

**Green Packaging: A Guideline and Tools for  
Environmentally Sound Packaging Practices for Computer  
and Electronics  
Products.**

May 2004

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A Group Project Proposal to the Donald Bren School of  
Environmental Science and Management, University of California,  
Santa Barbara

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## Abstract

In 1992 Hewlett Packard, along with a number of industry partners, developed an environmentally responsible packaging guideline. The document recognized that packaging professionals in the computer technology industry needed a guide to inform daily decisions regarding the environmental impacts of packaging systems. Twelve years have passed and there is now a desire to update this guideline and develop it into an industry wide education and certification program.

A group of four graduate students, candidates for a Master's degree in Environmental Science and Management at the Donald Bren School at UC Santa Barbara, will undertake the task of redeveloping the environmentally responsible packaging guideline. In addition, the team will develop a certification course that will inform packaging professionals on how to manage environmental impacts of the products they design.

The team consists of Elissa Loughman, Ryan McMullan, Brian Crumrine, and Shawn Decker (herein referred to as "the team"). The team was formed in March of 2004 and is scheduled to complete the project in April of 2005. In addition to a Bren School faculty advisor, Magali Delmas, the team will receive guidance and direction from Randy Boeller, Package Engineering Program Manager with Hewlett Packard. Packaging executives at IBM, AMD and other organizations involved with packaging and the computer technology industry will provide additional assistance.

## Objectives

The overall objective for this project is to provide corporations in the computer technology industry with comprehensive strategies, guidelines, and tools to advise their employees, as well as suppliers and customers, on how to devise, assess and implement packaging designs and practices that minimize adverse impact on the natural environment.

More specifically, the objective of this project will be to devise a tool that helps a packaging professional make decisions when considering the environmental impacts of a package design. A packaging engineer must consider a number of things during development of a specific package. These considerations include cost (of materials and shipping), performance (does the package adequately protect the product?), convenience (is the package easy to use?), compliance (does the package comply with legal requirements?), and, of course, environmental impact. The team will strive to create a guideline that helps packaging professionals understand how these diverse considerations impact the environmental performance of their designs.

Key aspects of our project include:



- Analysis of existing packaging designs and practices, including how companies have used the current guideline since it was created in 1992
- Analysis of how the waste management hierarchy applies to product packaging, as well as the reuse, recyclability and environmental impact of relevant packaging materials
- The business implications of packaging reduction, reuse and recycling
- Investigation of recycling infrastructure in relevant global markets
- Analysis of the international regulatory requirements regarding packaging and packaging waste

## Significance

This project has significance on a number of levels.

From a solid waste perspective, this group's work will help industry lower its contribution to the growing solid waste problem. According to the EPA, annual generation of municipal solid waste in the United States has increased from 88 million tons in 1960 to 229 million tons in 2001. Containers and packaging made up almost one third of those 229 million tons. The waste generated by industrial processes along the supply chain dwarfs municipal waste. Industry in the United States is reported to create 7.6 billion tons of nonhazardous waste each year. Industrial packaging significantly contributes to that figure.

The group's work will also provide education and training for packaging engineers and technicians on how to reduce waste, and emissions, and how to increase the use of recyclable and renewable resources.

This project will assist the computer technology industry in two ways.

The Guideline will help packaging engineers develop more environmentally friendly packaging, which will in turn improve the environment. This improved environmental performance of packaging will then make it easier to comply with legal requirements. Global regulations focused on reducing packaging waste are on the rise. Currently, there are environmental packaging design requirements in more than 25 countries and package reporting and advanced disposal fees in 30 countries (soon to be 35). All these countries' programs vary in terms of material definitions, packaging definitions, type of packaging covered, and fee structures. The redeveloped guideline will delineate these aspects and provide an educational/reference tool for the packaging professional. In addition, the certification program will give packaging executive in the industry a method by which to demonstrate that their commitment to complying with environmental packaging regulations.

Second, the team's work will help further the computer technology industry's commitment to designing for the environment (DfE). DfE is an engineering perspective in which the environmentally related characteristics of a product, process or facility are optimized. Hewlett Packard, IBM and others in the industry have stated a commitment to this philosophy. To learn more about HP's perspective on Design for the Environment, see the following web site:



<http://www.hp.com/hpinfo/globalcitizenship/environment/productdesign/design.html>

## Background

In 1992 Paul Russell, Corporate Packaging Process manager with Hewlett Packard, led an industry team that developed an environmental packaging guideline document. The document's goal was to educate the computer and electronics industry about the need and the possibilities to reduce the environmental impacts of product packaging.

