
ASUSTEK COMPUTER INC.	MMD TAIWAN LTD.
CIARA-TECH	NCS TECHNOLOGIES, INC.
CORPORATIVO LANIX, S.A. DE C.V	NEC DISPLAY SOLUTIONS, INC.
CTL CORPORATION	NORTHERN MICRO INC.
DELL, INC.	PANASONIC
EIZO NANAO CORPORATION	POSITIVO INFORMÁTICA S.A.
FUJITSU LIMITED	SAMSUNG ELECTRONICS AMERICA
FUJITSU TECHNOLOGY SOLUTIONS GMBH	SONY ELECTRONICS INC.
GAMMATECH COMPUTER CORPORATION	TOSHIBA
GETAC	TPV TECHNOLOGY LIMITED
HEWLETT-PACKARD	TRANSOURCE
HOWARD TECHNOLOGY SOLUTIONS, A DIVISION OF HOWARD	VIEWSONIC CORPORATION

APPENDIX C: EPEAT PARTNERS

EPEAT Reseller Partners

EPEAT Reseller Partners

APPENDIX D: CRITERIA LIST WITH OPTIONAL CRITERIA COMPLIANCE

Required Criteria — met by all products registered in EPEAT	
4.1 Reduction/elimination of environmentally sensitive materials	
R 4.1.1.1	Compliance with provisions of European RoHS Directive upon its effective date
R 4.1.3.1	Reporting on amount of mercury used in light sources (mg)
R 4.1.6.1	Elimination of intentionally added SCCP flame retardants and plasticizers in certain applications
4.2 Materials selection	
R 4.2.1.1	Declaration of postconsumer recycled plastic content (%)
R 4.2.2.1	Declaration of renewable/bio-based plastic materials content (%)
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
R 4.3.1.8	Minimum 65 percent reusable/recyclable
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
4.5 Energy conservation	
R 4.5.1.1	ENERGY STAR®
R 4.5.1.1	ENERGY STAR®
4.6 End of life management	
R 4.6.1.1	Provision of product take-back service
R 4.6.2.1	Provision of rechargeable battery take-back service
4.7 Corporate performance	

Required Criteria — met by all products registered in EPEAT	
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
R 4.7.3.1	Corporate report consistent with Performance Track or 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
R 4.8.3.1	Declaration of recycled content in packaging

EPEAT Optional Criteria Compliance Out of 1258 total active products		July 14, 2009
NOTE : Not all criteria apply to all products (e.g. for products without batteries, criteria 4.1.7.1 does not apply)		
4.1 Reduction/elimination of environmentally sensitive materials		
O 4.1.2.1	Elimination of intentionally added cadmium	989
O 4.1.3.2	Low threshold for amount of mercury used in light sources	958
O 4.1.3.3	Elimination of intentionally added mercury used in light sources	253
O 4.1.4.1	Elimination of intentionally added lead in certain applications	607
O 4.1.5.1	Elimination of intentionally added hexavalent chromium	1078
O 4.1.6.2	Large plastic parts free of certain flame retardants classified under European Council Directive 67/548/EEC	1210
O 4.1.7.1	Batteries free of lead, cadmium and mercury	764
O 4.1.8.1	Large plastic parts free of PVC	1235
4.2 Materials selection		
O 4.2.1.2	Minimum content of postconsumer recycled plastic	80
O 4.2.1.3	Higher content of postconsumer recycled plastic	45
O 4.2.2.2	Minimum content of renewable/bio-based plastic material	2

EPEAT Optional Criteria Compliance Out of 1258 total active products		July 14, 2009
4.3 Design for end of life		
O 4.3.1.6	Reduced number of plastic material types	1199
O 4.3.1.7	Molded/glued in metal eliminated or removable	1232
O 4.3.1.9	Minimum 90 percent reusable/recyclable	1139
O 4.3.2.1	Manual separation of plastics	1224
O 4.3.2.2	Marking of plastics	1243
4.4 Product longevity/life cycle extension		
O 4.4.2.2	Modular design	708
O 4.4.3.1	Availability of replacement parts	1131
4.5 Energy conservation		
O 4.5.1.2	Early adoption of new ENERGY STAR® specification	((227))
O 4.5.2.1	Renewable energy accessory available	480
O 4.5.2.2	Renewable energy accessory standard	3
4.6 End of life management		
O 4.6.1.2	Auditing of recycling vendors	940
4.7	Corporate performance	
O 4.7.2.2	Third-party certified environmental management system for design and manufacturing organizations	1202
O 4.7.3.2	Corporate report based on GRI	1130
4.8 Packaging		
O 4.8.2.2	Packaging 90% recyclable and plastics labeled	1223
O 4.8.3.2	Minimum postconsumer content guidelines	797
O 4.8.4.1	Provision of take-back program for packaging	471
O 4.8.5.1	Documentation of reusable packaging	136

APPENDIX E: EEBC BASELINE PRODUCT ASSUMPTIONS

Note: The data below are for a pre-EPEAT baseline product (i.e., a standard product available on the market circa 2006 that does not meet criteria established under EPEAT, e.g., non-RoHS and non-ENERGY STAR compliant). These data also include all components typically shipped as part of or with the computer unit. For example, all product data includes cables; and a computer processing unit includes a keyboard. For mobile phones, the reuse and recycling assumptions do not include the charger.

	Ref	Criteria/ attribute	Quantity	Units	Reference	Notes
Computer Processing Unit (CPU)	BASELINE PRODUCT ASSUMPTIONS FOR EPEAT CRITERIA					
	Reduced Toxicity					
	E 4.1.1.1	Average lead content per unit	47.3	g	Brady et al., 2003; Socolof et al., 2001a.	Assumes printed wire boards and cable contain most of lead in unit. Calculated based on Brady et al., 2003, data (for a computer system) minus lead content of CRT monitor (Socolof, 2001a) and calculated CRT lead content without glass (see below).
	E 4.1.1.1	Average mercury content (not including lamps) per unit	0	g	Company published product environmental profiles and declarations for 13 products offered by 4 companies, dated April 1998 - Nov. 2005; Brady et al., 2003; Li, 2004	Only referenced source of mercury in personal computers is in backlights of LCD monitors and notebooks.
	E 4.1.3.2 & E 4.1.3.3 E 4.1.1.1	Average number of lamps per unit	n/a	unit		
		Average mercury content in lamps	n/a	g		
		Average cadmium content per unit	0	g	Company published product environmental profiles and declarations for 13 products offered by 4 companies, dated April 1998 - Nov. 2005; Brady et al., 2003; Li, 2004	
	E 4.1.1.1	Average hexavalent chromium content per unit	1.3	g	MCC, 1996; CIWMB, 2006.	Calculated using MCC composition data (for computer system) minus reported values for Cr+6 in CRTs from CIWMB manufacturer reported data. For MCC study, calculation assumes all chromium in desktop is Cr+6.
	E 4.1.1.1	Average PBB content per unit	0	g	Company published product environmental profiles and declarations for 13 products offered by 4 companies, dated April 1998- Nov. 2005.	In addition, PBB is no longer manufactured (AEAT, 2001; BSEF, 2000).
	E 4.1.1.1	Average PBDE content per unit	0	g	Company published product environmental profiles and declarations for 13 products offered by 4 companies, dated April 1998 - Nov. 2005; and extrapolated from Brominated Science and Environmental Forum, 2000.1	Includes octa and penta PBDEs; deca-PBDE is not included in baseline since it is exempt from RoHs and this criteria.

