design guidelines for

sustainable packaging

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SUSTAINABLE PACKAGING COALITION®

GreenBlue®

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The Design Guidelines were printed with soy-based inks on processed chlorine-free paper with 100% postconsumer waste fiber made using Green-e certified renewable wind energy.

preface

As part of its mission to create design resources and in recognition that design is a critical leverage point, the Sustainable Packaging Coalition has compiled guidance on the design and development of environmentally responsible packaging.

While there is substantial guidance around design for the environment in general, the Coalition identified a need to consolidate the thinking, the information and the best practices for packaging. We hope this guidance may provide a basis for education on sustainability considerations as they relate to packaging and to help bring them into the mainstream of packaging development.

This guidance is not intended to be prescriptive. It is designed to be flexible and adaptable to the various needs of designers and the requirements of a diverse industry. It recognizes that there are factors that make designing for the environment dynamic and that tradeoffs often come with the territory. It focuses on design considerations and appropriate questions to ask. It includes issues that go beyond compliance and reflects the integration of sustainability and environmental considerations into the packaging design process.

This document is directed toward packaging designers and developers with thought toward how it might best serve them. We conceived it as a resource that can be readily updated and allow easy access to those portions that are of interest to an individual designer or developer. There is a general section that provides an overview of sustainability, cradle-to-cradle design and the SPC's definition of sustainable packaging. It then goes on to elaborate on how sustainable design is an extension of traditional design considerations.

This is followed by a series of sections that outline the various design strategies (e.g., *design for recycling*) that might be employed to meet a specific design objective (e.g., *resource recovery*). These sections are formatted as brochures that can be printed for easy reference. We expect this document to grow and change over time. We hope you will find it useful and encourage feedback for how it might be improved.

Finally, it is the challenge of the packaging design team to define their sustainability objectives and find the combination of sustainable strategies most appropriate for their package and organization. As we noted above, there are often tradeoffs. We are confident that the innovation that derives from the design process will lead to better and better solutions. The goal of this document is to inform that process.

Anne Johnson
Director of the Sustainable Packaging Coalition

acknowledgements

These guidelines are the result of a genuine and productive collaboration between GreenBlue staff and individual members of the Sustainable Packaging Coalition. Thank you, everyone.

Holly Robbins (*Target*) deserves special thanks for her substantial contributions throughout the project, which simply would not have happened without her vision, dedication and deep understanding of design for the environment. Steve Barrett and Fumi Watanabe at *Starbucks* were also key members of the production team, sharing design expertise and time throughout the project. Jenny Stephenson at *US EPA* got the whole project started with her initial research and writing, and we are grateful to Erica Rostedt at *Starbucks* for sharing her language and editing skills in the final copy-editing phase. Also, thank you, John Moes *(John Moes Design),* for jumping in at the last minute to help with production.

We also extend sincere thanks to the Content Subcommittee: Eric Brody (*NAU*), John Delfausse (*Esteé Lauder*), Jay Edwards (*Kraft Foods*), Sara Hartwell (*US EPA*) and Holly Robbins (*Target*) for all of their many hours on the phone working out the details of the content. And a hearty thank you to the entire SPC Design Guideline project team, in particular Scott Ballantine (*Microsoft*) for setting up all of the LiveMeetings to facilitate collaboration and Victor Bell & Catherine Goodall (*Environmental Packaging International*) for guidance on the regulatory sections of the document. Thanks to the rest of the GreenBlue staff for all of your support, especially Dr. Lauren Heine and Topher Buck for guidance in the material health portion of the document. We are truly fortunate to work with such talented people!

Martha Leflar, *Project Manager*
Anne Johnson, *Director, Sustainable Packaging Coalition*
Jason Pearson, *Executive Director, GreenBlue*

what is sustainability?

The term "sustainable development" has been around for a while. In 1987, the World Commission on Environment and Development defined it as "meeting the needs of the present without compromising the ability of future generations to meet their own needs."

Since then, individuals, organizations, and governments have been working together to give this definition practical meaning in the real world.

Sustainability is a systems concept that is simple common sense:

We need a healthy ***Planet*** to provide resources for our basic needs and to support the needs of our economies. ***People*** need robust commerce for employment and a healthy and productive environment to live in. Effective economies (***Profit***) need stable societies in which to operate and healthy employees to work.

It's clear that careful stewardship of the planet and its resources are essential for a sustainable future for society and business. But this isn't easy. As a society, we know where we want to go in terms of sustainability—but we don't know exactly how to get there.

As designers, however, we can be certain that if we are to ***improve what we make, reduce our impacts, and create a better world***, we will need to rethink the way we design at every scale.

Sustainability represents a ***tremendous design opportunity***: To design chemicals, materials, products, buildings, cities, and transportation systems that contribute meaningfully to a positive, sustainable future.

One of the sustainability frameworks that has proved valuable for designers is the language of ***cradle-to-cradle design*** found in the book *Cradle to Cradle: Remaking the Way We Make Things* by William McDonough and Michael Braungart.

leaders in sustainability

A growing number of individuals and organizations are taking up this design challenge.

For more ideas and inspiration, here are some websites:

www.bsr.org

www.ceres.org

www.cfsd.org.uk

www.chemistry.org

www.eco-labels.org/home.cfm

www.environmentaldefense.org

www.environmentalhealthnews.org

www.globalgreen.org

www.globalreporting.org

www.greenbiz.com

www.greenblue.org

www.grist.org

www.inform.com

www.naturalstep.org

www.o2.org

www.ourstolenfuture.org

www.pbs.org/tradesecrets

www.rmi.org

www.sijournal.com

www.solonline.org

www.sustainability.com

www.sustainableproduction.org

www.sustainablestyle.org

www.treehugger.com

www.turi.org

www.wbcsd.ch

www.worldchanging.com

www.zerowaste.org

what is cradle to cradle design?

The first industrial revolution left the planet with a legacy of unexpected consequences. Global climate change (and the chain of reactions resulting from it), erosion of the ozone layer, loss of biodiversity, and the bioaccumulation of toxic substances in our animals and children are only a few examples.

These consequences, however, are foreboding signs on both a global and molecular scale-signs we can no longer ignore. While we have created incredible materials and technologies, we have yet to design and engineer systems and behaviors to steward them effectively. We must tap into the same expertise and intelligence that created our current systems and ***refocus on designing truly sustainable solutions.***

In *Cradle to Cradle*, McDonough and Braungart ask us to imagine industrial systems modeled on the beauty and effectiveness of natural ecosystems. They identify three fundamental principles:

- ***Use current solar income*** The biological productivity of the planet is fueled by solar energy, the only resource that comes from outside our planet.
- ***Waste equals food*** There is no waste in nature; waste from one organism provides nutrients for another.
- ***Celebrate diversity*** Life thrives on diversity. Nature finds solutions by constantly adapting to fill niches.

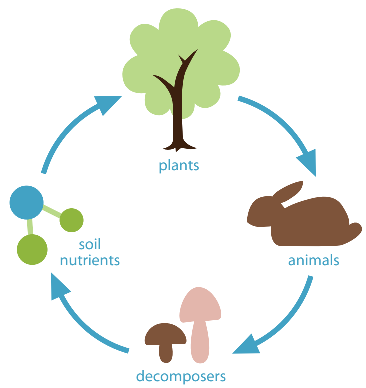
Cradle-to-cradle design envisions a world powered by the sun where growth is good, waste nutritious, and productive diversity enriches human and natural communities.

The industrial application of cradle-to-cradle design creates a cycle for

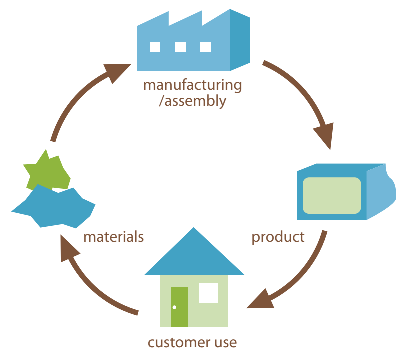
"We can accomplish great and profitable things within a new conceptual framework—one that values our legacy, honors diversity, and feeds ecosystems and societies.... It is time for designs that are creative, abundant, prosperous, and intelligent from the start."

~ William McDonough and Michael Braungart
Cradle to Cradle: Remaking the Way We Make Things

industrial materials. Like the earth's nutrient cycles, the flow of materials ***eliminate the concept of waste*** (cradle-to-cradle rather than cradle-to-grave). Each material in a product is designed to be safe and effective, as well as to provide quality resources for subsequent generations of products. In other words, materials



BIOLOGICAL CYCLE



TECHNICAL CYCLE

are conceived as nutrients and designed to circulate safely and productively.

Biological cycle includes materials that can be safely returned to soil through a degradation process. Deemed to be ecologically safe, these materials are renewable and biodegradable.

Cradle-to-cradle design envisions a world powered by the sun where growth is good, waste nutritious, and productive diversity enriches human and natural communities.

Technical cycle includes materials within industrial "metabolisms." In other words, industry can be modeled on natural processes and these industrial materials can be productively cycled. Valuable for their performance qualities and typically "non-renewable," technical nutrients are designed to circulate safely and perpetually through cradle-to-cradle product life cycles of manufacture, use, recovery and re-manufacture. A higher degree of stewardship is required for technical materials that cannot biodegrade.

The implementation of cradle-to-cradle means ***redesign at a system-wide level***. It requires the vision to creatively re-imagine industrial practices and to conceive a fully sustainable future. This has been the primary task of the ***Sustainable Packaging Coalition***: to define itself and its vision for the packaging industry, and to make that vision a reality.

a vision for sustainable packaging

The Sustainable Packaging Coalition (SPC) envisions a world where all packaging is sourced responsibly, designed to be effective and safe throughout its life cycle, meets market criteria for performance and cost, is made entirely using renewable energy, and once used is recycled efficiently to provide a valuable resource for subsequent generations. A true cradle-to-cradle system for all packaging.

definition of sustainable packaging

Sustainable packaging is:

- Beneficial, safe and healthy for individuals and communities throughout its lifecycle;
- Able to meet market criteria for performance and cost;
- Sourced, manufactured, transported and recycled using renewable energy;
- Able to maximize the use of renewable or recycled source materials;
- Manufactured using clean production technologies and best practices;
- Made from materials healthy in all probable end-of-life scenarios;
- Physically designed to optimize materials and energy;
- Effectively recovered and utilized in biological and/or industrial cradle-to-cradle cycles.

"We cannot solve our problems with the same thinking we used when we created them."

~ Albert Einstein

One of the initial projects of the SPC has been to define sustainable packaging. By providing ***a common framework,*** the packaging industry can evaluate current efforts, identify opportunities and begin to pursue strategies to develop sustainable packaging materials and systems.

As it stands now, the definition is intended as a "target vision." The definition criteria outline a framework for specific actions and will evolve over time with new materials and technologies. The SPC recognizes that the timelines will vary across criteria and packaging materials. However, together, these criteria characterize our vision for sustainable packaging.

Making this vision a reality begins with small steps. An entire system change can only happen when a wide network of people can begin to ask questions and make informed decisions. In that spirit, the rest of this document offers a combination of questions, tools, and resources for designers interested in ***moving toward a fully sustainable future.***

good design is vital

As a designer or developer, you might think that the consideration of sustainability would only limit your creativity. However, finding innovative solutions for sustainable packaging is an exciting opportunity.

Every design decision, from the choice of a base material to the design of a product label, can substantially influence whether a package ultimately enhances or degrades the overall quality of our communities, economies and environment. Sustainable design is a complex challenge, no doubt. However, since the vast majority of the overall energy and environmental impacts of a package can be determined in the design phase, it is also extremely important. The integration of physical design, material selection, and end of life considerations into an effective design process will help you to ***minimize the negative impacts*** while at the same time ***optimize the positive benefits*** of your design solutions. In other words, you can satisfy your creative ambitions and at the same time be environmentally responsible.

an opportunity to innovate

As a packaging designer, ***you play a central role in making the vision of sustainable packaging a reality.*** The SPC's definition of sustainable packaging is a design brief for the future of packaging and packaging systems, and the definition's eight key objectives describe a new vision of high quality packaging for the 21st century. What does this mean for you? Each of these objectives opens up numerous opportunities for new solutions that improve on existing approaches. These creative solutions will enhance both individual product differentiation and the true quality and value of collective human enterprise. This is the challenge before us as designers: to continue to innovate, to meet and exceed our performance in the new categories of excellence introduced by sustainability.

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design quality redefined

These new categories of excellence redefine design quality by adding an array of new criteria to conventions already familiar to designers. The criteria are not necessarily new; some simply extend existing considerations. As they stand now, conventional definitions of design quality are typically limited to cost, technical performance, appearance, and, in certain cases, regulatory compliance. However, when sustainability is added to the mix, it introduces an expanded set of criteria which may include optimizing resources, responsible sourcing, material health, and resource recovery. This means the ability to design packaging that ***strives for a whole new level of design quality***. *(See Expanded Definition of Quality chart)*

beyond design

Design is certainly a critical point to develop products that incorporate sustainability principles. Yet there is an ongoing debate on the broader framing issue of sustainable consumption. Though this debate has direct

an expanded definition of quality

design objective	key question	examples of strategies	conventional definition	expanded definition
technical performance	does the package protect the product?	• balance need with over-engineering • consider the whole packaging system • design for probable scenarios not worst case • research new technologies	X	X
cost	is the design cost-effective?	• align cost with target market • use materials & energy efficiently • amortize cost over life cycle	X	X
appearance	does the design communicate effectively?	• rethink assumptions • design for communication • weigh consquences	X	X
regulatory compliance	does the design meet or exceed regulations?	• design to meet applicable regulations • comply with any labeling requirements • anticipate regulatory changes	X	X
optimize resources	does the design optimize materials and energy?	• practice source reduction • use recycled content • design for transport		X
responsible sourcing	has the material been produced and delivered responsibly?	• design with environmental best practice • design with fair labor and trade practices • design with virgin renewable materials from sustainably managed sources		X
material health	are all materials healthy for people and the environment?	• know the chemistry of the materials in your package • know the potential health and environmental impacts over the life cycle of the package		X
resource recovery	where will the materials go after use?	• design for reuse • design for recycling • design for composting		X

implications for packaging, it is nonetheless outside the scope of most designers and the concern of this document. This debate is important to mention, however, because any decisions involving what defines sustainable levels and patterns of consumption will be ***a major force*** in the direction of sustainable packaging efforts.

design guidelines are a tool for asking good questions

These design guidelines are not a prescription for sustainability. Think of them as a tool for intelligently broadening the questions that we, as designers, ask ourselves. And for providing resources to help us ***respond creatively and effectively*** to these broader questions. Designers are only as good as the questions they ask. Good design emerges from good questions, and truly innovative design results from expanding the scope and ambition of the questions designers ask themselves.