Over twelve years have passed and much has changed in the way packaging is designed, managed and regulated worldwide. Executives at HP, and other technology companies, are interested in revising and updating the original set of guidelines. They see value in developing further their environmental packaging knowledge and practices.

Since the original guideline was distributed to packaging professionals, many improvements have been realized. For example, packaging engineers at HP use the following guidelines – based on the waste hierarchy of reduce, reuse and recycle – to reduce environmental impact:

- Design returnable/reusable packaging
- Eliminate the use of heavy metals such as lead, chromium, mercury or cadmium
- Eliminate the use of ozone-depleting substances (ODS) in the production of packaging materials
- Make packaging materials easily separable, e.g. avoid gluing foam to paperboard
- Mark or identify material type following ISO 11469 (the international standard for identifying plastic types)
- Maximize the use of post-consumer recycled content materials
- Use readily recyclable materials such as paper and corrugated materials

<http://www.hp.com/hpinfo/globalcitizenship/environment/productdesign/design.html>

Specific product improvements made by HP include:

- *Easy open bag for toner cartridges.* This new bag reduced packaging size by up to 30% and incorporated 30% post-consumer recycled content.
- *Reusable transit packaging for inkjet cartridge.* This reduced corrugated waste by 2,400 tons in 2002, saving \$1.5 million.
- *Bulk packaging for desktop computers.* This reduced packaging waste by 86% (about 900 tons a year). Initial savings were \$1.1 million in 2002 and are expected to be \$4 million in 2003.

The environmental impact of packaging is a topic that has already received a large amount of attention across all industry sectors. The team intends to capitalize on the information available in various locations and formats in developing the knowledge needed for completion of this project. Please see the “Approach” section for more information on where our knowledge will come from.

In addition, efforts in other industries that are similar to this project are particularly helpful to the project. Following is a summary of one effort that the team has come across thus far:



“Achieving Preferred Packaging: Report of the Express Packaging Project” (UPS and The Alliance for Environmental Innovation) – November 1998

This paper outlines a project undertaken by UPS and The Alliance for Environmental Innovation to improve the environmental performance of express packaging materials. The project grew out of a report by The Alliance, which analyzed the potential for environmental and market leadership in “shipper provided overnight delivery packaging.”

The goals of the UPS/Alliance project were to:

- Decrease the amount of material used in packaging
- Expand the use of reusable packaging
- Increase use of post-consumer content
- Eliminate bleached paper from all packaging

The two organizations worked together to find ways to achieve these goals. This required key decision makers at UPS to communicate directly with Alliance employees. The Alliance team members brought the technical expertise in analyzing environmental impacts to the table. Suppliers to UPS were also brought to the table and were able to contribute to finding ways to reduce material use and material alternatives.

The projects results were as follows:

- 29% lower use of virgin materials
- 14% less water use annually
- 49% reduction in hazardous air pollutants
- More functional and convenient packaging
- Increase market share
- Development of a 2-way reusable express package
- UPS will eliminate the use of bleached paper in all packaging
- The plastic Pak (a particular express package) will use 15% post consumer resin

See the entire report at <http://www.environmentaldefense.org/alliance/reportsindex.html>

## Approach

Team members will use knowledge gained at Bren, additional research, and expertise and information provided by the client organizations to develop this project.

The team began by gathering the necessary data and materials to form a base of knowledge about the packaging industry. HP has committed to provide the data that they have access to, including information on internal packaging practices, as well as those of suppliers. In addition to the research provided by HP, the team is supplementing the HP information with additional secondary research. This secondary research will be conducted using online journals and databases that are provided by the UCSB Library. The team has also subscribed to the Institute of Packaging Professionals and can now access to the IoPP Journal of Packaging.



The data that has been gathered has provided the team with a solid understanding of the information that will need to be included in the guideline. With this knowledge, a rough outline of the guideline was created in order to organize the team's ideas on how to structure the future guideline (shown below).

