

Measuring Environmental Benefits of Electronics Stewardship

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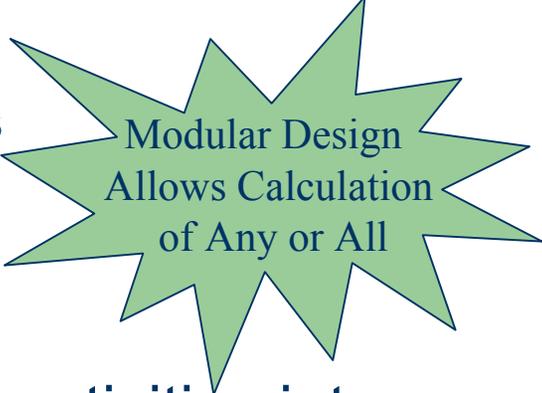
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FEC Partner Teleconference

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Overview of Electronics Environmental Benefits Calculator

- Allows federal agencies to **quantify** the environmental **benefits** of electronics stewardship
 - Purchasing EPEAT-registered products
 - Power management
 - Extending product life
 - Reuse and recycling of equipment
- Translates performance criteria and activities into estimates of quantifiable environmental benefits
 - Support decision making and resource allocation
 - Report on program achievements



Modular Design
Allows Calculation
of Any or All

Calculator Examples

Criteria/Activity	Metric or “Benefit”
RoHS Compliance	<ul style="list-style-type: none">● Quantity of toxic heavy metals avoided – total and breakdown● Hazardous waste reduction
Energy Star Compliance	<ul style="list-style-type: none">● Greenhouse gas emission reduction● Energy savings● Cost savings
Use of Post Consumer Recycled Plastic	<ul style="list-style-type: none">● Greenhouse gas emission reduction● Energy savings● Material conservation● Municipal solid waste reduction
Equipment Reuse & Recycling	<ul style="list-style-type: none">● Greenhouse gas emission reduction● Energy savings● Material conservation● Municipal solid waste reduction● Hazardous waste reduction

Overview of EEBC Tool (cont.)

- **Beta version now available**

- Computer equipment only
- Microsoft Excel Spreadsheet
- Current version on web 2/5/07
- Stay tuned for Listserv announcement of update

Funded by USEPA through Cooperative Agreement with University of Tennessee



Coming Soon

Cell phones
Web-based Tool

How the Calculator Works

- Selected **measurable criteria** based on
 - EPEAT product attributes & FEC program activities
- Defines “**baseline**” products & activities for criteria
 - E.g., quantity of hazardous material, energy use
- Calculates environmental **performance** or “benefit” of EPEAT product or activity **compared to baseline**
- Incorporates **life cycle data** where possible
- All data & assumptions documented & easily updated
 - Peer reviewed

Environmental Benefits

- Energy (kWh)
- GHG emissions (kg of CE & MTCE)
- Primary materials (kg)
- Toxic materials (kg)
- Hazardous wastes (kg)
- Municipal solid waste (kg)
- Air and water emissions (kg)
- Cost (\$) *Grand total is currently product and life cycle energy cost savings*

Benefits Calculated for Each Criteria

Criteria/Attributes	Metrics								
	Energy	Primary materials	GHG emiss.	Air emiss.	Water emiss.	Toxics	MSW	Haz waste	Cost
	(kWh)	(kg)	(kg of CE)	(kg)	(kg)	(kg)	(kg)	(kg)	(\$)
PURCHASING									
Reduced Toxicity									
RoHS-Pb reduction						*		*	
RoHS-Hg reduction (excludes lamps)						*		*	
Hg in light source; max avg of 3 mgHg/lamp						*			
Hg-free lamps						*		*	
RoHS-Cd reduction						*		*	
RoHS-Cr6+ reduction						*		*	
RoHS-PBB reduction						*		*	
RoHS-PBDE reduction						*		*	
Material Use									
Recycled content of product resin	*	*	*	*	*		*		*
Renewable/biobased material in product	*	*	*	*	*		*		*
Packaging									
Recycled content of packaging, corrugated	*	*	*	*	*		*		*
Recycled content of packaging, plastic/foam	*	*	*	*	*		*		*
Recycled content of packaging, other	*	*	*	*	*		*		*
Packaging avoided per unit by reuse	*	*	*	*	*		*		*
Energy Conservation									
Energy Star Compliant	*		*						*
USE									
% of units with power mgt features enabled	*		*						*
Extend life (longevity)	*	*	*	*	*	*	*	*	*
EOL									
Equipment Reused	*	*	*	*	*		*	*	*
Equipment Recycled	*	*	*	*	*		*	*	*

