



Using the Electronics Environmental Benefits Calculator (EEBC)

Updated: 7/25/2012

PURPOSE

This resource provides answers to frequently asked questions about the Electronics Environmental Benefits Calculator (EEBC), and in particular, questions about version 3.1.

GENERAL

What products are included in the EEBC?

The EEBC estimates the environmental benefits of improving the purchasing, use, and disposal of computer products, specifically computer desktops, liquid crystal display (LCD) and cathode ray tube (CRT) monitors, and computer notebooks/laptops. The EEBC also calculates the benefits of mobile phone reuse and recycling, and of recycling mixed loads of electronic equipment.

Why does the EEBC only include the benefits of purchasing environmentally preferable computer products?

In order to measure environmental benefits, clearly defined and measurable "green" performance criteria are needed. The Electronic Product Environmental Assessment Tool (EPEAT) and IEEE Standard 1680 Standard for Environmental Assessment of Personal Computer Products, provides such a set of measurable criteria for computer desktops, monitors, and notebook computers. Additional electronic products may be added to the EEBC when environmental performance standards are available.

What was changed in the EEBC between version 2.0 and 3.0?

Generally, the following updates were made for version 3.0. Please see Sheet 9 in the EEBC file for more details.

Revision	Reasoning
Default values for EPEAT-registered products have been updated to reflect the electronic products in the registry as of March 2012.	The required and optional criteria generally met by products in the EPEAT registry have changed since release of version 2.0.
Removed the ability to select a cathode ray tube (CRT) monitor for purchasing calculations. This data entry point was hidden, and not deleted, so that it may be restored in later versions, if needed.	CRTs have never been registered with EPEAT and none meet the current ENERGY STAR specification, so some critical data is not available to complete the purchasing calculations.
Removed the ability to select "Not Applicable" for EPEAT registration status for purchasing calculations.	All available products in the calculator can be registered, so the appropriate answers to registration status are "Yes" and "No."
Default values for energy use of a conventional product, a product meeting ENERGY STAR 4.* and a product meeting ENERGY STAR 5.* (the current specifications for computers and displays) have been updated.	The energy profiles of conventional products and ENERGY STAR qualified/EPEAT registered products have changed since release of version 2.0.
Power management rates for computers and monitors are entered separately for use calculations.	Allowing the entry of two different rates allows users to account for different enabling rates for the computer and display portions of notebooks.
Equivalency factors were updated and additional conversions were added.	Updated assumptions were available.



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Revision	Reasoning
	Please see references in the EEBC for details.
Corrections were made to address problems discovered during the use of version 2.0.	See Sheet 9 for a complete list.
References, notes and comments were revised, as needed, to reflect the changes made to the tool.	

What was changed in the EEBC between version 3.0 and 3.1?

Generally, the following updates were made for version 3.1. Please see Sheet 9 in the EEBC file for more details.

Revision	Reasoning
All assumptions in Sheets 8a and 8c reviewed and updated if a more complete, accurate or recent data source was available. Removed rows for data not being used in calculations. Removed comments that were no longer relevant or correct.	The baseline assumptions for products, and general assumptions used by the calculator were last updated in 2007. More complete, accurate or recent data sources were available for many assumptions.
Changed assumptions used for packaging calculations.	Since production of new packaging is likely to be globally sourced, assumptions needed for these calculations were based on available global data. Since packaging reuse is likely to be completed locally, assumptions needed for these calculations were based on available U.S. data.

Where is the online version of the EEBC?

The U.S. EPA is currently working on a web-based version of the EEBC, with an anticipated release date of winter of 2012/2013. All of the revisions noted above needed to be completed before work on the web-based version was started.

Who developed the EEBC and was it subject to peer review?

Version 1.0 of the EEBC Tool (released December 2006) was co-developed by Abt Associates, Inc. and Dillon Environmental Associates, in coordination with the University of Tennessee (UT) Center for Clean Products and Clean Technologies. Abt Associates and Dillon Environmental Associates were subcontracted by UT who was funded through a grant from the U.S. EPA Region 10 to develop the tool. Version 1.1 (released April 2007) was developed through a contract between U.S. EPA and the Eastern Research Group (ERG), with subcontracts to Abt Associates, Inc. and Dillon Environmental Associates. Version 2.0 (released March 2009) was developed under a contract between U.S. EPA and Abt Associates, Inc., with subcontracts to Dillon Environmental Associates and UT. Version 3.0 (released April 2012) was developed by the U.S. EPA. Version 3.1 (released July 2012) was developed under a contract between U.S. EPA and ERG.