Designers are only as good as the questions they ask. Good design emerges from good questions....

expanded questions change available design strategies

Expanding the scope of design questions to include new criteria or objectives has two important consequences for designers. First, we must ***rethink design strategies for conventional objectives*** such as cost, technical performance, appearance, and regulatory compliance. Second, we must learn new strategies to effectively address new design objectives. Part III describes briefly the implications of sustainability for conventional design strategies. Part IV provides greater detail on new design strategies that are useful in addressing the new landscape of sustainable design objectives.

design for sustainability

The expanded definition of quality encourages designers to rethink conventional design objectives, such as technical performance, cost, appearance, and regulatory compliance.

technical performance

physical protection

A primary goal for packaging is to protect the product. As you consider protective design features, try to evaluate the necessity of each protective feature offered by the packaging. Try to ***avoid over-engineering***. If a protective element is vital to preserve the product's integrity, then consider ways to optimize the amount of material needed to fulfill the protective function. Ask yourself:

- What physical protections does the package need to preserve product integrity?
- Has the package been designed to fulfill its useful life, but not over-engineered?

asset protection

In certain areas of retail, consumer packaging serves as a means of theft prevention. However, relying predominately on packaging for asset protection can often lead designers to over-package products. To break this cycle, challenge yourself to look for new and efficient ways to prevent pilfering, without creating redundant protection layers. Don't limit yourself by looking solely to the packaging to provide asset protection. The most effective solution may be to modify part of the support system. ***Be inventive and consider all methods*** of delivery and merchandising, such as changing fixtures or displays. Ask yourself:

- Are there changes in the system that will result in more efficient packaging?
- Is the system depending on the package to do too much?

Are there changes in the system that will result in more efficient packaging?

mechanical requirements

When designing a package, the resulting design should maintain adequate product protection and withstand all mechanical requirements associated with packing, handling, transporting and storing. Some product categories require more protection than others, but in general, the higher the value of the product, the higher its resource intensity (e.g., as with computer equipment), the greater the financial and environmental impact associated with packaging failure. However, trying to design your packaging for the worst-case scenario can often result in significant over-packaging. When it is appropriate, try ***designing packaging for probable handling scenarios*** instead. This may enable you to reduce the amount of material needed for the packaging and result in financial and environmental savings. Ask yourself:

- What are the mechanical requirements for the packaging?
- What is the shelf life of the product?
- What are the product modes of failure and how will the package prevent them?
- What are the distribution channels?

- Can you make changes to the package's supporting system (e.g., fixtures, shipping, etc.) to reduce the requirements of the packaging?
- Do you understand the total packaging requirements of the product (primary, secondary and any transport packaging) in order to optimize the use of materials between primary and transport packaging?

cost

Traditionally the cost of packaging has been closely linked to the base material used. However, while the base material is still the principal cost factor for packaging, packaging fees and advanced recovery fees are beginning to play a role in calculating costs. Widespread adoption of extended or shared producer responsibility legislation will impact packaging costs as well. The good news? Well-designed packaging that incorporates environmental considerations has the ***potential to result in great cost savings*** through the efficient use of energy resources, minimizing fees, and complying with regulations. Ask yourself:

Do you understand the true costs of the package across the life-cycle, including fees and disposal costs?

- Can the package be redesigned to be more efficient and cost-effective?
- Do you understand the true costs of the package across the life-cycle, including fees and disposal costs?
- What positive environmental decisions can result in cost savings at the package's end of life?

appearance

An important role of packaging design is to creatively communicate information to consumers, often by providing details to inform purchasing decisions. The use of marketing strategies (e.g., add-ons like foils, holographs, electronics or certain inks), however, may impact the recyclability or value of the packaging at the end of its life. Likewise, excessive reliance on packaging for marketing and messaging may result in over-packaging. In the same way you use packaging to convey information about a product, why not choose to ***educate consumers on the post use options for the packaging***? Try to creatively incorporate sustainability considerations into the package messaging. Ask yourself:

- Does all the marketing need to be carried on the package?
- Can signage carry more of the marketing than the disposable packaging?
- Have you carefully considered the impacts of add-ons?
- Can instructions for recovery be included in the labeling of the package or signage?

Can instructions for recovery be included in the labeling of the package or signage?

But it is very important when using "green" marketing claims, labeling and symbols to think about whether the claim can be substantiated and how it's likely to be interpreted by your customer. Misleading, illegitimate, overused, and unsubstantiated "green" claims can degrade the meaningfulness of a claim, label or symbol. In the U.S., the Federal Trade Commission (FTC) regulates marketing claims to try to prevent consumer deception and unfairness in the marketplace. The FTC has issued a document titled *Complying with the Environmental Marketing Guides,* explaining the proper use of green marketing. In the UK and Canada, they have adopted the ISO 14021 standard to govern environmental marketing claims. Ask yourself:

- Can any "green" marketing claims be substantiated?
- Do you understand the material labeling or symbolic system for packaging in the end market country?
- Are post-use instructions for the package clearly indicated, when appropriate?
- Are there any post-use prohibitions for the packaging that should be indicated?

regulatory compliance

Least we forget, there are many regulations governing packaging that you must be aware of. These regulations range from design requirements to labeling and recovery or end-of-life requirements. To avoid penalties, delays and fines, it is ***important to understand the packaging restrictions*** at your package's final destination. Some regulations are dependent on the type of product and others are related to the packaging design. Because this information is continually in flux, we will provide general guidance below and highlight more specific guidelines and resources within the appropriate design strategies. This does not replace the due diligence your company should conduct prior to bringing a package to market. Ask yourself:

- In which country or countries are you selling this product and packaging?
- Have all applicable regulatory requirements been identified?
- What regulations related to your product might also apply to packaging?
- What materials are banned or restricted at the package's final destination?
- Are there packaging fees, and could they be reduced by using different materials?
- Are there design requirements such as void space, layers, recycled content, recyclability, recoverability, etc.?
- If extensive legal labeling is required (as in pharmacy and personal products), can alternatives such as fold-out labels be used instead of making the package bigger?
- Are Certificates of Compliance with heavy metals or hazardous substances regulations and wood-treatment standards on file or available from each of your suppliers?
- Is it possible for your company to adopt a policy of using the strictest standards for all package designs?

Is it possible for your company to adopt a policy of using the strictest standards for all package designs?

general packaging guidance

In which country or countries are you selling this product and packaging?

regulations

- Directive 94/62/EC on Packaging and Packaging Waste, and its amendments
- U.S. Labeling Guidelines: Federal Trade Commission "Environmental Marketing Guides" (Similar in UK and Canada)
- AS/NZS ISO 14021:2000 Australia & New Zealand Standard, Environmental labels and declarations - Self declared environmental claims
- New requirements in China

standards

- EN 13427:2004 Requirements for the use of European Standards in the field of packaging and packaging waste
- Life Cycle Assessment General Principles Standard: ISO 14040:1997
- National Packaging Covenant, Australia http://www.deh.gov.au/settlements/waste/covenant/index.html

designing sustainably

The design of packaging influences the entire packaging supply chain, from material sourcing to material recovery. The diagram below reflects the material flow of packaging. Designers who understand this flow of materials are in the ideal position of optimizing a package for its entire life cycle.

Also, by understanding the relationships within the flow of packaging materials, designers can identify strategic partners who can help them work through problems along the way to designing sustainable packaging.

packaging material flows

This diagram reflects the flow of packaging materials from material sourcing to material manufacture o package manufacture to use to potential end-of-life fates. It also identifies the key players along the packaging supply chain.

The following pages provide detailed summaries of useful design strategies for addressing the new design objectives introduced by sustainability (see below).

This guidance is not intended to be prescriptive and is designed to be flexible and adaptable to the various needs of designers and the requirements of a necessarily diverse industry. It recognizes that there is an array of factors that make design for environment dynamic and that ***tradeoffs often come with the territory***. It focuses on the design considerations and appropriate questions to ask. It includes issues that go beyond compliance and reflects the integration of sustainability and environmental considerations into the packaging design process.

Each design strategy is formatted to act as a ***stand alone primer*** on the specified strategy or activity. Icons help communicate how specific sections or questions might relate to different audiences. As tools and resources develop in this area, these strategies will be expanded and revised.

Each of the design strategies include information on the following:

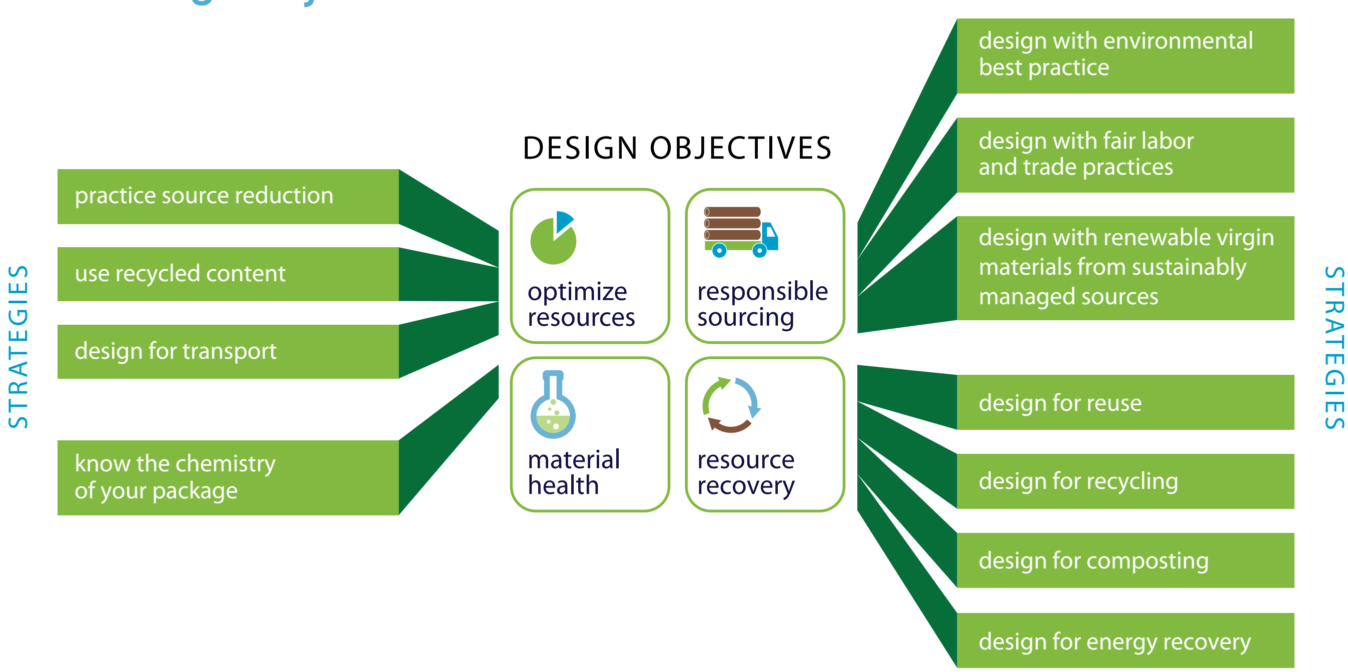
OVERVIEW INFORMATION

- *What is it?*
- *Why is it important?*
- *How do I do it?*
- *Questions to ask*