	Ref	Criteria/attribute	Quantity	Units	Reference	Notes
Computer Processing Unit (CPU)					Material Use	
	E 4.2.1.1 - E 4.2.1.3	Percent recycled content of plastic (resin) in product	0%		Assumption based on discussions and recommendations of FEC Plastics Task Force, 2003.	
		Average amount of plastic in product	1.21	kg	Atlantic Consulting and IPU, 1998.	Includes keyboard
		Average amount of recycled plastic (resin) content in product	0	kg		Calculated using % recycled content of plastic and average amount of plastic in product. See rows above.
	E 4.2.2.1 - E 4.2.2.2	Percent renewable/biobased material in product	0%			Assumption. Renewable/biobased currently not included in calculator version 2.0
		Average amount of molded plastic parts in product	1.21	kg	Atlantic Consulting and IPU, 1998.	Assumption: same as total plastic in product.
		Average amount of renewable/ biobased material in molded plastic in product	0	kg		Calculated using % renewable/biobased content of plastic and average amount of plastic in product. See rows above.
	E 4.8.3.1 & E 4.8.3.2	Percent recycled content of packaging, 1-corrugated	0%			This baseline value is assumed to be 0%, thus providing full credit for recycled content of packaging.
		Average amount of corrugated per unit package	2.49	kg	Atlantic Consulting and IPU, 1998.	Includes keyboard packaging.
		Average amount of recycled content of packaging, 1- corrugated	0	kg		Calculated using % recycled content and average amount of plastic in product. See rows above.
		Percent recycled content of packaging, 2-plastic/foam	0%			This baseline value is assumed to be 0%, thus providing full credit for recycled content of packaging.
		Average amount of plastic/foam per unit package	0.16	kg	Atlantic Consulting and IPU, 1998.	Includes keyboard packaging.
		Average amount recycled content of packaging, 2 - plastic/foam	0	kg		Calculated using % recycled content and average amount of plastic in product. See rows above.
		Percent recycled content of packaging, 3-other	0%			This baseline value is assumed to be 0%, thus providing full credit for recycled content of packaging.
		Average amount of other packaging per unit package	0	kg		Includes keyboard packaging
		Average amount of recycled content of packaging, 3- other	0	kg		Calculated using % recycled content and average amount of plastic in product. See rows above.

	Ref	Criteria/attribute	Quantity	Units	Reference	Notes
Computer Processing Unit (CPU)			Material Use (cont'd)			
	E 4.8.5.1	Packaging avoided per unit by packaging reuse	0	kg		This baseline value is assumed to be 0, thus providing full credit for packaging reuse.
		Average amount of packaging per product	2.65	kg	Atlantic Consulting and IPU, 1998.	Assumption: Equals amount of corrugated plus plastic. See rows above.
			Energy			
	E 4.5.1.1 - E 4.5.1.2	Annual unit energy consumption (UEC) with default enabling rate	507	kWh/y	EPA, 2006; Vokes and Sanchez, 2008.	This baseline value is an ENERGY STAR 3.0 qualified unit with enabling rate specified in sheet 8c.
		Annual unit energy consumption (UEC) with 0% enabling rate	541	kWh/y	EPA, 2006; Vokes and Sanchez, 2008.	
		BASELINE ASSUMPTIONS FOR USE AND END-OF-LIFE CALCULATIONS				
	O&M	Percentage of units with power management features enabled	8%		EPA, 2006.	See Sheet 8c for summary table for all products.
		Average lifetime of unit	49	months	FEC Pilot Partner Data, 2005; O'Brien, 2006.	This baseline value is for the initial user.
	EOL Mgt	Average weight of product	11.5	kg	U.S. EPA unpublished data based on (1) Florida Department of Environmental Protection. Brand sort database accessed 8/22/05. and (2) U.S. EPA. Municipal Solid Waste in The United States: 2003 Facts and Figures and previous years' editions of the same report.	Includes keyboard. EPA data for model years 2000 - 2004; average of 64 products. (Schneider, 2006)
		# of products reused	0	units	This baseline value is assumed to be 0, thus providing full credit for product reuse.	Includes keyboard. EPA data for model years 2000 - 2004; average of 64 products. (Schneider, 2006)
		# of products recycled	0	units	This baseline value is assumed to be 0, thus providing full credit for product recycling.	This baseline value is assumed to be 0, thus providing full credit for product reuse.
		Average hazardous material content in unit	1.636	kg	Sum of printed wire boards and insulation resin (plastic) on wire and cable. See rows below. Assumes printed wire boards and cables contain lead.	This baseline value is assumed to be 0, thus providing full credit for product recycling.
		Average weight of printed wire boards	1.273	kg	Li, 2004.	Sum of printed wire boards and insulation resin (plastic) on wire and cable. See rows below. Assumes printed wire boards and cables contain lead.
		Average weight of leaded glass	n/a	kg		

