GREEN ELECTRONICS COUNCIL
One World Trade Center
121 SW Salmon St., Suite 210
Portland OR 97204
www.greenelectronicscouncil.org
Voice: (503) 279-9382
Fax: (503) 279-9381

The Environmental Benefits of the Purchase or Sale of EPEAT Registered Products in 2006

Introduction

This is the first annual report that the Green Electronics Council plans to produce to estimate the life-cycle environmental benefits from the purchase or sale of EPEAT registered electronic products. EPEAT is a system for identifying environmentally preferable personal computers and monitors that is managed by the Green Electronics Council. The product registry and more information can be found at www.epeat.net. In EPEAT, participating manufacturers report to GEC the number of EPEAT registered products that they sell each year.

The tool used to make the estimates is the Electronics Environmental Benefits Calculator (EEBC), which was developed by the University of Tennessee Center for Clean Products and Clean Technologies under a Cooperative Agreement with the U.S. Environmental Protection Agency. The EEBC's primary input is the number and type of EPEAT registered products purchased. The tool then calculates the environmental benefits that result from the purchase of that many EPEAT registered products compared to the same number of a "conventional product."[1] The calculations include upstream impacts from raw material extraction and processing, product manufacture, and product use and disposition.[2] The "environmental benefits" reported below were obtained by entering into the EEBC the total number of EPEAT registered products sold in 2006 as reported by the manufacturers.

The EEBC is an excellent tool and has been carefully reviewed by EPA and other independent scientists. However, calculating the environmental benefits of products is notoriously difficult, subjective, and subject to misinterpretation. We encourage readers to carefully review the methodology as described below and in the EEBC itself in order to correctly interpret the results.

Executive Summary

Improvements in, and the increased use of, information technology has enabled significant improvements in the standard of living of much of the developed world and likely is a key to long term sustainability. However, given today's industrial technology and infrastructure, electronic products including personal computers and monitors also have significant negative environmental impacts. Like all products, these impacts come

[1] The EEBC assumes that the ENERGY STAR® power management features are enabled and used by the purchaser throughout the estimated 4-year life of computer desktops and monitors. The environmental benefits of EPEAT registered products will be significantly less if power management features are not enabled.

[2] 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 A.

from most stages of the product's life: extraction of raw materials from the earth and their refinement, manufacturing processes to turn these raw materials into a finished product, use (and often re-use) of the product, and ultimately end-of-life collection, treatment, and disposal and/or recycling. On top of that, computers and most electronics have supply chains and customer bases that span the globe, so transportation throughout the product's lifecycle is also significant.

While the environmental impacts are complex and may be 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.

Of these decision points, the purchase decision is arguably the highest leverage. Manufacturers design products that they hope will sell. 90% of the environmental attributes of a product are determined by its design. Design determines the materials used in the product, largely determines the supply chain, the production processes, strongly affects the product's energy consumption during its life, and affects the efficiency of end-of-life recovery. By purchasing environmentally preferable products purchasers send strong signals to manufacturers to design and manufacture greener products.

For electronic products the challenge has been how to identify environmentally preferable products. For laptops, desktops, and monitors that challenge has been met by EPEAT. Purchasers can simply specify EPEAT registered products and be assured that they are buying high performance products with less environmental impact across a spectrum of environmental attributes. All parties can review the list of EPEAT registered products and research their environmental attributes at www.epeat.net.

This report is intended to answer the next question: "Does specifying and buying greener electronics matter?" The answer is clearly a resounding "Yes!" Using the Electronics Environmental Benefits Calculator (EEBC) tool developed by the University of Tennessee Center for Clean Products and Clean Technologies under a Cooperative Agreement with the U.S. Environmental Protection Agency, using the methodology described in this report, we have calculated the environmental benefits of the purchase of EPEAT registered products in 2006. Even though this represents less than six months of purchases and some manufacturers didn't join EPEAT (and therefore had no EPEAT registered products) until late in the year, the magnitude of the environmental benefits is staggering.