RESOURCE INFORMATION

- *Material specific information*
- *Regulations & standards*
- *Resources*

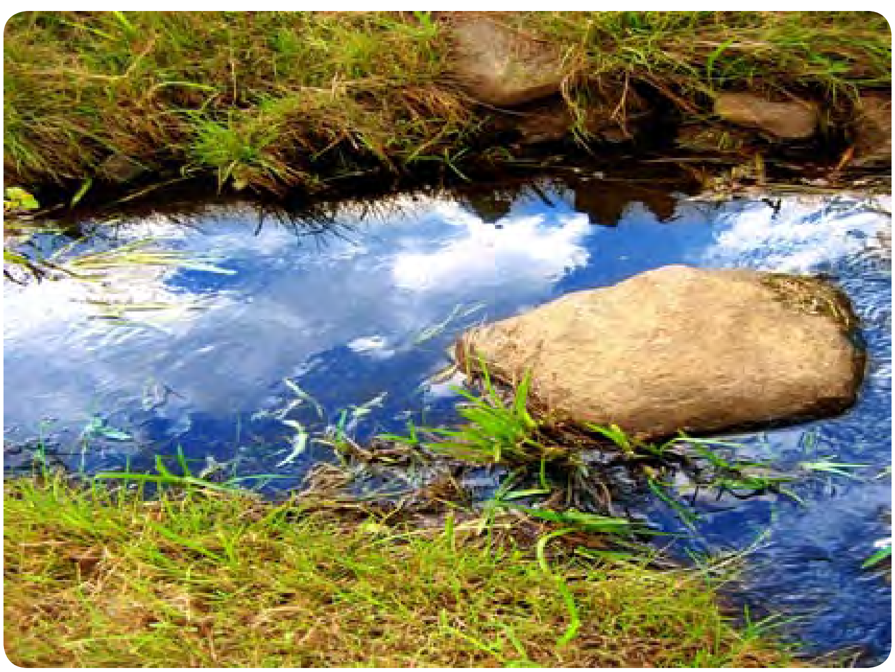
new design objectives



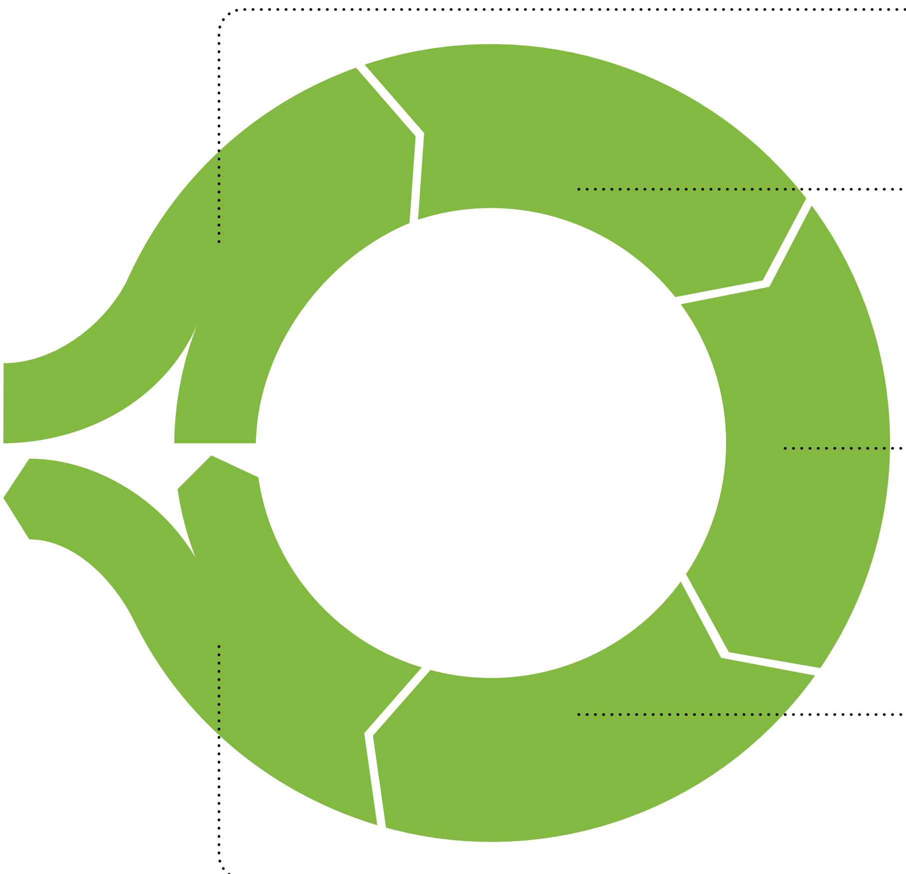
the life cycle icon

As the scope of design questions has expanded, a range of new design strategies has emerged to address them . To help designers quickly identify the areas of the packaging life cycle for which a particular strategy is relevant, we make use of a "life cycle icon." The icon is largely a distillation of the previously explained packaging material flows diagram.

Each of the design strategies displays a life cycle icon, demonstrating which stages of the life cycle the strategy affects. It provides a quick way for designers to answer the question "If I use this strategy to make design decisions, which of the five major stages in the life cycle can I influence in a positive way?"



the life cycle icon explained



sourcing
Includes raw material extraction and using recycled content as a feedstock

manufacture
Includes the manufacture of the material and converting that material into a package.

distribution
Includes warehousing and transportation from point of manufacture to point of use.

use
Includes use of the package for its intended purpose (and reuse)

end-of-life
Includes all of the fates a package could have after its use. Through recycling, materials can have new life.

example

design for recycling.

By using this strategy, designers can have a positive impact on the end-of-life and sourcing phases of a package's life cycle. Through Design for Recycling you can increase the amount of materials that get recycled and create feedstocks for creating new packaging. This does not mean that other phases of the life cycle will not be affected, but the primary value of this design strategy is its positive impact on these two stages.

[optimize resources]

practice source reduction

QUESTIONS TO ASK…

Could minor changes be made to the product that would eliminate the need for packaging?

Have all unnecessary packaging components been eliminated?

What level of protection does the product require?

Could handling specifications (e.g., padded trucks) decrease the amount of necessary packaging?

How can I balance the packages' performance requirements with the amount of material?

Can you further reduce the thickness or weight of the packaging without impacting performance?

what is it?

Source reduction is reducing the amount of materials entering the waste stream by redesigning products or patterns of production or consumption (USEPA). Source reduction is a fundamental eco-efficiency strategy and makes good business sense. It deals with both the resource intensity associated with materials throughout their life cycle as well as the amount of materials used in a single packaging design.

why is it important?

Source reduction is a simple strategy toward decreasing the environmental impact of your package. Reducing the amount of packaging delivers bottom line productivity and results in cascading environmental benefits throughout the package's life cycle. It conserves resources and saves energy spent on manufacturing and transportation. Consequently, less pollution, waste, and greenhouse gases are produced throughout the package's life cycle.

how do I do it?

process level

- Specify materials with lower impact production processes.
- Consider the minimal number of materials, additives or auxiliaries.
- Source materials from suppliers who implement environmental best practice.
- Select converters committed to the highest environmental performance and material efficiency.

package level

- Work with the product developer/designer to see if there are simple changes in the product that could result in a decrease or elimination of the need for packaging (e.g., concentrate formula and ship less water).
- Eliminate unnecessary materials in the packaging design.
- Reduce the size, weight or thickness of your package (e.g., light weighting).
- Optimize void space within the package design.
- Optimize the amount of necessary packaging with regard to primary and transport packaging.
- Consider the distance your materials are traveling.

QUESTIONS TO ASK… CONTINUED

Are the package's dimensions optimized to best fit the product?

Have you considered the entire packaging system - primary, secondary and tertiary packaging and various transportation and distribution modes - to determine how a material reduction in one part will affect the system, and where you can achieve the greatest net material reduction?

How will the design impact my supply chain and the manufacturability of the package?

Are there local sources of packaging materials?

regulations and standards

regulations

Europe, Asia and Canada Packaging Prevention Planning

South Korean *Ordinance of the Standards for Methods and Materials, Etc., of Product Packaging*

Australia *Code of Practice on Deceptive Practices in Packaging of 1990*

New Zealand Fair Trade Act

Japan Cosmetics Space Requirements

Taiwan Empty Space & Layer Requirements for certain items

standards

EN 13428:2004 *Requirements specific to manufacturing and composition - Prevention by source reduction*

resources

Design for the environment: life cycle assessment and sustainable packaging issues by S.G. Lee & X. Xu
http://www.inderscience.com/storage/f121568104321179.pdf

Hewlett-Packard's Guideline for Environmentally Responsible Packaging
http://packaging.hp.com/enviro/evsec03.htm

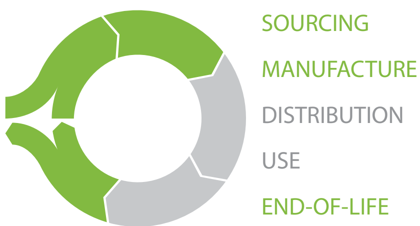
Minnesota Office of Environmental Assistance "Source Reduction Now"
http://www.moea.state.mn.us/berc/srn.cfm

Oregon Department of Environmental Quality "Packaging Evaluation"
http://www.deq.state.or.us/wmc/packaging/chklst/packagingchecklist.pdf

U.S. EPA Overview on Source Reduction
http://www.epa.gov/epaoswer/non-hw/muncpl/sourcred.htm

[optimize resources]

use recycled content



what is it?

Recycled content is material that has been recovered or diverted from solid waste and used as feedstock for a new product.

why is it important?

Most of the environmental impacts of a material are associated with raw material extraction and its virgin production. Using recycled materials offsets the need for virgin resources. In addition, the production of recycled materials typically consumes significantly less energy than that required for virgin production. As a result, using recycled materials reduces the consumption of resources and energy, and extends the useful life of materials currently in circulation.

For some materials and applications there are technical limits to the use of recycled content and in some cases, there may be economic limitations (e.g., availability). The appropriate level of recycled content is clearly influenced by market considerations and performance requirements.

QUESTIONS TO ASK…

Have the effects of using recycled material on the package's technical performance been thoroughly considered?

Has the impact of recycled materials been investigated throughout the process to identify cascading effects from use?

Does the supplier understand the affects of using recycled materials and any cascading effects?

Given the end market for the package, what are the readily recycled materials?

How does using recycled content affect the look and feel of the design?

Can you push minimum recycled content requirements further?

However, increasingly, recycled content goals are being put forward by governments, states and companies to promote innovation and encourage the development of secondary markets for packaging materials.

By using recycled materials we reduce the amount (and cost) of materials sent to landfills as waste. It creates pull in the marketplace and helps support the economic development of the recovery and reclamation industries necessary to the development of cradle to cradle systems for packaging materials. Using recycled materials is particularly important for materials that rely on non-renewable fossil fuel resources for energy or material inputs. For these materials, closed-loop recycling is sustainable management for the long term.

how do I do it?

- Determine whether the technical requirements of the package can be met using recycled content and if so, how much recycled content?
- Find suppliers with dependable sources of recycled materials that meet your packaging requirements.
- Consider whether the materials you use for your design are easily recyclable in the region the product will be sold. This will help to create closed-loop cycles.
- Discuss the use of recycled materials with marketing department and identify any market concerns early.
- If using recycled content is important to your company, setting internal goals for recycled content can help drive innovation and challenges the status quo.

regulations and standards

regulations

California's Rigid Plastic Packaging Container Law
http://www.ciwmb.ca.gov/plastic/RPPC/

Oregon's Rigid Plastic Packaging Container Law
http://www.leg.state.or.us/ors/459a.html

resources

Environmental Defense Buyers Guide to Recycled-Content Paperboard
http://www.environmentaldefense.org/documents/532_PaperboardReport.pdf#search=%22%22recycled%20content%22%20packaging%22

Environmental Protection Agency Recycled Content (ReCon) Tool
http://yosemite.epa.gov/oar/globalwarming.nsf/content/ActionsWasteToolsRecon.html

Environmental Protection Agency Recycling Overview
www.epa.gov/epaoswer/non-hw/muncpl/recycle.htm

100% Recycled Paperboard Alliance
http://www.rpa100.com/

Waste Management & Energy Savings, Benefits by the Numbers
http://yosemite.epa.gov/OAR/globalwarming.nsf/UniqueKeyLookup/TMAL6GDR3K/$File/Energy%20Savings.pdf

Zero Waste New Zealand Trust
www.zerowaste.co.nz

design for transport

QUESTIONS TO ASK...

Can I design a package that meets the technical requirements with lighter materials?

Can the transport package be eliminated or at least reduced through a change in the primary package (or vice versa)?

What type and size of transport packaging will be used to ship the product?

What height requirements does my receiver have?

For packages that will be shipped prior to being filled, how do I design a package that is compact, collapsible or foldable as to avoid "shipping air?"

Continued on next page...

what is it?

Design for the most efficient transport of a package and product. This strategy utilizes light weighting, using shipping space to the fullest extent (cubing out) and common footprint considerations in order to make the most efficient use of materials and energy with respect to transporting goods.

why is it important?

Considerations of transport packaging and pallet efficiency can result in energy, material and cost savings.

how do I do it?

- Optimize the designs of your primary packaging and transport packaging with regards to material and energy use.
- Consider whether the transport package can be eliminated through redesign of the primary package or vice versa.

- In order to decrease energy and resource demand, use light weighting (source reduction) strategies in your package design.
- Research the transport packaging to be used for your package, both pallet (typically 40 in by 48 in) and secondary packaging.
- Design your primary package to cube out the secondary packaging or transport packaging.
- Design your transport packaging to cube out on the pallet with no overhang and close to 1 inch underhang on all sides.
- Utilize the height of the truck with consideration to the receiver's height requirements.
- Use transport packaging that is fully recyclable or returnable.
- Encourage your distribution fleet to switch to hybrid vehicles or renewable energy sources if possible.
- If needed, look to service providers that specialize in transport packaging or logistics.

QUESTIONS TO ASK…

CONTINUED

How much and what types of energy will be used in transportation?

Are distribution routes optimized for efficiency?

Are there tools or service providers who could help with environmentally optimizing transport packaging?

regulations and standards

No guidance at this time.

resources

Corrugated Packaging Common Foot Print Page
http://cpc.corrugated.org/Applications/Produce/CommonFootprint/Default.aspx

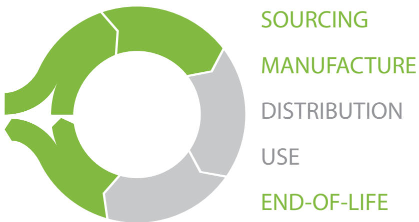
Fibre Box Association Corrugated Common FootPrint Page
http://www.fibrebox.org/Info/CCF.aspx

International Safe Transit Association
http://www.ista.org/

North Carolina Department of Environmental and Natural Resources,
"Pallet Management and Waste Reduction"
http://www.p2pays.org/ref/03/02765.pdf

Recyclable Transfer Packaging Roundtable
http://globalgreen.org

design with environmental best practice



QUESTIONS TO ASK…

Where do my raw materials come from and were they extracted/ harvested using any applicable best practices?

Does my supplier have a proven environmental commitment (e.g., Ceres Principles, Corporate Social Responsibility reporting)?

Do my suppliers understand why human and environmental health is important to me?

Does my supplier have internal goals to minimize the number of hazardous substances in their production processes?

What other measures is my supplier using to enhance their sustainability performance?

Does my supplier have any programs that go beyond compliance?

what is it?

As raw materials are extracted, refined and manufactured into materials for packaging, hazardous process chemicals may be used and various pollutants may be released or large quantities of by-products may be created that can impact the environment (e.g., mine tailings). These impacts occur during the raw material extraction and material production phases of the life cycle and fall under clean production considerations.

why is it important?