## Preliminary Outline

- I. Introduction
  - a. Abstract
  - b. Executive Summary
  - c. How To Use This Manual
  - d. Guide to the Contents
  
- II. Environmental Impact of Packaging
  - a. Brief example – demonstrate impacts
  - b. Material Impact Summaries
    - i. Paper
      1. Waste/Recycling
      2. Toxics
      3. Ozone Depletion
      4. Energy
      5. Etc.
    - ii. Cardboard
    - iii. Hard Plastic
    - iv. Plastic Foam
    - v. Etc.
  - c. You can make a difference!!! (i.e. these impacts can be mitigated)
  
- III. Establishing the Mindset/Balancing Issues
  - a. Paper or Styrofoam example (Please see Appendix 1 for a detailed description of this example.)

What if your cups come from another country with lax restrictions on the emission of pollution from manufacture?

    - i. Example tracing sources of environmental impact
    - ii. Present design tradeoffs and considerations
    - iii. Motivates establishing the mindset
  - b. Tradeoffs between environmental considerations
    - i. e.g. air pollution or water pollution?
  - c. Packaging Considerations (cost, protection, environmental, etc.)
    - i. How is environmental integrated with other priorities?
  - d. Scenarios - Describe a few “thought experiments”
    - i. e.g. Want to design an environmentally friendly package for product X to be shipped to country Y. Recycling infrastructure in country Y is low. How does this affect package design?



- IV. Managing Packaging Decisions
  - a. Short case study?
  - b. Impact Reduction Strategies
    - i. Material Reduction
    - ii. Design for Reuse
    - iii. Design for Recyclability
    - iv. Using Recycled Content
    - v. Alternative Materials
  - c. Finding more information/Staying up to date
  - d. Environmental Performance Characterization
    - i. How should products be labeled? (recycled-content, etc.)
  - e. Design for \_\_\_\_\_, Scenarios
  - f. Procedure for consideration

#### Appendices

- A. Materials guides (paper, plastic, metal)
- B. New Material Options (as of 2004)
- C. Glossary and Acronym Guide
- D. Standardized Symbols
- E. LCA Example
- F. Planning Templates

### **Packaging Professional Survey**

With an outline of the guideline established, the team began working on a survey that will be distributed, via the Internet, to various packaging professionals worldwide. The purpose of the survey is to gather specific information that will help create a document that will be both useable and effective in reducing the environmental impacts of the packaging industry. The survey has the potential to add to the team's knowledge of packaging and give insight into how the 1992 environmental packaging guideline was used and how it can be improved. The team also hopes to learn how packaging engineers envision themselves using the guidelines in the future. The rough outline of the guideline was used when creating the following survey:

#### Packaging Professional Survey

This survey has been created by a group of four graduate students from the Donald Bren School of Environmental Science and Management. The group is creating an updated version of the 1992 Hewlett Packard Environmental Packaging Guideline as their thesis project.

Please answer the following questions. Your answers will be recorded anonymously.  
[Use random question order]

#### **Demographics**

##### *6 Questions*

- 1) What company do you work for?
- 2) What division/group within the company?



- 3) What is your job title?
- 4) How long have you been working as a packaging professional?
- 5) What percentage of your job is spent designing/managing packaging?
- 6) What products do you design packaging for?

### Green Packaging Experience

#### 7 Questions

- 7) What is your biggest impediment to incorporating environmental considerations into packaging (availability, economics, protection)?
- 8) What environmental design technique do you use most often (if not sure circle one or more)?

Material Reduction   Design for Recycling   Design for Reuse  
Use of Low-impact Materials   Regulatory Compliance   Other \_\_\_\_\_

- 9) Rank these three packaging priorities in order of importance (#1 being highest).

Economics      Environmental      Protection

- 10) What materials do you most frequently use when packaging electronics products for large products such as monitors and for smaller products such as modems.
- 11) Are there any materials that have no feasible environmentally friendly alternatives in your packaging design?
- 12) Where do you see the most potential for environmentally improved packaging in the electronics industry (low-impact materials, material reduction, etc.)? Why?

