Development and Analysis of a Survey of Small and Medium-size Manufacturers of Electronic Parts, Components and Equipment

Needs Assessment—
Assistance Needed to Improve
Environmental Performance of
US SMEs in the Electronics Sector

Commission for Environmental Cooperation
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Un resumen ejecutivo está disponible en español
Un résumé est disponible en français

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Executive Summary

There are concerns that US small and medium-size enterprises (SMEs) are not sufficiently aware nor sufficiently able to respond to changes in parts, components and product design requirements being driven by the need of larger suppliers and original equipment manufacturers (OEMs) to comply with regulatory initiatives such as the European Restriction on Hazardous Substances (RoHS) Directive. Lack of information or lack of awareness of the potential impact of such initiatives and the associated pollution prevention opportunities could hamper access to global markets.

This needs assessment was conducted by the National Pollution Prevention Roundtable (NPPR) in response to a request made by the North American Clean Electronics Pollution Prevention Partnership (CEP3). This report summarizes the work done by NPPR to develop and distribute a survey requesting information from small and medium-size manufacturers of electronic parts, components and equipment on the awareness of regulatory initiatives to reduce the use of toxic substances and assistance needed to improve environmental performance, and to compile and interpret survey results. Part of the analysis will be the foundation for designing a plan for assistance to these companies including dissemination of information and training materials, as well as appropriate tools to help the improvement of the electronics supply chain environmental performance in North America.

The following conclusions can be drawn from the findings of the survey:

The purpose of the survey was to gather information from small and medium-size electronics manufacturers on the assistance needed to address the issue of toxic and hazardous constituents in electronic and electrical equipment. Key considerations in the development of an assistance program were to meet the spirit and intent of the CEP3 initiative.

- Information on effective pollution prevention measures and their benefits will help raise awareness. The information will need to be clear and concise as small firms have little time to address non-essential issues.
- Continued involvement and support from associations from across the United States is essential.

Although the US survey had a poor response rate, the findings largely correlate with those of the Canadian survey. Combining the US and Canadian survey results led to a greater understanding of the needs of this sector.

Part of the analysis will provide the foundation for designing an assistance plan for these companies, including dissemination of information and training materials, as well as appropriate tools to help improve the environmental performance of the electronics supply chain in North America.

1.0 Background

The North American Clean Electronics Pollution Prevention Partnership[1] (CEP3) is an initiative of Commission for Environmental Cooperation (CEC). CEP3 is a voluntary environmental leadership initiative among industry, government, and non-governmental organizations committed to eliminating or significantly reducing the use of identified toxics and hazardous constituents in electronics manufactured or imported in the North American market. The purpose of CEP3 is to take a prevention approach to reducing the health & environmental risks associated with electronics production & consumption.

There are concerns that US small and medium-size enterprises (SMEs) are not sufficiently aware nor sufficiently able to respond to changes in parts, components and product design requirements being driven by the need of larger suppliers and original equipment manufacturers (OEMs) to comply with regulatory initiatives such as the European Restriction on Hazardous Substances (RoHS) Directive. Lack of information or lack of awareness of the potential impact of such initiatives and the associated pollution prevention opportunities could hamper access to global markets.

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2.0 Survey Methodology

The purpose of the industry survey was to collect information on the training and technical assistance needs of small and medium-size manufacturers of electronics with regard to the challenges of:
- complying with international electronic environmental regulations,
- reducing the use of toxic substances during manufacturing and assembly, and
- improving overall company pollution prevention performance.

Survey Design

The survey and the methodology for its delivery were developed through consultations with staff of the Canadian Centre for Pollution Prevention.

The survey comprises of 20 questions and was designed to be completed online in 15 minutes by the respondent. The survey resided at <http://www.surveymonkey.com/s.asp?u=112463057088>. A copy of the survey can be found in Appendix I.

SurveyMonkey was used to create a professional online survey. The online tool was used to design the survey, deliver the survey via e-mail, collect responses and analyze results in real-time.

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[1] The CEP3 has been developed in response to the three North American National Roundtables for Pollution Prevention (NAP3). The CEC is headquartered in Montreal and was established by the North American Agreement on Environmental Cooperation, the environmental side agreement to the North American Free Trade Agreement (NAFTA).

Delivery of Survey

On 4 January 2007, the survey was distributed by e-mail to 349 SMEs and a reminder notice was sent on 26 January 2007, which also informed respondents that the survey deadline was extended to 31 January. The names of these contacts were obtained from several directories obtained from organizations focused on electronics manufacturers along with the online Yellowpages. The list of contacts can be found in Appendix II. The NAICS codes corresponding to the Clean Electronics Scoping Study (Kelleher 2006) were used to identify types of manufacturers responding to the survey.

Other activities to engage potential participants included contacting industry associations by e-mail and asking for their help in obtaining membership lists and promoting the survey. NPPR also interviewed the Vice President of Environmental Affairs, Richard Goss, from the Electronic Industries Alliance (EIA). He also volunteered to circulate the survey to his contacts.

Due to privacy issue constraints, NPPR was not able to access membership lists directly and had to rely on the goodwill of industry associations to promote the survey.

3.0 Target Audience and Response Rate

Target Audience and Industry Profile
The target audience for the survey comprised of those small and medium-size manufacturers of electronics that have facilities in the United States. In general, electronics manufacturing comprises of the following three types according to the North American Industry Classification System (NAICS):

- NAICS 33411: Computer and Peripheral Equipment
- NAICS 33431: Audio and Video Equipment
- NAICS 33441: Semiconductor and Other Electronic Components

NPPR searched several on-line databases and utilized the contacts with the industry trade associations to distribute the survey. The list of direct contacts is included in Appendix II.
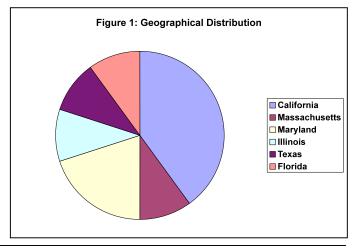
Response Rate

As of 31 January 2007, the closing date for the survey, a total of 13 respondents completed the survey for a response rate of roughly 4 percent. Generally, response rates for online surveys can range between 2 and 30 percent. For a survey of this size, the response rate is lower than expected, but the fact that the survey was live for the time period immediately before and after the Christmas season must be taken into account.

Distribution and Composition of Survey Respondents

Survey respondents were asked to indicate which state their company was located in.

As illustrated in Figure 1, the majority of respondents were located in California. This corresponds with research showing that roughly 34 percent of facilities in the United States are located in California. Massachusetts and Texas also have a high number of facilities and were represented in the survey respondents.