Data Inputs

- Analysis options for EPEAT purchases
 - **Basic analysis:** limited data inputs; more default values
 - **Customized analysis:** more data inputs; override defaults
- Data for basic from **FEC Annual Reporting Form**
 - EPEAT registered purchases -- **Section 2, Q4**
 - Power management -- **Section 3, Q1 & Q2**
 - Product lifetime -- **Section 3, Q1 & Q3**
 - Reuse & recycling – **Section 4, Q2**

Purchasing User Inputs

Example:
 1000 CPU
 1000 LCD
 500 Notebooks

EPEAT Silver

PURCHASING INFORMATION:	
USER INPUT	Input data or click answer
Product 1 Enter a product ID, if desired:	<input type="text"/>
Choose one	<input checked="" type="radio"/> Computer Processing unit (CPU) <input type="radio"/> Cathode ray tube monitor (CRT) <input type="radio"/> Liquid crystal display (LCD) <input type="radio"/> Notebook computer
Number of products purchased	<input type="text" value="1000"/>
Is the product EPEAT registered?	<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Not applicable
If yes, which EPEAT registration tier?	<input type="radio"/> Bronze <input checked="" type="radio"/> Silver <input type="radio"/> Gold <input type="radio"/> Do not know
Initial cost per unit (US\$) (Optional)	<input type="text"/>
<hr/>	
Product 2 Enter a product ID, if desired:	<input type="text"/>
Choose one	<input type="radio"/> Computer processing unit (CPU) <input type="radio"/> Cathode ray tube monitor (CRT) <input checked="" type="radio"/> Liquid crystal display (LCD) <input type="radio"/> Notebook computer
Number of products purchased	<input type="text" value="1000"/>
Is the product EPEAT registered?	<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Not applicable
If yes, which EPEAT registration tier?	<input type="radio"/> Bronze <input checked="" type="radio"/> Silver <input type="radio"/> Gold <input type="radio"/> Do not know
Initial cost per unit (US\$) (Optional)	<input type="text"/>
<hr/>	
Product 3 Enter a product ID, if desired:	<input type="text"/>
Choose one	<input type="radio"/> Computer processing unit (CPU) <input type="radio"/> Cathode ray tube monitor (CRT) <input type="radio"/> Liquid crystal display (LCD) <input checked="" type="radio"/> Notebook computer
Number of products purchased	<input type="text" value="500"/>
Is the product EPEAT registered?	<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Not applicable
If yes, which EPEAT registration tier?	<input type="radio"/> Bronze <input checked="" type="radio"/> Silver <input type="radio"/> Gold <input type="radio"/> Do not know

Use & EOL Data Inputs

Example: Reuse & Recycling

INSTRUCTIONS: This sheet is **OPTIONAL**. This sheet allows the user to provide data for calculating the environmental benefits of equipment use and disposition options. For this optional data analysis, enter data into appropriate fields below.

EQUIPMENT USE AND DISPOSITION INFORMATION:		
USER INPUT	Input data	
USE:		
Number of computers in service		
% of the computers that have CRTs		%
% of the computers that have LCDs		%
% that are notebook computers		%
% of computers with ENERGY STAR® standby-power function enabled		%
Average lifespan of computer systems		months
END-OF-LIFE:		
Reused¹:		
CPU: number of units reused	200	
CRT: number of units reused	200	
LCD: number of units reused		
Notebook computer: number of units reused	200	
Recycled:		
CPU: number of units recycled	800	
CRT: number of units recycled	800	
LCD: number of units recycled		
Notebook computer: number of units recycled	300	
Amount of mixed office electronics recycled ²		kilograms