	Ref	Criteria/attribute	Quantity	Units	Reference	Notes
(CPU)	BASELINE ASSUMPTIONS FOR USE AND END-OF-LIFE CALCULATIONS (cont'd)					
	EOL Mgt (cont'd)	Average weight of cold cathode fluorescent lamps (CCFL)	n/a	kg		
		Average weight of resin (plastic) in wire and cable	0.363	kg	Calculated based on data in Brady et al., 2003 with the assumption that 40% of cable for desktop system is sold with the processing unit.	Assumes that resins (plastics) contain lead stabilizers.
CRT Monitor	BASELINE PRODUCT ASSUMPTIONS FOR EPEAT CRITERIA					
	Reduced Toxicity					
	E 4.1.1.1	Average lead content per unit	30.7	g	Calculated based on the ratio of mass of CRT/LCD printed wire boards (Socolof et al., 2001b) applied to CIWMB (2006) manufacturer reported data.	Does not include CRT glass.
	E 4.1.1.1	Average mercury content (not including lamps) per unit	0	g	Brady et al., 2003; Socolof et al., 2001b.	Only referenced source of mercury in personal computers is in backlights of LCD monitors and notebooks.
	E 4.1.3.2 & E 4.1.3.3	Average number of lamps per unit	n/a	unit		
		Average mercury content in lamps	n/a	g		
	E 4.1.1.1	Average cadmium content per unit	0.059	g	CIWMB, 2006.	
	E 4.1.1.1	Average hexavalent chromium content per unit	0.139	g	CIWMB, 2006.	
	E 4.1.1.1	Average PBB content per unit	0	g	CIWMB, 2006.	No intentionally added PBB; small amount from recycled content materials.
	E 4.1.1.1	Average PBDE content per unit	0	g	Extrapolated from Brominate Science and Environmental Forum, 2000.1	Includes octa and penta PBDEs; deca-PBDE is not included in baseline since it is exempt from RoHs and this criteria.
	Material Use					
	E 4.2.1.1 - E 4.2.1.3	Percent recycled content of plastic (resin) in product	0%		Assumption based on discussions and recommendations of FEC Plastics Task Force, 2003.	
		Average amount of plastic in product	2.2	kg	Socolof et al., 2001a.	
		Average amount of recycled plastic (resin) content in product	0	kg		Calculated using % recycled content of plastic and average amount of plastic in product. See rows above.

	Ref	Criteria/attribute	Quantity	Units	Reference	Notes
CRT Monitor	Material Use (cont'd)					
	E 4.2.2.1 - E 4.2.2.2	Percent renewable/biobased material in product	0%			Assumption. Note: renewable/biobased currently not included in calculator version 2.0
		Average amount of molded plastic parts in product	2.2	kg	Socolof et al., 2001a.	Assumption: same as total plastic in product.
		Average amount of renewable/biobased material in molded plastic in product	0	kg		Calculated using % renewable/biobased content of plastic and average amount of plastic in product. See rows above.
	E 4.8.3.1 & E 4.8.3.2	Percent recycled content of packaging, 1-corrugated	0%			This baseline value is assumed to be 0%, thus providing full credit for recycled content of packaging.
	E 4.8.3.1 & E 4.8.3.2	Average amount of corrugated per unit package	2.05	kg	Company published environmental profiles and declarations. Average based on 2 products offered by 2 manufacturers.	
		Average amount of recycled content of packaging, 1- corrugated	0	kg		Calculated using % recycled content and average amount of plastic in product. See rows above.
		Percent recycled content of packaging, 2-plastic/foam	0%			This baseline value is assumed to be 0%, thus providing full credit for recycled content of packaging.
		Average amount of plastic/foam per unit package	0.7	kg	Company published environmental profiles and declarations. Average based on 2 products offered by 2 manufacturers.	
		Average amount recycled content of packaging, 2 - plastic/foam	0	kg		Calculated using % recycled content and average amount of plastic in product. See rows above.
		Percent recycled content of packaging, 3-other	0%			This baseline value is assumed to be 0%, thus providing full credit for recycled content of packaging.
		Average amount of other packaging per unit package	0.03	kg	Company published environmental profiles and declarations. Average based on 2 products offered by 2 manufacturers.	
		Average amount of recycled content of packaging, 3- other	0	kg		Calculated using % recycled content and average amount of plastic in product. See rows above.
	E 5.8.5.1	Packaging avoided per unit by packaging reuse	0	kg		This baseline value is assumed to be 0, thus providing full credit for packaging reuse.
		Average amount of packaging per product	2.78	kg		Assumption: Equals amount of corrugated plus plastic. See rows above.

	Ref	Criteria/attribute	Quantity	Units	Reference	Notes
CRT Monitor				Energy		
	E 4.5.1.1 - E 4.5.1.2	Annual unit energy consumption (UEC) with default enabling rate	174	kWh/y	EPA, 2006; Vokes and Sanchez, 2008.	This baseline value is an ENERGY STAR 3.0 qualified unit with enabling rate specified in sheet 8c.
		Annual unit energy consumption (UEC) with 0% enabling rate	485	kWh/y	EPA, 2006; Vokes and Sanchez, 2008.	
				BASELINE ASSUMPTIONS FOR USE AND END-OF-LIFE CALCULATIONS		
	O&M	Percentage of units with power management features enabled	77%		EPA, 2006; Vokes and Sanchez, 2008.	See Sheet 8c for summary table for all products.
		Average lifetime of unit	49	months	FEC Pilot Partner Data, 2005; O'Brien, 2006.	This baseline value is for the initial user.
	EOL Mgt	Average weight of product	23.2	kg	U.S. EPA unpublished data based on (1) Florida Department of Environmental Protection. Brand sort database accessed 8/22/05. and (2) U.S. EPA. Municipal Solid Waste in The United States: 2003 Facts and Figures and previous years' editions of the same report.	EPA data for model years 2000-2004; average weight of 12 products, with screen size ranging from 15" - 22". (Schneider, 2006.)
		# of products reused	0	units		This baseline value is assumed to be 0, thus providing full credit for product reuse.
		# of products recycled	0	units		This baseline value is assumed to be 0, thus providing full credit for product recycling.
		Average hazardous material content in unit	12.754	kg		Sum of printed wire boards and insulation resin (plastic) on wire and cable. See rows below. Assumes printed wire boards and cables contain lead.
		Average weight of printed wire boards	0.51	kg	Socolof et al., 2001b.	
		Average weight of leaded glass	11.7	kg	Monchamp et al, 2001.	Data for 17 inch monitor.
		Average weight of cold cathode fluorescent lamps (CCFL)	n/a	kg		
		Average weight of resin (plastic) in wire and cable	0.544	kg	Calculated based on data from Brady et al., 2003 with the assumption that 60% of cable for desktop system is to power and connect display unit.	Assumes that resins (plastics) contain lead stabilizers.