### Research

#### 3 Questions

- 13) What packaging-related periodicals (journals, magazines, etc.) do you follow (Have a list of top journals and magazines for them to check off)?
- 14) Please name a set of packaging guidelines or reference (not necessarily environmental) that you use frequently. Why do you use this frequently?
- 15) Have you used an Environmental Packaging Guideline before? Which one? [*watershed question for Old Guidelines Feedback*]

### Old Guidelines Feedback

#### 3 Questions [*asked only if yes to Green Packaging Experience question 7 is yes*]

- 16) How often do you use/reference the Environmental Packaging Guidelines?

Never    Once per year    Once per 6 months    Once per month    Once per week    Every Day

- 17) What aspects of the old guidelines do you not like? Which do you like?

- 18) What makes the old guidelines hard to use? Easy to use?



## New Guidelines Feedback

### 6 Questions

- 19) What would you like to see in an Environmental Packaging guideline (what would make it useful to you)(circle what is most important to you personally)?  
Examples Case Studies Step-by-Step Highly detailed text Concise text (with more detailed appendices) List of current regulations Other:
- 20) What topics of environmental packaging design would you like to see more information on?
- 21) When designing for the environment, what information is most difficult to obtain? What information slows you down?
- 22) Do you feel it is important to be registered through a certification exam?
- 23) Is there anything else you would like to say about environmentally responsible packaging?
- 24) May we call you for additional information?

The information collected from the survey will then be used to finalize the guideline outline.

## Next Steps

Upon finalizing the guideline outline the team plans to divide up the various sections of the guideline. Each team member will be responsible for becoming an expert on one or more topics in environmental packaging. The team members will then be responsible for researching and including the necessary information for each of their assigned sections. The team plans to divide the guideline into sections prior to summer to allow each group member time to begin their research.

In the Fall Quarter of 2004 the team will focus on gathering and organizing packaging data. During the research process all of the team members will be continually writing drafts of their section of the document. This will prevent the team from having to write the entire document at one time and from being rushed as deadlines approach. The Editor will then be responsible for organizing the various drafts and formatting the document.

During the revisions of the guideline the team will begin creating the online Certification Course. The purpose of the Certification Course is to ensure that packaging engineers associated with HP, AMD, IBM and other companies involved in the creation of the guidelines have an understanding of the environmental impacts of packaging as well as knowledge about how such impacts can be reduced. The information presented in the online Certification course will include the key information and environmental principles that are included in the guideline. The Certification Course will include an exam that is reflective of the information presented in the course. The course will last approximately 60 min and will be immediately followed by an exam.

The group intends to have rough drafts of the guideline, the Certification course and the Certification test complete by the end of the 2004 Fall Quarter. Winter Quarter will then be dedicated to completing the final revisions of the guideline and testing and making changes to the Certification Course and test.



In April the Green PKG project team will create a project poster that addresses their research and deliverables. They will also participate in the Group Project Presentation event hosted by The Bren School.

## Management Plan

### Group Structure and Management

As a group, Green PKG has appointed group members to various jobs that will be necessary to execute the project.

**Project Manager:** Brian Crumrine

Brian will act as the coordinator of the project and will keep the team on track regarding deliverables and deadlines. He will be responsible for weekly meeting agendas (except on “guest meeting facilitator” days; see Meeting Structure). In addition, Brian will act as the lead contact with the client and other contacts related to the project, unless otherwise arranged.

**Data Manager:** Ryan McMullan

Ryan will manage the mailing lists (bren and Yahoo), the G: drive folders, and other technological coordinating tools.

**Secretary:** Ryan McMullan

Ryan will be responsible for taking notes at all group meetings. He will record progress, assignments, and deadlines and post them on the Green PKG drive for each of the meetings.

**Editor:** Elissa Loughman

Elissa will be responsible for determining the style guide and merging documents into a standard format.

**Web Master:** Shawn Decker

Shawn will be responsible for development of the Green PKG web site and timely updates on that web site.

**Financial Manager:** Elissa Loughman

Elissa will be responsible for all purchases and expenditures throughout the course of the project. She will also be responsible for keeping track of all transactions and the teams account balance.

**Primary Contact:** Randy Boeller

Randy is the Package Engineer Program Manager at Hewlett Packard and works in Houston, Texas. Randy will provide as-needed counsel and assistance via email and phone.