¹ For example, sold, transferred, or donated to another user

² Conversions: 1 ton = 907 kg; 1 metric ton (MT)=1000 kg; 1 kg=2.205 lb

File Edit View Insert Format Tools Data Window Help

16 B I U \$ % , +.00 .00 90% Security...

A3 =

A	B	D	E	F	G	H	I
Alternate User Input	EPEAT Reference	Input data or click answer		units		Value used	units
Reduced Toxicity							
RoHS compliance (click yes if EPEAT registered)	E 4.1.1.1	<input type="radio"/> YES <input type="radio"/> NO					
Hg declaration, enter # of lamps with Hg	E 4.1.3.1	<input type="text"/>		lamps		not given	lamps
Maximum average Hg content per lamp, in milligrams (optional)	E 4.1.3.1	<input type="text"/>		mg Hg/lamp		not given	g Hg/lamp
Max average of 3 mg Hg/lamp	E 4.1.3.2	<input type="checkbox"/>					
Hg-free lamps	E 4.1.3.3	<input checked="" type="checkbox"/>				hg-free	
Material Use							
Recycled content of product resin declaration, check Y or N	E 4.2.1.1	<input type="radio"/> YES <input type="radio"/> NO					
If declared yes above, enter manufacturer's declared percent recycled content for product (optional)	E 4.2.1.1	<input type="text"/>				not given	
Recycled content (RC) of product resin, >10% RC	E 4.2.1.2	<input type="checkbox"/>					
Recycled content (RC) of product resin, >25% RC	E 4.2.1.3	<input type="checkbox"/>					
Renew/biobased material declaration, check Y or N	E 4.2.2.1	<input type="radio"/> YES <input type="radio"/> NO					
Use renew/biobased material, >10% in molded parts	E 4.2.2.2	<input type="checkbox"/>					
Product weight (<i>1 kilogram = 2.205 lb</i>)	E 4.2.3.1	<input type="text"/>		kilograms		not given	
Energy							
ENERGY STAR® (version 3.0)	E. 4.5.1.1	<input type="radio"/> Yes <input type="radio"/> No					
Early adoption of new ENERGY STAR® (version 4.0)	E 4.5.1.2	<input type="checkbox"/>					
Packaging							

3C.Alt user input-Purchasing / 4.Data comparisons / 5. RESULTS-savings / 6. GRAPHICAL RESULT!

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Calculator Results

- Quantities for each metric
 - Aggregate
 - By product & criteria
- Graphs of results
 - By metric (mass-based, energy, cost)
 - By life cycle phase (purchase, use, EOL)
 - By criteria
- Equivalents

Aggregate Savings by Inventory Metric

	A	B	F	G	H	I	J	K	R	S	T	
1			Results represent the following user selections:									
2			Purchasing:		ID:							
3			1000	CPU	no user ID given							
4			1000	LCD	no user ID given							
5			500	laptop	no user ID given							
6			Use:									
7			0		computer products in use							
8			End-of-life:									
9			200	reused CPUs	800	recycled CPUs						
10			200	reused CRTs	800	recycled CRTs						
11			0	reused LCDs	0	recycled LCDs						
12			200	reused notebooks	300	recycled notebooks						
13			0	reused mobile phones	0	recycled mobile phones						
14												
15												
16	Criteria reference E=EPEAT	CRITERIA/ATTRIBUTES	SAVINGS (difference from baseline) (kWh, kg, or \$) (savings are presented in scientific notation, e.g., 1.23E+06 = 1,230,000; and 1.23E-02 = 0.0123)									
17			<i>For explanations of calculations see Sheet 5b.</i>									
18			Energy savings	Primary material savings	GHG emission savings	Air emission savings	Water emission savings	Toxic material savings	MSW savings	Haz waste savings	Cost savings	
19			(kWh)	(kg)	(kg of CE)	(kg)	(kg)	(kg)	(kg)	(kg)	(\$)	
20			GRAND TOTAL (for all life-cycle phases)	2.84E+06	1.62E+06	2.23E+05	1.17E+07	2.45E+04	1.63E+02	3.62E+04	1.77E+04	2.46E+05
21			TOTAL All product purchases	8.86E+05	1.58E+06	6.95E+04	3.66E+06	7.65E+03	7.87E+01	0.00E+00	2.96E+03	7.68E+04
22			Subtotal: computer product 1 purchase	8.17E+04	1.46E+05	6.41E+03	3.37E+05	7.06E+02	4.86E+01	0.00E+00	1.64E+03	7.08E+03
23			Subtotal: computer product 2 purchase	7.39E+05	1.32E+06	5.80E+04	3.05E+06	6.39E+03	2.58E+01	0.00E+00	9.74E+02	6.41E+04
24			Subtotal: computer product 3 purchase	6.49E+04	1.16E+05	5.10E+03	2.68E+05	5.61E+02	4.36E+00	0.00E+00	3.46E+02	5.63E+03
25			TOTAL: Equipment use	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26			TOTAL: EOL disposition	1.95E+06	3.62E+04	1.53E+05	8.06E+06	1.69E+04	8.39E+01	3.62E+04	1.47E+04	1.69E+05
27			Subtotal: computer products	1.95E+06	3.62E+04	1.53E+05	8.06E+06	1.69E+04	8.39E+01	3.62E+04	1.47E+04	1.69E+05
28			Subtotal: mobile phones	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
29												