It is important to understand that every packaging material has an environmental footprint. By using suppliers who have proven track records of environmental compliance and who implement clean production practices, you support the use of environmental management systems that are intended to reduce the amount of hazardous chemicals or emissions released into the environmental and minimize the potential harm to human health.

how do I do it?

Create partnerships with suppliers who employ environmental best practice including:

- compliance with all necessary reporting requirements .
- internal goals to minimize the use of hazardous substances used and pollution prevention plans.
- using closed loop systems to recover or recycle process chemicals, water and energy.
- employing measures to go beyond compliance, like continuous improvement, using renewable energy, or research and development programs in green chemistry and green engineering.

regulations and standards

standards

EN 96/61/EC
http://ec.europa.eu/environment/ippc/index.htm

International Standards Organization ISO 14001

resources

California Office of Environmental Health Hazard Assessment
http://www.oehha.ca.gov/

CleanPrint **Canada**
www.cleanprint.org

Environmental Protection Agency Envirofacts Data Warehouse
http://www.epa.gov/enviro/index.html

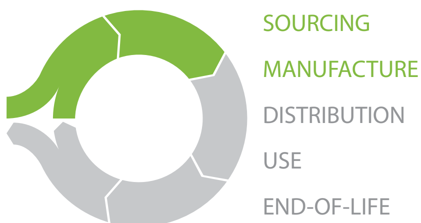
Europe, Integrate Pollution Prevention and Control
http://ec.europa.eu/environment/ippc/index.htm

Right-to-Know
http://www.rtk.net/

United Nations Habitat: Best Practices Database
http://www.bestpractices.org/

[responsible sourcing]

design with fair labor and trade practices



QUESTIONS TO ASK…

Does my supplier's policy on labor practices and fair trade coincide with my company's mission?

If in the US, does my supplier comply with all OSHA regulations?

Does my supplier use third party certifiers or issue a CSR report?

Does my supplier have any outstanding labor violations?

what is it?

Fair labor and trade are part of social equity, one of the three legs of sustainability. Fair trade is a trading partnership, based on dialogue, transparency and respect, that seeks greater equity in trade. It contributes to sustainable development by offering better trading conditions to, and securing the rights of, marginalized producers and workers (definition from FINE).

why is it important?

When procuring materials think about the employment practices of upstream actions associated with material excavation and production. As the materials and packaging are being produced, thoughtful consideration should be made to labor and wage issues, eco-justice and pollution of communities, unfair or unbalanced sighting of hazards or risks associated with social standing. It is important to foster a safe work environment by ensuring that workers have proper protections and training and are earning a fair wage.

how do I do it?

- Ensure that suppliers comply with any relevant supplier codes of conduct for your company.
- Check how often compliance is audited.
- Ask your suppliers about their policies regarding environmental, health and safety as well as labor practice.
- Find out from supplier if they use child labor and what are average working hours and wages.

regulations and standards

regulations

OSHA Worker Safety Laws (CFR 29)

standards

Fair Trade Labeling Organizations International

resources

Business for Social Responsibility, CSR Resources, Environmental Resources
http://www.bsr.org/CSRResources/Environment/EnvResources.cfm#rcycbchmk

Fair Labor Association
www.fairlabor.org

Transfair, Fair Trade Certified
http://www.transfairusa.org/

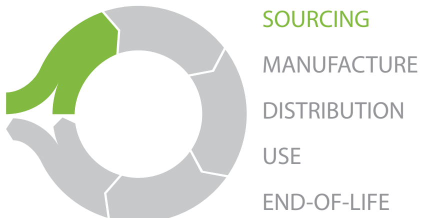
Fair Trade
http://www.fairtrade.org.

Fair Trade Federation
http://www.fairtradefederation.org/

Global Reporting Initiative G3 Guidelines
http://www.globalreporting.org

Make Trade Fair
www.maketradefair.com

design with renewable virgin materials from sustainably managed sources



QUESTIONS TO ASK…

Is this material derived from a source that is renewable or can be replenished?

Are you sourcing the material from a supplier that uses sustainable management practices?

Is the material or source appropriate given local resource demands?

what is it?

To ensure that biobased resources are truly renewable resources, the ecosystems from where they are sourced need to be carefully managed. Sustainably sourced renewable materials are those that are grown and harvested using management practices that maintain the productivity of natural systems without compromising their capacity for future generations.

why is it important?

Using materials that are generated from renewable resources that are sustainably managed encourages the use of best practices and ensures the productivity of renewable resources for future generations.

how do I do it?

- Reference certification programs for sustainable management practices. There are a number of certification systems all of which have different standards and requirements. Some certifications allow self-reporting while others require third party auditors. (For more information see resources below.)
- In your designs, specify renewable materials from sustainably managed sources.
- Consider the use of locally or regionally sourced materials, this will stimulate local economic growth as well as reduce required transportation energy.
- While certification systems exist for renewable materials, it is important to note that there is no comparable system for non-renewable materials.

regulations and standards

No guidance at this time.

resources

Canadian Standards International
http://www.csa-international.org/

Finland, Finnish Forest Certification System
http://www.ffcs-finland.org/pages/english/ffcs-system/overview.ph

Forest Stewardship Council
http://www.fsc.org/en/

Metafore
http://www.metafore.org

Programme for the Endorsement of Forest Certification
http://www.pefc.org/internet/html/

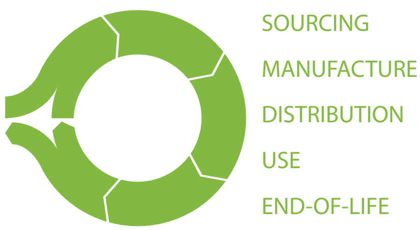
Rainforest Alliance
http://www.rainforest-alliance.org/programs/agriculture/certification/index.html

Sustainable Agriculture Research and Education
http://www.sare.org/

Sustainable Forestry Initiative
http://www.aboutsfi.org/

University of California, Sustainable Agriculture
http://www.sarep.ucdavis.edu/concept.htm

support green chemistry and green engineering



QUESTIONS TO ASK…

Can this material be made with less waste?

Can this material be made with less hazardous chemical synthesis?

Can this material be made with safer solvents and auxiliaries?

Can this material be made with less energy?

Can this material be made with renewable feedstocks?

Can this material be made so that it is safe and non-toxic?

what is it?

Green chemistry is the design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances. Green engineering is the design, commercialization and use of processes and products that are feasible and economical while reducing the generation of pollution at the source, and minimizing the risk to human health and the environment.

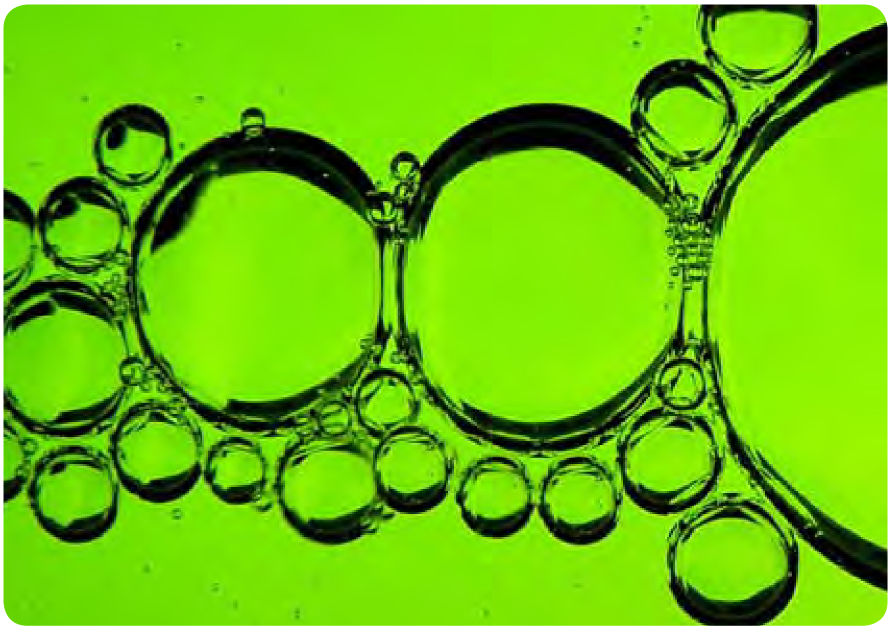
Although this information relates to chemists and engineers, we feel it is important to introduce these concepts to a broader audience so they receive wider adoption.

why is it important?

Green chemistry is a highly effective approach to pollution prevention because it applies innovative scientific solutions to real-world environmental situations. The framework designs materials that are safer for human and environmental health, generate less waste, require less energy, and use renewable feedstock. Green engineering is also important because it offers a holistic systems approach, looking at materials along a full life cycle. Moreover, alternative technologies developed through green chemistry or green engineering have proven to be economically superior and function as well or better than more toxic traditional options. When hazardous materials are cut from processes, all hazard-related costs are cut as well, significantly reducing hazardous materials handling, transportation, disposal and compliance concerns.

how do I support it?

Work with suppliers with a demonstrated interest in green chemistry and green engineering.



regulations and standards

No guidance at this time.

resources

12 Principles of Green Chemistry
http://www.epa.gov/greenchemistry/principles.html

American Chemistry Council
http://www.americanchemistry.com/s_acc/sec_topic.asp?CID=3&DID=6

Anastas, P.T. and J. Warner. 1998. *Green Chemistry Theory and Practice* (Oxford University Press: New York, 1998)

Center for Green Chemistry, Monash University, Australia
http://www.chem.monash.edu.au/green-chem/

Center for Green Chemistry, University of Massachusetts Lowell
http://www.greenchemistry.uml.edu/

Center for Green Manufacturing, University of Alabama
http://bama.ua.edu/~cgm/

Crystal Faraday
http://www.crystalfaraday.org/

EPA's Green Chemistry Program *http://www.epa.gov/greenchemistry/*

Green Chemistry, **Royal Society of Chemistry**
http://www.rsc.org/Publishing/Journals/gc/index.asp

Green Chemistry Institute
http://www.chemistry.org/portal/a/c/s/1/acsdisplay.html?DOC=greenchemistryinstitute\index.html

Greener Education Materials for Chemists, University of Oregon
http://greenchem.uoregon.edu/gems.html

Institute for Green Oxidation Chemistry, Carnegie Mellon University
http://www.chem.cmu.edu/groups/collins/index.html

International Union of Pure and Applied Chemistry (IUPAC)
http://www.iupac.org/divisions/III/303/index.html

National Science Foundation
http://www.nsf.gov/news/overviews/chemistry/chem_q05.jsp

Responsible Care
http://www.americanchemistry.com/s_acc/sec_statistics.asp?CID=176&DID=304

Society for Environmental Toxicology and Chemistry (SETAC)
http://www.setac.org/

[material health]

know the chemistry of the materials in your package

QUESTIONS TO ASK…

What base materials were used in the packaging?

What substances have been added to the base material?

What is the chemistry of any auxiliaries?

Is there potential to release known or potentially toxic substances?

Are there safer/healthier alternatives to use in the package?

Are there any materials bans or restricted substances where the package will be sold?

what is it?

Material health addresses the chemical composition of a material with a focus on the presence and release of substances harmful to human or ecological health. For packaging, special emphasis is placed on the potential for release in the use and end-of-life phases. The accumulation of known or potentially toxic substances in the biosphere and in our bodies is the subject of increasing concern for consumers, health professionals, regulatory agencies, and governments.

why is it important?

This information is important because chemicals and materials used in packaging can directly and indirectly affect the health of humans, other organisms, and entire ecosystems. Even if some chemicals are used in very small amounts the magnitude of packaging manufactured each year makes them a significant issue to address.

how do I do it?

- Take a proactive stance on the safety and environmental impact of your packaging by understanding the chemistry of the materials you use.
- Develop an internal list of substances of concern or identify external lists that your company could adopt.
- Ask your suppliers to identify the chemicals used in your packaging materials and auxiliaries, ideally down to 100 ppm.
- If confidentiality is a concern, ask your suppliers to (1) sign a confidentiality agreement, (2) use a third party certifier, or (3) self-certify that their materials do not contain any of your listed substances of concern (in some cases, it may be necessary or advisable to specify precise, nonzero concentration thresholds).

- Compare the constituents of your materials against internal or other substances-of-concern lists.
- Carefully select and specify the materials that meet performance requirements but are also safe in their likely end-of-life scenarios.
- Continuously monitor materials bans, restricted substances lists, and legislation prohibiting the use of certain substances within packaging.
- Develop or adopt tools and methodologies to assess material health to allow more transparent communication of material characteristics throughout the value chain.

material specific information

In regards to packaging, some additives that are important to scrutinize include:

- Plasticizers - improve flexibility
- Heat stabilizers - prevent thermal degradation
- Compatibilizers - allow two or more materials to co-exist in a polymer
- Dyes and pigments - change color
- Fillers - improve strength
- Light/UV stabilizers - reduce photodegradation
- Anti-oxidants - prevent oxidation
- Flame retardants - prevent combustion

Auxiliaries that are important to consider include:

- Inks
- Coatings
- Adhesives

regulations and standards

Directive 94/62/EC on Packaging and Packaging Waste, and its amendments (EU)

Model Toxics in Packaging Legislation (US)

resources

Altera Semiconductor Products: List of Banned Substances
http://www.altera.com/support/devices/reliability/environmental/banned-chemicals/rel-banned.html

Center for Disease Control National Report on Human Exposure to Environmental Chemicals
http://www.cdc.gov/exposurereport/

Kodak Substances of Concern List
http://www.kodak.com/US/en/corp/HSE/restmatmatrix.jhtml?pq-path=7244&CID=go&idhbx=hsesupplier

Kodak Material guidance for consumable and media products.
http://www.kodak.com/US/plugins/acrobat/en/corp/HSE/EKSP_1636V70.pdf

Kodak Packaging specific requirements.
http://www.kodak.com/US/plugins/acrobat/en/corp/HSE/EKSP-1594.pdf

LG Hazardous Substance Management
http://www.lge.com/about/environment/Hazardous_Substances_Management.jsp

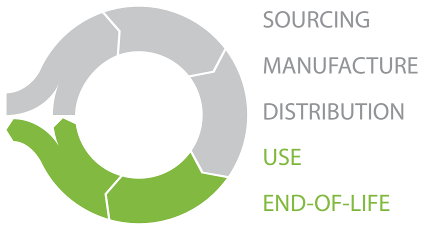
SC Johnson "Greenlist"
http://www.scjohnson.com/community/greenlist.asp
See presentation and case study at the bottom of the page.