By specifying and buying EPEAT registered laptops, desktops, and monitors in 2006 rather than "conventional products", the following environmental benefits will accrue over the lifetime of those products[3]:

[3] The EEBC assumes a 4-year lifetime when calculating energy savings for desktops and monitors, and a 3-year lifetime for notebooks. The figures were calculated using the EEBC Version 1.1, dated 4/18/07

- Save 13.7 billion kWh of electricity, enough to power 1.2 million U.S. homes for a year;
- Save 24.4 million metric tons of primary materials, equivalent to the weight of 189 million refrigerators;
- Prevent 56.5 million metric tons of air emissions (including GHG emissions);
- Prevent 1.07 million metric tons of carbon equivalent GHG emissions, equivalent to removing 852,000 cars from the road for a year;
- Prevent 118,000 metric tons of water pollutant emissions;
- Reduce the amount of toxic materials used by 1,070 metric tons, equivalent to the weight of 534,000 bricks, including enough mercury to fill 157,000 household fever thermometers;
- Avoid the disposal of 41,100 metric tons of hazardous waste, equivalent to the weight of 20.5 million bricks.

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 massive quantities of pollutants out of the world's air, water, and landfills, and conserving resources.

Further improvements can be realized by extending the life of EPEAT products and recycling products responsibly at the end of their life.

Background and Methodology

Electronics Environmental Benefits Calculator

The tool used to make the estimates is the Electronics Environmental Benefits Calculator (EEBC), which was developed for the Federal Electronics Challenge by the University of Tennessee Center for Clean Products and Clean Technologies under a Cooperative Agreement with the U.S. Environmental Protection Agency. The methodology embodied in this tool is described below and must be understood in order to correctly interpret the results. The tool was developed to enable purchasers and users of electronic products to calculate the environmental benefit of their purchase, use, and end-of-life management practices. The EEBC was designed to be compatible with EPEAT, and its primary input related to the *purchase* of products is the number of EPEAT registered products of each type purchased. The tool is available to the public at http://eerc.ra.utk.edu/ccpct/eebc/eebc.html.

EPEAT is a system to help purchasers identify environmentally preferable electronic products. Today it applies only to laptop and desktop computers and computer monitors but projects are being planned to expand it to other electronic product types over time. EPEAT was developed over a period of almost three years by a large group of stakeholders including environmental advocacy organizations, institutional purchasers, electronics manufacturers, U.S. EPA and other government officials, electronics recyclers, researchers, and others in a process facilitated by an independent non-profit supported by a grant from the U.S. EPA. EPEAT rates products as EPEAT Gold, EPEAT Silver, or EPEAT Bronze based on the product's environmental attributes. The

list, or registry, of EPEAT registered products and more information on EPEAT is available at www.epeat.net. Many institutional purchasers of information technology (IT) equipment, including the US Federal Government, require or prefer to buy EPEAT registered products. Manufacturers voluntarily participate and register their products in EPEAT to gain access to this market.

Manufacturers that participate in EPEAT are required to annually report the global unit sales of their EPEAT registered products to EPEAT through an industry trade association that acts as a data consolidator. The manufacturers reported sales for U.S., Canada, and global total sales. This report is based on global sales of EPEAT registered products. The first annual sales report covered the period from when EPEAT became operational in July 2006 to the end of 2006. These reported sales were entered into the EEBC, which calculated the environmental benefits of the sale or purchase of all EPEAT registered products sold in this time frame. The EEBC also has the capability to calculate the benefits of use and end of life management practices of a computer user. These EEBC data inputs were left at their default values for the calculations in this report (further benefits can accrue if users adopt responsible reuse and recycling practices).