	Ref	Criteria/attribute	Quantity	Units	Reference	Notes
LCD Monitor	BASELINE PRODUCT ASSUMPTIONS FOR EPEAT CRITERIA					
	Reduced Toxicity					
	E 4.1.1.1	Average lead content per unit	25.2	g	CIWMB, 2006.	
	E 4.1.1.1	Average mercury content (not including lamps) per unit	0	g		Assumes no Hg in LCDs when lamps are excluded.
	E 4.1.3.2 & E 4.1.3.3	Average total mercury content in lamps	0.016	g	Product of average number of lamps per unit and average mercury content in lamps, as presented in the following two rows.	Total mercury per unit is consistent with CIWMB (2006) manufacturer reported data (average of .019 g of mercury/unit).
		Average number of lamps per unit	4	unit	Analysis of EPEAT Product Registry in May 2008.	Average of 52 products between 17 -26 inches registered in 2007-2008.
		Average mercury content in lamps	0.004	g	Socolof et al., 2001b.	3.0 mg of mercury is cited in AEAT, 2001, and 3.99 mg in Socolof, 2001b. The higher value was chosen after a review of the EPEAT product registry in 8/2006 found that only LCDs qualified for silver designation met the criteria for maximum average of 3.0 mg of mercury per lamp.
	E 4.1.1.1	Average cadmium content per unit	0.029	g	CIWMB, 2006.	
	E 4.1.1.1	Average hexavalent chromium content per unit	0.53	g	CIWMB, 2006.	
	E 4.1.1.1	Average PBB content per unit	0	g	CIWMB, 2006.	No intentionally added PBB; small amount from recycled content materials.
	E 4.1.1.1	Average PBDE content per unit	0	g	Extrapolated from Brominate Science and Environmental Forum, 2000.	Includes octa and penta PBDEs; deca-PBDE is not included in baseline since it is exempt from RoHs and this criteria.
	Material Use					
	E 4.2.1.1 - E 4.2.1.3	Percent recycled content of plastic (resin) in product	0%			Assumption based on discussions and recommendations of FEC Plastics Task Force, 2003.
		Average amount of plastic in product	2.0	kg	Socolof et al., 2001a.	Based on 15" monitor
		Average amount of recycled plastic (resin) content in product	0	kg		Calculated using % recycled content of plastic and average amount of plastic in product. See rows above.
	E 4.2.2.1 - E 4.2.2.2	Percent renewable/biobased material in product	0%			Assumption. Renewable/biobased currently not included in calculator version 2.0
		Average amount of molded plastic parts in product	2.0	kg	Socolof et al., 2001a.	Assumption: same as total plastic in product.

	Ref	Criteria/attribute	Quantity	Units	Reference	Notes
LCD Monitor			Material Use (cont'd)			
	E 4.2.2.1 - E 4.2.2.2 (cont'd)	Average amount of renewable/ biobased material in molded plastic in product	0	kg		Calculated using % renewable/biobased content of plastic and average amount of plastic in product. See rows above.
	E 4.8.3.1 & E 4.8.3.2	Percent recycled content of packaging, 1-corrugated	0%			This baseline value is assumed to be 0%, thus providing full credit for recycled content of packaging.
		Average amount of corrugated per unit package	1.046	kg	Company published environmental data sheets and declarations. Average of 5 products.	
		Average amount of recycled content of packaging, 1- corrugated	0	kg		Calculated using % recycled content and average amount of plastic in product. See rows above.
		Percent recycled content of packaging, 2-plastic/foam	0%			This baseline value is assumed to be 0%, thus providing full credit for recycled content of packaging.
		Average amount of plastic/foam per unit package	0.393	kg	Company published environmental data sheets and declarations. Average based on 5 products.	
		Average amount recycled content of packaging, 2 - plastic/foam	0	kg		Calculated using % recycled content and average amount of plastic in product. See rows above.
		Percent recycled content of packaging, 3-other	0%			This baseline value is assumed to be 0%, thus providing full credit for recycled content of packaging.
		Average amount of other packaging per unit package	0.048	kg	Company published environmental data sheets and declarations. Average based on 5 products.	
		Average amount of recycled content of packaging, 3- other	0	kg		Calculated using % recycled content and average amount of plastic in product. See rows above.
	E 5.8.5.1	Packaging avoided per unit by packaging reuse	0	kg		This baseline value is assumed to be 0, thus providing full credit for packaging reuse.
		Average amount of packaging per product	1.487	kg		Assumption: Equals amount of corrugated plus plastic. See rows above.
			Energy			
	E 4.5.1.1 - E 4.5.1.2	Annual unit energy consumption (UEC) with default enabling rate	107	kWh/y	EPA, 2006; Vokes and Sanchez, 2008.	This baseline value is an ENERGY STAR 3.0 qualified unit with enabling rate specified in sheet 8c.
		Annual unit energy consumption (UEC) with 0% enabling rate	314	kWh/y	EPA, 2006; Vokes and Sanchez, 2008.	

	Ref	Criteria/attribute	Quantity	Units	Reference	Notes
LCD Monitor	BASELINE ASSUMPTIONS FOR USE AND END-OF-LIFE CALCULATIONS					
	O&M	Percentage of units with power management features enabled	81%		EPA, 2006; Vokes and Sanchez, 2008.	See Sheet 8c for summary table for all products.
		Average lifetime of unit	49	months	FEC Pilot Partner Data, 2005; O'Brien, 2006.	This baseline value is for the initial user.
	EOL Mgt	Average weight of product	7.1	kg	U.S. EPA unpublished data based on (1) Florida Department of Environmental Protection. Brand sort database accessed 8/22/05. and (2) U.S. EPA. Municipal Solid Waste in The United States: 2003 Facts and Figures and previous years' editions of the same report.	EPA data for model years 2000-2004; average weight of 16 products, with screen size ranging from 15" - 24". (Schneider, 2006.)
		# of products reused	0	units		This baseline value is assumed to be 0, thus providing full credit for product reuse.
		# of products recycled	0	units		This baseline value is assumed to be 0, thus providing full credit for product recycling.
		Average hazardous material content in unit	0.98	kg		Sum of printed wire boards, CCFLs and resin (plastic) in wire and cable. See rows below. Assumes that printed wire boards and cable contains lead; CCFLs contain mercury.
		Average weight of printed wire boards	0.43	kg	Socolof et al., 2001b.	
		Average weight of leaded glass	n/a	kg		
		Average weight of cold cathode fluorescent lamps (CCFL)	0.006	kg	CA DTSC, 2004. Average weight of CCFLs in 7 LCD samples.	
		Average weight of resin (plastic) in wire and cable	0.544	kg	Calculated based on data from Brady et al., 2003 with the assumption that 60% of cable for desktop system is to power and connect display unit.	Assumes that resins (plastics) contain lead stabilizers.
Notebook Computer	BASELINE PRODUCT ASSUMPTIONS FOR EPEAT CRITERIA					
	Reduced Toxicity					
	E 4.1.1.1	Average lead content per unit	8.71	g	CIWMB, 2006.	
	E 4.1.1.1	Average mercury content (not including lamps) per unit	0	g		Assumes no Hg in LCDs when lamps are excluded.
	E 4.1.3.2 & E 4.1.3.3	Average total mercury content in lamps	0.004		Product of average number of lamps per unit and average mercury content in lamps, as presented in the following two rows.	Total mercury per unit is consistent with CIWMB (2006) manufacturer reported data (average of 6.25 mg/LCD).