An Advisory Group guided the UT team in the development of the first version of the tool. 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 of version 1.0, the EEBC was also 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 other federal agencies. A list



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of Advisory and Peer Review Group members is provided on the University of Tennessee web site: <http://isse.utk.edu/ccp/projects/benefitscalculator/elecbenecalc.html>.

Subsequent versions have been reviewed and beta tested by a variety of users prior to final release.

USING THE EEBC

What data do I need to run the EEBC?

The minimum data input needed to run the calculator is the number of electronic products purchased, used, and/or disposed of; for example, the number of computer desktops, CRT monitors, LCD monitors, notebook computers, and/or mobile telephones.

- To calculate the benefits of purchasing EPEAT-registered products, the EEBC user also needs to indicate the EPEAT-registration level (that is, bronze, silver, or gold) for the entered products.
- To calculate the benefits of power management, the enabling rate for computers and/or monitors must be entered.
- To calculate the benefits of extending the life of products, the lifespan (in months) of the products must be entered.
- To calculate the benefits of recycling mixed loads of electronics, the weight of the mixed load is needed.

What if I only have data on EPEAT purchases or recycling? Can I still use the EEBC?

Yes, the EEBC is modular. A user can choose to calculate the benefits of one or more of the following:

- Purchasing EPEAT-registered computer products;
- Implementing computer and monitor power management;
- Extending the life of computer products;
- Reusing computer desktops, monitors (CRT and LCD), notebooks/laptops, and mobile phones;
- Recycling computer desktops, monitors (CRT and LCD), notebooks/laptops, and mobile phones; and
- Recycling mixed loads of electronic equipment.

How do I calculate environmental benefits using the EEBC in the Excel Spreadsheet format?

- Open the Excel Spreadsheet, enabling the macros. See the question below if you have trouble with the form elements in the spreadsheet (e.g., buttons).
- To calculate the environmental benefits of purchasing EPEAT-registered products (compared to a conventional product); enter data in Sheet 3a for up to three types of computer products.
- Additional data entry for EPEAT-registered products may be specified in Sheet 3c. Completion of data entry in Sheet 3c is optional, and requires detailed information about the EPEAT product's registration. This information is available in the EPEAT registry for registered products (<http://ww2.epeat.net/searchoptions.aspx>). If data is not entered in Sheet 3c, the EEBC assumes that the entered EPEAT registered products meet the default values for required and optional criteria at a particular tier.
- Enter data in Sheet 3b if you're interested in calculating the environmental benefits of computer and monitor power management; extending the life of computer products; and computer, monitor, and mobile phone reuse and/or recycling. Data can be entered into either or both Sheet 3a and Sheet 3b. See question below about potential double-counting.
- To view the results, go to Sheet 5a after completing the data entry on Sheets 3a, 3b and/or 3c. The aggregate result ("Grand Total") is in the first table. This table also presents subtotal results by purchasing, equipment use, and end of life management (i.e., reuse and recycling); and subtotal results by first year and lifetime accrual. The data entered into the EEBC is displayed at the top in the orange box. To see additional breakdowns of the results, scroll down the Sheet.



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- Explanations of the calculations for each criterion are available on Sheet 5b.
- Graphs of the results are available on Sheet 6.
- Equivalent measures, such as number of cars off the road or the amount of electricity to power households, are available on Sheet 7.

When should I use Sheet 3c?

As noted above, Sheet 3c allows you to specify which optional criteria a particular EPEAT-registered product meets. While the EEBC makes assumptions regarding which optional criteria each product at each tier meets, these assumptions are a generalization of the products in the EPEAT registry and may or may not accurately reflect the product that you purchase.

There are significant differences between products registered at the same tier (e.g., bronze, silver or gold) in the registry. If you only purchased a single product type by a single manufacturer, it may be beneficial to lookup the criteria that the products you purchased met and enter these criteria in Sheet 3c, in order to obtain the most accurate benefits.