### Meeting Structure

The team will meet once per week, meeting times will be scheduled at the beginning of each quarter. Each group member is expected to attend all meetings. The advisor, Magali, plans to



attend Green PKG meetings except when she has other meetings she must attend. If additional meetings are necessary they will be scheduled when needed. Each meeting will have an agenda that is planned by one of the team members. The group members plan to take turns leading weekly meetings, with Brian Crumrine, the group project manager leading the majority of the meetings. Ryan McMullan has been designated meeting note taker and records all topics discussed during the meeting and task assignments for the following week.

## Responsibilities of group members

Each person has been given a specific position within the team (stated in the Group Structure and Management Section). These positions are considered permanent unless something unforeseen occurs during the course of the project. Each group member is aware of their current responsibilities and is also aware that additional responsibilities may be assigned, as the project progresses.

## Systems to Ensure Deadlines are met

In each meeting Ryan, the team note taker, records assignments, who is responsible for completing that assignment and when the assignment should be completed. All meeting notes are then placed on the team's network directory and accessed at the start of each meeting. This will ensure that each member is aware of deadlines within the team as well as who is expected to meet those deadlines. This awareness that the entire group will have of all assignments should help remind all members as well as create an incentive for group members to keep up with deadlines. Ultimately the project manager will be aware of all tasks and deadlines and ensure that deadlines are met.

## Conflict Resolution

If a conflict arises, the team members will do their best to meet as soon as possible. Any group member will be able to call a meeting (outside of our regular meeting) during which the problem will be discussed and possible solutions created. For example, if a "slacker" problem arises the team members will first meet to discuss the issue. The team will work together to brainstorm ideas that could help resolve the problem and motivate the slacker. In addition documentation of slacking behavior will begin. Should the conflict persist, the group advisor will be informed of the problem and take part in discussing the best approach to dealing with the problem. At this point the issue can be addressed again in a group meeting including the team advisor to try to reconcile the problem using a different approach. If conflict arises between group members the members will be instructed to attempt to work things out on their own at first. If the problem continues then the issue will be brought to the team as a whole in hopes of finding a method that can be used to deal with the problem.

**Comment [bc1]:** Not sure if a one on one meeting is the best action in this circumstance. Let's discuss this.

## Data Management

The team will use a number of methods to catalogue and store information that is vital to the project:



- Green-PKG (G: Drive): A set of network directories have been established that will house the team's electronic files. The main subdirectories include Final Documents, Works in Progress, Readings and Meeting notes. These subdirectories will expand as needed.
- Green PKG on Yahoo Groups: The team has begun using Yahoo Groups for group email, contacts and Web links. This service allows the team to store this information in a place and manner that is accessible to all group members from any web connection. The whole team can be addressed by sending an e-mail to <greenpkg@yahoogroups.com>.

## Interactions

Magali will play an important advisory role in the team as well as in the project. She will be specifically contacted for guidance on a particular task and to answer questions that may arise. The team will also keep her up to date on the project by reporting progress at weekly meetings and sending her a copy of our HP progress reports.

Meetings with the HP clients will occur via conference call when necessary. These conference calls will be scheduled as far in advance as possible. Our clients will also be provided with progress updates via email at the end of each month. All communication with HP will be conducted via email and phone.

## Expectations of group members and faculty

After discussing both the team members' expectations for the project and the advisor's expectations it was realized that both parties' expectations fit very well together. Magali will be the "advisor." She will be available to answer any questions that may arise as the project progresses. She is not expected to be at every group meeting or to be the main liaison between HP and the team. The project will be guided by the expectations and requests of the contacts at HP, directed by the team, and advised by Magali. Magali's prior experience with the team project process will also be very valuable to the team. Overall the team expects to be the creators of this project, and will be the main communicators with HP. The team will produce the deliverables based on the recommendations and suggestions of their clients and advisors.