Figure 1: Geographical Distribution

- California
- Massachusetts
- Maryland
- Illinois
- Texas
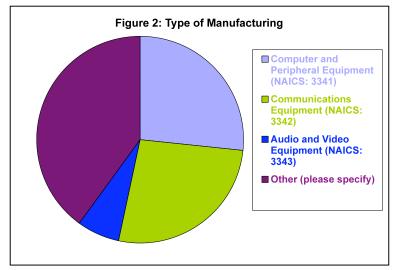- Florida

4.0 Summary of Survey Results

This section summarizes the results of the survey under the following subheadings:

- Characteristics of Survey Respondents
- Current Environmental Activities
- Awareness of Environmental Initiatives Aimed at the Electronics Sector
- Current Challenges in Improving Environmental Performance
- Information, Training and Technical Assistance Needs

4.1 Characteristics of Survey Respondents

The survey respondents were predominantly found in the Computer and Peripheral Equipment (NAICS: 3341) or under the "other" category (Figure 2). When asked to specify under other, responses included Electronic Test and Measurement as the most common response.

Figure 2: Type of Manufacturing

- Computer and Peripheral Equipment (NAICS: 3341)
- Communications Equipment (NAICS: 3342)
- Audio and Video Equipment (NAICS: 3343)
- Other (please specify)

Another interesting statistic derived from the survey was the geographic location of the markets for electronic industry companies. Fifty percent of the respondents indicated that 25 to 50 percent of their business is in the United States and the other 50 percent do over 51 percent of their business in the United States. Nearly 90 percent of respondents do under 25 percent of their business in Canada, 60 percent do between 25 and 50 percent of business in Europe and 45 percent of respondents do under 25 percent of their business globally.

Other significant highlights from the survey respondents:
- 61 percent have over 500 employees
- 70 percent have both a quality management system and an environmental management system
- 50 percent have an affiliation with an international industry association along with an affiliation with local, regional, and national association
- 63 percent are original equipment manufacturers while 18.2 percent consider themselves sub-assemblers.

4.2 Current Environmental Activities

The survey respondents had good systems in place to address potential environmental issues. Over 60 percent had an environmental health and safety manager and, as noted above, 70 percent had quality management systems.

Survey respondents were asked to provide insights on the current status of their pollution prevention initiatives. As expected, many were carrying out the options of training, housekeeping

and product substitution to some degree. Table 5 lists the types of pollution prevention activities engaged in by companies in the electronics sector.

Table 1: Current Pollution Prevention Activities Conducted by Facilities Surveyed	Percent of Facilities Engaged In
Integrate environmental considerations into purchasing practices	56
Integrate environmental considerations into inventory management systems	22
Use good housekeeping practices to minimize wastes	67
Change production schedules to minimize equipment and feedstock changeovers	22
Segregate byproducts at source	33
Staff are trained in materials handling and pollution prevention	67
Replace polluting materials used in production with non-polluting or less polluting materials and feedstock	78
Introduce new technologies or approaches to existing operating systems, processes or practices to reduce pollutants generated and materials, energy or water wasted	78
Integrate environmental criteria into the usual design considerations of performance, cost, quality, etc.	67
Use methods to prevent pollution over the entire life cycle of the product	67

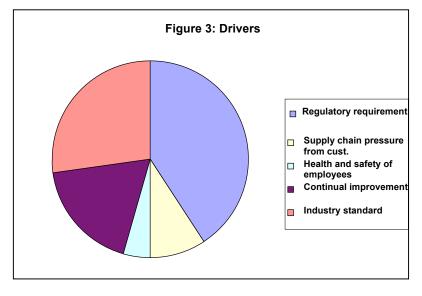## 4.3 Awareness of Environmental Initiatives Aimed at the Electronics Sector

The survey participants indicated that they were familiar with the RoHS directive, with approximately 80 percent of the respondents either fully or partially engaged in carrying out actions to address it. Interestingly, however, respondents claimed to have little knowledge of North American environmental initiatives aimed at the electronics sector, including the

governmental green electronics purchasing specifications, the US Electronic Product Stewardship Assessment tool (EPEAT), or Canada's Environmental Choice–Eco-logo Certification Criteria Document 158 on notebook and desktop computers, including monitors.

As highlighted in the February 2007 progress report on this project, the interview with Richard Goss of EIA gave information about California's expansion of its current RoHS regulations and a summary of the mandatory reporting requirements in Maine and Washington for computer and consumer electronics manufacturers.

As the drivers for taking action on environmental issues are regulatory requirements followed by industry standards and continual improvement (Figure 3), these two pieces of legislation may over time have an effect on respondents. Not one respondent cited cost-saving measures as a driver, even though they were encouraged to select as many drivers as possible.

Figure 3: Drivers

- Regulatory requirement
- Supply chain pressure from cust.
- Health and safety of employees
- Continual improvement
- Industry standard

4.4 Current Challenges in Improving Environmental Performance
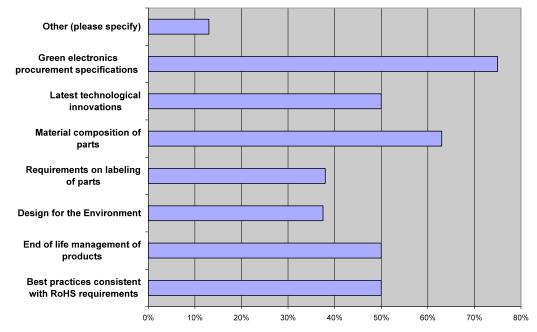
A list of twelve issues was provided to participants to gain a sense of what was hindering their respective companies from improving their environmental performance. The top four reasons are highlighted in Table 2.

Table 2: Barriers to Improved Environmental Performance	
Issue	**Response (%)**
Time	66
Insufficient resources for monitoring, measurement, and compliance auditing	55.6
Not enough information on new and emerging environmental performance requirements from markets and authorities	44.4
No in-house expertise	33.3

4.5 Information, Training and Technical Assistance Needs

The needs for improving environmental performance vary among SMEs in the electronics sector. As evidenced by Figure 4, access to electronics procurement specifications (75 percent) followed by material composition of parts (63 percent) were the two identified most often. One respondent indicated "other" and when asked to specify, the response was interesting: "What is the industry doing with regard to upstream supply chain information and such details as availability and standardization in providing data on the content of toxic materials required for downstream manufacturers to achieve regulatory compliance? A great deal of money has been spent on infrastructure and preparation, only to find the industry is not capable of or willing to support [such initiatives]."