Manufacturers reported their total sales of the products that they had registered in EPEAT - not the sales to purchasers that required EPEAT, or the sales *because* of EPEAT. In addition, many of the environmental criteria of EPEAT are also requirements of other programs or countries, including Energy Star and the EU's RoHS and WEEE regulations. Therefore the environmental benefits reported cannot be characterized as the environmental benefits solely of, or because of, EPEAT. They should be understood to be the environmental benefits that have accrued from the purchase or sale of EPEAT registered products. EPEAT has played a role in realizing these benefits but can claim little credit for them. The credit lies with researchers who have developed enabling technologies, with regulators, other programs, environmental advocates, and purchasers who have demanded greener products, and with manufacturers who have responded to this demand by designing and manufacturing greener products.

Of particular note are Energy Star and the EU's RoHS and WEEE regulations. Energy Star has been a very effective program for recognizing energy saving products, for increasing consumer awareness of the importance of energy efficiency, and for providing effective standards and a market incentive for manufacturers to make more energy efficient products. While Energy Star is a program of the US government it has been adopted by many countries around the world and has global impact. Similarly, although the European Union's Restriction of Hazardous Substances (RoHS) and Waste Electrical and Electronic Equipment (WEEE) regulations carry the force of law only in the EU they have effectively transformed the manufacturing and recycling of electronic products globally.

The environmental benefits reported herein come from the purchase of EPEAT registered products. However, the benefits accrue from all phases of the life of the products themselves. For instance, by buying an energy efficient computer the user (and the environment) benefits from reduced power consumption over the life of the product, and

reduced unit energy consumption lowers the upstream material inputs and emissions associated with power generation. Similarly, by buying a computer containing less toxic materials these resources will not be used or released into the environment at the end of the product's life.[4] So, the reported benefits are the result of an informed purchase decision but are realized over time and in other places.

The EEBC estimates environmental benefits for eight metrics:

- Energy use;
- Greenhouse gas emissions;
- Primary material use;
- Total air emissions;
- Water emissions;
- Toxic material use;
- Hazardous waste generation;
- Solid waste generation; and
- Costs, where feasible.

The EEBC calculates the benefits of EPEAT-registered products by comparing their attributes, such as material composition and energy consumption, to the attributes of "conventional" or "baseline" products. The attributes of conventional products were defined using multiple published sources, including available life cycle analyses, while the attributes of EPEAT registered products were defined by the EPEAT criteria. For example, an EPEAT-registered product is assumed to meet the European Union's Restriction on Hazardous Substances (RoHS), while a conventional product does not. Thus, in the case of lead, the baseline desktop computer unit is assumed to contain lead-based solder, while EPEAT-registered products are assumed to be lead-free.[5] The researchers who developed the EEBC anticipate updating the definitions of the "conventional products" every few years as products improve, subject to the availability of funding to do so.

The environmental benefits calculations are limited to those EPEAT criteria that can be quantified for the eight selected metrics. The environmental benefits of some EPEAT criteria are not easily quantified (e.g., ease of product disassembly, corporate reporting criteria, providing a product take back option), and therefore, are not included in EEBC. Below is a summary of the EPEAT criteria included in the EEBC calculations. Appendix A provides a detailed explanation of which benefits (or metrics) were calculated for each criterion.

The EEBC allows the user to select the EPEAT registration tier, or specify which EPEAT criteria the selected product(s) meet. When the EPEAT registration tier (bronze, silver or

[4] Using fewer toxic materials will also result in less mining of these materials, mining wastes, and wastes generated during product manufacture. The current version of the EEBC, however, does not calculate these upstream environmental benefits for toxic material use.

[5] Nominal lead levels (<1000 ppm in homogeneous materials) allowed under RoHS are assumed to be negligible (or zero) in the EEBC for two reasons: 1) the difficulty in obtaining data for each homogeneous material; and 2) the expected levels of precision in the calculations made in the tool.

gold) is selected, the EEBC relies on default assumptions regarding each criterion and whether a given registration tier is expected to meet that criteria. These default assumptions were based on an analysis of actual EPEAT registrations, which will be evaluated over time and default assumptions adjusted, as needed.