If you are calculating the benefits of purchasing a variety of different registered products by different manufacturers, the assumptions made in the EEBC will likely be reflective of the products you purchased.

Why aren't the buttons or menu items working?

The EEBC utilizes macros, short software instructions, to aid navigation and perform certain calculations. To ensure that the EEBC functions properly, please ensure that macros are enabled to run:

- In Excel 2007, these settings are found through the meta button (where "Save" is), and clicking on Excel Options -> Trust Center -> Trust Center Settings -> Macro Settings.
- In Excel 2003, these settings are through Tools -> Macro -> Security.

Please be sure to reset your Macro security settings after using the file.

If I use the EEBC to calculate environmental benefits of purchasing EPEAT registered products, can I also use the EEBC to calculate power management, product reuse, and recycling benefits? Wouldn't this be "double counting"?

The EEBC can be used to calculate the environmental benefits of product reuse and recycling, but it does not calculate these activities for data entered on EPEAT purchases since product reuse and recycling by the user are not specific EPEAT criteria. To calculate the benefits of reuse and recycling, an EEBC user must enter data in separate data entry fields (Sheet 3b).

The calculations for energy savings are handled differently for data entered on Sheet 3a (EPEAT-registered purchases) and Sheet 3b (power management).

Sheet 3a - Purchasing

EPEAT-registered products are required to meet the technical requirements of the applicable ENERGY STAR specification. As a result, EPEAT-registered products are more energy efficient than a conventional product, and may be power managed to save more energy.

The EEBC uses a baseline that is equivalent to a conventional product on the marketplace that does not meet the ENERGY STAR technical requirements, and compares this conventional to the user entered product. The user entered product (for all three EPEAT tiers) is assumed to be an ENERGY STAR 5.* qualified product. Benefits are calculated using either default enabling rates or user-defined enabling rates (which can be entered in Sheet 3c). In either case, the enabling rates are kept the same for the conventional and purchased product.



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For example, if the purchased product has a user-entered enabling rate of 50%, then the conventional unit will also have an enabling rate of 50%. Similarly, if the user does not enter an enabling rate, then the purchased product and conventional product will use the same default enabling rate. This method ensures that the energy savings attributable to purchasing an EPEAT-registered product are the result of the energy efficiency gains over the baseline, not from a change in behavior (e.g., enabling power management).

Sheet 3b – Power management

In contrast, the EEBC calculates the benefits of behavior change using the data entered in Sheet 3b.

The EEBC uses a baseline of the number of user entered ENERGY STAR qualified products, enabled at the default rates. The EEBC compares this baseline to number of user entered ENERGY STAR qualified products, enabled at the user entered rates. Since these savings vary across ENERGY STAR 4.* and ENERGY STAR 5.*, the EEBC compares them separately, which is why the user must enter the number of ENERGY STAR 4.* and ENERGY STAR 5.* qualified units separately.

If the user entered rate is less than or equal to the baseline rate, then no benefit is calculated. In version 3.1 of the EEBC, the following enabling rates are used for the baseline:

- Desktop computers: 8%
- CRT monitors: 81%
- LCD monitors: 81%
- Notebooks (computer portion): 8%
- Notebooks (display portion): 81%

In some cases, inclusion of the EPEAT-registered products entered in Sheet 3a in the number of units in use in Sheet 3b may result in duplication of benefits (or “double-counting”). If the user does not change the default rate for EPEAT-registered purchases in Sheet 3c, then they may include the purchases entered in Sheet 3a in the units in use in Sheet 3b without duplication of results. Any change to the default enabling rate in Sheet 3c for purchases may cause duplication of results if the purchased units are also entered in Sheet 3b.

Why am I getting no results for enabling power management or extending the life of equipment?

The EEBC compares the user entered data (e.g., power management rate or life span) to the baseline data for the entered product. If the user entered data is less than or equal to the baseline, then no benefits are calculated.