Figure 4: Needs for Environmental Improvement

Survey participants were asked about the format they would prefer for receiving assistance in addressing environmental performance issues. The top three options, as noted in Figure 5, were best practices guides, followed by case studies, and Webinars/facilitated seminars disseminated via the Internet.
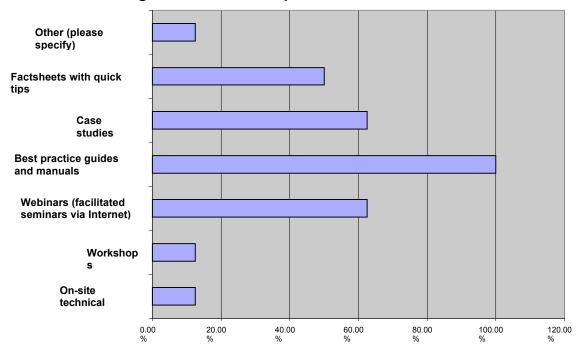
Figure 5: Preferred Options for Assistance

The principal sources of information currently relied upon by the survey participants include trade publications (100 percent), industry and company websites (87.5 percent), and suppliers (50 percent).

All of the survey respondents were interested in follow-up information. They were also all interested in receiving further information on best practices and on the survey results. One-third of them were interested in being contacted with further information in support of this initiative.

4.6 Comparison to Canadian Survey Results

A major difference between the two surveys lay in the numbers of respondents. The NPPR survey produced only about half as many respondents as the Canadian survey, which could have affected its conclusions. The results from the two surveys showed several similarities along with some interesting differences. The common areas of greatest significance concerned the types of information of most interest to SMEs and the preferred options for receiving it and technical assistance.

For Canadian SMEs, the information of greatest interest concerned green electronic procurement specifications, material composition of parts, best management practices consistent with RoHS requirements, end-of-life management of electronics, and the latest technological innovations. The methods for receiving information, in order of preference, included webinars, case studies and factsheets. These items were preferred over on-site technical assistance and workshops.

What the responding companies felt to be a hindrance to improving their environmental performance was one of the most interesting differences between the surveys. The Canadian survey indicated that insufficient capital to undertake new technologies was a leading hindrance, while the NPPR survey revealed this to be less of a problem than time.

5.0 Lessons Learned and Recommendations

5.1 Lessons Learned

Despite the survey responses, the following lessons were garnered from developing, conducting and evaluating a survey of small and medium-size manufacturers of electronic parts, components and equipment.

- *Associations and companies rarely give out contact information other than website contact forms*. Although our contact at EIA and other such contacts attempted to circulate the survey, NPPR had difficulty finding other contact information from websites and the online yellow pages. Many of the contacts gave only general e-mail addresses, which increased the chance that the surveys were not given to the right person in the company.

- *Deeper involvement of the associations in the survey*. Although a number of the associations were aware of the survey, they could have been more actively involved in the process. Activities, such as co-signing the initial survey and promoting the survey internally through newsletters and on association websites, might have helped increase their involvement.

- *Businesses' main motivation for pollution prevention comes from regulatory requirements.* The requirements imposed by regulations are effective in getting businesses to start making changes, but other methods must provide the motivation for them to go beyond those requirements.

- *Environmental stewardship is a competitive advantage in the electronics sector.* In order for businesses to be competitive both nationally and internationally, improved environmental performance can be key. The importance of this and the benefits that can accrue from it are things that should be made clear to businesses that have not yet attempted to improve their environmental performance.

- *Flexibility is a key attribute of any environmental program targeted at SMEs.* Facilities within this sector have diverse needs and it appears that many are starting

from different levels. Therefore, program features need to be broad enough to attract participants with differing levels of interest.

- ***Reliance on trade publications for direction on environmental issues.*** The electronics sector seems especially to rely on trade publications for guidance with environmental issues.

- ***Do not neglect the white goods manufacturers who were not the target of the survey.*** There may be opportunities to advance awareness in this niche of the sector.

- ***Cost savings was not a significant driver to seeking environmental improvements.*** In most pollution prevention projects, cost savings is one the top reasons for seeking environmental improvements. However, respondents to this survey did not pinpoint cost savings as an opportunity. There seems to be a strong sense among those in the sector that substituting for the RoHS-targeted substances will be costly.

5.2 Recommendations

To build awareness and momentum for the project, the initial objectives for the project should be to create a set of early "wins" for the project. Specifically, in the United States, CEP3 should:

- Set up a series of RoHS-readiness webinars (telephone conferences with Internet presentation of materials using a Powerpoint® presentation). Each webinar would focus on a specific issue. These webinars will allow SMEs to participate without necessitating travel to a specific location. Advertising them can be done through NPPR membership roles and trade associations.

- Research, develop and distribute a number of best management practices that address compliance issues, pollution prevention opportunities and costs implications for addressing the RoHS directive.

- Document and distribute case studies of SMEs in North America that have successfully addressed the RoHS directive.

- Work toward including the electronics sector in the Green Suppliers Network program. The Green Suppliers Network is a collaborative venture among industry, the US Environmental Protection Agency (EPA), and the US Department of Commerce's Manufacturing Extension Partnership (MEP). The Green Suppliers Network works with all levels of the manufacturing supply chain to improve processes and minimize waste generation.

- Prepare and implement a communications plan that would engage all stakeholders in the electronics sector, including customers, suppliers, trade publications, academic websites/publications, local chambers of commerce, and industry associations.

6.0 Conclusions

The following conclusions can be drawn from the findings of the survey:

The purpose of the survey was to gather information from small and medium-size electronics manufacturers on the assistance needed to address the issue of toxic and hazardous constituents in electronic and electrical equipment. Key considerations in the development of an assistance program were to meet the spirit and intent of the CEP3 initiative.

- Information on effective pollution prevention measures and their benefits will help raise awareness. The information will need to be clear and concise as small firms have little time to address non-essential issues.
- Continued involvement and support from associations from across the United States is essential.

Although the US survey had a poor response rate, the findings largely correlate with those of the Canadian survey. Combining the US and Canadian survey results led to a greater understanding of the needs of this sector.

Part of the analysis will provide the foundation for designing an assistance plan for these companies, including dissemination of information and training materials, as well as appropriate tools to help improve the environmental performance of the electronics supply chain in North America.

References

Kelleher, M. 2006. Clean Electronics Scoping Study (unpublished paper prepared for the CEC Secretariat). May. Montreal: CEC.