	Ref	Criteria/attribute	Quantity	Units	Reference	Notes
Notebook Computer		Reduced Toxicity (cont'd)				
	E 4.1.3.2 & E 4.1.3.3 (cont'd)	Average number of lamps per unit	1	unit	Analysis of EPEAT Product Registry May 2008.	Average of 30 products between 7..5 to 15.4 inches registered in 2007-2008.
		Average mercury content per lamps	0.004	g	Socolof, 2001b.	3.0 mg of mercury is cited in AEAT, 2001, and 3.99 mg in Socolof, 2001b. The higher value was chosen after a review of the EPEAT product registry in 8/2006 found that only some LCDs qualified for silver designation met the criteria for maximum average of 3.0 mg of mercury per lamp.
	E 4.1.1.1	Average cadmium content per unit	0.001	g	CIWMB, 2006.	This is assumed not to include NiCd batteries. NiCad batteries haven't been used in these products for about 10 years. (Burkitt, 2006.)
	E 4.1.1.1	Average hexavalent chromium content per unit	0.008	g	CIWMB, 2006.	
	E 4.1.1.1	Average PBB content per unit	0	g		No intentionally added PBB; small amount from recycled content materials.
	E 4.1.1.1	Average PBDE content per unit	0	g	Extrapolated from Brominate Science and Environmental Forum, 2000.1	Includes octa and penta PBDEs; deca-PBDE is not included in baseline since it is exempt from RoHs and this criteria.
		Material Use				
	E 4.2.1.1 - E 4.2.1.3	Percent recycled content of plastic (resin) in product	0%			Assumption based on discussions and recommendations of FEC Plastics Task Force, 2003.
		Average amount of plastic in product	1.29	kg	Jang, Townsend and Yoon, 2006. Average of 15 laptops manufactured between 1993-1998.	
		Average amount of recycled plastic (resin) content in product	0	kg		Calculated using % recycled content of plastic and average amount of plastic in product. See rows above.
	E 4.2.2.1 - E 4.2.2.2	Percent renewable/biobased material in product	0%			Assumption. Renewable/biobased currently not included in calculator version 2.0
		Average amount of molded plastic parts in product	1.29	kg	Jang, Townsend and Yoon, 2006.	Assumption: same as total plastic in product.
		Average amount of renewable/ biobased material in molded plastic in product	0	kg		Calculated using % renewable/biobased content of plastic and average amount of plastic in product. See rows above.
	E 4.8.3.1 & E 4.8.3.2	Percent recycled content of packaging, 1-corrugated	0%			This baseline value is assumed to be 0%, thus providing full credit for recycled content of packaging.

	Ref	Criteria/attribute	Quantity	Units	Reference	Notes
Notebook Computer			Reduced Toxicity (cont'd)			
	E 4.8.3.1 & E 4.8.3.2 (cont'd)	Average amount of corrugated per unit package	1.025	kg	Company published environmental product data sheets and declarations. Average based on 4 products.	
		Average amount of recycled content of packaging, 1- corrugated	0	kg		Calculated using % recycled content and average amount of plastic in product. See rows above.
		Percent recycled content of packaging, 2-plastic/foam	0%			This baseline value is assumed to be 0%, thus providing full credit for recycled content of packaging.
		Average amount of plastic/foam per unit package	0.322	kg	Company published environmental product data sheets and declarations. Average based on 4 products.	
		Average amount recycled content of packaging, 2 - plastic/foam	0	kg		Calculated using % recycled content and average amount of plastic in product. See rows above.
		Percent recycled content of packaging, 3-other	0%			This baseline value is assumed to be 0%, thus providing full credit for recycled content of packaging.
		Average amount of other packaging per unit package	0	kg	Company published environmental product data sheets and declarations. Average based on 4 products.	Assumes 2 material types for notebook products.
		Average amount of recycled content of packaging, 3- other	0	kg		Calculated using % recycled content and average amount of plastic in product. See rows above.
	E 5.8.5.1	Packaging avoided per unit by packaging reuse	0	kg		This baseline value is assumed to be 0, thus providing full credit for packaging reuse.
		Average amount of packaging per product	1.347	kg		Assumption: Equals amount of corrugated plus plastic. See rows above.
			Energy			
	E 4.5.1.1 - E 4.5.1.2	Annual unit energy consumption (UEC) with default enabling rate	75	kWh/y	Vokes and Sanchez, 2008.	This baseline value is an ENERGY STAR 3.0 qualified unit with enabling rate specified in sheet 8c.
		Annual unit energy consumption (UEC) with 0% enabling rate	80	kWh/y	Vokes and Sanchez, 2008.	

	Ref	Criteria/attribute	Quantity	Units	Reference	Notes
Notebook Computer	BASELINE ASSUMPTIONS FOR USE AND END-OF-LIFE CALCULATIONS					
	O&M	Percentage of units with power management features enabled			Sanchez, 2006.	Not applicable as the baseline notebook computer is not part of ENERGY STAR's Office Equipment program and has not modal specifications that could be enabled. See Sheet 8c for summary table for all products.
		Average lifetime of unit	38	months	O'Brien, 2006.	This baseline value is for the initial user.
	EOL Mgt	Average weight of product	3.08	kg	U.S. EPA unpublished data based on (1) Florida Department of Environmental Protection. Brand sort database accessed 8/22/05. and (2) U.S. EPA. Municipal Solid Waste in The United States: 2003 Facts and Figures and previous years' editions of the same report.	Average of EPA data for model years 2000-2004; includes 55 products ranging in weight from 2.8 to 8.0 pounds (1.3 kg to 3.6 kg). (Schneider, 2006.)
		# of products reused	0	units		This baseline value is assumed to be 0, thus providing full credit for product reuse.
		# of products recycled	0	units		This baseline value is assumed to be 0, thus providing full credit for product recycling.
		Average hazardous material content in unit	0.693	kg		Sum of printed wire boards, CCFLs and resin (plastic) in wire and cable. See rows below. Assumes that printed wire boards and cable contain lead; CCFLs contain mercury.
		Average weight of printed wire boards	0.51	kg	Jang, Townsend and Yoon, 2006. Average of 15 laptops manufactured between 1993-1998.	
		Average weight of leaded glass	n/a	kg		
		Average weight of cold cathode fluorescent lamps (CCFL)	0.001	kg	CA DTSC, 2004. Average weight of CCFLs from 3 laptop samples.	
		Average weight of resin (plastic) in wire and cable	0.182	kg	Estimated based on data from Brady et al., 2003. Estimates that a notebook computer has 50% less cable than a CPU.	Assumes that resins (plastics) contain lead stabilizers.