Toxics in Packaging Clearing House
http://www.toxicsinpackaging.org

Toxic Use Reduction Institute
http://www.turi.org/

US EPA Design for Environment: Flexographic Ink Options: A Cleaner Technologies Substitute Assessment
http://www.epa.gov/dfe/pubs/flexo/ctsa/index.html

design for reuse



QUESTIONS TO ASK...

Given the application of the package, can this package be designed for reuse?

If so, who is the package intended to be reused by?

How will it be reused?

Can it be refilled?

Can the package be made with an identifiable and valuable consumer reuse for another purpose?

Are there incentives in place for reuse?

What are the environmental impacts for reuse compared to one-way packaging?

At the end of life, how can this package be recovered?

what is it?

Design for reuse extends the life of a package by enabling it to be refilled or reused multiple times by the consumer, retailer, or producer. Reusable packaging should be designed so that it can be reused in a manner that is safe and cost-effective with special attention to transportation distances necessary to complete the cycle.

why is it important?

Reusing a package or packaging material increases the material's useful life. This is an environmentally positive design strategy because you gain increased return from the original material processing inputs. It can also lead to a decreased demand for new material, which conserves resources, cuts processing energy, and reduces pollution.

how do I do it?

- It is important to consider the application of the package and whether reuse is an option e.g., when dealing with food packaging, reusability should be carefully analyzed.

- Be wary of using design for reuse as an excuse for over designing. In reality, if the consumer does not want or need the reusable package, then the added durability of the package is wasted.
- If the package is designed with the intent that retailers or producers will reuse it, consumers must have an incentive to return the package, and recovery systems need to be in place to facilitate collection. Therefore, it is important to consider the infrastructure and logistical needs of designing a packaging system based on reuse.
- Consider the environmental benefits of packaging to be reused with one-way packaging.
- At some point, even a well designed and utilized reusable package will reach the end of its usefulness. Therefore, it is still necessary to think about material selections and how the packaging material will be recovered.

regulations and standards

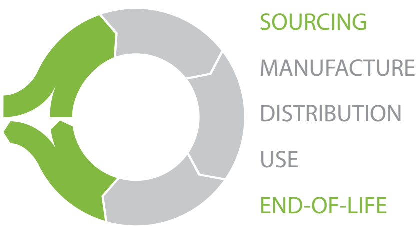
standards

EN 13429:2004 *Reuse of Packaging*

resources

Hewlett-Packard Guidelines for Environmentally-responsible Packaging
http://packaging.hp.com/enviro/evsec03.htm

design for recycling



QUESTIONS TO ASK…

Is the package recyclable?

Is it made from commonly recycled materials?

Is it labeled appropriately?

Is it a package that a consumer would think is recyclable (shape/style)?

Where will the package be sold?

Is collection infrastructure for the material available at the package's destination?

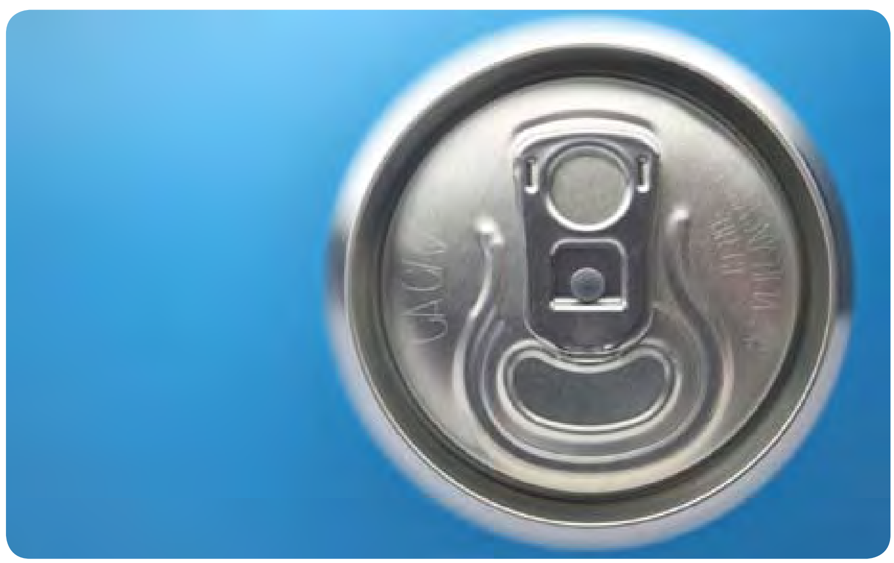
Is the design compatible with the collection and recovery technologies?

Is there a viable commercial market for these post-consumer-recycled packaging materials?

what is it?

Recycling is the reprocessing of materials at the end of their primary life ideally for use in a similar application. Design for recycling emphasizes the optimal physical design and construction of a package to facilitate its recovery.

Design for disassembly (a subset of design for recycling) is a design strategy that focuses on designing packaging that is easy to take apart to facilitate the recovery of the materials through recycling. It is typically relevant for complex and multi-material packaging applications. The economics of recycling are largely related to the purity and ease with which a material can be recovered. If mixtures of materials are used in packaging and they are not separable or separating them is time intensive, then the economic value diminishes.



why is it important?

Recycling captures and extends the valuable life of materials that would have otherwise gone to waste. Recycling is an essential strategy for the sustainable cycling of packaging materials—especially non-renewable materials. It generates a multitude of benefits, including supplying industry with valuable materials, creating jobs, and results in the conservation of natural resources and energy.

how do I do it?

- Select packaging materials that have high recycling rates.
- The base packaging material must be recyclable. Be sure that color tints do not impact the package's ability to be recycled.
- In accordance with any labeling legislation where the package will be sold, the package should be clearly labeled indicating its preferred recycling stream. Think about this as an opportunity to educate the consumer.
- Ensure that coatings, inks, material combinations, and add-ons are consistent with recycling technology.
- Considering the implications of all materials, features, and add-ons can help reduce complications later on.
- Dialogue with the relevant material supplier(s) to address any project-specific opportunities or trade-offs.
- Recycling relies on actions taken by consumers with limited knowledge and resources. First the consumer needs to recognize the package as recyclable. Second, they have to know how to properly recycle it. As a designer you have the ability to increase the likelihood that your package is actually recycled.
- It is easiest to recycle a package made of only a single material because it simplifies consumers' decisions as to how to properly dispose of the package, and it reduces the possibility of contaminating the material stream when the package is recycled.

QUESTIONS TO ASK…

CONTINUED

How many materials are being used in this package?

Are any materials bonded?

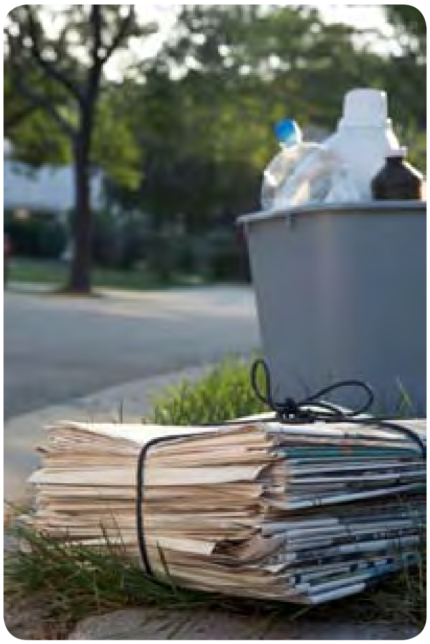
Are there any coatings, barriers, or laminates on the materials you are using?

Are there disassembly considerations with this package design?

Is each material labeled so that it can be identified during disassembly?

Is this package designed for take back?

Is the necessary take back infrastructure in place?



- Permanently adhering two materials together can diminish the package's recyclability. If two packaging components cannot be separated and one component is recyclable, but the other is not; then the package as a whole is not recyclable. Understanding what materials are compatible with a recycling technology is important if they are permanently bonded.
- Additionally, to gain more control over the lifecycle and material management of their packaging, producers may decide that take back programs are a viable and optimal solution. The advantage of take back programs is that during the initial design phase producers can plan and properly design for the packaging material's next use.
- Moreover, take back programs offer you another opportunity to touch your consumers—at the point of sale and at the point of take back. Thus, it can lead to increased consumer loyalty.

FACTS TO KNOW…

Waste management practices and recycling recovery rates vary from region to region and country to country.

In the US, most municipal recycling programs collect corrugate, paperboard, office paper, aluminum, glass, steel, and plastics.

Bottles made of PET and HDPE are the most commonly collected and recycled plastics.

material specific information

paperboard/corrugate

When combined with paperboard or corrugate, these features can complicate recycling:

Non-fluted paperboard packaging:

- Plastic film laminations and extruded coatings
- Foil stamping/par
- Film applied over a cut-out (often called windowing)
- Hot-melt adhesives
- UV-cured printing inks
- Wax and other moisture preventative coatings

Corrugate:

- E-beam inks
- UV coatings
- Wax and other moisture preventative coatings
- Radio Frequency Identification (RFID) tags[1]

plastics

- Think carefully about the overall material composition of the package.
- Smart design decisions can dramatically enhance the recyclability of plastic packaging.
- Carefully select the material attachments you use for closures, labels, coatings, color and adhesives.
- Decorative inks and foils may be a contaminate to the recycling process. This will help maintain the value of the plastic when it is recovered.
- Do NOT mix incompatible resins or attachments. They can degrade the resin stream, and cause complications at recycling facilities.

biopolymers

- Additives are integrated into all types of polymers, including biopolymers, to manipulate their physical performance.
- Biodegradable polymer additives can include coupling agents, plasticizers, fillers, dyes, and pigments.
- Given the potential for direct interaction with ecological systems after product use, biodegradable products should be manufactured with an added measure of safety regarding the assessment and selection of additives.

NOTES

[1]Radio Frequency Identification (RFID) tags

RFID tags consist of a computer chip connected to an antenna and a substrate on which the antenna resides. They may contain silver, copper, silicon, adhesives, and nickel. The antennae are usually made from copper, but they can also be made from aluminum. Printed antennae are typically made from silver. RFID tags are potential contaminants for recyclers and manufacturers using recycled materials. As a result, if your customer or company wants RFID tags, work to understand the potential impacts of having RFID tags on packaging materials and plan ways to minimize or mitigate those impacts.

steel

Recyclability is and has been an integral aspect of the steel packaging industry for some time, but here are a few components to avoid:

- Lead based inks
- Features made from other metals, e.g. copper - specifically, the can top and bottom material should be consistent with the sidewall (aluminum foil has not been shown to cause a significant issue)
- Plastic components on a steel package, although not particularly troublesome, should be selected for compatibility with steel recycling
- Paints and plastic coatings go into the furnace with the steel. They are typically not a problem unless they are chlorinated, which can result in problematic emissions.

aluminum

- Like steel, aluminum is endlessly recyclable.
- Like other materials however, care should be taken with inks and coatings as they go into the furnace along with the aluminum and can cause problematic emissions or potentially act as contaminants, especially metals.
- Different types of aluminum may affect the application of the recycled aluminum or necessitate additional metallurgical processing.
- Thin foil laminations can be expensive to separate from aluminum and negatively impact the recoverability of aluminum in this application though there are emerging technologies and efforts underway to address this situation.

glass

- Similar to steel and aluminum, glass is infinitely recyclable.
- The use of recovered glass, referred to as "cullet," in glass furnaces reduces the melting temperature of the glass and thus saves energy.
- One of the challenges associated with glass recycling lies with co-mingled collection of glass packaging of various colors. When colored glass is collected together, breakage and cross-contamination inevitably occurs, thereby lowering the value of the resulting cullet.
- Flint, or white glass, is highly desirable.
- Currently only clear (flint), green and amber glass are considered recyclable for new container use.
- While glass remains a very recyclable material, the following packaging components are problematic to the glass recycling process:
  - cobalt blue pigment
  - metal tamper-evident rings
  - metal-based inks when used in on-glass printing applications

regulations and standards

standards

EN 13430 Requirements for packaging recoverable by material recycling

ISO 14021:1999(E)

resources

American Plastics Council
2004 National Post-Consumer Plastics Recycling Report
http://www.plasticsresource.com/s_plasticsresource/docs/1700/1646.pdf

Association of Postconsumer Plastics Recyclers
http://www.plasticsrecycling.org/guidelines-labelsprotocol.asp
The APR offers guidance on choosing closures, coatings, and labels that will not contaminate the plastics recycling stream.

BioCycle, The State of Garbage in America
http://www.seas.columbia.edu/earth/SOGJan2004.pdf; http://www.jgpress.com/archives/_free/000089.html
BioCycle collects data on US state and regional waste management practices.

EU Directive 2000/53/EC on End-of-Life Vehicles
http://ec.europa.eu/environment/waste/elv_index.htm

Europa, European Commission's Environmental Portal, Packaging and Packaging Waste
http://europa.eu.int/comm/environment/waste/packaging_index.htm

European Aluminum Association
www.aluminum.org

European Union
http://europa.eu.int/comm/environment/statistics_en.htm
This page has links to EU data and statistics about the environment and sustainable development.

Paper Industry Association Council
www.paperrecycles.org
This website contains statistics and information supporting paper and paperboard packaging products recycling.