## Deliverables

- A redeveloped environmental packaging guideline document – This new document will include information and strategies designed to enable computer and electronics packaging professionals to improve the environmental performance of their business practices.
- Certification Course – A course curriculum designed to reinforce the key points from the guideline.
- Certification exam – A test designed to certify that professionals have a solid comprehension of principles related to environmental packaging



## Milestones

Group Project Deadlines:

	Proposed Date of Completion
<b>Spring Quarter 2004</b>	
Rough draft of Guideline outline	May 11, 2004
Draft of Final Project Proposal	May 12, 2004
Advisor's review of Project Proposal completed	May 18, 2004
Survey completed and distributed	May 26, 2004
Final Project Proposal	May 26, 2004
External Review	May 26, 2004
Analysis of Survey data completed	June 4, 2004
Research tasks for summer work assigned	June 4, 2004
Website created and up-to-date	June 4, 2004
Report on external review due to advisors	June 8, 2004
Peer and Faculty evaluations due	June 10, 2004
<b>Fall Quarter 2004</b>	
Organize Research into a Rough Draft of the Guidelines	Nov. 5, 2004
Fall Project Presentations	Nov. 5, 2004
Completed Draft of Guidelines	Dec. 3, 2004
Draft of Curriculum and Certification Test completed	Dec. 3, 2004
Peer and Faculty evaluations due	Dec. 3, 2004
<b>Winter Quarter 2005</b>	
Final Draft of Guidelines completed	Jan. 10, 2005
Post Curriculum and Certification Test online for use	Jan 15, 2005
Info for Group Project Presentation Program Submitted	March 4, 2005
Submit invitation list to Group Project Coordinator	March 4, 2005
Final Guidelines Document due to Advisors	March 11, 2005
Project Brief due to Advisor and GP Coordinator	March 11, 2005
<b>Spring Quarter 2005</b>	
Poster Completed	1 wk prior to presentation
Project final oral presentation	Date not yet confirmed
Final Reports archived in Bren School office	1wk after presentation
Advisor and Peer Evaluations due to GP Coordinator	1wk after presentation

## Opportunities



There will be numerous opportunities to establish links with outside advisors and the environmental community. Specifically, stakeholders will include not only clients, but also the customers, suppliers and contractors they do business with. Where compliance issues are involved, government regulatory agencies, such as the EPA, will also influence the project.

During the course of the project the team hopes to form mutually beneficial relationships with contacts at computer technology companies, packaging suppliers and consulting firms. Currently, the team has one primary client contact at Hewlett Packard and a number of other industry contacts that will act as advisors and sources of information during development of the project. This list of clients and advisors is as follows:

### **Primary Client Contact**

Randy Boeller  
Package Engineering Project Manager, Technical Package Design  
Hewlett Packard  
Houston, TX.

### **External Advisors**

Shaye Hokinson  
Extended Producer Responsibility  
Advanced Micro Devices, Inc.  
Sunnyvale, CA

Susie Elkins  
Corporate Packaging  
Global Logistics Operations Support, Integrated Supply Chain  
IBM  
Charlotte, NC

Bob Sanders, STSM  
Corporate Packaging Programs  
Global Logistics Operations Support, Integrated Supply Chain  
IBM  
Durham, NC

Paul Russell, CPP/Fellow  
Packaging Process Manager  
Hewlett Packard  
Paris, France



## Budget

Costs for this project will be limited to minor expenses, including office supplies, postage, phone charges, software and presentation materials.

<b>Group Project Budget:</b>	<b>\$1100</b>
<b>Printing Budget:</b>	<b>\$200</b>
<b>Total budget:</b>	<b>\$1300</b>

HP will cover any expenses that exceed the initial budget. In addition, HP will pay for the printed publication of the final guideline document as well as host a web-based version at [www.hp.com](http://www.hp.com).

### Predicted Expenses

- Packaging Literature (Journal Subscriptions and Books): \$200
- Online research reports: \$250
- IoPP Membership: \$15
- Survey monkey(online survey tool): \$20
- Conference calls: \$200
- Printing: \$200

**Total Predicted Expenses: \$885**

### Budget justification

- The majority of the expenses, \$465 will be spent on packaging literature and access to online packaging research reports. Before updating the Packaging Guidelines, it is necessary for the team to gather data on packaging design, regulation, technology, and materials. The quality of the deliverables will be reflective of the information that is gathered.
- Survey Monkey will be used to create a survey that can be distributed via the Internet to various packaging engineers associated with HP, IBM and AMD. The purpose of this survey is to gain an inside perspective on how to design effective packaging products that uses less energy and have a greater recycle ability.
- All the Hewlett Packard contacts and external stakeholders live rather far from Santa Barbara. Because of this distance the team will need to contact these people via email and conference calls.
- Throughout the project the team will need to print research articles and various drafts of the guidelines. Upon completion of the project and the Green Packaging Guidelines a Project poster will be printed. Hewlett Packard has agreed to cover the cost of printing copies of the final draft of the guideline for distribution.