	Ref	Criteria/attribute	Quantity	Units	Reference	Notes
Mobile Telephone	BASELINE ASSUMPTIONS FOR USE AND END-OF-LIFE CALCULATIONS					
	EOL Mgt	Average weight of product	0.136	kg	US EPA, unpublished data.	Based on retailer product specifications for 27 models from 2000 and 2006, ranging in weight from 1.4 – 13.9 ounces. Assumes mass of product includes handset with battery, and not charger or accessories.
		Average weight of battery	0.045	kg	MPPI, 2006a	Assumes battery is 1/3 of weight of mobile phone (MPPI, 2006a). The weight of the battery is subtracted from the mass of the phone for reuse calculations, since the battery is usually recycled rather than reused with the handset (MPPI, 2006a). Battery weight is also subtracted from the weight of the phone to calculate material composition of the phone (without the battery).
		# of products reused	0	units		This baseline value is assumed to be 0, thus providing full credit for product reuse.
		# of products recycled	0	units		This baseline value is assumed to be 0, thus providing full credit for product recycling.
		Average lead content per unit	0.64	g	Pb at 0.7% by weight, not including battery or accessories (Lindholm, 2003).	Update assumption in future as it's reported that most of the mobile phone manufacturers have phased out lead containing solder in mobile phones (Nokia, 2005).
		Average mercury content per unit	0	g	Nokia, 2005; MPPI, 2006b.	Currently no mercury in mobile phones. Mercury was used in fluorescent tubes to light displays in older phones.
		Average cadmium content per unit	0	g	Cadmium is not present in mobile phones at level greater that 0.1% by weight (Lindholm, 2003,) nor was cadmium detected by Townsend et al., 2004 or CA DTSC, 2004b.	Nickel cadmium batteries are no longer used in mobile phones, although may be found in older phones still in use (Nokia, 2005). As of 2000, Ni-Cad batteries were used in 15% of mobile phones (Fishbein, 2002.)
		Average hexavalent chromium content per unit	0.820	g	Cr at 0.9% by weight (Lindholm, 2003).	Assumes all Cr is Cr+6.
		Average PBB content per unit	0	g	PBBs have not been used in mobile phones (MPPI, 2006b).	TBBA used in PWB is most common brominated flame retardant in mobile phones (Nokia, 2005.)
		Average PBDE content per unit	0	g	PBDE was not listed as a constituent of mobile phones at a level greater than 0.1% by weight (Lindholm, 2003.)	

	Ref	Criteria/attribute	Quantity	Units	Reference	Notes
	BASELINE ASSUMPTIONS FOR USE AND END-OF-LIFE CALCULATIONS					
	EOL Mgt (cont'd)	Average hazardous material content in unit (total)	0.054	kg		Includes PWBs only; assumes PWBs contain lead.
Mobile Telephone		Average weight of printed wire boards	0.054	kg	Townsend et al., 2004.	PWBs are 40% of product mass. Assumes PWBs contain lead.
		Average weight of leaded glass	n/a	kg		
		Average weight of cold cathode fluorescent lamps (CCFL)	n/a	kg		
		Average weight of resin (plastic) in wire and cable	n/a	kg		
		Average weight of copper per mbl ph	0.013	kg	USGS, 2006.	
		Average weight of palladium per mbl ph	0.000	kg	USGS, 2006.	
		Average weight of silver per mbl ph	0.000	kg	USGS, 2006.	
		Average weight of gold per mbl ph	0.000	kg	USGS, 2006.	
		Average weight of precious metals per mbl ph	0.000	kg		Includes palladium, silver, and gold.
		Plastics	58.0%		Nokia, 2005.	
		Ferrous metals (steel)	3.0%		Nokia, 2005.	
		Copper and its compounds	15.0%		Nokia, 2005.	
		LCD Glass	11.0%		Lindholm, 2003.	
		Precious Metals	-			
		Other	13%		Nokia, 2005.	
		% material collected for recycling that is recycled	100%			Assumption
		% material collected for recycling that is reused	0%			Assumption

	Ref	Criteria/attribute	Quantity	Units	Reference	Notes
Mixed Office Electronics	BASELINE ASSUMPTIONS FOR USE AND END-OF-LIFE CALCULATIONS					
	EOL Mgmt	Product composition of mixed electronics destined for recycling:				Assumes that equipment is obsolete and destined for a demanufacturing facility, not an asset recovery operation.
		CRT Monitors	65%	by weight	UNICOR, 2008.	
		Desktop processors	6%	by weight	UNICOR, 2008.	
		Other office electronics	28%	by weight	UNICOR, 2008.	Includes LCDs, notebooks, printers, copiers, scanners, fax machines.
		Miscellaneous electronics	1%	by weight	UNICOR, 2008.	For example, VCRs, cell phones.
		Disposition of mixed electronics:				
		Percentage of equipment recycled	85%	by weight	UNICOR, 2008.	Includes material and energy recovery.
		Percentage of equipment/components reused	15%	by weight	UNICOR, 2008.	
		Material composition of mixed electronics destined for recycling:				
		Plastics	22.0%		UNICOR, 2008.	Majority is ABS, ABS/PC, HIPS
		Ferrous metals (steel)	44.1%		UNICOR, 2008.	
		Cu content	4.5%		UNICOR, 2008.	From copper-bearing non-ferrous metals (cables, low grade PWB, transformers, fans, motors, and high&medium grade PWB).
		Non-ferrous metals. Cu-bearing, excluding Cu content	11.7%		UNICOR, 2008.	Includes cable, low grade PWB, transformers, motors, fans, minus the actual copper content. UNICOR provided an estimate of "non-ferrous metals, Cu-bearing" from which we subtracted out copper content.
		Silver content	0.003%		UNICOR, 2008.	From high&med-grade PWB.
		Gold content	0.001%		UNICOR, 2008.	From high&med-grade PWB.
		Palladium content	0.000%		UNICOR, 2008.	From high&med-grade PWB.

	Ref	Criteria/attribute	Quantity	Units	Reference	Notes
Mixed Office Electronics	BASELINE ASSUMPTIONS FOR USE AND END-OF-LIFE CALCULATIONS					
	EOL Mgmt (cont'd)	High/medium grade PWBs, excluding precious metal and Cu content	4.5%		UNICOR, 2008.	
		CRT Glass	8.8%		UNICOR, 2008.	
		Non-ferrous metals, Aluminum	4.4%		UNICOR, 2008.	
		High/medium Grade PWBs	5.3%		UNICOR, 2008.	Includes copper and precious metals content.
		Low Grade PWBs	7.0%		UNICOR, 2008.	Includes copper content.
		Total PWBs	12.3%		UNICOR, 2008.	Includes low, medium and high grade printed wire boards; used in hazardous waste calculation.
		Plastic (resin) wire insulation (excluding copper wire)	3.4%		UNICOR, 2008.	Used in hazardous waste calculation.
		Fate of mixed electronics sent for recycling:				
		% of Material Collected for Recycling that is recycled	85%		UNICOR, 2008.	
		% of Material Collected for Recycling that is reused	15%		UNICOR, 2008.	