ProEurope (Packaging Recovery Organization Europe)
http://www.pro-e.org/

Recoup Plastics Recyclability by Design
http://www.recoup.org/business/default.asp

Society of Plastic Industry: SPI Resin Identification Code Guide to Correct Use
http://www.plasticsindustry.org/outreach/recycling/2124.htm

Steel Recycling Institute
www.recycle-steel.org

U.S. Environmental Protection Agency
Municipal Solid Waste in the United States: 2003 Facts and Figures
http://www.epa.gov/msw/msw99.htm

U.S. EPA
Municipal Solid Waste Generation in the US: Facts and Figures
http://www.epa.gov/msw/msw99.htm
Updated approximately every two years, the EPA Municipal Solid Waste Generation report on the amount of packaging waste generated, recycled and disposed.

WRAP (Waste and Resources Action Program), Material Program
http://www.wrap.org.uk/materials/
WRAP is an UK non-profit organization concentrated on increasing recycling and creating markets for recycled materials. Their site has detailed information on materials including glass, plastic, aggregates, paper, and organics.

design for composting

SOURCING
MANUFACTURE
DISTRIBUTION
USE
END-OF-LIFE

QUESTIONS TO ASK...

Can compostable materials meet the performance requirements of my package?

Is the entire package biodegradable?

Are there any materials or additives that are not compatible with biological systems and might accumulate or are persistent in the environment if released through biodegradation?

How can I inform the consumer that the package is compostable within the appropriate certification and labeling requirements?

what is it?

Composting is sometimes referred to as organic recovery. Composting recovers the nutrient value of organic materials through biodegradation processes. While biodegradation occurs naturally in the environment, at the scale of waste management, the process needs to be effectively managed to maintain optimal conditions (e.g., appropriate oxygen and temperature), ensure the purity of the resultant compost and reduce the amount of greenhouse gases released during the process.

Composting is a potential end-of-life option for bio-based materials and products that recovers some of their value through a managed biological process similar to that found in nature. This can be considered a carbon neutral option for packaging, meaning that managed biological cycling of biobased materials does not contribute any extra carbon dioxide to our atmosphere.

why is it important?

Organic materials (paper, paperboard products, yard trimmings and food scraps) comprise approximately 59% of the municipal solid waste stream in the U.S (US EPA 2003). Diverting this material from landfills saves landfill space and reduces the greenhouse gas emissions associated with landfills. Another significant benefit is that the nutrients from the resulting organic matter can be returned to the earth, used as a soil amendment, and ideally displace some petroleum-based fertilizers.

how do I do it?

- First, understand your terminology.
  - Degradable vs. Biodegradable.

    Degradable means that through physical or photochemical means a substance will fragment. This does not mean that the substance always returns "safely" to the soil, only that it is in small pieces.

    Biodegradable means that fragments are consumed by microorganisms as a food & energy source and converted to carbon dioxide, water and humus.
  - Compostable infers that a substance biodegrades and has satisfied a particular set of criteria established in a given standard (e.g., rate of biodegradation, conditions required, completeness). When making claims of compostability the applicable standard should be referenced. (See a list of different certifications below.)
- Using your necessary performance characteristics, decide whether "compostable" packaging could be used to meet your needs.
- Any packaging that is likely to end up in a home or managed composting system should be designed to ensure that the base material and all components are biodegradable and will not result in any chemical contamination of the compost.
- The package should be tested for biodegradability and resulting quality of the compost analyzed.
- Research available composting infrastructure where the product will be sold to see if it is a viable option for end-of-life recovery.
- This standard should extend to the use of any degradable packaging as it may end up in the environment through litter.

QUESTIONS TO ASK…

CONTINUED

Will the package properly breakdown in a home compost pile or does it have to be managed in an industrial composting facility?

How can I communicate that to the consumer (given applicable labeling requirements)?

If the packaging must be composted at a managed facility, is there availability of such facilities where the package will be sold?

FACTS TO KNOW…

Landfills do not contain the correct moisture or oxygen conditions for effective biodegradation. When decay does occur in landfills, it tends to be anaerobic (no oxygen present) and results in the emission of methane, a greenhouse gas that has 21 times more greenhouse gas impact than CO_2. (http://www.epa.gov/methane/scientific.html). *In some parts of the U.S., landfill gas is captured, scrubbed and used for energy generation. However, landfills remain one of the major anthropogenic sources of greenhouse gases in the U.S.*

Managed composting as a waste management strategy is in its infancy in the U.S. There are approximately 3,000 facilities in the states and very few of them are accepting packaging.

Other parts of the world are aggressively diverting organic materials and packaging from the landfill stream and encouraging composting.

material specific information

Some examples of typically biodegradable packaging materials are listed below. This is by no means a complete list. Please note that it is especially important to consider the material health characteristics of biodegradable materials including additives and auxiliaries, as there is potential for a direct release of these substances to the environment.

- Corrugated
- Hemp
- Kenaf
- Kraft paper
- Molded fiber
- Natural fibers
- Palm Fiber
- Paperboard
- Polyhydroxyalkanoates (PHA)
- Polylactic Acid (PLA) (managed conditions only)
- Starch based polymers
- Wheat Straw

regulations and standards

standards

American Society of Testing and Materials D6400-03/ASTM 6868

EN 13432

Germany DIN CERTCO

Japan GreenPla

resources

BioCycle, *http://www.jgpress.com/biocycle.htm*
BioCycle is a journal that specializes on composting and organics recovery.

Biodegradable Products Institute (BPI), *http://www.bpiworld.org/*
BPI sponsors a logo program designed to certify and identify products that will biodegrade and compost satisfactorily in actively managed compost facilities.

DIN CERTCO, *http://www.dincertco.de/en/competencies/products/certification_in_the_environmental_field/index.php*
DIN CERTCO is the certification organization of the German Institute for Standardization, DIN. DIN CERTO certifies biodegradable products for the IBAW compostability label, which is used in Europe.

Environmental Defense Paper Task Force Paper on Non-Wood Fiber Sources
http://www.environmentaldefense.org/documents/1634_WP13.pdf

Japan, GreenPla
http://www.bpsweb.net/02_english/01_details_e/katudo/katudo.htm

International Association of Bioplastics and Biodegradable Polymers (IBAW)
http://www.ibaw.org/

Labeling Biodegradable Products
http://www.biomatnet.org/publications/SMT4-2187FinalSynthesis.pdf

Metabolix, PHA Structure and Properties
http://www.metabolix.com/natures%20plastic/properties.html

NatureWorks, Composting Facilities Across the US
http://www.natureworksllc.com/download_bulletin.asp?id=77

Sustainable Biopolymer Purchasing Guidelines
http://www.healthybuilding.net/biopolymers/index.html

U.S. Composting Council, *http://www.compostingcouncil.org*
The USCC is a trade and professional organization promoting compost.

U.S. Department of Agriculture, Biobased
http://www.biobased.oce.usda.gov/public/exe_orders.cfm

glossary of terms

additives A substance added in small amounts to something else to improve, strengthen, or otherwise alter it.

advanced recovery fees
a financing system designed to cover recycling costs by collecting fees paid by consumers at the point of purchase and distributing the revenues to collection and recycling centers.
Source: http://www.technology.gov/reports/2006/Recycling/ExecSummary.pdf#search=%22%22advanced%20recovery%20fee%22%20%20arf%22

auxiliaries In packaging, something added to the external surface of the packaging that is not incorporated into the base material (e.g., coatings, adhesives, labels).

bioaccumulation The increase in concentration of a substance in living organisms as they take in contaminated air, water, or food because the substances are very slowly metabolized or excreted.

biobased The USDA Definition of Biobased under Section 9002 of the Farm Security and Rural Investment Act of 2002 is: "a product determined by the Secretary to be a commercial or industrial product (other than food or feed) that is composed, in whole or in significant part, of biological products or renewable domestic agricultural materials (including plant, animal, and marine materials) or forestry materials." Executive Order 13134 on Developing and Promoting Biobased Products and Bioenergy defines a biobased product as "a commercial or industrial product (other than food or feed) that utilizes biological products or renewable domestic agriculture (plant, animal, and marine) or forestry materials." *Source: http://www.biobased.oce.usda.gov/public/exe_orders.cfm*

biodegradable Reliable scientific evidence that the entire product or package will completely break down and return to nature, i.e. decompose into elements found in nature within a reasonably short period of time after customary disposal. *Source: Draftsmart, 16 C.F.R. § 260.7 (b)*

biodiversity Refers to the variety and variability among living organisms and the ecological complexes in which they occur. Diversity can be defined as the number of different items and their relative frequencies. For biological diversity, these items are organized at many levels, ranging from complete ecosystems to the biochemical structures that are the molecular basis of heredity. Thus, the term encompasses different ecosystems, species, and genes. *Source: http://www.epa.gov/OCEPAterms/*

biological nutrients Materials that can be safely returned to soil through the degradation processes found in biological systems. These materials that are rapidly renewable, biodegradable and all inputs are deemed to be ecologically safe.

cleaner technology Technologies that extract and use natural resources as efficiently as possible in all stages of their lives; that generate products with reduced or no potentially harmful components; that minimize releases to air, water and soil during fabrication and use of the product; and that produce durable products which can be recovered or recycled as far as possible; output is achieved with as little energy input as is possible. *Source: http://ec.europa.eu/environment/enveco/industry_employment/annex2.pdf*

closure A seal or cap used as a packaging component.

composting The controlled biological decomposition of organic material in the presence of air to form a humus-like material. Controlled methods of composting include mechanical mixing and aerating, ventilating the materials by dropping them through a vertical series of aerated chambers, or placing the compost in piles out in the open air and mixing it or turning it periodically. *Source:* http://www.epa.gov/OCEPAterms/

cradle to cradle A design objective in which all products are made from renewable resources or valuable non-renewable resources that are perpetually cycled in closed-loop systems.

cradle to grave A model of industrial systems in which material flows on a linear path, from extraction through a brief use phase, before ending up as waste. Cradle-to-grave systems are sometimes referred to as the "take-make-waste" model of industry. *Source: http://www.greenblue.org*

cullet Crushed glass. *Source: http://www.epa.gov/OCEPAterms/*

design for environment Systematic consideration of design performance with respect to environmental health and safety objectives over the full product and process. *Source: http://www.moea.state.mn.us/p2/dfe.cfm*

disposal costs the cost of getting rid of excess or surplus property or material from the inventory. It may include costs of demilitarization, detoxification, redistribution, transfer, donation, sales, salvage, or destruction. It may also reflect the costs of hazardous waste disposition (including long-term storage) and environmental cleanup. Disposal costs may occur during any phase of the acquisition cycle.
Source: http://www.oas.kirtland.af.mil/AoAHandbook/index.html

distribution channels All of the individuals and organizations involved in the process of moving products from producer to consumer. The route a product follows as it moves from the original grower, producer or importer to the ultimate consumer. *Source: www.powerhomebiz.com/Glossary/glossary-D.htm*

electron beam inks (E-beam inks) An ink that dries by chemical reaction caused by high energy electrons. They consist of one or more monomers and oligomers that polymerize on exposure to radiation generally without the use of solvents. *Source: http://www.aqmd.gov/rules/reg/reg11/r1171.pdf* and *http://www.p2pays.org/ref/02/01504.pdf*

eco-efficiency The strategy for "sustainability' of minimizing harm to natural systems by reducing the amount of waste and pollution human activities generate. *Source: http://www.greenblue.org*

ecosystems The interacting system of a biological community and its non-living environmental surroundings. *Source: http://www.epa.gov/OCEPAterms/*

energy recovery Obtaining energy from waste through a variety of processes (e.g., combustion). *Source: http://www.epa.gov/OCEPAterms/*

extended producer responsibility or product stewardship Calls on those in the product life cycle—manufacturers, retailers, users, and disposers—to share responsibility for reducing the environmental impacts of products.

extrusion coating A process wherein a film of molten polymeric material is extruded onto the surface of a substrate material and cooled to form a continuous coating. *Source: Fundamentals of Packaging Technology*

fair trade A trading partnership, based on dialogue, transparency and respect, that seeks greater equity in international trade. *Source: www.maketradefair.com*

green chemistry The design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances.

green engineering The design, commercialization and use of processes and products that are feasible and economical while reducing the generation of pollution at the source, and minimizing the risk to human health and the environment.

green marketing Green or Environmental Marketing consists of all activities designed to generate and facilitate any exchanges intended to satisfy human needs or wants, such that the satisfaction of these needs and wants occurs, with minimal detrimental impact on the natural environment. *Source: Polonsky, Michael Jay. 1994b. "A Stakeholder Theory Approach to Designing Environmental Marketing Strategy." Unpublished Working Paper.*

greenhouse gases A gas, such as carbon dioxide or methane, which contributes to potential climate change. *Source: http://www.epa.gov/OCEPAterms/*

hazardous substances Any material that poses a threat to human health and/or the environment. Typical hazardous substances are toxic, corrosive, ignitable, explosive, or chemically reactive. *Source: http://www.epa.gov/OCEPAterms/*

heavy metals Metallic elements with high atomic weights; (e.g. mercury, chromium, cadmium, arsenic, and lead); can damage living things at low concentrations and tend to accumulate in the food chain. *Source: http://www.epa.gov/OCEPAterms/*

hot-melt adhesives An adhesive, solid at room temperature, that is liquefied by heat, applied molten, and forms a bond by cooling and solidifying. Based on thermoplastic polymers generally modified with resins and/or waxes. Usually used in range of 120 to 205° C (250 tto 400° F). *Source: Fundamentals of Packaging Technology*

life cycle of a product All stages of a product's development, from extraction of fuel for power to production, marketing, use, and disposal. *Source: http://www.epa.gov/OCEPAterms/*

light-weighting A subset of source reduction achieved by designing with less material or lighter materials

material health Addresses the chemical composition of a material with a focus on the presence and release of substances harmful to human or ecological health.

non-renewable materials Any natural resource that is depleted at a rate faster than the rate at which it regenerates.

package A form that is intended to contain, protect/preserve, aid in safe and efficient transport and distribution, and finally act to inform and motivate a purchase decision on the part of a consumer. *Source: Fundamentals of Packaging Technology*

packaging components Any part of packaging that can be separated by hand or by using simple physical means.