## References

Crumrine, B., R. Geyer, and P. Russell. *Green Packaging: A Guideline and Tools for Environmentally Sound Packaging Practices for Computer and Electronics Products: Original Group Project proposal*. (2004).

Donald Bren School of Environmental Science and Management. *Group Project Guidelines Class of 2005*. (2005).

EPA References

Hocking, Science



## Example: Paper v. Styrofoam

You go to your local deli and order a soft drink. When you go to the soda fountain they have both Styrofoam and paper cups. Which do you choose? Why?

This choice is a good example of evaluating two choices of packaging for a product. The answer is not simple and illustrates the complex interactions that are involved in evaluating your options. This example is just meant to illustrate the mindset needed to evaluate the options. More technical and detailed issues will be addressed in Section 4 and 5 of the guideline.

Here are some steps that you can go through to investigate this decision.

### First Step: What are the materials used for packaging?

**Paper Cup:** A paper cup is made out of paper with a little glue. They are also commonly coated in wax for better waterproofing.

**Styrofoam Cup:** A Styrofoam cup is made out of expanded polystyrene (a plastic).

### Second Step: Where did these materials come from?

**Paper Cup:** Paper is created from trees, a renewable resource. It thus carries the impact of logging and forestry (including associated impacts of roads, cut forests, transportation, timber mills, and paper mills). Food regulations prohibit making food-quality paper goods from recycled paper; so all paper cups are virgin paper. Since paper is created from trees it also draws CO<sub>2</sub> from the atmosphere, offsetting its impact on climate change. If wax coated, the wax is made from petroleum, a non-renewable resource, with the associated impacts of oil extraction (including drilling, transportation, risk of oil spills, and refining pollution).

**Styrofoam Cup:** Polystyrene is a plastic and thus a petroleum product (non-renewable), with the associated impacts of oil extraction (including drilling, transportation, risk of oil spills, and refining pollution). Styrofoam cups use more petroleum than is used in paper cup production.

### Third Step: How was the product made?

**Paper Cup:** The process of separating the fiber from trees also requires some fuel input (petroleum, though less than for Styrofoam) and chemicals, and leaves about 50% waste from wood. The paper is typically bleached with chlorine bleaches, creating water pollution (much of which is treated prior to release in the U.S.). In total, paper cups create over 500 times the



wastewater as Styrofoam cups (though this is treated in the US). The paper is then rolled, cut, printed, and glued into a cup.

**Styrofoam Cup:** Polystyrene is produced by polymerizing styrene, which is a carcinogen released during manufacture. The polystyrene is melted and then blown (expanded) with a blowing agent, pentane. Styrofoam first gained notoriety by using ozone-depleting CFCs as a blowing agent, but these have been phased out and are no longer used. Now pentane is used which, while ozone layer safe, contributes to ground-level ozone (smog) and is a potent greenhouse gas. Also, the same sized Styrofoam cup is made with 1/6 of the material (by weight) to make paper cups, so the impact of producing a kg of Styrofoam is distributed among more cups.

#### **Fourth Step: What will happen to it when it is finished being use?**

**Paper Cup:** If it is not waxed, then it can be recycled in some paper recycling programs. If thrown away, it goes to a landfill where it partially degrades into methane (a potent greenhouse gas and potential fuel) and CO<sub>2</sub> (this decomposition is more pronounced in humid climates). Some landfills extract their methane for use as fuel before it goes into the atmosphere, but this is not universal practice. If a paper cup ends as litter, it decomposes after several weeks.

**Styrofoam Cup:** While Styrofoam is technically recyclable, the infrastructure does not exist to recycle it in all but a few areas (largely due to its light weight). In the landfill, it does not degrade and occupies a larger amount of volume for its weight than paper cups. If a Styrofoam cup ends as litter it does not decompose.

This exercise shows the myriad of issues to consider when making your choice. Section 4 will discuss some tools you can use to evaluate the choice more quantitatively.

#### **Final Questions**

What do you do if there are no recycling programs in your region that recycle paper cups?