In the current analysis of EPEAT registered products, EPEAT Silver was assumed for all product types. This is a reasonable assumption, given that over 85 percent of all registered units are EPEAT Silver. The Table below indicates which criteria are assumed for EPEAT Silver product declarations in the EEBC. Again, these are reasonable assumptions, which align with actual declarations in the EPEAT registry. Less than 20% of all registered product declared to the criterion listed below that are not considered typical of an EPEAT Silver product, while over 85 percent of registered products declared to the criteria included in the EEBC as EPEAT Silver assumptions.

EPEAT Criteria in the EEBC

Criteria in EEBC	EPEAT Reference	Assumed criterion in EEBC for EPEAT Silver products?
RoHS compliance (Pb, Hg, Cd, Cr6+, PBB, PBDE)	4.1.1.1 Required	Yes
Hg in light source; maximum average of 3 mg Hg/lamp	4.1.3..2 Optional	Yes
Hg-free lamps	4.1.3.3 Optional	No
Recycled content of product resin (10%, 25%)	4.2.1.2-3 Optional	No
Energy Star® Compliant	4.5.1.1 Required	Yes
Recycled content of packaging	4.8.3.1 Required – Declaration only Optional - % content	No
Minimum 25% recycled content of corrugated packaging	4.8.3.2 Optional	No
Packaging avoided per unit by packaging reuse	5.8.5.1 Optional	No

An Advisory Group guided the University of Tennessee team in the development of the EEBC. The Advisory Group, comprised of representatives from the U.S. EPA, state government, industry and not-for-profits, provided essential feedback on issues such as the scope of the tool, functionality, user interface and presentation of results. Upon completion, the EEBC was subject to an extensive Peer Review Process, which focused on the baseline data inputs, assumptions and benefits calculations. The Peer Review Group included representatives from industry, the U.S. EPA, and the federal government.

The EEBC also explicitly outlines all the assumptions for EPEAT and “conventional” products so that users can review all data inputs, and any assumptions can be updated in the future as new data becomes available.

Finally, one must recognize that calculating the "environmental benefits" of buying environmentally preferable computers is like calculating the "savings" from purchasing products on sale. The best way to save money is to buy nothing. Similarly, the best way to reduce the environmental impact of these products at the time of purchase is to simply not buy them – it is usually better to extend the life of products currently in use, to refurbish, upgrade, and re-use products as long as practical. And then, when it is time to buy a new product, recycle the old one responsibly and exercise the power of your purchase on the market by buying an EPEAT registered product.

Product Sales Data

Sales data was provided by the 12 manufacturers that had subscribed to EPEAT before the end of 2006. Those manufacturers are:

- Apple
- CTL
- Dell
- Gateway
- Hewlett Packard
- Lenovo
- NEC Display Solutions
- Northern Micro
- Panasonic
- Prosys-Sona
- Sony Electronics
- Toshiba America Information Systems, Inc.

Manufacturers voluntarily register products in EPEAT. These companies were instructed to report the total combined unit sales of all their EPEAT registered products sold in 2006 from the time each product was registered in EPEAT until the end of the year. Data was provided for each product type registered in EPEAT (notebook computers, desktop computers, integrated desktop systems, and computer monitors) and for each of the following sales regions: U.S., Canada, Rest of the World, Total. Subscribing manufacturers were compelled to report by their agreement to participate in EPEAT and data was received from all subscribers.

In order to protect the confidentiality of manufacturer's sales data, manufacturers reported the data to the Electronics Industry Alliance (EIA) (www.eia.org), an electronics industry trade association, who generously agreed to act as a data consolidator. Many of the subscribing manufacturers are members of EIA but it should be noted that EIA performed this service without compensation and for non-EIA members as well. Many thanks to EIA for their support of EPEAT!