plasticizers A material that, when added to other polymeric materials, imparts a softness or flexibility by acting as an internal lubricant. *Source: Fundamentals of Packaging Technology*

post-consumer recycling Use of materials generated from residential and consumer waste for new or similar purposes; e.g. converting wastepaper from offices into corrugated boxes or newsprint. *Source: http://www.epa.gov/OCEPAterms/*

primary packaging The material that first envelopes the product.

recovery rate Percentage of usable recycled materials that have been removed from the total amount of municipal solid waste generated in a specific area or by a specific business. *Source: http://www.epa.gov/OCEPAterms/*

recycle Minimizing waste generation by recovering and reprocessing usable products that might otherwise become waste (.i.e. recycling of aluminum cans, paper, and bottles, etc.). *Source: http://www.epa.gov/OCEPAterms/*

recycled content The amount of material by weight collected, separated or otherwise recovered from a waste stream for use in the form of raw materials, in the manufacture or assembly of a new package or product. *Source: 16 C.F.R. § 260.7 (e)*

recycling Recycling is a series of activities that includes collecting materials that would otherwise be considered waste, sort and processing recyclables into raw materials, and manufacturing raw materials into new products. *Source: http://www.epa.gov/epaoswer/non-hw/muncpl/recycle.htm*

renewable energy Energy resources such as windpower or solar energy that can keep producing indefinitely without being depleted. *Source: www.nrdc.org/reference/glossary/r.asp*

renewable resources Any natural resource that is depleted at a rate slower than the rate at which it regenerates.

resource recovery The process of obtaining matter or energy from materials formerly discarded. *Source: http://www.epa.gov/OCEPAterms/*

reuse Use of a product more than once, wither for the same purpose or for a different purpose. Reusing, where possible, is preferable to recycling because the item does not need to be reprocessed before it can be use again. *Source:http://www.epa.gov/epaoswer/non-hw/muncpl/reduce.htm#reuse*

secondary packaging A package or containment of a primary package. *Source: Fundamentals of Packaging Technology*

shelf life The expected time within which the quality of a product is acceptable. *Source: Fundamentals of Packaging Technology*

source reduction Reducing the amount of materials entering the waste stream from a specific source by redesigning products or patterns of production or consumption(e.g., using returnable beverage containers). Synonymous with waste reduction. *Source: http://www.epa.gov/OCEPAterms/*

supply chain The all inclusive set offacilities, and suppliers that participate in the sale, delivery and production of a particular product. *Source: Inverstorwords.com 2003*

sustainability Loosely defined as: seeking to provide the best outcomes for the human and natural environments both now and into the indefinite future. It is a systemic concept, relating to the continuityof economic, social, institutional and environmental aspects of human society, as well as the non-human environment. Many in the industry believe that this term has not been properly defined. *Source: www.wikipedia.com*

sustainable consumption The use of goods and services that satisfy basic needs and improve quality of life while minimizing the use of irreplaceable natural resources and the byproducts of toxic materials, waste, and pollution. *Source: http://www.sierraclub.org/sustainable_consumption/*

sustainable design Taking consideration of environmental impacts during all stages of a products without unduly compromising other criteria such as cost, functionality and reliability. *Source: http://www.lboro.ac.uk/research/susdesign/SDN/seminars/6th%20meeting/Frank%20OConner%20presentation.pf*

sustainable development Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. *Source: The World Commission on Environment and Development*

tamper-evident closure A closure system having an indicator or barrier to entry which, if breached or missing, can reasonably be expected to provide visible evidence to consumers that tampering has occurred. *Source: Fundamentals of Packaging Technology*

technical nutrients These materials, valuable for their performance qualities and typically "non-renewable," are designed to circulate safely and perpetually through cradle-to-cradle product s of manufacture, use, recovery and re-manufacture.

transport packaging *(or tertiary packaging)* Packaging conceived so as to facilitate handling and transport of a number of sales units or grouped packagings in order to prevent physical handling and transport damage. *Source: http://www.opsi.gov.uk/si/si2004/20041188.htm*

UV-cured coatings / printing inks Inks/coatings consisting of multifunctional polymers (acrylates, acrylated oligomers), monofunctional diluent monomers, and the photoinitiators that use UV light to complete the curing process. The UV coatings have the advantages of rapid curing, low process temperatures, extremely low VOC content (less than 0.01 lb VOC/gal coating) and HAP content, lower energy costs due to the elimination of drying ovens, and are generally solvent free. *Source: http://www.epa.gov/ttn/atw/mcan/mcanbidp.pdf*

void space The unutilized or empty space inside packaging or in between packages during transit leading to wasteful use of resources. *Source: http://www.wasteonline.org.uk/resources/InformationSheets/Packaging.htm*

windowing Using a transparent membrane to display the contents of a package

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a vision for sustainable packaging

The Sustainable Packaging Coalition envisions a world where all packaging is sourced responsibly, designed to be effective and safe throughout its life cycle, meets market criteria for performance and cost, is made entirely using renewable energy and once used, is recycled efficiently to provide a valuable resource for subsequent generations. In summary: a true a cradle to cradle system[1] for all packaging.

The mission of the Sustainable Packaging Coalition is to advocate and communicate a positive, robust environmental vision for packaging and to support innovative, functional packaging materials and systems that promote economic and environmental health.

The purpose of this document is to take the important first step in articulating an agreed upon definition of the term "sustainable packaging" so that all parties are working toward the same vision. By providing a common framework, the packaging industry can evaluate current efforts, identify opportunities and begin to pursue strategies to develop sustainable packaging materials and systems.

The definition is intended as a "target vision" for companies to strive toward through continuous improvement and will evolve over time with new materials and technologies.

NOTES

1 Cradle to Cradle Design is based on principles of Industrial Ecology and Design for Environment (DfE). Similar to Industrial Ecology, materials and energy flows are conceived as 'metabolism' and like DfE, it proposes that we design with the environment in mind, considering all phases of the product life cycle.

II. definition of sustainable packaging

NOTES

2 No ranking is implied in the order of criteria

The criteria presented here blend broad sustainability objectives with business considerations and strategies that address the environmental concerns related to the life cycle of packaging. These criteria relate to the activities of our membership and define the areas in which we actively seek to encourage transformation, innovation and optimization. We believe that by successfully addressing these criteria, packaging can be transformed into a cradle to cradle flow of packaging materials in a system that is economically robust and provides benefit throughout its life cycle—a sustainable packaging system.

sustainable packaging[2]:

A. Is beneficial, safe & healthy for individuals and communities throughout its life cycle;
B. Meets market criteria for performance and cost;
C. Is sourced, manufactured, transported, and recycled using renewable energy;
D. Maximizes the use of renewable or recycled source materials;
E. Is manufactured using clean production technologies and best practices;
F. Is made from materials healthy in all probable end-of-life scenarios;
G. Is physically designed to optimize materials and energy;
H. Is effectively recovered and utilized in biological and/or industrial cradle to cradle cycles.

These criteria outline a framework for specific actions. The SPC recognizes that the timelines for achievement will vary across criteria and packaging materials. Together, these criteria characterize our vision of sustainable packaging.

III. explanation of criteria

a. beneficial, safe and healthy for individuals and communities throughout its life cycle

i. relevance to sustainable development

In addition to "profitability" the other two pillars of sustainability—social equity and the environment-- are growing areas of corporate focus. As part of globalization, companies are expanding operations and are increasingly being held accountable for actions resulting in negative social or environmental consequences. The emergence of the corporate social responsibility report reflects the growing focus on corporate citizenship, accountability, and transparency.

ii. relevance to packaging

The global packaging industry is conservatively estimated at $417 billion and employs more than five million people all over the world[3]. The benefits of packaging to individuals and communities vary from the creation of meaningful, stable employment, to the protection, preservation, safety, and transport of products and food stuffs. Packaging allows key marketing and product differentiation and educates and informs the consumer. At the same time, the procurement, production, transport and disposal of packaging can have negative consequences for both the environment and societies around the globe. The SPC believes that through intelligent packaging and system design, it is possible to "design out" the potential negative impact of packaging on the environment and societies.

NOTES

3 PRIMEDIA Business Magazine & Media, Inc. Global Packaging Market, February 1, 2003. Online. Paper, Film & Foil Converters. July 22, 2005 <http://pffconline.com/mag/paper_global_packaging_market/>

NOTES

4 Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. World Population Prospects: The 2004 Revision and World Urbanization Prospects: The 2003 Revision, 2005. Online. United Nations. July 22, 2005 *http://esa.un.org/unpp*

iii. strategies and opportunities

Cradle to cradle principles offer strategies to improve the material health of packaging and close the loop on packaging materials including the creation of economically viable recovery systems that effectively eliminate waste. These strategies support communities through the creation of gainful employment and improvements to the environment. Corporate social responsibility, accountability and equitable wages are all part of creating a sustainable system.

b. meets market criteria for performance and cost

i. relevance to sustainable development

Economic growth and prosperity are essential components of sustainable development. The United Nations estimates that the population of the planet will grow from 6.4 billion in 2005 to 9.0 billion by 2050, roughly a 40% increase in global population[4]. Efficient and productive industry engaged in truly sustainable practices is essential to meet the incredible increase in demand for goods and resources that this growth implies. Historically, increased packaging use has accompanied economic growth. A goal of sustainable packaging is to facilitate economic growth by delivering benefits of packaging without the negative impacts associated with traditional packaging designs.

ii. relevance to packaging

Ongoing profitability is a fundamental element of sustainable business practice. Managing the cost of packaging procurement, production, and product delivery with the desired functionality and appearance are key to a profitable business. The SPC membership has observed that the true cost of packaging is becoming more complicated as costs that have traditionally been borne by society (e.g., disposal) are being redirected to producers through legislation and levies. Sustainable packaging design considers the full life cycle of the package, recognizes the principle of Shared Product Responsibility[5] and consequently seeks to minimize the total packaging system cost through efficient and safe package life cycle design.

iii. strategies and opportunities

Sustainable packaging initiatives offer multiple strategies to meet and even exceed market criteria for performance and cost, including: improved package design, resource optimization, enhanced material selection, and source reduction[6]. Education of business colleagues, suppliers, consumers and regulators is also an important vehicle to connect a sustainable packaging strategy to existing market needs.

Collaboration across the packaging supply chain will facilitate understanding, help identify opportunities to improve materials and packaging systems and enable sustainable alternatives to be developed with zero or little additional cost. Experience from other sectors that are starting to embrace the principles of sustainable business indicates that improvements in product quality and profitability are often realized. Other benefits of sustainable packaging include brand enhancement and new sources of materials made available through mechanisms like materials pooling.

Innovative new packaging materials from renewable resources and step change advances in recovery/recycling systems, while still on the horizon for many materials are actively being used in other parts of the world. While there may be costs associated with the transition to new packaging materials or recovery strategies, there will also be savings. Some of these direct savings could include reduced regulatory and tipping fees, and reduced environmental management costs.

NOTES

5 OECD defines Shared Product Responsibility as a voluntary system that ensures responsibility for the environmental effects throughout a product's life cycle by all those involved in the life cycle. The greatest opportunity for extended product responsibility rests with those throughout the commerce chain—designers, suppliers, manufacturers, distributors, users and disposers - that are in a position to practice resource conservation and pollution prevention at lower cost. *http://www.biac.org/statements/env/FIN97-12_biac_discussion_paper_epr.pdf*

6 Definition of Source Reduction from U.S. EPA: "Source Reduction refers to any change in the design, manufacture, purchase, or use of materials or products (including packaging) to reduce their amount or toxicity before they become municipal solid waste. Source reduction also refers to the reuse of products or materials."

c. sourced, manufactured, transported and recycled using renewable energy

i. relevance to sustainable development

The wide-scale use of fossil fuels as the primary source of energy is one of the principal factors contributing to many local, regional and global pollution issues including climate change, acidification, ozone depletion, mercury build up, photochemical ozone, and particulates. Renewable energy potentially offers a solution to many of the environmental, social and economic issues central to the development of a sustainable world. The most common types of renewable energy include solar energy (passive and active); windpower; hydroelectric; biomass (biofuels and biopower); tidal energy; and geothermal.

ii. relevance to packaging

Today most packaging materials and conversion processes rely on fossil fuel-based energy to a greater or lesser extent. The transition from fossil fuels to renewable energy throughout the packaging supply chain will require changes at many levels over a significant timeline. The SPC recognizes that it is not possible, in the short to medium term, to migrate all materials and processes to renewable energy sources and that the rate limiting step will be the availability of a sustainable supply of renewable energy.

iii. strategies and opportunities

Companies are beginning to address the need to shift to renewable energy through a variety of strategies. In the near term, making fossil-fuel based systems as efficient as possible is an effective strategy for moving toward sustainability with very real economic and environmental return. At the same time, there must be a dedicated effort to diversify the energy mix and build momentum behind the transition to renewable energy. This transition is being encouraged through the direct purchase of renewable energy, through carbon credits, or tradable renewable allowances (TRECS).

Transportation is a significant source of fossil fuel consumption associated with packaging. Companies experience direct cost benefit from improving fleet performance through optimized distribution or better fuel efficiency. Companies are also encouraging the use of bio-based fuels, hybrid vehicles, and innovative technologies through internal measures or by acknowledging the efforts of suppliers. These types of activities help develop markets for renewable energy and offer alternatives to fossil fuel as strategies toward a more sustainable energy future.

d. maximizes the use of renewable or recycled source materials

i. relevance to sustainable development

The use of renewable or recycled materials creates sustainable material flows and thus provides materials for future generations.

Using recycled materials (renewable or non-renewable) encourages waste reduction and the conservation of resources. The use of renewable materials reduces dependence on non-renewable resources, uses current solar income to create raw materials (greenhouse gas neutral), and encourages sustainable management of resources.

ii. relevance to packaging

The use of renewable or recycled materials supports the development of sustainable packaging by improving its environmental profile and providing a source of future packaging materials. The physical deterioration of some materials through mechanical reprocessing (i.e., recycling) currently poses a limit to effective and economic reutilization of some packaging materials. Many of these limitations are being addressed by innovative technologies.