Appendix I—Survey

Capacity of Electronics Manufacturers to Improve Environmental Performance

The purpose of this survey is to assess the information, training and technical assistance needs of small and medium-size manufacturers of electronics to participate in the Clean Electronics Pollution Prevention Partnership (CEP3). The CEP3 is a voluntary environmental leadership initiative committed to eliminating or significantly reducing the use of identified toxics and hazardous constituents in electronics manufactured or imported in the North American market. The CEP3 has been developed by a working group of the North American Commission for Environmental Cooperation.

This survey is being conducted by the National Pollution Prevention Roundtable on behalf of CEP3. The National Pollution Prevention Roundtable is a 501(c) (3) non-profit organization that is a national forum for promoting the development, implementation, and evaluation of efforts to avoid, eliminate, or reduce pollution at the source. Additionally, similar surveys are being conducted on behalf of CEP3 by the Canadian and Mexican Pollution Prevention Roundtables.

This survey will take approximately 10 minutes to complete and can be answered on your computer using SurveyMonkey.com. The results of the survey will be used to develop an assistance program for small and medium-size manufacturers of electronics to improve their environmental performance specifically on the issue of toxic and hazardous constituents in electronic or electrical equipment. We would be pleased to share the results of the survey with you should you be interested.

Please complete the survey by January 19, 2007.

1. What type of electronics manufacturing does your company do? (Please select all that apply)
___ Computer and Peripheral Equipment (NAICS: 3341)
___ Communications Equipment (NAICS: 3342)
___ Audio and Video Equipment (NAICS: 3343)
___ Semiconductor and Other Electronic Components (NAICS: 3344)
___ Other (Please specify)

2. Where does your company reside within the electronics supply chain? (Select all that apply)
___ First tier supplier of components
___ Second tier supplier of components
___ Subassembly
___ Original equipment manufacturer
___ Other (please specify)

3. How many people are employed at your company?
___ 1-10
___ 11-50
___ 51-100
___ 101-250
___ 251-500
___ Over 500

4. What state is your company primarily located in?
_____

5. What is your facility's zip code?

_____

6. Where does the market for your company's products exist geographically by percentage

	0%	under 25%	25-50%	51-75%	Over 76%
USA					
Canada					
Mexico					
Europe					
Global					

7. What affiliations does your company currently maintain?
___ Local Chamber of Commerce
___ Regional industry association
___ National industry association
___ International industry association
___ No affiliation with an association

8. Does your company have a Health, Safety and Environment Manager?
___ Yes
___ No
___ Don't know

9. Does your company have a:
(Select all that apply)
___ Quality management system
___ Environmental management system
___ None of the above
___ Don't know

10. Pollution prevention is the reduction or elimination of pollution at the source (source reduction) instead of at the end-of-the-pipe or stack.

As per the definition of pollution prevention above, does your facility take or has your facility taken the following pollution prevention measures to improve its environmental performance?

	Not considering it	Planning to consider it	Considering it currently	Carrying out to some degree	Carrying it out fully	Not applicable
Integration of environmental considerations into purchasing practices						
Integration of environmental considerations into inventory management systems						
Use good housekeeping practices to minimize wastes						
Change production schedules to minimize equipment and feedstock changeovers						
Segregate by-products at source						
Training staff in materials handling & pollution prevention						
Replacing polluting materials used in production with non-						

polluting or less polluting materials and feedstock						
Introduced new technologies or approaches to existing operating systems, processes or practices to reduce pollutants generated and materials, energy or water wasted						
Integrate environmental criteria into the usual design considerations of performance, cost, quality etc.						
Use methods to prevent pollution over the entire life cycle of the product						

11. Does your company take any measures to reduce and/or eliminate the use of the following substances? (Select all that apply)
___ Lead
___ Mercury
___ Cadmium
___ Hexavalent Chromium
___ Polybrominated biphenyls (PBBs)
___ Polybrominated diphenly ethers (PBDEs)
___ None of the above
___ Other (please specify)

12. If you checked any of the substances above, what was your reason for reducing or eliminating the use of the substance(s)? (Select all that apply)
___ Regulatory requirement
___ Cost savings
___ Supply chain pressure from customer
___ Health and safety of employees
___ Continual improvement
___ Industry standard

13. What is your company's level of awareness and/or response on the following initiatives?

	Not aware of this initiative	Aware of this initiative	Planning to address	Carrying out actions to address to some degree	Carrying out actions to address fully	N/A
Restriction on the use of certain Hazardous Substances (RoHS) Directive (in Europe)						
Waste Electrical and Electronic Equipment (WEEE) Directive (in Europe)						
California's SB20/50						
Government green electronics procurement specifications						
U.S. Electronic Product Environmental Assessment Tool (EPEAT)						
Canada's Environmental Choice –Eco-logo Certification Criteria Document 158 on notebooks and desktop computers including monitors						

14. Has your company ever had difficulties exporting products outside the United States due to environmental regulatory restrictions (i.e. RoHS)? If yes, can you please elaborate on the difficulties your company encountered and how they were resolved.

15. What are issues have you faced that are hindering your company from improving its environmental performance? (please check all that apply)
___ Not enough information on what pollution prevention is and what it can do to help a company's environmental and quality performance
___ Not enough information on new and emerging environmental performance requirements from markets and authorities
___ Little upper management support
___ Time
___ No in-house expertise
___ Insufficient training
___ Inadequate documentation systems for record keeping
___ Insufficient resources for monitoring, measurement, and compliance auditing
___ Insufficient capital to undertake investments in new technologies
___ Financial resources to undertake pollution prevention measures
___ Core culture of company is non-supportive
___ Other (please specify)

16. What would your company be interested in learning more about? (please check all that apply)
___ Best practices consistent with RoHS requirements
___ End of life management of products
___ Design for the Environment
___ Requirements on labeling of parts
___ Material composition of parts
___ Latest technological innovations
___ Green electronics procurement specifications
___ Other (please specify)

17. What options for information, training and technical assistance would you prefer? (please check all that apply):
___ On-site technical assistance visits
___ Workshops
___ Webinars (i.e. facilitated seminars via the internet)
___ Best practices guides and manuals
___ Case studies
___ Fact sheets with quick tips
___ Other (please specify)

18. What sources of information do you currently rely upon to stay informed of issues that impact your business? (please check all that apply)
___ Trade publications
___ Industry and company websites
___ Customers
___ Suppliers
___ Local industry associations
___ Academic websites and publications
___ Other (please specify)

If you are interested in contributing further to this initiative or would like more information, please provide your name and contact information below. We may follow-up with you over the coming months.