In version 3.1 of the EEBC, the following enabling rates are used for the baseline:

- Desktop computers: 8%
- CRT monitors: 81%
- LCD monitors: 81%
- Notebooks (computer portion): 8%
- Notebooks (display portion): 81%

In version 3.1 of the EEBC, the following life spans are used for the baseline:

- Desktop computers: 51 months
- CRT monitors: 51 months
- LCD monitors: 51 months
- Notebooks/laptops: 38 months



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The references for these assumptions are detailed in Sheets 8a and 8c.

Why are the results of enabling an ENERGY STAR 4.* product greater than the results of enabling an ENERGY STAR 5.* product?

ENERGY STAR 5.* products are more energy efficient during their lifespan than ENERGY STAR 4.* products. That is, the energy used by an ENERGY STAR 5.*, both when power managed and not power managed, is less than an ENERGY STAR 4.* product, again, both when power managed and not.

However, the difference between the energy used by an ENERGY STAR 5.* product that is power managed and an ENERGY STAR 5.* that is not power managed is smaller than the difference between the energy used by an ENERGY STAR 4.* product that is power managed and one that is not power managed.

Since Sheet 3b is calculating the benefits of only the behavior change of enabling power management; and the difference between enabled and non-enabled ENERGY STAR 5.* products is smaller than the difference between enabled and non-enabled ENERGY STAR 4.* products; the results of enabling an ENERGY STAR 4.* product are greater than enabling an ENERGY STAR 5.* product.

EEBC CALCULATIONS

How does the EEBC calculate the benefits of EPEAT-registered products when products can meet different performance criteria (e.g., recycled content or mercury-free lighting)?

An EEBC user can specify the EPEAT-registration level (i.e., bronze, silver, gold) for each user selected product type. The EEBC calculation assumes an environmental performance profile for each product type and EPEAT level, based on actual product registrations (see Sheets 8b1 and 8b2).

An EEBC user can also choose to customize the profile of its product using a separate worksheet (Sheet 3c) that overrides the EEBC default assumptions.

Does the EEBC calculate the environmental benefits resulting from all EPEAT criteria, both required and optional?

The EEBC calculates environmental benefits for both EPEAT required and optional criteria, using default profile assumptions for EPEAT tiers as described above. The EEBC does not calculate benefits for all EPEAT criteria. In developing the EEBC, only EPEAT criteria that were considered measurable and are established at the time of product purchase were included in the EEBC. For example, the EEBC does not calculate the benefits of product recyclability and life extension criteria, nor does it calculate the benefits of the provision of a take back service.

The table below shows the EPEAT criteria that are included in the EEBC calculations. As an example, the default profile of an EPEAT Silver product is shown. These criteria are the ones incorporated into the environmental benefit calculations for EPEAT Silver product purchases. The EPEAT default profiles, which are based on the current EPEAT product registry, were updated in version 3.0 to reflect the distribution of products in the registry in March 2012.

Criteria in EEBC	EPEAT Reference	Profile of EPEAT Silver products
RoHS compliance (Pb, Hg, Cd, Cr6+, PBB, PBDE)	4.1.1.1 Required	All products: Yes



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Criteria in EEBC	EPEAT Reference	Profile of EPEAT Silver products
Hg declaration; number of lamps with Hg; maximum average Hg content per lamp	4.1.3.1 Required	CPU: N/A LCDs: 3 lamps, 0.003 grams Notebooks: 0 lamps, 0 grams
Hg in light source; maximum average of 3 mg Hg/lamp	4.1.3.2 Optional	CPU: N/A LCD: yes Notebooks: yes
Hg-free lamps	4.1.3.3 Optional	CPU: N/A LCD: no Notebook: yes
Recycled content of product resin declaration; percentage	4.2.1.1 Required – Declaration Optional - % content	All products: 0%
Recycled content of product resin (10%; 25%)	4.2.1.2; 4.2.1.3 Optional	All products: No; No
Meets Energy Star® requirements	4.5.1.1 Required	All products: Yes
Recycled content of packaging	4.8.3.1 Required – Declaration Optional - % content	CPU: 35% in corrugated; 0% in plastic; 0% in other LCD: 50% in corrugated; 5% in plastic; 0% in other Notebook: 63% in corrugated; 10% in plastic; 4% in other
Minimum 25% recycled content of corrugated packaging	4.8.3.2 Optional	All products: Yes
Reusable packaging	4.8.5.1 Optional	All products: No

Does the EEBC calculate the total life cycle environmental impacts of computer products, that is, from mining to production, use, and disposition?