Go to graphs

Go to Equivalents

Beta Version.....Preliminary Results

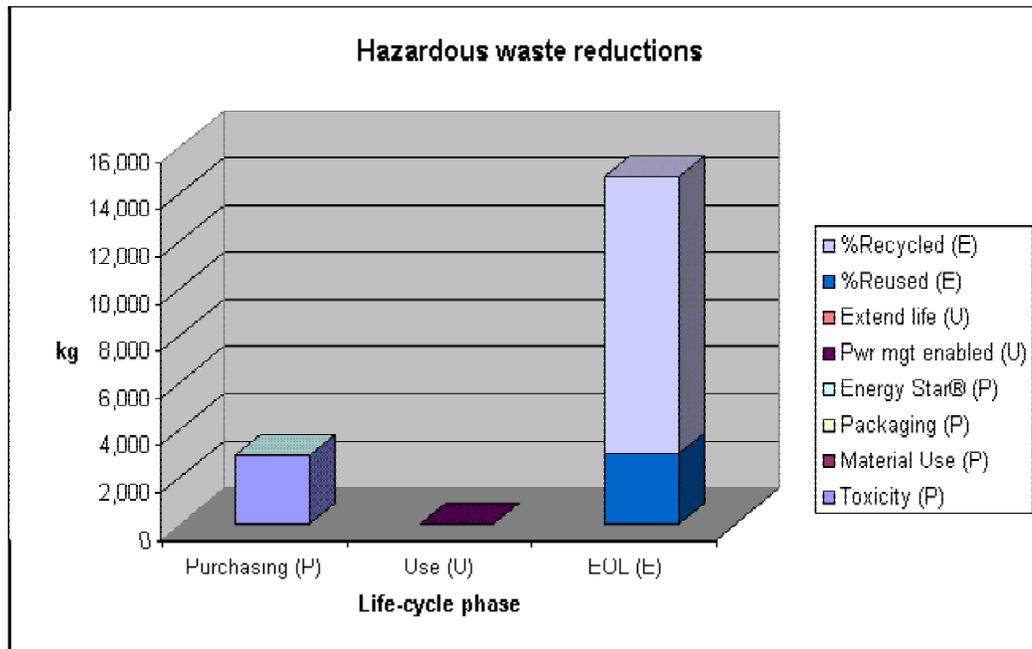
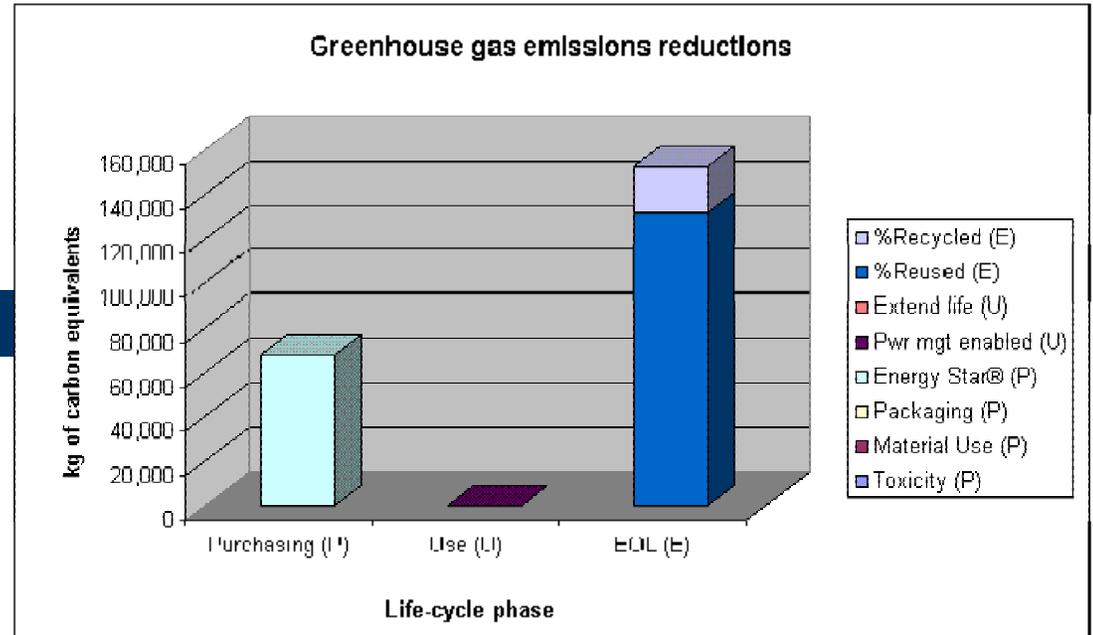
Preliminary Results