19. Contact Information:

Name: _____
Job Title: _____
Telephone: _____
E-mail Address: _____
Company name: _____

20. I am interested in:
___ Receiving survey results
___ Receiving further information on best practices for my industry
___ Being contacted for further details to support this initiative
___ Other (please specify)

Appendix II—Contacts

Company	Category
Hughes Circuit, Inc.	Circuit Board Assembly and Repair
R & D Circuits Inc	Circuit Board Assembly and Repair
Accu-sembly, Inc.	Circuit Board Assembly and Repair
KNP Electronics, Inc	Circuit Board Assembly and Repair
Captronics, Inc.	Circuit Board Assembly and Repair
Inovaxe Corporation	Circuit Board Assembly and Repair
Affordable Computer Repair	Circuit Board Assembly and Repair
Stellar Manufacturing Inc.	Circuit Board Assembly and Repair
Pete's Computer Solutions	Circuit Board Assembly and Repair
Cascade Electronic Service	Circuit Board Assembly and Repair
KBC Electronics Inc.	Circuit Board Assembly and Repair
Sage Reps	Circuit Board Assembly and Repair
Eagle Electronics Inc.	Circuit Board Assembly and Repair
Flextron Circuit Assembly	Circuit Board Assembly and Repair
Integrated Test Corporation	Circuit Board Assembly and Repair
Quick Response Technologies	Circuit Board Assembly and Repair
Inhome computer Services	Circuit Board Assembly and Repair
T S X Technologies	Circuit Board Assembly and Repair
Clover Electronics Inc.	Circuit Board Assembly and Repair
Computers2Go	Circuit Board Assembly and Repair
Aston PC	Circuit Board Assembly and Repair
Baytron Ltd	Circuit Board Assembly

	and Repair
F.A.Y. solutions	Circuit Board Assembly and Repair
Tv Doctor	Circuit Board Assembly and Repair
A & H Tech	Circuit Board Assembly and Repair
Audio Technical Services	Circuit Board Assembly and Repair
Electronics Assembly	Circuit Board Assembly and Repair
Final Coat, LLC.	Circuit Board Assembly and Repair
Computer Repair of Covina	Circuit Board Assembly and Repair
Francis Creek Electronics	Circuit Board Assembly and Repair
Elite Tek services	Circuit Board Assembly and Repair
Nyco Systems	Circuit Board Assembly and Repair
Uniflex Circuits Inc.	Circuit Board Assembly and Repair
D.G. Assembly Fabrication Services	Circuit Board Assembly and Repair
Emergency Computer Technician Ltd.	Circuit Board Assembly and Repair
Parker Group the Inc.	Circuit Board Assembly and Repair
S.J. Cheek Jr. & Associates, LLC.	Circuit Board Assembly and Repair
LSI Electronics	Circuit Board Assembly and Repair
Atlantic Systems Electronics Inc	Electronic Testing Equipment Service and Repair
Instrument Calibration Technical services	Electronic Testing Equipment Service and Repair
Phoenix Systems of Nc	Electronic Testing Equipment Service and Repair
Test Equipment Solutions Today	Electronic Testing Equipment Service and Repair
Wintronics	Electronic Testing Equipment Service and Repair

Utility Equipment Inc.	Electronic Testing Equipment Service and Repair
US Office Solutions Tampa	Electronic Testing Equipment Service and Repair
Rochester Industrial Services	Electronic Testing Equipment Service and Repair
Peachtree Calibration	Electronic Testing Equipment Service and Repair
JNR Electronics	Electronic Testing Equipment Service and Repair
Shaud's Electronics	Electronic Testing Equipment Service and Repair
A Plus Calibrations	Electronic Testing Equipment Service and Repair
Audio Technical Services	Electronic Testing Equipment Service and Repair
Instrument Meter Specialties	Electronic Testing Equipment Service and Repair
Fayad Computer Sales and Servicing	Electronic Testing Equipment Service and Repair
National Test Equipment Inc.	Electronic Testing Equipment Service and Repair
Vincent electronics	Electronic Testing Equipment Service and Repair
Lestronics	Electronic Testing Equipment Service and Repair
Burton Industries	Electronic Testing Equipment Service and Repair
O.E.C. International Inc.	Equipment and Supply Wholesale and manufacture
Instruments and Parts Inc	Equipment and Supply Wholesale and manufacture

Sun Rep	Equipment and Supply Wholesale and manufacture
Bob Curran	Equipment and Supply Wholesale and manufacture
Carl's Electronics	Equipment and Supply Wholesale and manufacture
Vision Technical Sale	Equipment and Supply Wholesale and manufacture
Dual Bridge Corporation	Equipment and Supply Wholesale and manufacture
Troika Studios	Equipment and Supply Wholesale and manufacture
Total Tech Release	Equipment and Supply Wholesale and manufacture
Sierra Control systems	Equipment and Supply Wholesale and manufacture
Diablo Industries	Equipment and Supply Wholesale and manufacture
Baldwin Technologies Pcb Designs	Equipment and Supply Wholesale and manufacture
Lightwave Technologies	Equipment and Supply Wholesale and manufacture
Cip Process Inc.	Equipment and Supply Wholesale and manufacture
Hybrid Design Associates	Equipment and Supply Wholesale and manufacture
Martin's Technique	Equipment and Supply Wholesale and manufacture
Tusonix Inc.	Equipment and Supply Wholesale and manufacture
Electron Tubes for Industry	Equipment and Supply Wholesale and manufacture

	Equipment and Supply
Norfolk Electronics	Wholesale and manufacture
Benchmark Structural Ceramics Corporation	Equipment and Supply Wholesale and manufacture
Scanrom Publications	Equipment and Supply Wholesale and manufacture
Brookdale Electronics, Inc.	Equipment and Supply Wholesale and manufacture
NY Components	Equipment and Supply Wholesale and manufacture
Advance Circuit Technology Inc.	Equipment and Supply Wholesale and manufacture
E-Mags Electronic Publishing	Equipment and Supply Wholesale and manufacture
Delta Computer Systems Inc.	Equipment and Supply Wholesale and manufacture
Season Components Co., Ltd.	Equipment and Supply Wholesale and manufacture
Permacor Inc.	Equipment and Supply Wholesale and manufacture
Ferrite International	Equipment and Supply Wholesale and manufacture
Ft. Worth Electronics	Equipment and Supply Wholesale and manufacture
Transfong Enterprises Inc.	Equipment and Supply Wholesale and manufacture
Rose Electronics	Equipment and Supply Wholesale and manufacture
Mercron	Equipment and Supply Wholesale and manufacture
Correctional Systems, Inc.	Equipment and Supply Wholesale and manufacture