The EEBC is not a product life cycle analysis. The EEBC calculates environmental benefits (savings or reductions) of an EPEAT registered product, compared to a conventional product. The EEBC only calculates environmental benefits for performance criteria covered by EPEAT. Depending on the EPEAT criteria and metric, the EEBC may use life cycle data to calculate benefits. For example, energy consumption and recycled material content criteria include savings from upstream processes associated with material production, while the upstream benefits of removing RoHS restricted metals are not included in EEBC benefits calculations. Here, the EEBC only tallies the amount of material directly in the product. The use of life cycle data in EEBC calculations was largely influenced by the availability of data. Additional life cycle data may be incorporated into future upgrades of the EEBC.



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Does the EEBC calculate the environmental benefits of purchasing ENERGY STAR® products?

Yes, the environmental benefits of ENERGY STAR features are incorporated into the EEBC in two ways. First, the EEBC calculates the benefits of ENERGY STAR 5.* features as one of the required performance criteria of EPEAT. In calculating environmental benefits, the EEBC assumes that the ENERGY STAR power management features of EPEAT-registered products are enabled at the default or user entered rate over the lifespan of the product. The EEBC also assumes that a conventional unit is also power managed at the default or user entered enabling rate.

Second, the EEBC can also estimate the environmental benefits of computer and monitor power management, independent of EPEAT purchases. This is because an EEBC user can separately calculate the benefits of enabling the ENERGY STAR power management features of its computer inventory, above the default rate. These calculations assume that a baseline percentage of computer desktops, notebooks and monitors have the ENERGY STAR features enabled, based on published computer usage patterns. Entering a percentage of enabled units above the default rate for these products results in environmental benefits; entering a number of enabled units below the default rate will not show any benefits.

Please see question above about potential double-counting between energy efficiency gains from purchasing (Sheet 3a) and power management (Sheet 3b).

How do I estimate the number of ENERGY STAR 4.* vs. ENERGY STAR 5.* products in service?

The ENERGY STAR 5.0 specification for monitors went into effect on October 30, 2009 for displays less than 30 inches. Any ENERGY STAR qualified monitors purchased after this date is likely to meet ENERGY STAR 5.0. Any ENERGY STAR monitors older than this date are likely to meet ENERGY STAR 4.*.

The ENERGY STAR 5.2 specification for computers went into effect on July 1, 2009. Any ENERGY STAR qualified computers purchased after this date are likely to meet ENERGY STAR 5.2. Any ENERGY STAR computers older than this date are likely to be ENERGY STAR 4.*.

Please note that there are currently no CRT monitors qualified to the ENERGY STAR 5.0 specification. Any ENERGY STAR qualified CRT monitors in use at your organization are likely ENERGY STAR 4.* or older.

Example

Facility A has the following electronic equipment in use, with associated power management enabling rates:

100	Desktop computers
50	CRT monitors
70	LCD monitors
30	Laptop/notebook computers

Estimated percentage of enabled monitors: 90%
Estimated percentage of enabled computers: 60%

Facility A bought 50 of the desktop computers and all 30 laptop/notebook computers in 2011 – they are all ENERGY STAR 5.2. The other 50 desktop computers were bought in 2008 – they are ENERGY STAR 4.*. Facility A bought the 70 LCD monitors with the new computers in 2011 – they are all ENERGY STAR 5.0. The CRT monitors in use have been around since 2006 – they are ENERGY STAR 4.*.

This data would be entered as follows in the EEBC:



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USE AND END-OF-LIFE INFORMATION					
User Input	Input data				
Use:	Total number of ENERGY STAR® 4.* units	Total number of ENERGY STAR® 5.* units	Percentage of COMPUTERS with power management features enabled (%)	Percentage of DISPLAYS with power management features enabled (%)	Average lifespan of units (Months)
<i>Data inputs for computers and monitors only</i>					
Desktop computers (CPUs)	50	50	60%		
Cathode ray tube monitors (CRTs)	50			90%	
Liquid crystal display monitors (LCDs)		70		90%	
Notebook computers		30	60%	90%	
Total number of units in service (4.* and 5.*)		250			

What is included in the first year benefits vs. the lifetime benefits?