1 Penta-PBDE was not routinely used in computers (AEAT, 2001). Octa-PBDE may have been used as flame retardant in ABS resins. Octa-PBDE was not declared by companies in 12 environmental profiles/declarations reviewed for the calculator tool, even when ABS was the primary resin. Additionally, based on available industry statistics, we calculated that the use of octa in electronic and electrical products is very small (.05% of BFRs used in electronic and electrical equipment). According to the Bromine Science and Environmental Forum (2000), 2.5% of all plastics in electronic and electrical products contain BFRs. In the Americas, the total market demand for octa-PBDE was only 2.3% of the volume of major BFRs (including TBBPA, Deca, octa, penta, HBCD), compared to deca-PBDE at 41% and TBBPA at 37%. In addition, 14% of BFRs used in E & E equipment in Europe goes into business machines, compared to 72% in televisions.

ASSUMPTIONS FOR EPEAT REGISTRATION TIERS FOR COMPUTERS AS OF 5/21/08.

This table may be updated by the Green Electronics Council in the future, based on distribution of registrations in EPEAT.

CRITERIA		BRONZE					SILVER					GOLD					NOTES
		ALL	CPU	CRT	LCD	NTBK	ALL	CPU	CRT	LCD	NTBK	ALL	CPU	CRT	LCD	NTBK	
Reduced Toxicity																	
E 4.1.1.1-M	RoHS compliance	M	*assume same for all products*				M	*assume same for all products*				M	*assume same for all products*				
E 4.1.3.1-M	Hg declaration, # of lamps with Hg	NA	NA	NA	4	1	NA	NA	NA	4	1	NA	NA	NA	4	1	Based on an analysis of the EPEAT Product Registry, May 2008.
E 4.1.3.1-M	Maximum average Hg content per lamp declaration, in grams	NA	NA	NA	0.003	0.003	NA	NA	NA	0.003	0.003	NA	NA	NA	0.003	0.000	g Hg/lamp declaration (must be consistent with two rows below)
E 4.1.3.2-O	Max average of 3 mg Hg/lamp (Y/N)	yes	NA	NA	yes	yes	yes	NA	NA	yes	yes	yes	NA	NA	yes	yes	Based on an analysis of the EPEAT Product Registry, May 2008.
E 4.1.3.3-O	Hg-free lamps (Y/N)	no	NA	NA	no	no	no	NA	NA	no	no	NA	NA	NA	no	yes	Based on an analysis of the EPEAT Product Registry, May 2008.
Material Use																	
E 4.2.1.1-M	Recycled content of product resin declaration (Y/N)	no	*assume same for all products*				no	*assume same for all products*				yes	no	no	yes	no	Yes declaration does not specify if or how much RC, only that it is declared.
E 4.2.1.1-M	If declared yes for recycled content of product resin, manufacturer's declared percent recycled content for product	0%	*same for all products*				0%	*same for all products*				NA	NA	NA	10%	NA	Assumes that any company that incorporates recycled content into product will go for an optional point (min. 10% recycled content).
E 4.2.1.2-O	Recycled content of product resin, >10% RC (Y/N)	no	*same for all products*				no	*same for all products*				NA	no	no	yes	no	Based on an analysis of the EPEAT Product Registry, May 2008.
E 4.2.1.3-O	Recycled content of product resin, >25% RC (Y/N)	no	*same for all products*				no	*same for all products*				NA	no	no	yes	no	Based on an analysis of the EPEAT Product Registry, May 2008.
E 4.2.2.2-O	Use renew/biobased material, >10% in molded parts (Y/N)	no	*same for all products*				no	*same for all products*				no	*same for all products*				Not included in EEBC version 1.0, 1.1 or 2.0. Tier assumptions based on EPEAT Product Registry analysis May 2008.
E 4.2.3.1-M	Declared product weight (kg)	M					M					M					Currently not used in tool
Key:	M=Mandatory (note: EPEAT standard now uses "Required") O=Optional																
Note:	Must use the word "yes" above, unless it is a value Gray shading means mandatory and don't need to change any inputs to table White cells require input (for optional criteria and mandatory declarations)																

ASSUMPTIONS FOR EPEAT REGISTRATION TIERS FOR COMPUTERS AS OF 5/21/08.

This table may be updated by the Green Electronics Council in the future, based on distribution of registrations in EPEAT.

CRITERIA		BRONZE					SILVER					GOLD					NOTES
		ALL	CPU	CRT	LCD	NTBK	ALL	CPU	CRT	LCD	NTBK	ALL	CPU	CRT	LCD	NTBK	
Energy																	
E. 4.5.1.1-M	ENERGY STAR® (version 4.0/4.1)	yes	*assume same for all products*				yes	*assume same for all products*				yes	*assume same for all products*				EEBC v. 2.0 incorporates ENERGY STAR 4.0/4.1 as the mandatory criterion
E 4.5.1.2-O	ENERGY STAR® Early Adopter		*no functionality in EEBC v. 2.0*														Not included in EEBC v. 2.0 as no specifications available for early adoption.
Packaging																	
E 4.8.3.1-M	Packaging type 1: Corrugated/paper fiber packaging (%RC)	0%	*same for all products*				25%	*same for all products*				25%	*same for all products*				Based on an analysis of the EPEAT Product Registry, May 2008.
E 4.8.3.1-M	Packaging type 2: Plastic/foam/resin packaging (%RC)	0%	*same for all products*				0%	*same for all products*				6%	*same for all products*				6% is the default value for miscellaneous plastics use in US EPA's Recycled Content (RECON) calculator tool available at http://yosemite.epa.gov/oar/globalwarming.nsf/content/ActionsWasteToolsRecon.html
E 4.8.3.1-M	Packaging type 3: Other or additional paper/plastic packaging types (%RC)	0%	*same for all products*				0%	*same for all products*				0%	*same for all products*				Based on an analysis of the EPEAT Product Registry, May 2008.
E 4.8.3.2-O	Comprehensive Procurement Guidelines (CPG) recycled content of corrugated packaging: minimum 25% (Y/N)	no	*same for all products*				yes	*same for all products*				yes	*same for all products*				Yes assumes 25%. Tier assumptions based on analysis of EPEAT Product Registry, May 2008.
E 4.8.5.1-O	Reusable packaging (Y/N); Y=5 reuses	no	*same for all products*				no	*same for all products*				no	*same for all products*				Yes assumes 5 reuses. Tier assumptions based on analysis of EPEAT Product Registry, May 2008.
Cost Premiums																	
n/a		0%					0%					0%					Based on data and personal communications with state and federal purchasers and manufacturers.
Key:	M=Mandatory (note: EPEAT standard now uses "Required") O=Optional																
Note:	Must use the word "yes" above, unless it is a value Gray shading means mandatory and don't need to change any inputs to table White cells require input (for optional criteria and mandatory declarations)																

APPENDIX E REFERENCES

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APPENDIX F: REVISIONS TO THE EEBC

Revisions to the Tool Between Versions 1.1 and 2.0
Below are the major changes to the tool (Table 1) and corrections that have been made to the tool (Table 2).