Count on Tools, Inc.	Equipment and Supply Wholesale and manufacture
Outsource Electronics Inc.	Equipment and Supply Wholesale and manufacture
Duane Jaworski & Associates	Equipment and Supply Wholesale and manufacture
Caltronics Design and Assembly Inc.	Equipment and Supply Wholesale and manufacture
Inteprod LLC	Equipment and Supply Wholesale and manufacture
Trs Ceramics Inc.	Equipment and Supply Wholesale and manufacture
Connector And Socket Resource Group	Equipment and Supply Wholesale and manufacture
DBM Technologies	Equipment and Supply Wholesale and manufacture
L & L Assemblies	Equipment and Supply Wholesale and manufacture
Nova Engineering Inc.	Equipment and Supply Wholesale and manufacture
Cardinal Circuit	Equipment and Supply Wholesale and manufacture
Maxtek	Equipment and Supply Wholesale and manufacture
Universal Instruments Corporation	Equipment and Supply Wholesale and manufacture
Apex America Inc.	Equipment and Supply Wholesale and manufacture
Circuit Manufacturing Inc.	Equipment and Supply Wholesale and manufacture
Smart Electronics and Assembly	Equipment and Supply Wholesale and manufacture

Selco Products Company	Equipment and Supply Wholesale and manufacture
General Wiring Components	Equipment and Supply Wholesale and manufacture
GRE America Inc	Equipment and Supply Wholesale and manufacture
Jiv Electronics	Equipment and Supply Wholesale and manufacture
Channel Microwave Corporation	Equipment and Supply Wholesale and manufacture
Summit Assembly	Equipment and Supply Wholesale and manufacture
South Valley Design	Equipment and Supply Wholesale and manufacture
Kaiser Electro-Optics	Equipment and Supply Wholesale and manufacture
Starled	Equipment and Supply Wholesale and manufacture
Daico Industries	Equipment and Supply Wholesale and manufacture
Accurate Electronics	Equipment and Supply Wholesale and manufacture
Automation electronics	Equipment and Supply Wholesale and manufacture
Delta Tau Systems	Equipment and Supply Wholesale and manufacture
CeeJay	Equipment and Supply Wholesale and manufacture
Tocabi America Corporation	Equipment and Supply Wholesale and manufacture
KEA Electronics	Equipment and Supply Wholesale and manufacture

Global Manufacturing Solutions	Equipment and Supply Wholesale and manufacture
Speck Electronics	Equipment and Supply Wholesale and manufacture
Astronic	Equipment and Supply Wholesale and manufacture
Engineering Specifics Association Inc.	Equipment and Supply Wholesale and manufacture
Elma Electronics Inc.	Equipment and Supply Wholesale and manufacture
Jem America Corporation	Equipment and Supply Wholesale and manufacture
Topline Corporation	Equipment and Supply Wholesale and manufacture
Aja Video	Equipment and Supply Wholesale and manufacture
Raycon Technology	Equipment and Supply Wholesale and manufacture
Power Devices Inc	Equipment and Supply Wholesale and manufacture
Micro Analog	Equipment and Supply Wholesale and manufacture
Anyeparts.com	Equipment and Supply Wholesale and manufacture
Segue Electronics Inc.	Equipment and Supply Wholesale and manufacture
TCE	Equipment and Supply Wholesale and manufacture
Circuit Spectrum Inc	Equipment and Supply Wholesale and manufacture
Gainwa International	Equipment and Supply Wholesale and

	manufacture
	Equipment and Supply
Pertel Communications Inc	Wholesale and manufacture
	Equipment and Supply
Racestuff	Wholesale and manufacture
	Equipment and Supply
Synergetics	Wholesale and manufacture
	Equipment and Supply
International Printing	Wholesale and manufacture
	Equipment and Supply
Viking Electronics	Wholesale and manufacture
	Equipment and Supply
Powerline Control Systems	Wholesale and manufacture
	Equipment and Supply
Abbott Technologies Inc.	Wholesale and manufacture
	Equipment and Supply
Vector Electronics & Technologies	Wholesale and manufacture
	Equipment and Supply
American LED	Wholesale and manufacture
	Equipment and Supply
Mr. Sprockets	Wholesale and manufacture
	Equipment and Supply
International Power	Wholesale and manufacture
	Equipment and Supply
Solid Electric Corporation	Wholesale and manufacture
	Equipment and Supply
Bishop Electronics Corporation	Wholesale and manufacture
	Equipment and Supply
Engine Electronics	Wholesale and manufacture
	Equipment and Supply
Vos Systems	Wholesale and manufacture
Mercury United Electronics Inc.	Equipment and Supply Wholesale and

	manufacture Equipment and Supply
Varatouch Technology Inc.	Wholesale and manufacture Equipment and Supply
A Flex	Wholesale and manufacture Equipment and Supply
Accurate Circuit Engineering	Wholesale and manufacture Equipment and Supply
Filter Concepts	Wholesale and manufacture Equipment and Supply
Gigavac	Wholesale and manufacture Equipment and Supply
CD International Technology Inc.	Wholesale and manufacture Equipment and Supply
Microwave Power Inc	Wholesale and manufacture Equipment and Supply
Nissho Electronics Corporation	Wholesale and manufacture Equipment and Supply
American Relays Inc	Wholesale and manufacture Equipment and Supply
Buf Technology	Wholesale and manufacture Equipment and Supply
Universal Instruments Corporation	Wholesale and manufacture Equipment and Supply
Aurum Assembly Plus Inc	Wholesale and manufacture Equipment and Supply
COHU	Wholesale and manufacture Equipment and Supply
Strat Edge Corporation	Wholesale and manufacture Equipment and Supply
VAS Engineering	Wholesale and manufacture Equipment and Supply
AEM Inc.	Wholesale and

	manufacture
	Equipment and Supply
Wintriss Engineering Corporation	Wholesale and manufacture
	Equipment and Supply
Regal Electronics Inc.	Wholesale and manufacture
	Equipment and Supply
Toko America	Wholesale and manufacture
	Equipment and Supply
Turbo Electronics	Wholesale and manufacture
	Equipment and Supply
Datum Systems Inc.	Wholesale and manufacture
	Equipment and Supply
Neptune Systems	Wholesale and manufacture
	Equipment and Supply
Engineered Components Co.	Wholesale and manufacture
	Equipment and Supply
HauteSpot Networks	Wholesale and manufacture
	Equipment and Supply
Pacific Coast Circuits	Wholesale and manufacture
	Equipment and Supply
A Squared Technologies Inc	Wholesale and manufacture
	Equipment and Supply
General Electronic Devices	Wholesale and manufacture
	Equipment and Supply
Lintelle Engineering Inc	Wholesale and manufacture
	Equipment and Supply
Hirose Electric	Wholesale and manufacture
	Equipment and Supply
Topaz Systems Inc.	Wholesale and manufacture
	Equipment and Supply
Wireless Concepts Inc	Wholesale and manufacture
Microwave Monolithics Inc.	Equipment and Supply Wholesale and