The EEBC separately provides information on benefits accrued in the first year of owning, using, or reusing/recycling an electronic product and the benefits accrued over the lifetime of owning and using a product. These benefits are broken out as follows:

First Year:

- All savings from reduced toxicity, recycled content material use, recycled content in packaging, and reuse of packaging from the purchase or lease of an EPEAT-registered product.
- One year of energy efficiency savings from use of an EPEAT-registered product or from enabling power management on a product above the default rate.
- All savings from the reuse and recycling of any electronic equipment.

Lifetime:

- All the benefits listed in the first year savings.
- All savings from the reduction in hazardous waste at the end-of-life of an EPEAT-registered product.
- The remaining years of energy efficiency savings from the use of an EPEAT-registered product, or from enabling power management on a product above the default rate. The number of years in a product's lifetime is based on the average lifetime of the product.
- All savings from extending the life of electronic equipment.

What assumptions does the EEBC use in making the environmental benefits calculation?

The EEBC makes assumptions about the material composition and energy use of EPEAT and conventional products, the profile of EPEAT registered products, and the life cycle impacts resulting from material and energy inputs as well as reuse and recycling. The various assumptions and default values used in the EEBC, along with reference sources, are explicitly outlined in the Excel Spreadsheet version of the EEBC (see Sheets 8a – c). The EEBC user can also customize EPEAT product profiles using Sheet 3c.

ENVIRONMENTAL BENEFITS

What environmental benefits does the EEBC calculate?

The EEBC calculates eight environmental benefits: energy savings, greenhouse gas reductions, air emission reduction, water emission reduction, hazardous waste reduction, toxic material reduction, primary material savings, and cost savings. With the exception of greenhouse gas emissions, these benefits are considered "inventory" metrics that measure the mass or quantity of the metric that is reduced (e.g., amount of hazardous waste), and NOT the "impact" of the metric in the environment (e.g., toxicity). Greenhouse gas (GHG) reduction is the one exception. The GHG metric takes the GHG



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emissions from the total air emissions and applies the global warming potential to the mass, to calculate GHG equivalents (as carbon or CO₂-equivalents). Sheet 5b in the EEBC provides more details on benefits calculations.

Are greenhouse gases also included in the total air emissions metric?

Yes, the total air emissions metric includes the mass of all air emissions, including gases that contribute to global warming. The greenhouse gas (GHG) metric takes the different greenhouse gases from the total air emissions and applies global warming potential factors to the mass of each gas to calculate GHG equivalents as carbon or CO₂-equivalents.

What's the difference between toxic material savings and hazardous waste savings?

Toxic material savings are a direct measure of the sum of the toxic materials (by weight) found in conventional products that are restricted in EPEAT products, either as required or optional criteria. Hazardous waste savings are the sum of the components (by weight) that are rendered hazardous by toxic constituents, and therefore, their disposal is restricted or monitored. For example, the toxic material metric includes the reduction in the use of mercury in backlights and lead solder on circuit boards. The hazardous material metric, in contrast, includes the entire weight of the mercury backlights, circuit boards and leaded CRT glass.

Do water emissions savings include water pollutants and the volume of water?

Water emission savings are pollutants only. The EEBC does not capture the volume of water saved.

What factors are included in the EEBC cost savings estimates?

In the current version of the EEBC, cost savings are only calculated based on energy savings. The energy cost savings are life cycle based. That is, the cost savings do not benefit just the equipment user, but may accrue throughout the product life cycle (for example, reducing material consumption reduces the energy needed to produce materials).

In version 3.1 of the EEBC, a discount rate is not applied to the cost savings over the calculated lifetime savings.

REFERENCES

The Electronics Environmental Benefits Calculator may be downloaded as a Microsoft Excel® spreadsheet at: <http://www.epa.gov/fec/publications.html#calculator>.

CONTACT INFORMATION

If you have questions related to this resource or need other assistance with the State Electronics Challenge, please contact info@stateelectronicschallenge.net.