Savings By Product & Criteria

Criteria reference	CRITERIA/ATTRIBUTES	SAVINGS (difference from baseline) (kWh, kg, or \$) <small>(savings are presented in scientific notation, e.g., 1.23E+06 = 1,230,000; and 1.23E-02 = 0.0123)</small>								
E=EPEAT		Energy savings	Primary material savings	GHG emission savings	Air emission savings	Water emission savings	Toxic material savings	MSW savings	Haz waste savings	Cost savings
		(kWh)	(kg)	(kg of CE)	(kg)	(kg)	(kg)	(kg)	(kg)	(\$)
18	<i>For explanations of calculations see Sheet 5b.</i>									
92	TOTAL (product 2 purchase)	7.39E+05	1.32E+06	5.80E+04	3.05E+06	6.39E+03	2.58E+01	0.00E+00	9.74E+02	6.41E+04
93	PURCHASING	Product 2 1000 LCD								
94	Reduced Toxicity									
95	E 4.1.1.1 RoHS compliance-Pb						2.52E+01		9.74E+02	
96	E 4.1.1.1 RoHS compliance-Hg (excludes lamps)						0.00E+00			
97	E 4.1.3.1-2 Hg in light source; max avg of 3 mgHg/lamp						5.00E-03			
98	E 4.1.3.3 Hg-free lamps						0.00E+00		0.00E+00	
99	E 4.1.1.1 RoHS compliance-Cd						2.87E-02		incorporated above	
100	E 4.1.1.1 RoHS compliance-Cr6+						5.30E-01		incorporated above	
101	E 4.1.1.1 RoHS compliance-PBB						0.00E+00		incorporated above	
102	E 4.1.1.1 RoHS compliance-PBDE						0.00E+00		incorporated above	
103	SUBTOTAL						2.58E+01		9.74E+02	
104	Material Use									
105	E 4.2.1.1-3 Recycled content of product resin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00		0.00E+00
106	E 4.2.2.1-2 Average renewable/biobased material in product	<i>***** this criterion is not calculated in Version 1.0 of this Tool *****</i>								
107	SUBTOTAL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00		0.00E+00
108	Packaging									
109	E 4.8.3.1-2 Average recycled content of packaging, 1-corrugated	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00		0.00E+00
110	E 4.8.3.1-2 Average recycled content of packaging, 2-plastic/foam	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00		0.00E+00
111	E 4.8.3.1-2 Average recycled content of packaging, 3-other	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00		0.00E+00
112	E 4.8.3.1-2 CPG minimum 25% for recycled content-corrugated	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00		0.00E+00
113	E 5.8.5.1 Packaging avoided per unit by packaging reuse	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00		0.00E+00
114	SUBTOTAL	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00		0.00E+00
115	Energy									
116	E 4.5.1.1 Energy Star 3.0	7.39E+05	1.32E+06	5.80E+04	3.05E+06	6.39E+03				6.41E+04
117	E 4.5.1.3 Energy Star 4.0 (displays only)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00				0.00E+00
118	SUBTOTAL	7.39E+05	1.32E+06	5.80E+04	3.05E+06	6.39E+03				6.41E+04
119	Product cost									
120	Cost									0.00E+00
121	PURCHASING SUBTOTAL (product 2)	7.39E+05	1.32E+06	5.80E+04	3.05E+06	6.39E+03	2.58E+01	0.00E+00	9.74E+02	6.41E+04