	manufacture
	Equipment and Supply
Aircraft Stamping Co. Inc.	Wholesale and manufacture
	Equipment and Supply
Navone Engineering	Wholesale and manufacture
	Equipment and Supply
Applied Engineering Inc.	Wholesale and manufacture
	Equipment and Supply
Aphex Systems Ltd.	Wholesale and manufacture
	Equipment and Supply
Opti-Cal	Wholesale and manufacture
	Equipment and Supply
Electronic Material Industries, Inc.	Wholesale and manufacture
	Equipment and Supply
Alco	Wholesale and manufacture
	Equipment and Supply
Tsc Electronics Ltd.	Wholesale and manufacture
	Equipment and Supply
Ledtronics Inc.	Wholesale and manufacture
	Equipment and Supply
Actron, Inc.	Wholesale and manufacture
	Equipment and Supply
Solomon Technology Corp.	Wholesale and manufacture
	Equipment and Supply
Summit Technology	Wholesale and manufacture
	Equipment and Supply
Griffin Enterprises	Wholesale and manufacture
	Equipment and Supply
Linear Technology	Wholesale and manufacture
	Equipment and Supply
JEMM Controls Inc	Wholesale and manufacture
	Equipment and Supply
Q Corporation	Wholesale and

	manufacture
	Equipment and Supply
All American Electronics	Wholesale and manufacture
	Equipment and Supply
Strasburg-Jarvis Inc.	Wholesale and manufacture
	Equipment and Supply
Networks International Corporation	Wholesale and manufacture
	Equipment and Supply
SE2 Labs	Wholesale and manufacture
	Equipment and Supply
Phoenix Precision Inc.	Wholesale and manufacture
	Equipment and Supply
International Configurations Inc.	Wholesale and manufacture
	Equipment and Supply
Custom connector Corporation	Wholesale and manufacture
	Equipment and Supply
PAVE Technology Co.	Wholesale and manufacture
	Equipment and Supply
Tri-Tec West Engineering Corp.	Wholesale and manufacture
	Equipment and Supply
Delta Services	Wholesale and manufacture
	Equipment and Supply
Alpine Engineered Products Inc.	Wholesale and manufacture
	Equipment and Supply
American Custom Components	Wholesale and manufacture
	Equipment and Supply
Kerr Machine & Engineering	Wholesale and manufacture
	Equipment and Supply
Southeast Circuits, Inc.	Wholesale and manufacture
	Equipment and Supply
Conquest Technology Inc.	Wholesale and manufacture
Whitman Products Co Inc.	Equipment and Supply Wholesale and

	manufacture
	Equipment and Supply
Electro Circuits Corporation	Wholesale and manufacture
	Equipment and Supply
Perceptive Signal Technologies	Wholesale and manufacture
	Equipment and Supply
Vastbright Technology	Wholesale and manufacture
	Equipment and Supply
FRF Circuits Inc.	Wholesale and manufacture
	Equipment and Supply
Oracle Manufacturing LLC	Wholesale and manufacture
	Equipment and Supply
Frank O'Connell West Coast Circuits	Wholesale and manufacture
	Equipment and Supply
Casskay Cad Design	Wholesale and manufacture
	Equipment and Supply
Mac Electronics	Wholesale and manufacture
	Equipment and Supply
Seacole-CRC	Wholesale and manufacture
	Equipment and Supply
Chemcut Corp	Wholesale and manufacture
	Equipment and Supply
Herco Technology	Wholesale and manufacture
	Equipment and Supply
Rouleau & Associates	Wholesale and manufacture
	Equipment and Supply
Pinkerton Products Inc.	Wholesale and manufacture
	Equipment and Supply
Summit	Wholesale and manufacture
	Equipment and Supply
Orion PCB Design	Wholesale and manufacture
	Semiconductor
Smith Semiconductor	Manufacture

Accent Optical Technologies	Semiconductor Manufacture
Brooks Automation	Semiconductor Manufacture
National Semiconductor Corporation	Semiconductor Manufacture
Roboteq Inq	Semiconductor Manufacture
Selling Precision	Semiconductor Manufacture
Alnabwey Express Corp	Semiconductor Manufacture
007 Electronics Network	Semiconductor Manufacture
Telephonics A Griffon Corporation	Semiconductor Manufacture
Formula Corp	Semiconductor Manufacture
System to Asic Inc.	Semiconductor Manufacture
Ideal Semiconductor	Semiconductor Manufacture
Servi Sure Corporation	Semiconductor Manufacture
Ball Semiconductor	Semiconductor Manufacture
Boc Edwards Kachina	Semiconductor Manufacture
STM consulting	Semiconductor Manufacture
SPM Inc.	Semiconductor Manufacture
IPS Custom Automation	Semiconductor Manufacture
Memory Strategies International	Semiconductor Manufacture
Luna Technical Sales, Ltd.	Semiconductor Manufacture
AJ Integrated Services	Semiconductor Manufacture
Optical Dynamics Corporation	Semiconductor Manufacture
Semiconductor Online Global Fab	Semiconductor Manufacture
Semiconductor Equipment LLC	Semiconductor Manufacture
Goria Corporation	Semiconductor

	Manufacture
Advanced Power Technology Inc	Semiconductor Manufacture
Advance Quartz Fusion	Semiconductor Manufacture
Fujikin of America	Semiconductor Manufacture
Microtec Plastics Inc.	Semiconductor Manufacture
Semi-Probes	Semiconductor Manufacture
Intel Corporation	Semiconductor Manufacture
Conquer Industries Inc.	Semiconductor Manufacture
Mattson Technology	Semiconductor Manufacture
Mission Peak Optics	Semiconductor Manufacture
Morgan Semiconductor Products	Semiconductor Manufacture
Herrara's Mechanical Design and Engineering Services	Semiconductor Manufacture
Kinetix Test Systems, LLC	Semiconductor Manufacture
Robson Technologies Inc.	Semiconductor Manufacture
TDK Semiconductor	Semiconductor Manufacture
Johnstech International	Semiconductor Manufacture
Comdel Rf Power Systems Inc.	Semiconductor Manufacture
Excelt Precision	Semiconductor Manufacture
Laminar Technologies Inc.	Semiconductor Manufacture
Reaction Technology Inc.	Semiconductor Manufacture
B & J Specialties	Semiconductor Manufacture
Neutronics	Semiconductor Manufacture
Sigma Probe	Semiconductor Manufacture
Intertest Equipment Services	Semiconductor Manufacture