TABLE 1: Major Changes

3a, 3c, 4, 5a	The "Initial cost per unit" data entry fields on tabs 3a and 3c have been hidden, as well as associated calculations and results on tabs 4 and 5a.
3b	The number of in-use computer desktops, laptops, CRT monitors, and LCD monitors can now be entered independently of each other (the total number of monitors does not have to equal the number of computer desktops). The user can also input the number of each product type that are ENERGY STAR 3.0 and 4.0, as well as the enabling rate.
3b	The lifespan for in-use computer desktops, laptops, CRT monitors and LCD monitors can now be entered separately.
3b, 8a, 8c	The tool can now calculate the benefits of recycling mixed office electronics. Benefits are based on the percent composition of materials in mixed office electronics. Typical material composition of mixed office electronics sent to recycling is now shown in the assumptions in sheet 8a. In calculating benefits, the tool assumes 85% of mixed office electronics sent to recycling are recycled, and 15% are reused. A separate data entry row for "reused" mixed electronics was deemed inappropriate, since piece counts (not weight) are the typical unit of measure for donation and asset recovery operations. For the federal user to claim reuse, they should be using programs such as Computers for Learning or GSA's Transfer/Donation to States program that track by unit not weight.
3c, 8d-f	The user can now enter an ENERGY STAR 4.0 enabling rate for each product being considered for purchase. The Unit Energy Consumption is calculated on tabs 8d-f. If no enabling rate is provided, the default is used.
4	The tool now uses ENERGY STAR 3.0 as a baseline for all energy savings calculations.
5a	Both lifetime and first year benefits are now calculated. First year benefits include: 1) the environmental benefits accrued in the first year of purchasing an EPEAT-registered product, including everything under "Reduced Toxicity," "Material Use," and "Packaging," plus one year of energy savings; 2) the environmental benefits accrued in one year of utilizing power management features of computers in service; and 3) all of the environmental benefits from end-of-life activities. Lifetime benefits include all benefits over the course of the product's lifetime.
5a	In version 2.0 of the tool, ENERGY STAR benefits have been altered for purchased products. The baseline is now an ENERGY STAR 3.0 product, and the purchased product (for all three EPEAT tiers) is an ENERGY STAR 4.0 product. Benefits are calculated using either default enabling rates or user-defined enabling rates. In either case, the enabling rates are kept the same for the baseline and purchased product. For example, if the purchased product has a user-entered enabling rate of 50%, then the baseline will also have a user-entered enabling rate of 50%. Similarly, if the user does not enter an enabling rate, then the purchased product and baseline will use the same default enabling rate.1

5b	Explanatory text was revised as needed.
7	Equivalency factors were updated for Annual Household Energy Use, Annual Passenger Car Emissions, and Annual Municipal Solid Waste (MSW) Generation per US Household.
8b1	The baseline for average computer system lifetime now takes into account the user-entered distribution of products.
8b2	Default values for EPEAT-registered products have been updated.
8c	The method for calculating the environmental benefits of cell phones was revised. Calculations were previously based on a the percent of process energy that is realized when cell phones are recycled. However, this percentage was based on a misinterpretation of the Singhal et al., 2005 study. Environmental benefits for cell phones are now based on the percent composition of materials in cell phones and the impacts associated with those materials. The unit energy cost in Table 3 was also updated.
8c	The conversion factor for calculating GHG emissions from electricity generation was changed from 0.0785 kgCE/kWh to 0.19 kgCE/kWh.
8d-f	ENERGY STAR-related assumptions have been updated to reflect the most recent specifications for computers and monitors.

1In version 1.1 of the tool, the enabling rate used to calculate the baseline UEC was set to a default value, independent of the enabling rate of the purchased product. (While version 1.1 did not allow the user to enter enabling rates for purchased products, it did allow the user to choose different ENERGY STAR levels, which had different enabling rates built into the assumptions.) In contrast, in version 2.0 of the tool, the enabling rate used to calculate the baseline UEC is varied to match the enabling rate of the purchased product. As a result, if default enabling rates or enabling rates near the default value are used, then ENERGY STAR results from version 2.0 of tool will be comparable to ENERGY STAR results from version 1.1 of the tool. However, please note that ENERGY STAR assumptions have been updated, so results from version 1.1 and 2.0 will not be identical. If the user enters enabling rates much larger than the default enabling rate, the ENERGY STAR benefits from version 2.0 of the tool will be less than ENERGY STAR benefits that would result from using the methods in version 1.1 of the tool. For example, in version 2.0 of the tool, CPUs have a default enabling rate of 8%. This gives a baseline UEC of 507 kWh/year and a purchased product UEC of 369 kWh/year for a difference of 138 kWh/year. In version 2.0 of the tool, if the user enters an enabling rate of 60% for CPUs, that gives a baseline UEC of 286 kWh/year and purchased product UEC of 211 kWh/year for a difference of 75 kWh/year. Similarly, if the user enters enabling rates much smaller than the default enabling rate, the ENERGY STAR benefits from version 2.0 of the tool will likely be greater than ENERGY STAR benefits from version 1.1 of the tool.

TABLE 2: Major Changes

SHEET	CORRECTIONS
3b	Fixed broken links between values entered in cells D9-D11 on sheet 3b and calculations on sheet 4.
3c	Corrected CPG calculation for product 2
5a	Corrected calculation of ENERGY STAR savings for "all products detail" (rows 70 and 75)
8b2	Corrected calculation of "Maximum average Hg content per lamp declaration"
Throughout	Corrected spelling of "Polad"

ABOUT THE GREEN ELECTRONICS COUNCIL

The Green Electronics Council is a program of the International Sustainable Development Foundation which is a 501(c)(3) not-for-profit organization located in Portland Oregon. The GEC was established in 2006 with a mission to inspire and support the effective design, manufacture, use and recovery of electronic products to contribute to a healthy, fair and prosperous world. Through its partnerships with the electronics industry and environmental organizations, government agencies, manufacturers and other interested stakeholders, the GEC:

- Implements market-driven systems to recognize and reward environmentally preferable electronic products; and
- Builds the capacity of individuals and organizations to design and manage the life cycle of electronic products to improve their environmental and social performance.

EPEAT is currently GEC's major project. However, in September of 2008, in partnership with the Yale Center for Green Engineering and Green Chemistry, GEC is hosting a forum to develop a vision and definition of "Sustainable Information and Communications Technology." In addition, GEC also conducts and publishes research related to electronics and the environment.

For more information, see www.greenelectronicscouncil.org.

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