Manufacturers reported sales of desktops, laptops, monitors and integrated desktop systems. Because one manufacturer makes nearly all the integrated systems, and because the EEBC has no input for integrated systems, we have combined the reported sales of integrated systems with the laptops on the theory that an integrated system is most like a

laptop. We neither have nor sought information to support this so it is certainly an approximation. However, the reported sale of integrated systems was only a few percent of total sales so, for the purposes of this report the error induced is likely to be negligible.

EIA provided the following sales information to EPEAT:

Adjusted 2006 Unit Sales of EPEAT Registered Products

Region	Desktops	Laptops	Monitors	Total
USA	4,316,773	3,406,011	6,373,262	14,096,046
Canada	172,718	220,360	351,516	744,594
Rest of world	7,610,590	5,231,837	8,877,653	21,720,080
Total	12,100,081	8,858,208	15,602,431	36,560,720

The totals at the bottom of the table were entered into the EEBC.

Analysis of Sales Data

Sales by Region: U.S, Canada, Rest of World

By feeding the sales figures above by area into the EEBC one can easily calculate the environmental benefits derived from purchases in those geographies. Note that because these are lifecycle impacts that can occur in other times and places than when the product is bought, it cannot be said that these are the benefits *to* or *in* these areas. They are the benefits stemming from the purchase of products in those geographies.

The benefits reported above come from the combined sales of each of the three product types, and each product type has a different impact per unit based on the environmental attributes of that product type. Therefore, to find the benefit of the purchase of only one product type, or one or more products sold in a geographic area one must use the calculator. It would not be accurate to multiply the total benefits reported by the appropriate percentage of sales.

Percentage of Products Sold that are EPEAT Registered

Using U.S., Canadian, and global unit sales data one can also easily calculate the percentage of total desktops and laptops sold in these areas that are EPEAT registered. This answers the question “What percentage of overall sales of laptops and desktops are of EPEAT registered products?” This is not a good approximation of the percentage of “models” currently on the market that are EPEAT registered because our sales figures are heavily weighted by the very large quantities of a few models sold to institutions. In addition, it is not an estimate of the number of products sold *because* of EPEAT, or on contracts that require EPEAT.

Percentage of Total 2006 Unit Sales that are EPEAT Registered Products

Region	Desktops	Laptops	Total
USA	13.0%	12.1%	12.6%
Canada	5.1%	8.3%	6.3%
Rest of world	6.7%	9.0%	7.4%
Total	8.0%	9.9%	8.7%