Modular Process Technology Corporation	Semiconductor Manufacture
Silitronics	Semiconductor Manufacture
Advanced Linear Devices Inc.	Semiconductor Manufacture
RPM Technical Services	Semiconductor Manufacture
Advances Analogic Technologies Inc.	Semiconductor Manufacture
UMC	Semiconductor Manufacture
Maxim Integrated Products	Semiconductor Manufacture
KS Equipment	Semiconductor Manufacture
McJunkin Corporation	Semiconductor Manufacture
BAE Systems	Research, Design, and Development
Morrow Technologies Corporation	Research, Design, and Development
Silver Engineering Inc.	Research, Design, and Development
Richard Marcel Drafting and Design	Research, Design, and Development
Suncoast Systems Inc.	Research, Design, and Development
Teltronics Inc.	Research, Design, and Development
Kintech Manufacturing Inc.	Research, Design, and Development
Tampa Microwave Laboratory	Research, Design, and Development
Imaging Sensors and Systems	Research, Design, and Development
Tele-Comm International	Research, Design, and Development
Gleason Research	Research, Design, and Development
Advance	Research, Design, and Development
Aircom Inc	Research, Design, and Development
Chitron Electronics	Research, Design, and Development
I F Engineering	Research, Design, and Development

Thin Films Research Inc.	Research, Design, and Development
Hyacinth Technology Inc.	Research, Design, and Development
Electronic Filter Solutions	Research, Design, and Development
Sigtek	Research, Design, and Development
Advanced Vehicle Techonologies Inc.	Research, Design, and Development
Fusion UV Systems Inc	Research, Design, and Development
Inventrace	Research, Design, and Development
Impellimax	Research, Design, and Development
Advanced Micro Systems Inc.	Research, Design, and Development
Star One Productions Inc.	Research, Design, and Development
Testwave LLC	Research, Design, and Development
Signal Processing Group	Research, Design, and Development
Datanet Systems	Research, Design, and Development
Optical Electronics Inc.	Research, Design, and Development
Equilution	Research, Design, and Development
Pro-Comm	Research, Design, and Development
Bartal Design Group Inc.	Research, Design, and Development
L C Engineers Inc.	Research, Design, and Development
Moor Electronics Inc.	Research, Design, and Development
RWAY Communications	Research, Design, and Development
Opertune.com	Research, Design, and Development
Precision Filters Inc	Research, Design, and Development
Polyfusion	Research, Design, and Development
Jadak Technologies	Research, Design, and Development

Globalstar	Research, Design, and Development
Custom Electronics Inc.	Research, Design, and Development
Astria Industries Inc	Research, Design, and Development
Advanced Power Components	Research, Design, and Development
Millennium Antenna	Research, Design, and Development
Black River Systems Company Inc	Research, Design, and Development
Sophisticated Circuits Inc	Research, Design, and Development
Manufacturing Services Inc	Research, Design, and Development
Andres & Associates Engineers	Research, Design, and Development
Pathways Development Group Inc	Research, Design, and Development
J & J Engineering Inc	Research, Design, and Development
Decagon Devices	Research, Design, and Development
Schweitzer Engineering Labs	Research, Design, and Development
rpm systems corporation	Research, Design, and Development
edr electronics inc	Research, Design, and Development
Capital Advanced Technologies Inc	Research, Design, and Development
Lindsey Engineering	Research, Design, and Development

EEE Industry in the United States[2]

The US exported $151.5 billion worth of IT and high tech goods in 2003. Japan was the top destination ($15.6 billion) followed by Canada ($12.2 billion). Key facts for the US IT and high tech industry are presented in Table 1.

Table 1 US IT and High-Technology Industry Key Facts, 2003[3]

Total Output of goods and services	$1.24 trillion
Exports	$151.5 billion
Imports	$207.5 billion
Companies revenue	$2 trillion
Semiconductor sales	$85 billion
R&D investment	$50.18 billion
Software industry (2001)	$183 billion
Spending on IT software and services	$434 billion
Server market	$18.2 billion
Offshore IT software and services	$10 billion
Employment	5,760,000
Semiconductor employment	284,000

The hi-tech industry depends on semiconductors, the microchips that power and control computers, telephones and a host of other devices. US companies dominate world wide chip sales. Chipmakers and semiconductor companies make up a significant portion of the electronics companies in the US. Worldwide chip sales were expected to reach $214 billion in 2004 (data are not available). Intel, AMI (Applied Materials Inc) and AMD (Advanced Micro Devices) are key chip manufacturers based in the United States. Chipmaker Intel budgeted $4.8 billion in R&D (research and development) spending in 2004.

Statistics for the 10 most actively traded stocks in the US in the hardware and software industries are shown in the table below.

Table 2: Ten Most Actively Traded Stocks in the US, 2003

Rank	Company	Annual Revenues ($) 2003[4]
1	IBM	$89 billion
2	Hewlett Packard	$73 billion
3	Dell Inc	$41.4 billion
4	Microsoft Corporation	$32.187 billion
5	Intel Corp	$30.141 billion
6	Ingram Micro Inc	$22.612 billion
7	Electronic Data Systems (EDS) Corp	$21.476 billion
8	Tech Data Corp	$17.406 billion
9	Computer Sciences Corp	$14.767 billion
10	nStor Technologies Inc	$12.602 billion

Some of these companies are focused on software rather than hardware manufacturing (in the US or overseas) and would therefore not be of interest to the CEP3 program.

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[2] Taken from the unpublished Clean Electronics Scoping Study prepared by M. Kelleher for the CEC Secretariat in May 2006.

[3] the North America IT and High Technology Sectors, A company and Industry Analysis, September 2004, Mergent. <http://webreports.mergent.com>.

[4] "Largest Companies in the Electronic/Electrical Equipment and Components Industry by Sales, 2003, Business Rankings (annual), Dun and Bradstreet, Inc. 2004, p. V-80. *Business Rankings Annual 2005*. Thomson Gale, 2005. Reproduced by the Business and Company Resource Center, Farmington Hills, Mich: Gale Group, June 2002

Aerospace products are the primary IT and high-tech export, and are outside the scope of the CEP3 program. The top imported commodities are computers and telecommunications equipment.