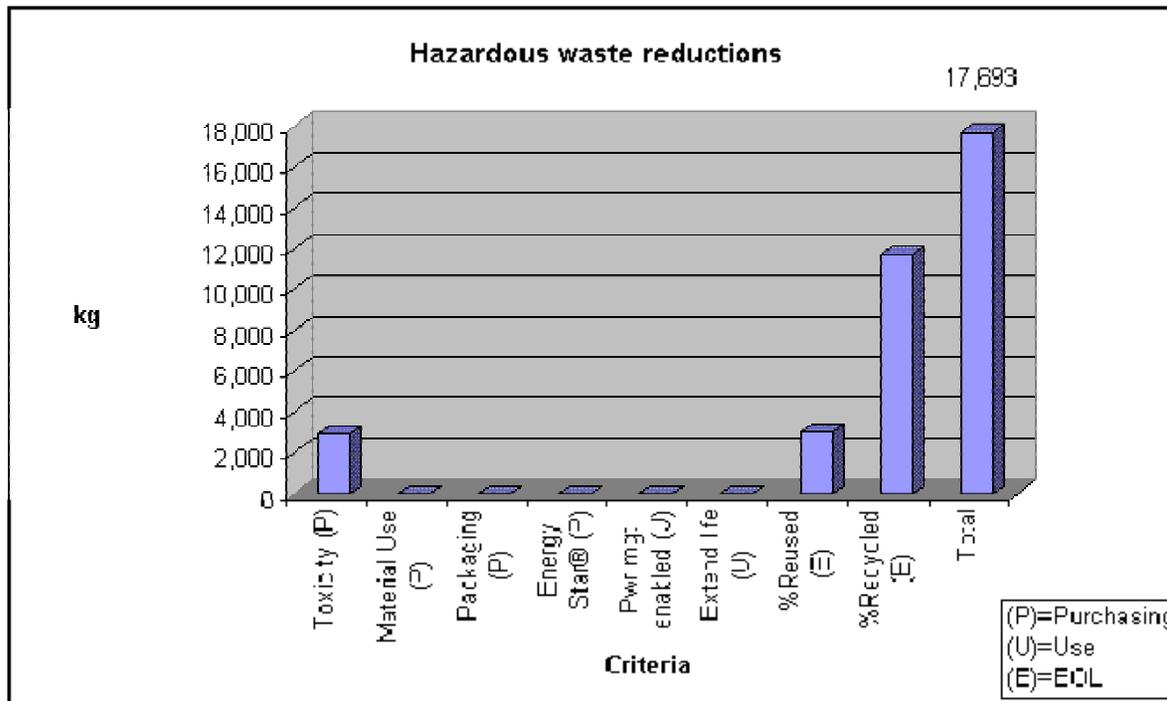
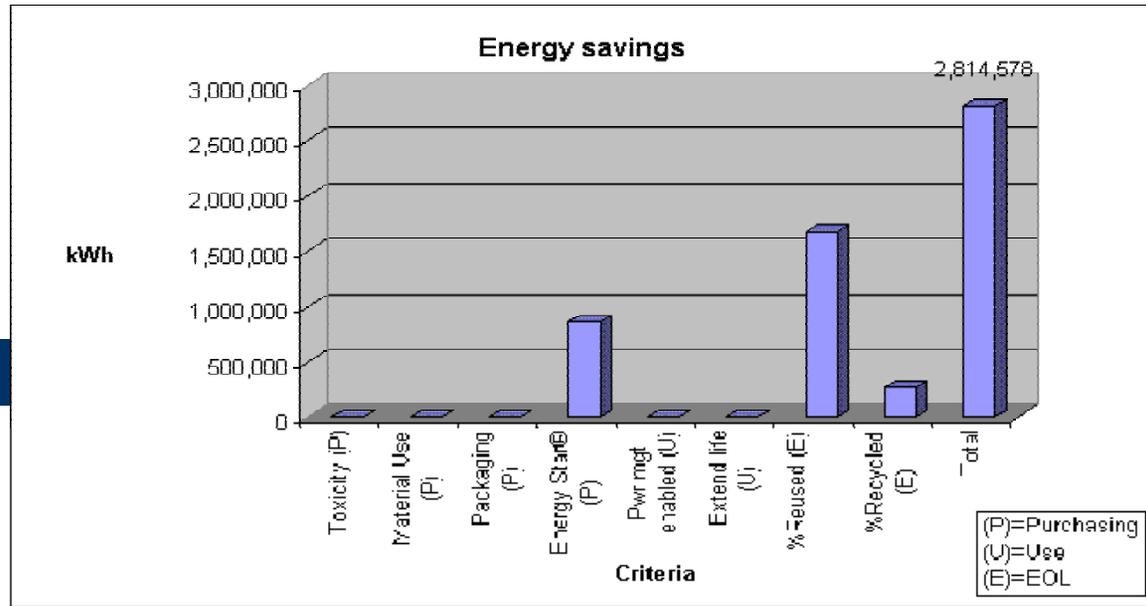
Sample Graphs