Appendix A

Description of EEBC Calculations by EPEAT Criteria

Source: EEBC, Version 1.1, Excel Spreadsheet 5b

EPEAT Criteria		Metrics
Reduced Toxicity		All reduced toxicity calculations compare the user-inputted purchase data for a unit to a pre-EPEAT baseline (conventional) unit.
E 4.1.1.1	RoHS compliance - Pb, Hg, Cd, Cr6+, PBB, PBDE	**Toxic material savings:** direct reduction in the amount of toxic material (e.g., lead) in purchased product compared to baseline unit. **Haz waste savings:** the addition of toxic materials to a component (e.g., lead in a printed circuit board, wire and cable or CRT glass) can render the entire component hazardous if landfilled. This metric takes into account the reduction in hazardous components (by weight) at the EOL resulting from the avoidance of toxic material in the purchased product. Note the Hg RoHS criterion excludes lamps and cathode ray tubes.
E 4.1.3.1-2	Hg in light source; max avg of 3 mgHg/lamp	**Toxic material savings:** gives credit if product has max level of 3 mg of Hg in lamp, based on direct reduction in the amount of toxic material in purchased product compared to baseline unit. **Haz waste savings:** not calculated here since it would be repetitive of savings calculated under the RoHS-Hg criterion.
E 4.1.3.3	Hg-free lamps	**Toxic material savings:** direct reduction in amount of toxic material in purchased product compared to baseline unit. If Hg-free lamps selected, benefits from this criterion override the previous one for max of 3 mg. **Haz waste savings:** not calculated here since it would be repetitive of savings calculated under the RoHS-Hg criterion.
Material Use		Savings are based on the amount of virgin resins not produced due to the replacement of virgin resin with recycled content in the products as compared to a pre-EPEAT baseline, which is currently assumed to have zero recycled content in the product resins. These calculations use data from the average of three typical resins in computers: ABS (acrylonitrile-butadiene-styrene), HIPS (high impact polystyrene), and PC (polycarbonate).
E 4.2.1.1-3	Recycled content (RC) of product resin	**Energy, primary material, total air emissions, and water emissions savings:** based on all energy used, materials used, air releases and water releases, respectively, from producing the virgin resins (including materials extraction and processing associated with resin production; this life-cycle data are from European sources: BUWAL and APME, see Sheet 8c, Table 7). **GHG emissions savings:** based on GHG emissions (i.e., a subset of air emissions that have global warming potential); as above, based on the materials extraction and processing of the three resins; data also based on BUWAL and APME. **MSW savings:** assumes the average amount of recycled content in the product resins is the amount of solid waste saved. Note, this does not include all solid waste from materials extraction, as other metrics above, as these data were not readily available for Version 1.0. Note, **Haz waste savings are not included** since the resins themselves are not hazardous wastes and all hazardous waste from materials extraction and processing data were not readily available for version 1.0. **Cost savings:** cost of electricity of energy savings calculated above. For cost estimation purposes, this simply assumes that all production energy to produce the resins is electric energy.
Packaging		Savings are based on the amount of virgin packaging materials (corrugated cardboard or resins) that are not produced due to the recycled content (RC) of the packaging as compared to a pre-EPEAT baseline, which is assumed to have zero recycled content in the packaging. Zero recycled content was chosen as the baseline in order to calculate the total benefit of RC, not just the incremental benefit of increasing RC. For resin packaging, these calculations use data from the average of four typical resins in packaging LDPE (low-density polyethylene), HDPE (high-density polyethylene), PET (polyethylene terephthalate) and PS (polystyrene).

E 4.8.3.1-2	Avg. RC of packaging: 1-corrugated, 2-plastic/foam, 3-other	**Energy, primary materials, GHG, total air emissions, water emissions, solid waste, and cost savings:** Same as "Recycled content of product resin" (above under "Material Use"), but specific to the packaging type. Note, packaging type 2 and 3 are both based on average data for the four common packaging resins: LDPE, HDPE, PET, and PS.
E 4.8.3.1-2	CPG min 25% for recycled content-corrugated	**Energy, primary materials, GHG, total air emissions, water emissions, solid waste, and cost savings:** Same as RC of packaging-corrugated except this assumes 25% recycled content if this item checked in Sheet 3c, or if the EPEAT tier chosen in Sheet 3a defaults to meeting the Comprehensive Procurement Guidelines (CPG).
E 5.8.5.1	Packaging avoided per unit by packaging reuse	**Energy, primary materials, GHG, total air emissions, water emissions, solid waste, and cost savings:** Assumes a package is reused 5 times and savings are based on not producing the packaging 5 times, as compared to the baseline, where no reuse is assumed. Otherwise, these calculations are the same as for RC of packaging or product resins, except instead of savings based on RC, it is based on the amount not produced for an entire package.
	Energy	Savings are based on the future use of a purchased product, which is compared to a pre-EPEAT (non-ENERGY STAR) product.
E 4.5.1.1 & 3	ENERGY STAR 3.0 or 4.0	**Energy savings:** based on the unit energy consumption (UEC) of a product over the life of the product. **Primary material savings, GHG, total air emissions, and water emissions savings:** use life-cycle data for materials and emissions associated with the use of electricity, based on the energy savings calculated under "energy savings" above. **Cost savings:** cost of electricity calculated under "energy savings" above.
	Product cost	
	Cost	**Cost savings:** based on any price premium for an EPEAT product (see Sheet 8b2 for cost premium assumptions).