Under cradle to cradle principles, materials should be recovered through either biological or industrial cycles or both. Many renewable or bio-based materials are suitable for recovery through either mechanism. Materials from non-renewable resources should be recycled. Since the value of these materials cannot be recovered by natural processes, they require a high degree of stewardship throughout their life cycle to ensure that they are recovered and re-used.

Specifiers and designers striving for sustainable packaging should ensure the recyclability of materials, especially if they are made from non-renewable resources. Environmentally preferable procurement and prescriptive regulations regarding the environmental characteristic of packaging are expanding and often incorporate recyclability[7] and recycled content requirements.

iii. strategies and opportunities

Recycled or Renewable Source Materials

A key strategy for improving the sustainability of packaging is maximizing the use of renewable and recycled materials. The availability, performance, and price of some renewable or recycled materials affect the feasibility of incorporating them into new packaging designs. Material and technological advances that positively influence these factors for renewable and

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7 The presence of infrastructure to collect and recycle materials is incorporated into some definitions of recyclability. These definitions pose a significant barrier to material innovation as it continues to favor the use of existing materials versus the development of optimized materials that may not currently have infrastructure for collection and recovery.

recycled materials can substantially improve the practicality of their use.

The sourcing of recycled materials is closely linked to end-of-life issues. From experience to date, it is clear that demand for recycled materials and the creation of market pull is a key driver for strengthening the recovery and recycling industry needed to provide them.

Virgin Source Materials

One strategy used to address concerns associated with the production of virgin bio-based packaging materials is sourcing from sustainably managed and certified sources. This tactic is used currently to address forestry and agricultural practices. While there is some focus on the sourcing of non-renewable resources through clean production, there is not a comparable set of well-accepted sustainability practices or certifications directed toward the value chain for the sourcing of non-renewable resources.

e. manufactured using clean production technologies and best practices

i. relevance to sustainable development

Clean production refers to the continuous application of "an integrated preventive environmental strategy to increase overall efficiency and reduce risks to humans and the environment." This includes conserving raw materials, water and energy, eliminating toxic and dangerous raw materials, and reducing the quantity and toxicity of all emissions and waste at source during production processes[8].

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8 United Nations Environmental Programme. Cleaner Production - Key Elements. May 11, 2001. Online. UNEP Production & Consumption Branch, July 22, 2005 *http://www.uneptie.org/pc/cp/understanding_cp/home.htm#definition*

ii. relevance to packaging

Clean production represents environmentally responsible practice and applies to any industrial activity including the production of packaging. Packaging uses significant quantities of energy, water and materials in manufacturing and production processes. Clean production seeks to reduce and ultimately eliminate the environmental impact of any emissions and toxins emerging from these production processes.

iii. strategies and opportunities

Eco-efficiency strategies are currently pursued to minimize emissions, energy use and waste. Some examples include voluntary emission reduction or elimination programs, and the use of cleaner technologies.

Encouraging companies and suppliers to ensure their production processes meet clean production best practice standards, supports responsible manufacturing, worker safety and sustainable packaging. It can also ultimately reduce costs, improve quality and long term profitability.

New approaches and technologies are on the horizon. Advances are being made on closed-loop systems and beneficial reuse to eliminate wastes. Green Chemistry[9] and Green Engineering[10, 11,] represent encouraging signs that the technical and scientific intelligence that created the technological transformation of the 20th century is now being directed toward solutions to unintended consequences.

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9 Definition of Green Chemistry: the design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances *http://www.epa.gov/greenchemistry/whats_gc.html*

10 Definition of Green Engineering: the design, commercialization, and use of processes and products, which are feasible and economical while minimizing 1) generation of pollution at the source and 2) risk to human health and the environment. *http://www.epa.gov/opptintr/greenengineering/index.html*

11"Green Engineering transforms existing engineering disciplines and practices to those that promote sustainability. Green Engineering incorporates development and implementation of technologically and economically viable products, processes, and systems that promote human welfare while protecting human health and elevating the protection of the biosphere as a criterion in engineering solutions. *http://enviro.utoledo.edu/Green/SanDestin%20summary.pdf*

f. made from materials healthy in all probable end-of-life scenarios

i. relevance to Sustainable Development

Human and ecological health is a basic requirement of sustainable development. Material health is a cradle to cradle principle that addresses the use, presence and release of harmful substances to the environment. The accumulation of problematic substances in the biosphere and in our bodies is the subject of increasing concern for consumers, health professionals and governments.

ii. relevance to packaging

Packaging may contain certain chemicals that result in the unintended release of harmful substances during the life cycle of the package, particularly at the end-of-life. While these chemicals are typically utilized in small amounts, the scale and quantity of packaging waste can render them significant. Ensuring all ingredients—including additives, inks, adhesives, and coatings - are safe for human and environmental health throughout their life cycle is a vital aspect of sustainable packaging design.

iii. strategies and opportunities

Careful selection and specification of the safest materials available to meet the package performance requirements is the preferred strategy. Currently, companies continuously monitor materials bans, restricted substances lists, and legislation prohibiting the use of certain substances within packaging. There is also a need for an ongoing dialog to examine what is in packaging materials and to encourage the optimization

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12 The Natural Step. Design, 2004. Online. The Natural Step, July 22, 2005 *<http://www.naturalstep.org/services/design.php>*

of material formulations for human and environmental health. The development of tools and methodologies to assess material health is underway and will allow more transparent communication of material characteristics throughout the value chain.

g. physically designed to optimize materials and energy

i. relevance to sustainable development

Seventy percent of the overall impact of a product is determined in the design phase[12]. By thinking about the entire life cycle of a product during the design phase and identifying critical aspects, it is possible to anticipate impacts and eliminate problems and waste up front. For this reason, anticipatory design is a fundamental best practice for sustainable products and packaging.

> *"It is not possible to repeat too often that waste is not something which comes after the fact...picking up and reclaiming scrap left over after production is a public service, but planning so that there will be no scrap is a higher public service."* - Henry Ford, 1924

ii. relevance to packaging

Typically companies design packaging to meet critical cost, performance and marketing requirements. Sustainable packaging design adds consideration of life cycle impacts including: energy use over the life of the package, impact of materials in end-of-life scenarios and appropriateness of the design/materials to facilitate material recovery. Other factors that should be considered in the design phase are consumer behavior and the variation of established recovery systems by market.

iii. strategies and opportunities

Several methodologies are currently used to support sustainable design including, Design for Environment, Design for Disassembly, and Source Reduction. Corporate strategies to address packaging design include developing sustainable design guidelines and embedding them within product development processes. It is important to note that sometimes the adoption of one design strategy over another may result in tradeoffs. One design may focus on minimizing energy impacts over the life of the package and another may focus on the use of recycled content. Internal corporate sustainability objectives may influence the weighting of specific life cycle impacts and thus influence ultimate internal design strategies. In general, sustainable packaging design calls on designers to weigh these factors against each other and optimize their use as a whole. Standardization and communication of sustainable design strategies and their adoption by the packaging industry will create significant advances toward more sustainable packaging.

h. effectively recovered and utilized in biological and/or industrial cradle to cradle cycles

i. relevance to sustainable development

Currently, economic expansion and the related growth in resource use are considered to be inconsistent with sustainable development. Creating sustainable flows of materials will reduce the overall use of finite natural resources and minimize waste. Effective recovery means creating the collection and recycling infrastructure necessary to close the loop on materials in order to provide valuable resources for the next generation of production.

ii. relevance to packaging

The greatest challenge to the development of sustainable packaging is the creation of economically viable and effective systems to collect and recover value from materials. The recovery phase of the packaging life cycle is the recipient of the cumulative impacts of all upstream decisions.

Effective recovery implies the significant collection and recovery of material at the highest value that is economically feasible (see Figure 1). As suggested by the discussion under previous criteria, effective recovery can be achieved through supply chain collaboration, by the coordinated efforts of the packaging system to create healthy and recyclable materials, by packaging designed for recovery, and by establishing appropriate collection and recovery infrastructure with the combined support of end users - brand owners, retailers and consumers.

iii. strategies and opportunities

There are many methods of collecting and recycling packaging materials to recover their intrinsic value to society. In reality, the established recovery infrastructure in the country in which the product is sold/used, together with market dynamics, will ultimately determine the method through which a package will be recovered. Some of the more common recovery methods are discussed below.

Biological Recovery (Managed Composting)

The earth's biosphere effectively recovers the nutritive value of basic biological materials. The conditions for effective biological degradation do not exist in landfills and the release of problematic substances is a further concern. It is necessary to engineer and manage biological recovery systems to ensure safe and effective recovery of value from biological materials. Managed composting and anaerobic digestion with energy recovery are examples of managed biological recovery systems. Landfills are not.

Technical Recovery (Recycling)

As nature cannot effectively recover many man-made packaging materials, engineered recovery systems are necessary to avoid their accumulation in the environment and to recapture their value. Some examples of technical recovery include mechanical and chemical recycling of plastics and thermal recycling of metals and glass. It is also possible to recover biological materials in technical systems (e.g., paper recycling). The ability to economically recover value varies by material, regional variations in infrastructure and technology, and consumer behavior.

Energy Recovery[13] (Waste to Energy)

Energy recovery is increasingly used as a method to recover value from packaging materials. Safe incineration with energy recovery, waste to energy facilities, and the use of plastic and paper as an alternative fuel are

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13 These comments are only valid for incinerators that do not emit dioxins and other pollutants into the atmosphere (i.e., they are equipped with appropriate waste air scrubbing and cleaning processes. The latter is referred to "safe incineration with energy recovery")

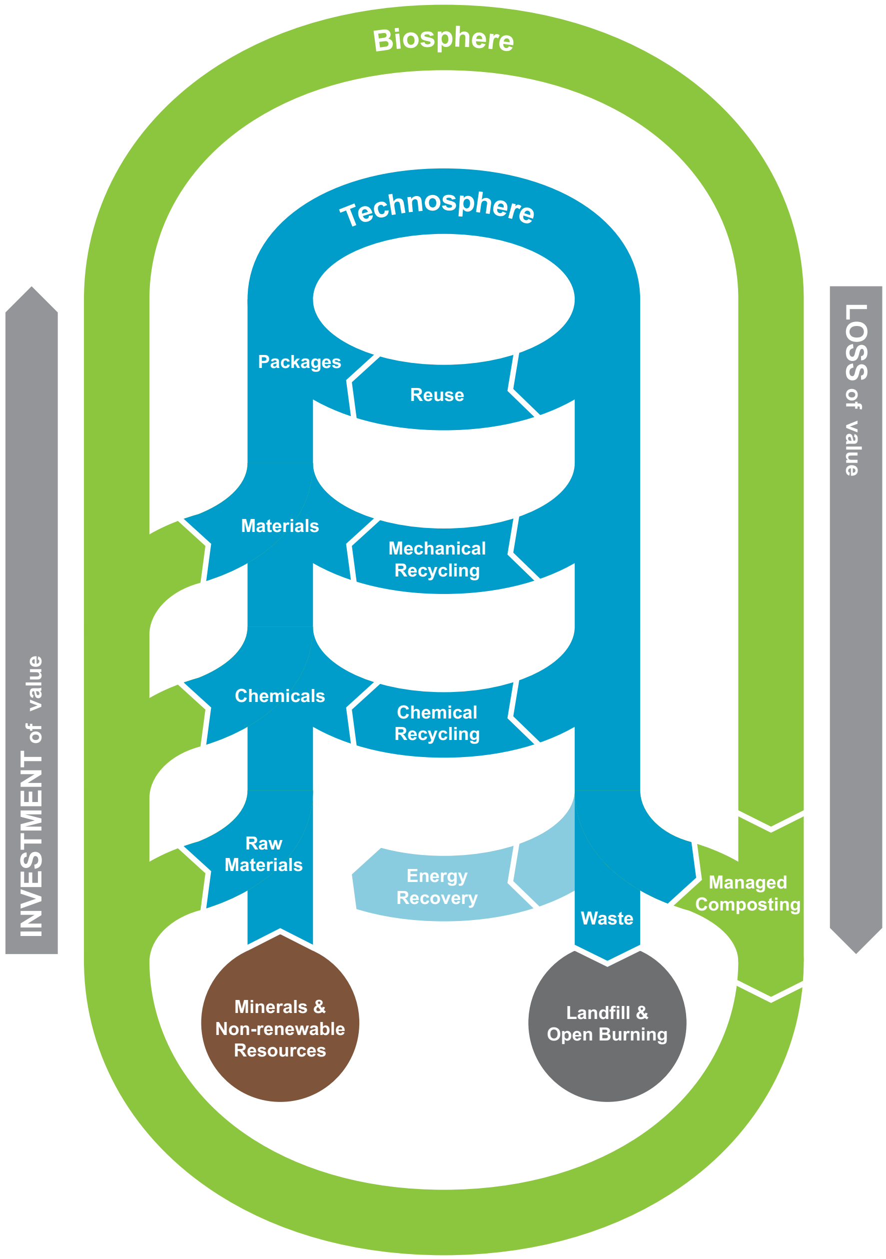
all energy recovery methods. These technologies represent conversion of material to energy.

While energy recovery does not represent a sustainable use of non-renewable packaging materials (e.g., fossil fuel based plastics), it is a preferable interim alternative to landfills, litter, or uncontrolled burning.

For bio-based materials, energy recovery has different implications. Bio-based materials are a preferred alternative to fossil fuels as they are renewable and are considered carbon neutral with respect to climate change.

The best efforts to meet many of the criteria outlined in this definition (e.g., performance and cost, renewable energy, safe materials, optimally designed packaging) will only result in sustainable packaging if it is collected and recovered. Ideally, materials and recovery options should be introduced at the same time, which requires coordination along the entire value chain.

a cradle to cradle vision for the recovery of material value



This figure represents an idealized vision for cradle to cradle material flows and other possible end-of-life scenarios for packaging. Cradle to cradle principles suggest recovering materials at their highest value when feasible. This figure does not represent a waste management hierarchy.

iv. resources

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