By Life Cycle Activity



Sample Graphs

By Criteria



Results as Equivalents

based on grand totals:

Data summed for:	Purchasing:	Use:	EOL:	
	Product 1: 1000 CPU	0 computer products in use	200 reused CPUs	800 recycled CPUs
	Product 2: 1000 LCD		200 reused CRTs	800 recycled CRTs
	Product 3: 500 laptop		0 reused LCDs	0 recycled LCDs
			200 reused notebooks	300 recycled notebooks
			0 reused mobile phones	0 recycled mobile phones

Metric:	Equivalency:
Energy Savings = electricity to power	250 US household(s) in a year
Greenhouse Gas Reduction* = removing	177 passenger car(s) from the road per year
Solid Waste Reduction = solid waste generated by	19 US household(s) in a year
Primary Material Savings* = the weight of	12554 refrigerator(s)
HW Reduction = the weight of	8846 brick(s)
Toxic Material Reduction:	
all toxics, including Hg = the weight of	81 brick(s)
mercury only = the mercury in	9.84 mercury fever thermometer(s)
Air emissions* =	11716 metric ton(s) of air emissions
Water emissions* =	25 metric ton(s) of water emissions
Cost savings =	\$245,915

* These may be proportionally greater than other metrics as they include all material inputs, including those from upstream processes.

Purchase 1000 EPEAT Silver desktops w/LCDs &
500 EPEAT Silver notebooks

Reuse 200 desktops, 200 CRTs, 200 notebooks

Recycle 800 desktops, 800 CRTs, 300 notebooks

Benefits Summary

	Savings	Equivalent
Energy*	2.8 million kWh	250 households/yr
GHG Emissions*	223 MTCE	177 cars off road/yr
Primary Materials*	1,620 tons	12,554 refrigerators (by wt)
Toxic Materials	163 kg (all) 6 grams	81 bricks (all toxics) 10 Hg thermometers
Hazardous Waste	17.7 tons	8846 bricks (by wt)
MSW	36.2 tons	19 households/yr
Cost Savings*	\$245,915**	

* Incorporates Life Cycle Benefits

** Product and life cycle energy costs

E.O. 13423...

Electronics Management Goals

- 95% of electronic products purchased meet EPEAT
- Enable Energy Star® features on 100% of computers and monitors (Not included in calculation)
- Reuse, donate, sell, or recycle 100% of electronic products

Calculator Data Inputs

EEBC V. 1.1 (3/9/07)

- 1.5 million computers in service
- 95% EPEAT Silver purchases; 2/3 desktop w/LCD, 1/3 notebooks
- 100% recycled; 2/3 desktop w/CRT, 1/3 notebooks

Preliminary Results

Benefits of E.O. 13423

	Savings	Equivalent
Energy*	1,190 GWh	104,686 households/yr
GHG Emissions*	93,200 MTCE	73,966 cars off road/yr
Primary Materials*	1.55 million tons	11.9 million refrigerators (by wt)
Toxic Materials	159 tons (all) 5.7 kg Hg	79,657 bricks (all toxics) 9,368 Hg thermometers
Hazardous Waste	6,950 tons	3.5 million bricks (by wt)
MSW	36,400 tons	18,849 households/yr
Cost Savings*	\$103 million**	

* Incorporates Life Cycle Benefits

** Product and life cycle energy costs

Contact Information

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Calculator Available on FEC Website:
<http://www.federalelectronicschallenge.net/resources/bencalc.htm>

.....Stay tuned for updates & web-based tool